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Aspects of seismic hazards caused by the Mining

Lothar Becker – Daugherty,
Phd Student, CCTFC "Politehnica" University Timisoara, Romania and Lecturer, University of Applied Sciences, Saarbruecken, Germany

Abstract- Mining in Saarland, Germany, brought prosperity but also to more damage to the environment. The earthquakes due to mining operations have produced destructions of the underground and the buildings. The following are some significant damage patterns mining induced as a consequence vibrations, and the technical options to eliminate.

Index Terms: **Cracks in buildings, Mining-related shocks, Mining damage, Soil liquefaction**

I. INTRODUCTION

Saar region of Germany is rich in coal which has led in the past to prosperity. Of the 36 old mines in Saarland, all are closed and no longer produce [1].

Fig.1 Luisenthal Mine 1955, Saarland, Germany[1]

Influence on the environment has produced and produces today destruction of land and buildings. It further analyzes the main forms of land and destruction of surface effects On 23 February 2008, which occurred to date strongest vibration events in Saarland with a maximum vibration velocity of 93.54 mm / s, which corresponds to a value of 4.0 on the Richter scale.

II. EFFECT OF MINING ON GROUND FOUNDATION, MONTAIN FRACTION

Mining change the tension and deformations of the massif affected by underground mining. As a result, displacements occur, which could cause damage related to the degree of destruction is based on the following factors:

- Size of the gap due to the mine
-Opening depth
- The technique used and the age of exploitation
- Operating speed in slaughter

Prognose the movement and deformation of the earth surface can be treated by using continuum mechanics theory. Mining depth has no influence on soil surface if they meet safety depth [2] measured from the ground surface Hs, equation (1):

$$Hs = Ks \cdot m \quad (1)$$

KS- safety factor
m- thick layer operation
for coal deposits safety factor is greater than 100.

If H is the depth of the mine when in practice we the following situations:

Hs > H Ground surface, collapses

We give two examples of soil disposals

Fig.2 Ground break- Essen, Germany [3],[4]

Fig. 3 Ground break, Witten, Germany [3], [4]

Ground break with diameter and depth of 6 m. Free underground spaces detected have been filled with Lava grained. Only in the Ruhr area there are approximately 11,500 mine openings, which show the size of the problem. Hs = H field at the surface is less affected H > H s field at the surface do not deform or are less than 20 mm. Area of and affected by mining underground gap can be calculated [4] according to studies conducted by equation (2):

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EB = Ds + Mf +2 (A+S +Tf) (2)

Important parameters are the soil depth and diameter to mine. Research field [3] showed that the size of area affected is 6-8 times higher than the surface of the mine. Maximum terrain deformations of the surface directly influenced by the thickness exploited. There were maximum deformations of 3 m for a layer thickness of 4 m exploited mine. After ca. 3.5 years of soil deformation reaches finals.

III. EXPLOSION OF ROCK -ROCK BURSTS AND BLOW MINES-BUMPS ACTION ON THE CONSTRUCTION

After mining work place changes the state of efforts in the coal layer and therefore can produce large stress concentrations that exceed the limit are breaking producing so-called explosion of rock (rock bursts) or blow mine (bumps). How dangerous are these phenomena show accidents in the gold mines in Kolar, India where within 3 years over 50% of all fatalities were due to explosions rock. Blow Mine is a strong shock due to dislocation of cantitatimari ore from underground opening, a phenomenon similar to tectonic earthquakes and is mainly due to dislocation or movement within the mass of coal, usually along a fault. Underground explosions in mines, especially the explosion of rock and mine blows most closely resembles the phenomenon of natural earthquakes. Eruptive rocks are more prone to explosions rock than sedimentary rocks. Blast load from a spherical cavity produces high pressure gas. It produces the rupture zone, cracks and shear and generate seismic waves longitudinal and transverse. Pressure p decreases in intensity with increasing distance from the source explosive and mechanical stress decrease and become smaller than the breaking strength of the soil. Detonation wave velocity concerned mining works reaching speeds between 4-6 km / s.

Amplitude of oscillation are proportional to the amount of explosive Q Oscillations caused by the explosion process is reflected and refracted waves due to a much longer duration of action than during direct source. Affected buildings may be aesthetic or architectural deterioration hazardous or dangerous deterioration of the structural frame. The phenomenon of resonance, even at low frequencies, has a negative effect and stress damage. Cracking occur very often necessary flue openings, openings for doors or windows or where materials meet different physical and mechanical characteristics. These damages are proportional to the amplitude and the frequency inversely proportional to the speed of propagation of vibration.

To avoid crack some authors give values of allowable displacement to avoid cracks occur depending on vibration frequency in Hz. At a frequency of 5 Hz are permissible value of 2,6 mm at 50 Hz of 0.28 mm Mine explosions produce the building vibration frequencies between 6-60 Hz. In case of low buildings like houses or villas vibration acceleration levels are defined according to the gravitational acceleration g, which are produced varying degrees of damage to the building:

g / 500-acceleration limit value allowed g / 100- acceleration limit for keeping the rigidity of the construction at lower values do not show significant damage / 202 /

g / 20- limit acceleration, higher values cause serious damage

g / 100-limit breaking acceleration, higher values lead to the destruction of the building.

After his theory. Medvedev [3] consider the oscillation speed v mm / s as decisive for describing the effects of vibrations on buildings.

If V <15 mm / s not dangerous at V = 60-120 mm / s occurring cracks in plaster, between 120-240 mm / s appear Considerable damage to the building, and at v> 480 mm / s are great damage and buildings collapse.

Other studies indicate acceptable levels for field trips particles depending on the type of building under the action of seismic vibrations.

The ramshackle buildings or monuments of art values of 0.05 mm and on civil and industrial buildings that comply with the regulations values of 0.76 mm. Following studies of similarity between explosive mining and natural earthquakes can say the following:

In a detonation having energy W = 4.3 .10 Joules / kg produced an earthquake of magnitude M = 0 and for an earthquake of magnitude M = 7.4 it is necessary 10 exp 8 t explosive. Underground mine explosions cause earthquakes of magnitude M = 3.4. On 23 February 2008, which occurred to date strongest vibration events in Saarland with a maximum vibration velocity of 93.54 mm / s, which corresponds to a value of 4.0 on the Richter scale? Experiences have shown that in situ coal mines seismic waves increase as the size grows underground operating room. If the ceiling collapse was found that the main vibration shock has already occurred 10-15 minutes before the actual collapse. This experience shows that seismic pulses are generated by coal under stress and microseismic intensity increases when breaking is imminent. Size microseismic rate represents a qualitative criterion breaking. Microseismic rock stable rate is very small but if breakage becomes 10-100 times higher. From studies done at a mine in Michigan breaking established criteria; if microseismic rate increased twice or more within a 24 hour rock explosion is imminent. Another method of forecasting earthquakes generated by mining works is based on increasing the speed of propagation of seismic waves due to increased co-modulus if the rock mechanical tensions are increasing. Currently it is used to determine the speed of propagation of the wave ultrasonic vibration method having high frequencies between 500-2000 Hz. The mining new seismic waves occur only in volumes of subterranean spaces larger than 5 ha. Seismic vibrations occur in underground holes average about 20 ha and powerful movements occurring in underground holes 60-100 Ha .

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IV. LIQUEFACTION EARTH DURING VIBRATION

Soil liquefaction effects, especially saturated sand deposits can cause significant damage to many buildings construction. Compress saturated sands due to the dynamic demands and interior stress are taken from the water in the pores, leading to a significant decrease in strength and stiffness earth. The result is an importance deformation of the massive of soil. One of the most spectacular examples related to liquefaction earth is the tilt of a block of flats in intensity earthquake of 7.5 Richter in 1964 in the town of Niigata, Japan [5].

In engineering practice it is important to answer the following questions:

- Event mining can cause soil liquefaction?
-Effect on neighboring buildings?
- What are the optimal constructive solutions for the prevention of destruction?

Shear strength of sands in the soil in the horizontal direction is about. 50% of the vertical load at similar conditions.

A high sensitivity of liquefaction has blunt soils in combination with a high water table cloth. A high sensitivity of liquefaction has blunt soils in combination with a high water table cloth. In order to assess the risk of soil liquefaction caused by mining efforts compare with cyclical strength of the earth. Besides the algorithms very complicated analytical calculations based on how many parameters and nonlinear calculations using finite element method there are a number of empirical methods have shown limited usefulness in engineering practice. As major parameters are considered vibration magnitude, distance from the source to the building as well as geotechnical and topographic conditions. Youd, Americans researcher, compare the values measured and the displacement prognotizate by calculation but the differences are very large, ranging -50% and + 200% [6]. How technology can reduce the risk of soil liquefaction?

-Improving soil
- Appropriate constructive measures for structural strength and foundation.

The soil can be improved in the following ways:

- Vibrate the penetration depth and replaced with treated soil, stone or concrete.

-Dynamic compaction depth in the fall of weights The result is optimal only up to ca. 10 m depth from the soil surface.
- Earth in deep mixed cement
- Vertical drainage systems and individual shaped dense network.

If such lands cohesive clay degradation are much fewer efectuate studies for nuclear power plant sites give these maximum permissible speed v max mm / s depending on the Structure of the resistance:

Excavation completed for the execution of concrete	
V max =	250 mm / s
Concrete reinforced =	100
Concrete reinforced between 7 and 28 days =	50
Energy Equipment	<50

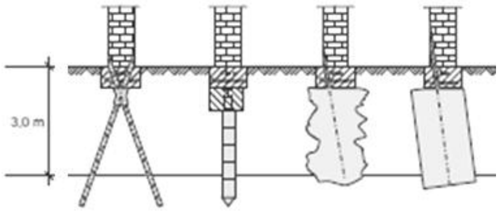

Fig. 4 Foundation reinforcement [7]

V. VIBRATION-IMPACT ON PEOPLE AND BUILDINGS

The perception of vibration starts from 0.1 mm / s German Norm-DIN 4150 standards give speeds of vibration as follows: Depending on the building type, frequency value from 1-100 Hz in foundations and nets on the first floor Values between 3 and 50 mm. In order to assess whether the vibrations of mine are decisive for damage to buildings Pohl [8] method is used successfully [7]. The main parameters are architectural history and year of construction, building dimensions, foundation shape, and construction and ceiling construction.

Dimensions of Construction

- The length of the example of 10 to 40 m are given points 1 to 15
- Number of stages, for example, from 1 to 5 are given points from 0 to 20

Architectural form of the building

-Simply rectangular 0, form simple maze complex 4, maze 7 ,maze and extended 10 points

Foundation

- Form the foundation

At the same level, with or without basement 0, with different levels 3, with different levels and partial basement 6 points
Area Foundation: breaking outside line 0 inside her 5 points

-Structural frame stiffeners

Rigid, reinforced concrete constructive 0, less rigid masonry with wooden floors 6, non-rigid, construction beams lemn12 points

-The history of the building and destruction

Previous destructions: good 0, average condition 5 bad shape 10 points
Year built: after 2000 - 0 1980-2000-2, -4 1960-1979, 1930-1959- 5 1900-1929-7 before 1900-10, historic 25 points
The building totals corresponding points and then determine the maximum allowable speeds vibrations at frequencies between 1 and 10 Hz in the foundation.

Amount of points:	> 48	37-47	28-36	21-27	< 20
Vibration speed mm / s	3.0	5.0	8.0	12	20

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If the sum of the points for building is less than value measured vibration at foundation level then result: The listed building damage have been caused by the mining-caused vibrations.

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AUTHOR'S PROFILE

Lothar Becker, Ing. TH

Foreign languages: Spanish and English

Career:

Training as a technical draftsman in the field of steel construction

Project leader for construction and civil engineering projects

Leader of a department for construction chemicals

Ing. Civil (Universität Juan Misael Saracho)

Phd Student, CCTFC "Politehnica" University Timisoara, Romanie

Owner of an engineering Office for Building

Lecture at the University of Applied Science Saar, Germany

Department of Civil Engineering

Member of ING / Technical Chamber of Saarland

Member of BDB / association of German builders and architects

(President of the BDB, *off – duty)*

Publication:

Numerous scientific Papers, Publications, Technical Studies and postgraduate courses in the field of Rehabilitation of Structural Damage.

"Mechanical equipment for rehabilitation of mining damage"

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