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AN REVIEW: STRATA CONTROL IN UNDERGROUND COAL MINING

[1]Raj Ashish ,[2] Prashant Kumar Singh

[1, 2] Assistant Professor , Mining Department , Kalinga University Naya Raipur , Chhattisgarh

Abstract-In underground coal mining, final extraction is connected with hazards in the workplace of accidents related to roof and side collapse due to in equal stratum movement in the active mining zone. During Bord and Pillar extraction, strata movement demonstrates dynamism on loading impact in proportion to rise in goaf span and area, resulting in the establishment of a dynamic loading zone and effect inside working regions, including at goaf-edges. The loading effect is often greatest towards the goaf-edges, lessening further into the dynamic loading zone, necessitating advance depillaring panel support. Any geological anomalies or weak zones in the working region may encourage the release of mining-induced stress, resulting in collapses or un-eventualities. Strong overlaying rock structures in their current state Strong underlying rock formations may even cause gradual caving, expanding the dynamic loadinga zone and causing irregular strata behaviour. Proper apprehension of stratum movements, including defining, dynamic loading zone with effect, as well as subsequent preventive measures, can regulate stress release. Instrumentation but also monitoring of strata movement during final extractions, combined with correct analysis, has emerged as a major global method for preventing strata movement.

Keyword- Underground mine strata, Equipment, Technique

I. INTRODUCTION

The development of the generation in lots of branches of engineering is pretty fast in latest years. However, in case of underground coal mining, the development isn't always as expected. It remained lots with conventional systems, and just a few tries have been made to adopt/soak up latest trends. Although it is able to be attributed partially to availability and adoptability of the cutting-edge mining machinery, however additionally particularly because of barriers of to be had strata manage generation, be in underground (appropriate designs of workings and aid systems) or opencast mines (appropriate layout of pit slopes, and stabilization of excessive walls/break dumps etc). Prospects of coal mining relies upon upon the amount and great sensible demand, warmness energy, ash content, caking index, economics of mining, marketplace pricing shape for the to be had produce and scope of value addition via way of means of manner of washing or processing of ROM (Singh, 2007).The elements are stimulated via way of means of geographical distribution with great sensible abundance, intensity sensible availability, geomorphology of coal complexity of the deposits and amenability to monetary mining options. More than 98% of our coal assets arise in 7 jap states, with Jharkhand accounting for 29.1%, Orissa 24.3 %, Chhattisgarh 17.1%, and West Bengal 11.1 %. Madhya Pradesh 7.eight%, Andhra Pradesh 6.9% and Maharashtra 3.6%. Depth sensible coal useful resource estimate as on 1st January, 2007 is offered in (GSI,2007). The distribution of the coal assets are geographically imbalanced with simply 2% of the worldwide useful resource to be had in eight jap and significant states of the u . s .. A massive a part of the u . s . has to move coal from those far flung regions or import from the favorable international marketplace. The Australian and Chinese coal marketplace is effervescent with sports and organized to feed Indian marketplace. In olden days, because of loss of right instruments, qualitative observations with restricted opportunity of quantification cause a few empirical relations/thumb rules. However, now-days, with advanced generation of mining/instrumentation, numerical models - pc packages for evaluation of statistics; investigators gained superior pleasure thru observational approaches. Acceptability of such research via way of means of the sphere personnel can be advanced via way of means of right interpretation of the statistics so generated via way of means of professionals withinside the strata monitoring. There is a want to be extra progressive in software of the present instrumentation with right making plans via way of means of skilled strata manage engineers which may also cause opportunity of change in current practices for higher protection and economic system of mining venture.In each coal mining company, Strata Control Cell will be installed at company and vicinity levels inside three hundred and sixty five days as in step with suggestions of the tenth National Conference of Safety in Mines held at New Delhi 26-twenty seventh Nov, 2007. However, until now strata manipulate mobileular now no longer set up in all of the coal mining regions as required. This can be attributed in part because of loss of right responsiveness many of the officers of some coal mining Industries. Strata manipulate mobileular in coal mines can help mine managers, for components of Systematic Support Rules, tracking strata manipulate measures in a systematic manner to make certain efficacy of supportgadget and, for procurement/deliver of nice assisting materials. This trouble may be addressed via way of means of righttracking of strata and taking ok manipulate measures in time. Geotechnical instrumentation despite the fact that hasbeen considerably used within side the coal mines, nevertheless there's no general processes for challenge the investigation in addition to sort of instrumentation for tracking of the strata behaviour. Keeping this in view, brief term guides have been held at NIT-Rourkela on “Trends in strata manipulate strategies and instrumentation for enhancing protection in coal mines” at some stage in July 28th--31st, 2008, and Nov 19th - 22nd , 2009.The Mining Engineering branch of NIT-Rourkela additionally carried out Workshop/ Training packages in coalfield regions of M/s SCCL, SECL, WCL, MCL and so forth beneath Neath the TEQIP backed via way of means of the World Bank thru National Project Implementation Unit at some stage in Oct-Dec’08. Strata manipulate technology have passed through enormous alternate and it's miles pertinent that the sphere engineers have to study with inside the nation of the artwork instrumentation for effective implementation of the strata manipulate measures in coal mines.

II UNDERGROUND COAL MINING

Nearly 61% of the entire reserve of coal is predicted inside 300m intensity cover, dispensed in all coalfields from Godavari Valley to Upper Assam. The top first-rate coking coal of Jharia is to be had specially in higher coalhorizons even as the advanced first-rate non-coking coal of Raniganj is to be had in decrease coal horizons. The first-rate coal of significant India to Maharashtra is likewise to be had specially in seams inside this intensity range. As a end result all of the mines labored such seams extensively, basically growing on pillars and depillaring with sandstowing. With the detrimental economics of sand stowing and non availability of virgin patches for further development, maximum of the mines had been working- splitting or cutting the pillars, triumphing roof or floor coals manually or with SDL, conveyor combination The useful resource function of coal suggests almost 37% inside three hundred-700m intensity cowl and a small portion (7 %) under 600m intensity cowl. Quality coal under 300m intensity cowl in Raniganj, Jharia, East and West Bokaro, North and South Karanpura, Sohagpur, and so forth ought to be the primary goals for underground mining. The coals of Godavari and Wardha Valleys can also be blanketed on this class due to preferential pricing structure. The alternatives international over for such deposits are pillar mining- pillar mining the usage of non-stop miner, longwall mining and sublevel or vital caving with unique help gadget in case of complicated thick seams. Best overall performance of pillar mining is mentioned from that of Churcha mine, the simplest unit to go 1Mt annual manufacturing withinside the country. Flat 3m thick seams become labored with commute vehicle and scraper loaders imported in 1960, used with out layout amendment or even spare returned up help. The revel in treasured become now no longer repeated in every other mine despite the fact that the equal equipments have been delivered in some different mines. The subsequent era pillar mining gadget – non-stop miner loader and bolting meeting has entered in the mines after almost four many years with very encouraging overall performance at Chirimiri and Tandsi mines The gadget has given 12-15t productiveness and common manufacturing of 40000 t according to month. Identical mines below appropriate geo-mining circumstance ought to be diagnosed and unique geological exploration ought to be accomplished for the deployment of such machines. From coal reserve and fine evaluation and seam thickness and gradient,such webweb sites appear like in Rangundam, Sohagpur, E and W Bokaro, N and SKaranpura, Jharia and Raniganj coalfields in which a massive proportion of fine coal seams are nevertheless virgin. Isolated patches with fine coal seams in close to flat seams past restricting stripping ratio in, M P and Chhattisgarh can also be explored for the advent of non-stop miners. Longwall era ought to be followed with due attention of coal seam parameters, panel geometry and coal fine in seams under 300m intensity cowl in Jharia, Raniganj, Godavari Valley, Sohagpur, E Bokaro and S Karanpura in which bulk of coking and advanced grade non coking coals inside three hundred-600m and under 600m intensity are estimated. The faces ought to be geared up with excessive potential help with fast yielding valves to maintain floor motion shocks regularly felt because of big roof. High helps appropriate for 3-5m seam thickness ought to be utilized in regions in which 12 - 15km lengthy panels will be formed, every of two to 3km duration and face duration of 250 to 300m. Gate avenue drivage era the usage of non-stop miner, bolter and loader meeting ought to be perfected to preserve boost training of the panels in order that the faces should get unhindered operation for its existence Mining of complicated deposits frequently labored with sand stowing has didn't meet the manufacturing target, productiveness and economics. The approach of reducing with mass caving in vertical phase like horizontal reducing willing reducing or sublevel and vital caving used correctly in complicated deposits of Yugoslavia, Romania, Soviet Union, Poland or France may also must be perfected for underground mining of thick seams. Power help for running over sand stowed ground even as mining thick seams in slices is to be had withinside the international market, in particular in Hungary may also show to be appropriate for running of thick seams below riverbeds in distinctive coalfields. Methane drainage from the seams below mining ought to be accomplished to make sure higher running environment, protection of the people and the workings. The running mines, with small patches declared to be virgin until date ought to now no longer be decided on for the deployment of longwall mining or non-stop miners as perpetually they lack vertical and horizontal shipping facility and ok wide variety of panels for gadget existence time. Geological exploration to find appropriate panels for every set of gadget with seam thickness variation in the permissible limit, coal of fine and roof rock formation ought to be accomplished intensive before introducing one of these value in depth era with non-stop miners in three hundred-400m intensity cowl and longwall era under 400m intensity cowl. Necessary steps to make sure their achievement is summarized asfollows

- Shaft sinking era ought to be perfected to increase get entry to to deeper seams
- Back up facility – vertical and horizontal shipping, processing and dispatch gadget ought to be compatible to the mass manufacturing era.
- Equipment deliver and spare availability ought to be ensured for green complete existence overall performance
- Man strength training inclusive of education and on face operational talent ought to be evolved on priority
- Work tradition ought to be advanced in recognize of devotion, dedication and variation of modern era with efficiency
- Program ought to have help of the state for continuity and economic returned up
- So some distance as possible, the gadget ought to be imported lock inventory and barrel to begin with, observed by manufacture in the country.

The state has to equipment up for massive underground manufacturing inside subsequent 3 to 4 many years; for three hundred to 400Mt annual manufacturing. The involvement of business homes and people of main international gamers ought to be endorsed for State of Art useful resource enter and managerial help.

III STRATA CONTROL

With the arrival of present day coal mining techniques, it has come to be vital to undertake roof bolting as a primary of help in area of the conventional supports. About 2500 million lots of coal has been locked in pillars of which most effective approximately a thousand million lots is amenable to opencast mining, approximately 1500 million lots is to be extracted via way of means of underground mining. Strata manipulate control is one of the important motives for dropping of pillars.

Although generation has stepped forward now-a-days with the creation of Blasting Gallery technique, Integrated Caving technique and Hydraulic Mining, a number of them are unsuccessful with the lack of trials at Churcha, Kottadih, etc., and lots of greater because of loss of appropriate strata manipulate techniques. Salient capabilities that lead to ordinary troubles in underground coal mining include; developments in help structures are associated with cloth for bolts (cuttable bolts, tendon, resin, acconex, etc.,for grouting, swellex, truss bolts), mobility of helps (cellular roof help), capability of helps (high capability shields, props) (Gupta and Prajapati, 1997; Khan and Hassani, 1993). Mobile helps had been efficiently deployed for depillaring (Larry, 1998). Support capacities as much as 80 lots are to be had and want creation in Indian coalfields. It affords an upward lively pressure at th instantaneously roof strata and consequences in regular cave line driven again into goaf. This lets in a extensive stook to be mined whilst depillaring, thereby steeply-priced and comparatively unproductive cycle of splitting of pillars and associated help may be minimised. In close to future, the idea of man-much less mining desires to be tailored to the maximum feasible volume for advanced protection, production, and productivity. Continuous tracking of strata behaviour in phrases of convergence of openings earlier on both facet ofthe extraction line, and strain degrees over pillars, stooks earlier of the extraction and ribs with inside the goaf became required via far flung tracking devices for knowledge the strata mechanics at important conditions of roof falls. Continuous tracking of help pressures became tried to research the rock mass reaction to mechanised pillar extraction (Follington IL and Huchinson, 1993). Integrated Seismic System (ISS) became brought for an experimental trial at Rajendra mine, SECL, for prediction of strata motion throughout coal extraction with the aid of using longwall mining. The device advanced with the aid of using South Africa works at the precept of tracking microseismic sports via geophones. The idea of tele tracking or on line tracking is but to be mounted to enhance the protection components in underground coal mining. The use of Borehole TV Camera for caveability research is the want of the hour for precise evaluation of strata behaviour throughout mining.

IV PURPOSE OF GEOTECHNICAL INSTRUMENTATION

Geotechnical instrumentation despite the fact that has been significantly used withinside the coal mines, nevertheless there may be no standard methods for challenge the investigations in addition to kind of instrumentation for tracking the strata behavior. Over the years, geotechnical instrumentation and strata manipulate technology have undergone huge alternate and it's far pertinent that the sector engineers ought to be taught withinside the kingdom of the art instrumentation for powerful implementation of the strata manipulate measures in coal mines. Purpose of the instrumentation ought to be clean for the planners earlier than commissioning any devices for knowledge strata behaviour. Inadequate variety or incorrect choice of devices may also result in hazardous selections with the aid of using mine planners, whilst greater than required variety/kind of devices, now no longer handiest result in confusion however also uneconomical. Therefore, skilled strata manipulate engineers with right knowledge of the sector problem, and enough expertise on interpretation of the so generated information are number one requirements for a a success instrumentation program.

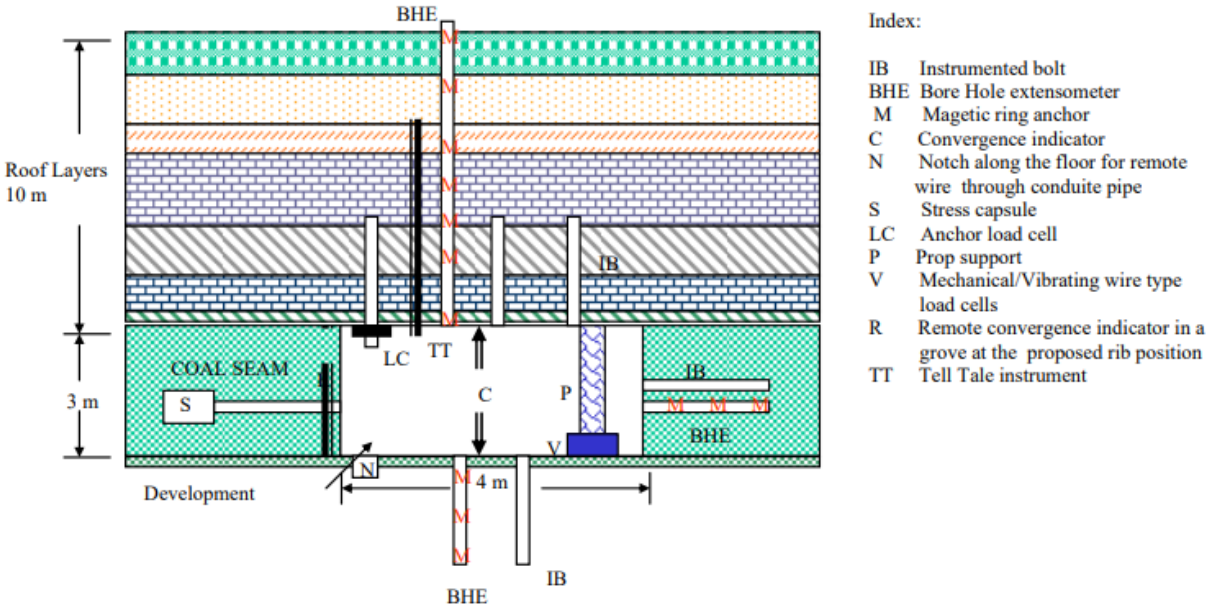

Fig 1: Typical instrumentation for strata monitoring round underground workings

MINING OPTIONS

In the mild of constrained coal reserve in Indian territory, constrained best coal reserve, best coal reserve within 300m intensity cowl drastically disturbed via way of means of pillar mining and negative recuperation with pillar mining, it's far advocated to head for huge floor mining in all of the important coal basins as much as the stripping ratio of 1:10. Similarly in case of newly explored strength grade coal bearing basins- Singrauli, Rajmahal, Korba, Mand Raigarh, and Talcher etc, it's far advocated to head some distance floor mining as much as 1:eight stripping ratio. The coal seams beneathneath in decided on basins of best coals – Sohagpur, E&W Bokaro, N&S Karanpura, Jharia, Raniganj, Wardha and Godavari valleys are advocated to head for underground – longwall, pillar mining with non-stop miner and mining with vertical manufacturing awareness era in case of thick coalescing

seams. No pillar mining is techno-economically possible beneathneath 400m intensity cowl and there fore in deeper coal basins, longwall is the best era however with State of Art device and annual manufacturing assure above 2Mt. In view of greater than 1/2 of the proportion of overall coal in seams over 5m thickness, longwall cutting in a single or different shape is suggested. The destiny of the mining enterprise needs greater emphasis on meticulous utility of rock engineering techniques, guide layout, change to the present recommendations thru observational approaches, for cost powerful and secure mining operations. Many studies and educational establishments initiated many research to help coal enterprise for higher, green and secure extraction of coal thru i) analytical evaluation and mathematical models, ii) empirical evaluation and models, and iii) numerical modeling with computerization. Some of the rock mechanics analyses have been aimed toward i) guide layout in complicated mining conditions, ii) partial extraction beneathneath water bodies/townships thru extensive stall techniques, and iii) mechanized depillaring with cable bolting as important guide. The techniques have been web website online particular and have been designed for intermediate degree of mechanization and techno-economically possible in phrases of manufacturing and productivity. Still there's a scope for rock mechanics utility withinside the following areas :

- Development of medical techniques for max recuperation beneathneath floor structures
- Exploitation of thick and more than one seams for shallow intensity covers
- Utilisation of overwhelmed overburden cloth for stowing
- Support designs for deep mining of thick seams

Surface mining as much as 1:10 stripping ratio in case of best coal seams and as a minimum 1:eight in case of strength grade coal have to be usual earlier than a number of the coal fields are subjected to slaughter mining vis a vis selective mining of higher seams of best coal with dumping of burden over the decrease seams. This will block the destiny of floor mining in coalfields of Damodar Valley, MP and Chhattisgarh. Concurrent reclamation and rehabilitation of the mining vicinity to the extent higher than the pre mining reputation have to be performed and the hire be again to the oustees for agriculture, forestry or different gainful usage.

V CONCLUSIONS

In today's Indian coal mining scenario, meticulous assessment and appropriate software of the above mining alternatives may also result in effective and secure mining of coal deposits with due regard to eco-friendliness and conservation. The information evolved in a number of the rigors mainly in vital India has been allowed to be frittered away as opposed to their consolidation and extension. Development of thick seams with out ascertaining the technique of very last extraction will be discouraged withinside the hobby of conservation of coal. The numerical version outcomes in a normal depillaring panel are akin to the sector observations . Comparatively low strain degrees withinside the fashions in comparison to the sector observations can be attributed to idealization of depillaring to 2 dimensional domains. The numerical version outcomes on strain attention over pillar, stook and the rib confirmed version of 3.6%, 8.33% and 6.12%, respectively in comparison to the sector observations for 7 m thick coal seam. India's destiny coal mining will depend upon how effectively and economically we will make the most deep coal deposits through underground mining practices with protection and generic degree of productivity. Further research are required for advent of a few modern strata tracking strategies together with vast use of ISS, Borehole TV Camera and so forth thru software of appropriate rock engineering strategies.

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