ISSN [Online]: 2583-2654

Illumination Survey in Opencast Mines

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Abstract: The primary objective of the project was to develop a systematic scientific approach for achievingbetter illumination standards in the mine and ensuring safe visual working environment in theselected opencast mines with regard towards the statutory standards. The research investigation wascarried out with the aim to conduct illumination survey to check if the standards were met with respect to Directorate General of Mines Safety (DGMS) standards at different places of work in the mine and of different HEMMs followed by design of appropriate illumination systems based on illumination requirements. The illumination survey of existing lighting system in various working areas i.e., haul road, coal transport road, dump yard, OB and coal faces, dump road, workshops. The instrument used for the survey was a Metravi-1332 Light meter. . The illumination models weredesigned for haul road, coal transport road and dump road using DIALux software and virtual luminaries were used according to the requirement. The illumination models were designed for haulroad, coal transport road and dump road using DIALux software and virtual luminaries were usedaccording to the requirement. The road lighting designs were performed as per CIE EN 13201standard, which is used internationally for road lighting. The design models satisfied the requiredminimum lighting as stated by DGMS standards. For OB and coal faces it is better to install amobile lighting arrangement (tower mounted/truck mounted) as the face moves rapidly and theperipherallightingprovidedwon't be able toilluminatethefaceasthefaceadvances.

I. INTRODUCTION

Illumination plays a critical role in mining for providing a suitable work environment for theworkerswhichisessentialforachievinghigherproduction.Surfaceminesaresufficientlyilluminated by the sun in the day times but needs to be provided with some artificial illuminationduring the night times for safe operations of various machineries at different work places.

The increased mechanization demands adequate and suitable lighting inorder to reduce accidents. Physiological reasonableness of an individual to his workplace is particularly significant from security perspective. It is realized that if a task is performed in poor lighting for long time, sign of strain appear in the individual and if not checked, can lead to physical illness. Good lighting encourages visual performance, improves quality of work, reduces the frequency of errors and prevents fatigue, and improves visual communication with the working environment. In open cast mining wherein production is the primary objective, activities are carried out even during nightshifts; it requires effective illumination at workplaces. The productivity and safety of miners is affected due to dark surroundings and low surface reflectance. Therefore it is very difficult to meetthe lighting norms specified by various regulatory bodies. Hence for achieving better illuminationstandardsasystematicscientificapproachi stobefollowedinmines.Aneffectivelightinginstallatio nisonewhichhastriobenefitsofworkingwithsafety,effi ciencyandreasonablecomfort.Thelightingdesignproce ssbeginsbycarefullydeterminingtheseneedsandthenpr actical, technical, and economic factors are considered in establishing an appropriate illuminationsystem design. There are various environmental factors that affect the visibility of the surroundingstonamefewlikelowsurfacereflectance,su spendeddust,andwatervaporsthatcausebackscattering

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and thereby reduce apparent luminance. An optimized lighting design should takeintoaccount thesefactorsalongwith luminairedesign aspects for and effectiveillumination.

II. OBJECTIVE OF THE PROJECT

The primary objectives of the project was to design an effective lighting system at different places of work to ensure safe visual working environment in an opencast mining project with due compliance of statutory standards.

III. LITERATUREREVIEW

Yadavetal.(2015)proposedtointroduceasimulationstudyofdesignsfortheuniformillumination over a rectangular-target surface (underground mine 26m x 4.8 m display) utilizingpower LEDs. This financially effective lighting included various arrangements of courses of actionof LEDs that give a nearby uniform light dimension for given optimized parameters. The optimizedestimations of the factors in the courses of action were acquired by the utilizing of MATLABcapacitiesfor optimized tool box.

Lakshmipathy et al. (2014) dealt with structure and advancement of ideal lighting parameters forhaul roads in Surface Coal Mines utilizing MATLAB. The examination report demonstrates that thedesign parameters such as spacing and number of poles will differ with the adjustment in standards.In the end the trial study uncovers that tallness of mounting with tilt angle is essential to accomplishall the required lighting measures. Least height of lighting arrangement, as a rule, ought to beadministered by HEMM of most extreme tallness moving on the road. Height of pole might bedifferedfrom12to16metersforhaulroadofaround12 meterswidth,whichisgenerallypredominantinIndian open cast coal mines.

Tripathy and Chowdhury (2014) completed an exploratory enlightenment review of the presentsituation of lighting framework in different working territories of an automated opencast coalmine,thesharpperceptionyieldedtheoutcomesthat currentluminancelevelswerefoundgenerally insufficient in the vast majority of the work places and consequently, improvementmeasures were taken by point by point examination of the overarching issues and planning alegitimate structure whichfitsthe requiredlightening arrangementofthatmine by utilizingDIALuxprogramming.

Paletal.(2012) proposed structure arrangement of haul road lighting for an opencast coal mineutilizingefficientgreenpower.Amodelboardwasadditionallydevelopedanditindicatedgenuinelyconsistent lumenyield overfluctuatinginput voltages.

Das and Roul(2005) carried out an illumination study at National Aluminum Company LTD(NALCO),highlyautomatedopencastbauxitemineandtheproposedstructureincludedtoaccommodate 9m lighting pole and 18m adjustable tilt-capable tower. Additionally, plan of Haulroadand auxiliaryhaul road framework was performed.

Aruna and Jaralikar(2012) gave a structure of a lighting framework for bothmineralandoverburdenbencheswhichdependedonthebaseadequatereflectedlightandthereflecteduniformity ratio. For this situation a stretch of a 1.0 km Haul road was considered for the procedureexamination of different sorts of lighting frameworks. The design was attempted with five distinctsorts of lighting arrangements. Light mounting heights were changed at five stages, to be specific,8,10,12,14,and16m.Designunderwetconditionsacquiredanabundancecostof9.4%for mineral bench haul road and half for overburden bench haul road. Design under wet surfaceconditions guaranteed the base light level even under most exceedingly terrible state of surfacereflectivitywith minor increment in expense.

IV. IMPLEMENTATION OF METRAVI1332 DIGITAL LIGHT METER

For simple lighting installations, an acceptable lightning design can be produced by simple

ISSN [Online]: 2583-2654

manualcalculations based on the tabular data. For more complex projects mathematical modeling on thecomputer is viable and for more optimized and larger projects, lightning design software can be putinto use.

The lightning layout can be inspected for uniformity and illuminance depending on factors such aspositioning, fixture height and photometric characteristics. The location, design parameters andworking conditions can be set and the computer uses this information to produce a contour chartoverlaid on the project floor plan, providing information about the expected lighting level at theprovidedheight.Theamountofartificiallightreceive dinaninternalspacecantypically beanalyzed by undertaking a daylight factor calculation. Operating costs of the lightning installationscanbeoptimized by including the effect of lights from the luminaries using anadvanced program.

- Theinstrumentthat isused fortheilluminationsurveyis Metravi1332 DigitalLight-meter.
- Accuracy:Statedaccuracyat23°C±5°C (73°F±9°F)<70%relativehumidity.
- Weight:210gincludingbattery.
- MeasurementRange:2.5 timespersecond.
- Battery:Standard9Vbattery(NEDA1604, IEC6F22.006P)
- Batterylife:200 hourstypicalwith carbonzincbattery.
- Display:31/2digitliquiddisplay(LCD)withm aximumreadingof1999.

- Batterylife:200 hourstypical withcarbonzincbattery
- Dimensions:190mm(H)x 65.5mm(W)x (D)
- Weight: 210g including battery
- PhotometricFormulas:10.764footcandles=lu x(lumens/meter2)0.0929.lux=footcandles(lumens /foot2)

Range:200lux, 2000lux,20klux,200klux,

Fig 1

(Please refer page 216)

- 200fc,2000fc,20kfc, 200kfc
- Resolution:0.1lux,0.1fc
- SpectralResponse:Metraviphotopic(TheMet raviphotopiccurveisaninternationalstandardfor thecolor responseof theaveragehu man eye)
- AcceptanceAngle:f2< 3%cosinecorrected(150°)
- TemperatureCoefficient:0.1x(specifiedaccur acy)/°C(<18°Cor>28°C),0.056x(specifiedaccuracy)/ F°(<64.4°For 82.4° F)
- Peakholdresponsetime:>50mS pulselight.

Iftheresultsarenotsatisfactory,preparationofilluminatio nplanforcoaltransportroad,haulroad and dump roadusingDIAL

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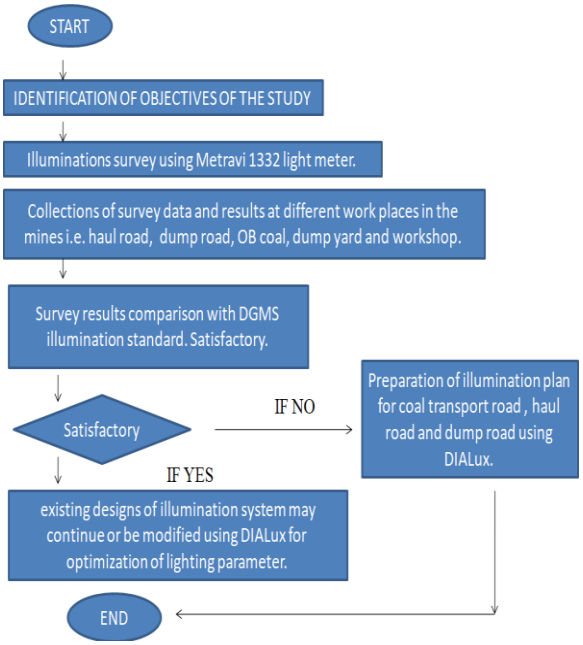
Flow chart for illumination design Methodology for open cast project

- Start theAnalysis.
- WeidentifytheobjectivesoftheStudies.
- Illuminationssurveyusingmetravi1332light meter.
- CollectionofSurveydataandresults.
- Differentresultsatdifferentworkplaces.
- WorkplaceslikeHaulroad,Dumproad,Dump yardetc.
- SurveycomparisonwithDGMSstandards.
- Iftheresultsaresatisfactory,existingdesignsof illuminationsystemmaycontinueorbemodifiedusingDIALUX foroptimizationoflighting parameter.



V. RESULTS

- Overall haul road illumination in mines will be satisfactory. There were luminaries tilted inleft/right directions mentioned at some of the poles, due to which lux levels were reduced.The effective using of both 60W and 200WLED lighting wherever necessary made themineilluminationbetter.
- Measurement of road illuminance will be conducted by measuring illuminance between themidpoint of the two adjacent poles and the spread of light was observed. The illuminancemeasurementwill beobtained duringthe surveyfor haul road.
- The dumping yard operations were mainly operated in the day shifts. During night shiftsmachine breakdowns and coal face operations are operated. So there were no lights installedindump road and dump yard.
- In workshops (in dozer, shovel and dumper section) the illumination levels will be notsatisfactory as per DGMS circular. Hence More LED lights must be installed whereverneccessaryforsatisfyingDGMS norms.
- In dumper parking area only 2 luminaries will be installed. A tower mounted flood lightsystem can beinstalledto optimizeelectricityandefficiencycosts.

VI. CONCLUSION

- For haul road 1 and Coal transport road, lux levels were not satisfactory as per DGMSstandards (10 lux). For Haul road 2 though the average lux level is satisfactory but non-uniformlight distribution madeitappear less illuminated thanit should be.
- From dumping yards, it was found that proper illumination was not provided in the dumpedges. The luminance levels in the quarry no. 5 dumping yard (2.5H lux and 4.5V lux) andquarryno.4dumpingyards(2.5Hluxand1Vlux)wer enotsatisfactoryaspertherecommendedDGMS standards (15H luxand 15Vlux).
- Inworkshops(indozer,shovelanddumpersectio n)theilluminationlevelswerenotsatisfactory as per DGMS circular. The number ofHPSV lamps must be increased forsatisfyingDGMS norms.

REFERENCES

[1]. Trotter,D.A.,(1982).TheLightingofUndergroundMines.Montreal(Canada):TransTechPublications.

[2]. Ganslandt,R.,&Hofmann,H.,(1992).HandbookofLightingDesign.NewYork(USA),VerlagVieweg.

[3]. DirectorateGeneralofMinesSafety,(2017).Legis.CircularNo.2.Dhanbad(India):DGMS

[4]. Rushworth, A. M., Talbot, C. F., Von Glehn, F. H., Lomas, R. M., & Franz, R. M. (2001).Role of Illumination in Reducing Risk to Health and Safety in South African Gold andPlatinumMines.Pretoria(South Africa),SafetyinMines ResearchAdvisoryCommittee.

ISSN [Online]: 2583-2654

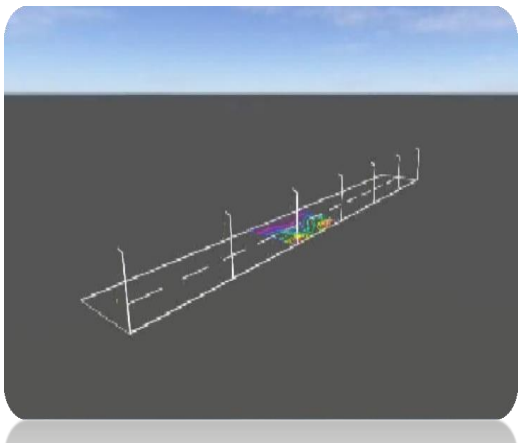
[5]. *Yadav, P., Pal, N., Kumar, D., & Krishna, S. V. (2015). LEDs Lighting Arrangements forUnderground Mines. TELKOMNIKA Indonesian Journal of Electrical Engineering, 15(1),14-19.*

[6]. *Lakshmipathy, N., Murthy, S. N., &Aruna, M. (2014). Problems Encountered in the Typesof Lighting Systems generally used in Surface Mining Projects, A Case Study. Int. J. Eng.Sci,3(9), pp. 61-72.*

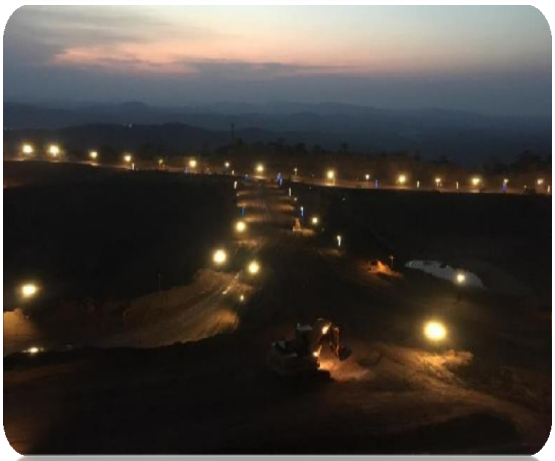
[7]. *Karmakar, N.C., Aruna, M., &Rao, Y.V. (2005). Development of Computer Models forDesign and Economic Analysis of Lighting Systems in Surface Mines. 20th World MiningCongresson MiningandSustainable Development,Tehran(Iran), pp.541-543*

[8]. *Aruna, M., &Jaralikar, S. M. (2012). Design of Lighting System for Surface Mine Projects.TELKOMNIKA,10(2),pp:235.*

Fig 1



Schematic Diagram of Coal Transport road:



Main Haul road lighting in mines: