

# Design of Illumination system for Haul Road and Dump Yard of an Opencast Coal Mine

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**Abstract:** This paper focusses on design of appropriate illumination system for haul road, overburden transport road and dump yard in a mechanized coal mine. It was established that the designed illumination system satisfied the DGMS standards for opencast mines at different working places.

## 1. INTRODUCTION

The provision of adequate illumination to ensure a safe visual working environment is particularly difficult to meet in coal mining. The paper focusses on : Design of appropriate illumination systems based on illumination requirement for: (i) Haul road (ii) Overburden(OB) transport road and (iii) Dump yard in a highly mechanized coal mine.

## 2. ILLUMINATION DESIGN & METHODOLOGY

- Conduct of illumination survey at haul road, OB transport road and dump yard using Metravi 1332 digital lux meter and checking the adequacy of illuminance level vis-à-vis DGMS standards.
- Illumination design as per requirements.

## 3. DESIGN OF ILLUMINATION SYSTEM FOR AN OPENCAST COAL PROJECT: CASE STUDY

Based on illumination requirement in various workplaces in the mine suitable illumination models were developed and presented in this segment. During the illumination survey, it was noticed that the existing system of lighting was found inadequate for the mine; hence a new system of illumination was developed and proposed at appropriate places where illumination levels were unsatisfactory.

### 3.1. Design of Haul Road Illumination System

A model for haul road illumination system was simulated which resulted significant improvement in the uniformity ratio and also low wattage of lamp was used than the existing lighting. The optimized parameters for the lighting arrangement are given in the Table 1.

**Table 1: Details of Haul Road Lighting Arrangement Setup**

|   |              |
|---|--------------|
| Haul Road Specifications,                   |              |
| Road length                                 | 1.6 Km       |
| Road Width                                  | 80m          |
| Luminaire Specifications                    |              |
| Lamp wattage                                | 250Watt HPSV |
| Luminaire Arrangement, $E_{min}$ [lx]: 3.95 |              |

### 3.2. Design of Dump Road Illumination Systems

The Dump road illumination system was facing the same problem as that of the haul road; it was found that the road side which has luminaires installed has much higher lux levels than the end point along the

width of the road causing significantly less uniformity of light. A model for dump road illumination system was simulated which resulted in improvement of the uniformity ratio and also low wattage of lamp was used than the existing lighting. The optimized parameters for the lighting arrangement are given in the Table 2.

**Table 2: Details of Dump Road Lighting Arrangement Setup**

|                          |                                    |
|--------------------------|------------------------------------|
| Dump Road Specifications |                                    |
| Upper Dump Road length   | 1K m                               |
| Lower Dump Road length   | 600 m                              |
| Road Width               | 40m                                |
| Luminaire Specifications |                                    |
| Lamp wattage             | 250Watt HPSV, $E_{min}$ [lx]: 5.75 |

### 3.3. Design of OB Road Illumination System

A model for OB road illumination system was simulated which resulted significant improvement in the uniformity ratio and also low wattage of lamp was used than the existing lighting. The optimized parameters for the lighting arrangement are given in the Table 3.

**Table 3: Details of OB Road Lighting Arrangement Setup**

|                          |                                    |
|--------------------------|------------------------------------|
| Haul Road Specifications |                                    |
| Road length              | 400m                               |
| Road Width               | 16m                                |
| Luminaire Specifications |                                    |
| Lamp wattage             | 150Watt HPSV, $E_{min}$ [lx]: 3.73 |

### 3.4. Design of Dumping Yard Illumination Systems

The illumination design for dumping yards, as per the DGMS guidelines provides visibility of dump edges with a minimum horizontal illuminance level of 3 lux, to avoid slip/fall accidents. The luminaire arrangements for dumping yard is give in Table 4.

**Table 4: Details of Dump Yard Lighting Arrangement Setup**

|   |                    |                         |             |             |
|---|--------------------|-------------------------|-------------|-------------|
| Dump Yard Specifications                  |                    |                         |             |             |
| Dump Yard Area                            |                    | 120 x 80 m <sup>2</sup> |             |             |
| Luminaire Specifications                  |                    |                         |             |             |
| Lamp wattage                              |                    | 1000Watt HPSV           |             |             |
| Luminous flux (approx.)                   |                    | 130000 lumen            |             |             |
| Pole height                               |                    | 11m                     |             |             |
| Luminaire Arrangement for Upper Dump Yard |                    |                         |             |             |
| Pole No.                                  | Distance from Edge | No. of lamps            | Positioning | Focus Angle |
| 1   | 80                 | 2                       | L           | 6°          |

|   |     |   |   |    |
|---|-----|---|---|----|
|   |     |   | R | 7° |
| 2 | 80  | 2 | L | 6° |
|   |     |   | R | 7° |
| 3 | 100 | 1 | - | 6° |
| 4 | 100 | 1 | - | 6° |
| 5 | 120 | 1 | - | 6° |
| 6 | 120 | 1 | - | 6° |

#### 4. CONCLUSION

From illumination survey of the haul road it was found that although lux levels were satisfactory but non-uniform light distribution made it appear less illuminated than it should be. Also the design is made, considering the economic viability of the model. For, haul road and dump road lighting uniformity ratio has been maintained as per the international standard (since no uniformity criteria is mentioned in DGMS standards). Dumping yard illumination model were satisfied in the dump edges as per DGMS standards i.e. with a lux level of 3 lux. Hence by adopting the newly designed illumination system the visual environment of the mine workings can be improved