

ISBN 3 900 734 86 0



COMMISSION INTERNATIONALE DE L'ÉCLAIRAGE
INTERNATIONAL COMMISSION ON ILLUMINATION
INTERNATIONALE BELEUCHTUNGSKOMMISSION

TECHNICAL REPORT

GUIDE TO THE LIGHTING FOR OPEN-CAST MINES

CIE 128- 1998

UDC: 628.971.9
628.977.1:622.33

Descriptors: Lighting for outdoor work
Mine lighting

CIE 128 - 1998

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CIE GUIDE TO THE LIGHTING FOR OPEN-CAST MINES

SUMMARY

Open-cast mines cover a large area and continually change their shape as mining proceeds. Effective illumination is required to achieve production and safe operation of various machinery at different work areas.

Mobile mining machinery is equipped with luminaires powered by on board generators. Movable lighting towers are used in the mine faces for general lighting. Deep, compact pits and permanent facilities such as stockpiles, conveyors and processing plant, can be lit from fixed lighting arrangements.

Illuminance levels are provided for each work area to meet the visibility requirements of equipment operators and other workers.

Luminaires must have a high degree of protection against ingress of dust and moisture due to the atmosphere prevalent in open-cast mines. Luminaire design and installation must facilitate ease of maintenance. Strict adherence to agreed-upon maintenance schedules is important for prevention of undue loss of light with time and to avoid capital investment in higher initial lighting levels thus saving energy.

Lighting quality parameters like average illuminance, uniformity and glare limitation have been described. Further guidance can be obtained from existing CIE publications. Requirements for areas typical of open-cast mines have been given.

GUIDE POUR L'ECLAIRAGE DES MINES A CIEL OUVERT

RESUME

Les mines à ciel ouvert couvrent de grandes surfaces dont la forme change continuellement au cours de l'exploitation. L'éclairage efficace des zones de travail est important pour la productivité du matériel qui suppose un capital investi élevé et pour la sécurité du personnel et du matériel.

Une machine mobile d'extraction est équipée d'un système d'éclairage autonome. Des tours mobiles d'éclairage sont utilisées sur les faces de taille des mines pour l'éclairage général. Les creusements profonds, les puits compacts et les aménagements permanents tels que les piles de stockage, les convoyeurs et les zones de transformation peuvent être éclairés par des installations fixes.

Les exigences de visibilité des opérateurs et les systèmes d'éclairage utilisés sur les machines et sur différentes zones sont couvertes par ce document.

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Les luminaires doivent posséder un haut degré de protection contre l'agressivité des poussières et des moisissures dues à l'atmosphère qui prévaut dans les mines à ciel ouvert. La conception des luminaires et leur installation doit faciliter leur maintenance. Le strict respect d'une politique de maintenance concertée est important pour prévenir des pertes de lumière anormales au cours du temps et de plus pour éviter, en contribuant ainsi aux économies d'énergie, un investissement excessif dû à la fourniture de niveaux d'éclairage initiaux plus élevés.

Les paramètres de qualité tels que l'éclairage moyen, l'uniformité et la limitation de l'éblouissement sont décrits dans ce document. D'autres indications peuvent être tirées de publications CIE existantes. Des exigences sont données pour les zones typiques des mines à ciel ouvert.

CIE LEITFADEN FÜR DIE BELEUCHTUNG VON TAGBAU-MINEN**ZUSAMMENFASSUNG**

Tagbauminen nehmen eine große Fläche ein und ändern im Laufe des Abbaus ständig ihre Form. Eine effiziente Beleuchtung der Arbeitsplätze im Minenbereich ist wichtig für die Produktivität in einem Bereich mit hohen Anlageinvestitionen und für die Sicherheit der Anlagen und des Personals.

Die mobile Minenausstattung ist mit aggregatbetriebener Beleuchtung versehen. Bewegliche Beleuchtungstürme werden in den Minen für die Allgemeinbeleuchtung verwendet. Tiefe, kompakte Gruben und ständige Einrichtungen, wie Lager, Förderbänder und Verarbeitungsanlagen, können von fixen Beleuchtungsanlagen beleuchtet werden.

Anforderungen des Bedienungspersonals an die Sichtbarkeit sowie an Maschinen und in verschiedenen Bereichen verwendete Beleuchtungssysteme werden hier behandelt.

Aufgrund der in Tagbauminen vorherrschenden Atmosphäre müssen die Leuchten gegen das Eindringen von Staub und Feuchtigkeit gut geschützt sein. Design und Installation der Leuchten müssen eine leichte Wartung ermöglichen. Ein striktes Einhalten der vereinbarten Wartungstermine ist wichtig, um unnötigen Lichtverlust im Laufe der Zeit zu verhindern, und um Investitionen in ein höheres Anfangsbeleuchtungsniveau zu vermeiden und damit Energie zu sparen.

Parameter für die Beleuchtungsqualität, wie durchschnittliche Beleuchtungsstärke, Gleichmäßigkeit und Blendungsverminderung wurden beschrieben. Weitere Richtlinien können bestehenden CIE-Publikationen entnommen werden. Anforderungen an für Tagbauminen typische Gebiete werden genannt.

1. SCOPE

The guide specifies the points to be considered for the design of lighting for open-cast (also called 'open-cut' in some countries like Australia) mines in view of the processes involved in the open-cast mining. Three types of lighting are involved: machine-mounted, movable and fixed.

2. INTRODUCTION

Open-cast mines cover a very large area, sometimes measuring over 50 square kilometres. The mining area continuously changes with the progress of the mining operations, making it almost impossible to provide any kind of permanent lighting.

The operations involved are extensively mechanised using very large, diesel or electric powered, mobile construction type equipment. As the capital investments are very high, most mines work 24 hours a day. Proper and effective illumination in these mines is very important not only for the productivity but for the safety of the personnel, machines and vehicles moving continuously on changing and temporary working areas and roads.

Open-cast mining engineering includes two kinds of work: *Stripping* (excavating, transportation and piling waste) and *mining* (excavating, transportation as well as piling and unloading mined material), having their specific lighting requirements.

3. OPEN-CAST COAL MINES

Usually one of the longer sides of the area is considered as the starting line for the mining operation and is called "fixed face". The "A" grade coal is often available at a depth of approximately 90 m. This means first removing the over burden (the earth and rock overlying a coal bed) and then transporting this to a predetermined site.

As the removal and transporting requires moving the machines and vehicles to the operation sites, the entire area is gradually converted into benches in order to reach the coal bed. For easy operation and for the movement of vehicles up and down there are limitations on the maximum height of a face and the height and width of the benches. The bench height of mining is 8 - 12 m, but the height of piling yards is 30 m. The conditions encountered at these areas are given in Figure 3.1.

4. OPEN-CAST METAL AND NON-METAL MINES

Open-cast mining operations are used for many other ores and substances like iron ore, copper ore, manganese ore, limestone, lignite (brown coal), etc.

Most of these mines operate in more or less similar fashion as the open-cast coal mines with similar equipment.

Iron ore mines are large, open pit mines. Here also, the benching method is employed using loading shovels and haulage trucks, which transport the ore to a primary crusher. From there a conveyor belt takes the ore to a secondary crusher. Some iron ore is then processed into pellets at a plant located adjacent to a mining pit.

5. MINE FACE LIGHTING REQUIREMENTS

Most of the mining materials have very poor reflectance, being black and dark brown in colour.

It is not possible to have permanent lighting systems installed, as the area of work is continuously changing in a quarry.

There are two ways of lighting the mine face:

- a) from the machines - this is the most preferred and used method;
- b) by portable floodlights or temporary pole mounted equipment.

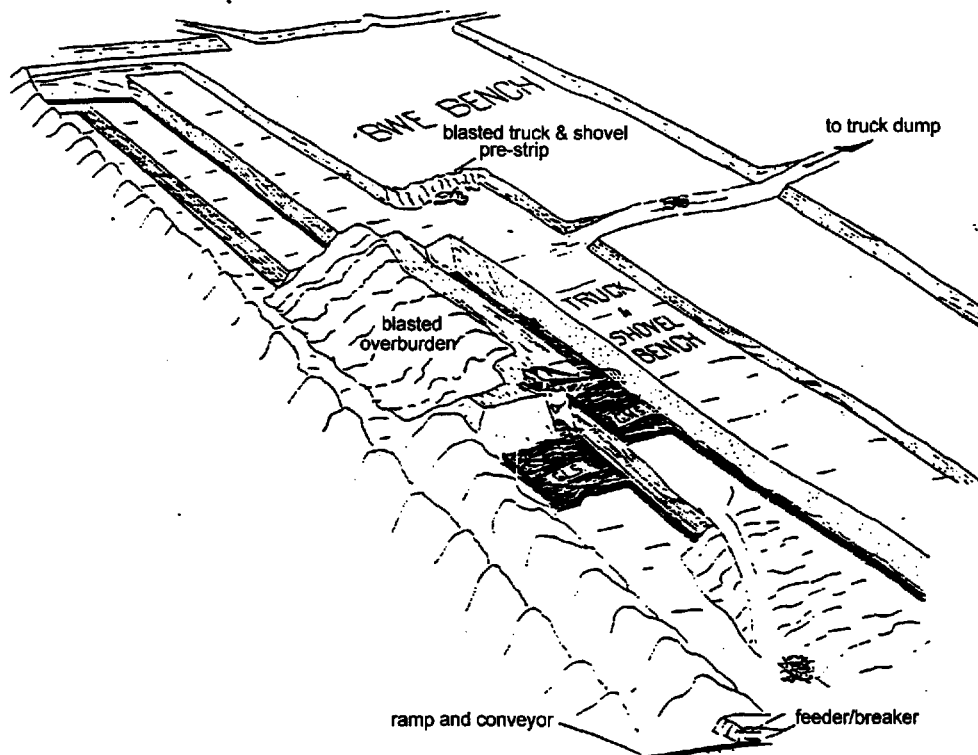


Figure 3.1: Overburden removal and coal mining operation.

5.1 The visibility requirement for operators of the machines

Machines used in open-cast mining are draglines, stripping shovels, loading shovels, haulage trucks, drilling rigs, scrapers, bulldozers, graders, and bucket-wheel system, as well as service vehicles like fuel and lubrication trucks, water trucks, explosive trucks, maintenance trucks, cable handler, tyre handler and low loader.

The operators of these machines must be able to see clearly the exact areas of various operations, which are quite often at long distances, and manoeuvre their equipment while excavating, dumping, loading etc. There are many safety considerations like seeing moving objects during excavation, seeing the ladders and handrails of the machines, viewing the edge of the dump, readily detecting hazards and seeing other moving equipment.

6. LIGHTING REQUIREMENTS FOR AREAS OTHER THAN MINE FACES

6.1 Haul roads

As the work progresses in the mining areas, the mining face moves further and further away from the fixed face and moves from one bench to a lower bench (see Figure 3.1), and the haul roads continuously change in direction and depth. With time the early part of the haul roads become permanent but the major part remains temporary in nature.

These temporary unmetalled roads are dusty with frequent bends and change in slopes. Here the visibility requirement is very high in order to counter the hazardous situations.