Study of Application of LED lighting Systems in Mines

INTRODUCTION:

The work done on project contains field observations in underground and opencast mines showing general lighting requirements and standards set by government. In this paper, the output illuminance levels of LEDs are tested for underground mines. The aim is to prove that LEDs can be used as light source in underground and opencast mines. These illuminance levels are checked with the help of LightTools Software by simulation method. The results are then compared with the values of other conventional lamps to prove the positive aspects of LEDs.

DESIGNING MODEL LUMINAIRE AND TUNNEL:

LightTools Software is first used to design a LED luminaire. According to the requirements we select a Philips LumiLeds, white LED, model no. LXK2-PWW2. The LED required for underground mines, need to have a Lambertian pattern with low temperature coefficient such that its output levels should not vary extensively with slight change in temperature. The structure of Luminaire resembles a rectangular box of dimensions 40*20*12 cms. Six LEDs are fixed in a rectangular array as shown in fig. below.
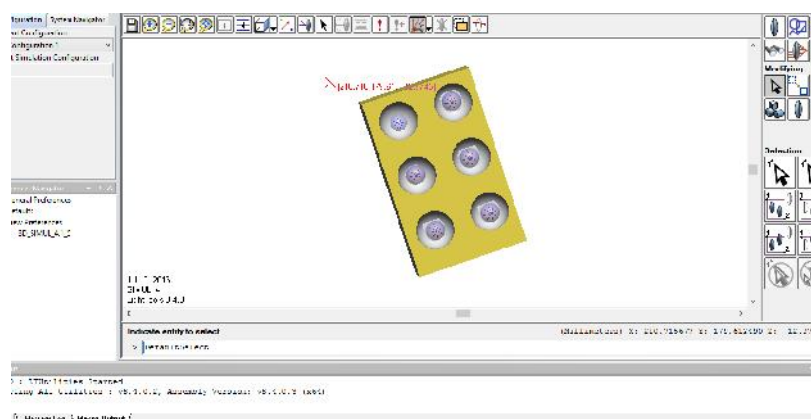

Fig. Luminaire

The designed Luminaire is fixed inside a similar modelled tunnel. This tunnel is similar to underground roadways. The tunnel walls are assigned optically absorbing properties.

In mines, the surfaces are rough and do not reflect light but rather scatter it thereby reducing its intensity. Most of the times these walls are whitewashed to increase their

reflecting properties. The tunnel modelled in LightTools are made rough by using the 3D textures feature.
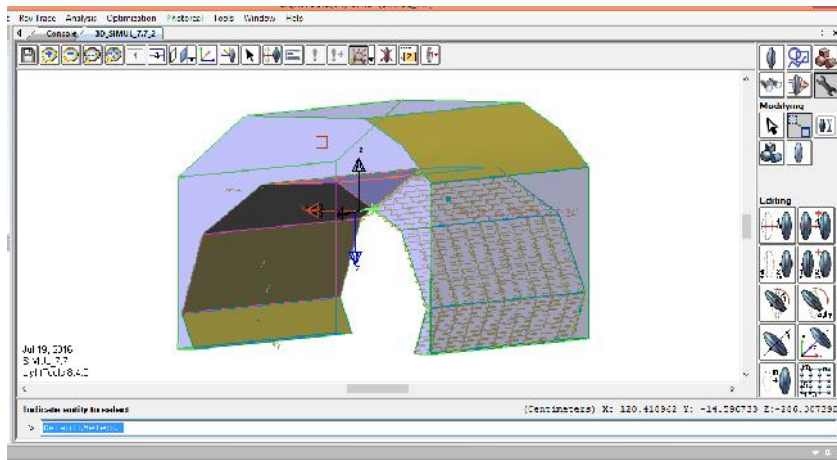

Fig. Tunnel

The tunnel section designed is 15-20meters in length. Total 3 Luminaires are fixed on the roof along the center axis, at equal intervals. This model is then simulated.

SIMULATION RESULT:

According to Indian mining standards, Underground roadways need to have an average of 4 Lux illuminance levels. A plane surface receiver is placed as shown below and the simulation results are obtained.
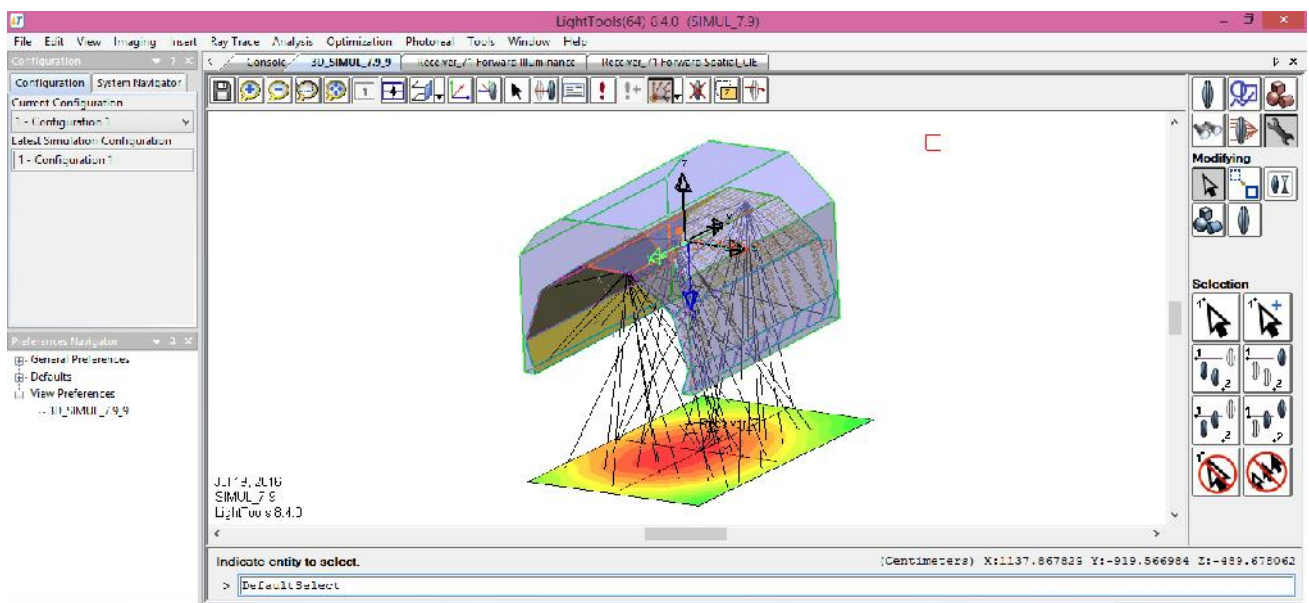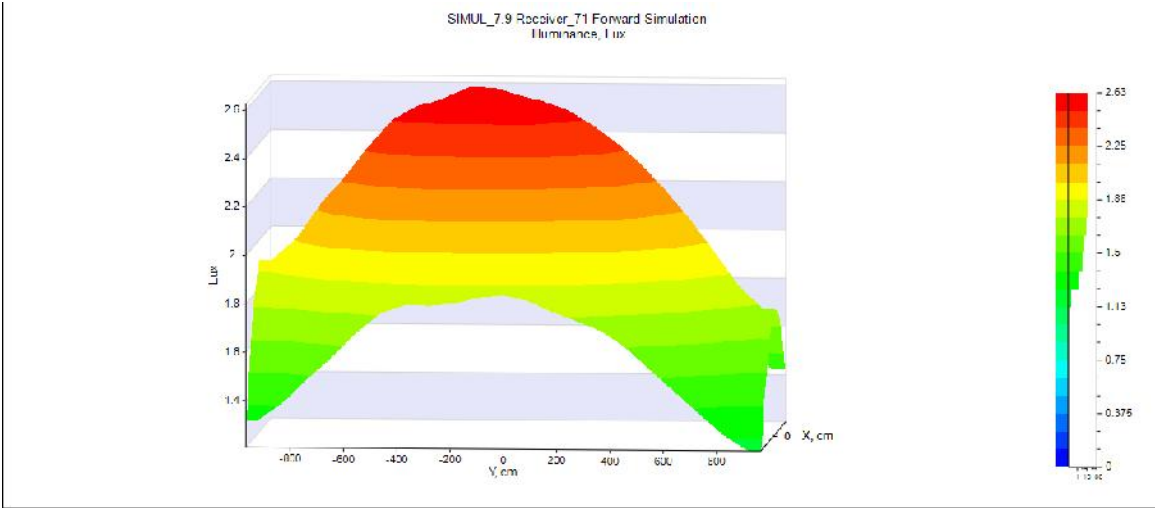

Fig. Simulated Model

Fig. Forward Simulation result.

The output illuminance levels obtained are approx. equal to 2.6 Lux. The colour chart shows an equally illuminated roadway. The output illuminance level has a Gaussian profile.
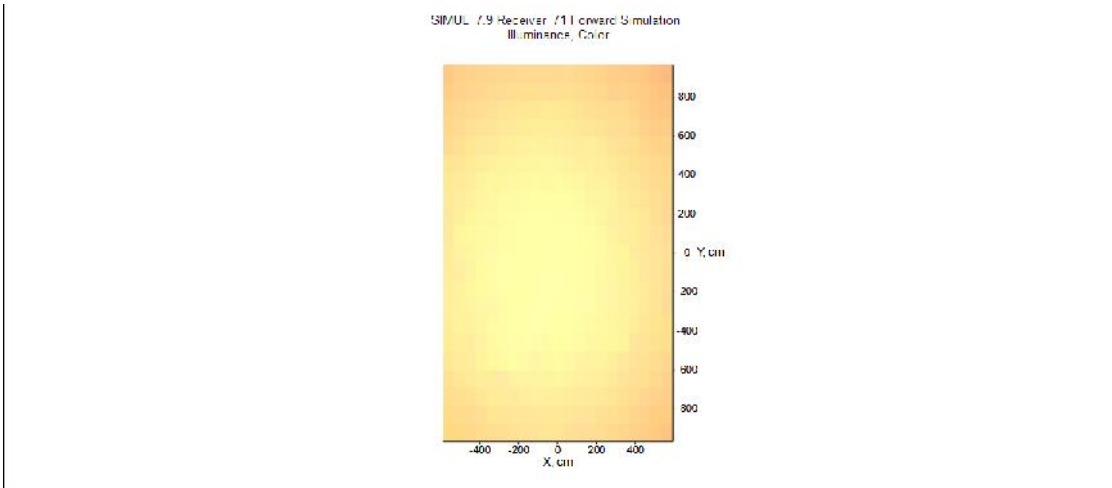

Fig. Colour Chart

A detailed simulation result is shown below. The output levels obtained are close to the standard values. The detailed simulation result shows that for incident power equal to 470 Lumen, the illuminance levels obtained are equal to 2.63 Lux.

The simulation results show an overall average error of 4.02%. At peak, the error is equal to 3.53%. This shows that LEDs luminaires can be used for mines.
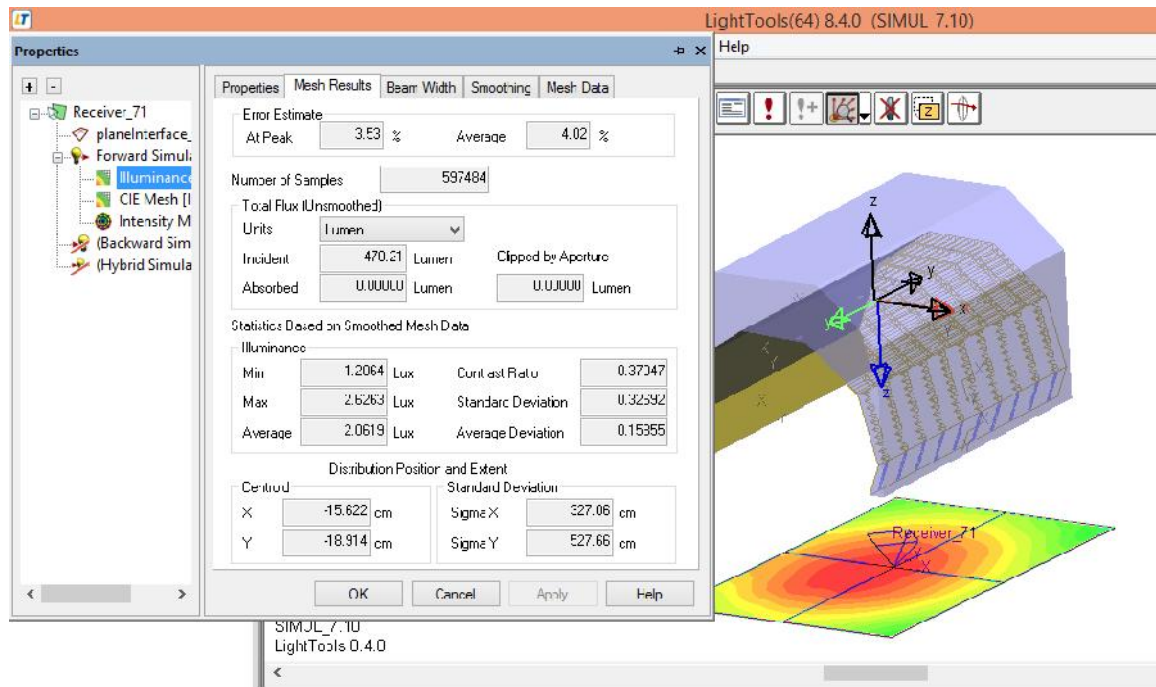
Fig. Detailed Simulation Result

CONCLUSION:

LED luminaires can be designed to achieve maximum illumination in mines. LEDs are solid state source which reduces the danger of accidental fires normally observed in other sources. Before actually manufacturing any model it can be designed in LightTools or similar software and checked for output values.