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Expert Opin Environ Biol 2016, 5:3(Suppl)
http://dx.doi.org/10.4172/2325-9655.C1.012



## A cost effective daylighting system for energy saving in multi-story building

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The use of artificial light such as electric lighting in a building makes up a significant proportion of the electric energy consumption. In commercial buildings, 40% to 50% of energy consumption is accounted for by artificial lighting. Efficient daylight buildings are estimated to reduce the energy consumption needed for electric lighting by 50% to 80%. An optical fiber daylighting system (OFDS) that captures high intensity direct component of solar light, focuses it into an optical fiber and distributes the visible part of it into buildings would be an ideal lighting supplement to artificial lights in commercial buildings. Breakthroughs of this technology have been, however, delayed due to technical problems related to optical fiber: Limited light transport distance and too high price. In this paper, we introduce a modified optical fiber daylighting system (M-OFDS) which can eliminate the disadvantages of optical fiber. Sunlight is concentrated through a Fresnel lens, and then focused onto a piece of large core POF. The output light from POF is collimated by a collimator attached at the end of fiber. The collimated and high condensed sunlight beam travels in the free space. The redirecting flat mirrors are utilized to change the direction of beam into the room. Because the transport medium is the air, the transmission loss becomes trivial. The high condensed beam with small size can be reached to the inside of the building easily through the entrances, windows, or vents of building. Some limitations of conventional OFDS such as transmission loss and high cost of POF are eliminated by using the proposed M-OFDS. The system was designed and simulated using LightToolsTM software. A prototype of MOFDS was fabricated and experimented under real condition. The simulation and experiments results shown that, system can achieve an optical efficiency of >50%, and 30 m of sunlight transport distance. This study is the first to use the method of light transmission in free space to overcome the limitation of high installation cost of conventional OFDS. It shows great potential for commercial and industrial scale daylighting fields.

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