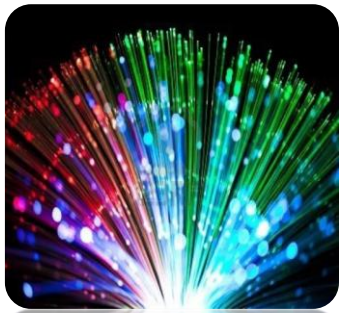
PUSAT KECEMERLANGAN KEJURUTERAAN DAN TEKNOLOGI JKR (CREaTE)

LIGHT TRANSMITTING CONCRETE

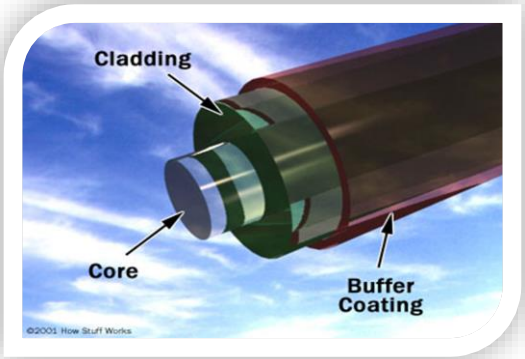
MAKMAL PENYELIDIKAN STRUKTUR , KONKRIT DAN ALAM SEKITAR
BAHAGIAN INOVASI, PENYELIDIKAN DAN PEMBANGUNAN KEJURUTERAAN (BIPPK)

INTRODUCTION

- Light transmitting concrete is an innovation in concrete building material.
- It was made from **96% of concrete** and **4% by weight of optical fibres**.
- The density of concrete is around **2100 kg/m3** to **2400 kg/m3**.
- The concrete based building material have light-transmissive property.
- Mainly due to the uniform distribution of high numerical aperture **Plastic Optical Fibres (POF)** throughout its body.



Hair thin cylindrical fibre of glass or any transparent dielectric medium



Structure of the optical fibre

MATERIALS USED FOR PRODUCING LIGHT TRANSMITTING CONCRETE

Cement + Sand + Water = Fine Concrete

Optical Fibre

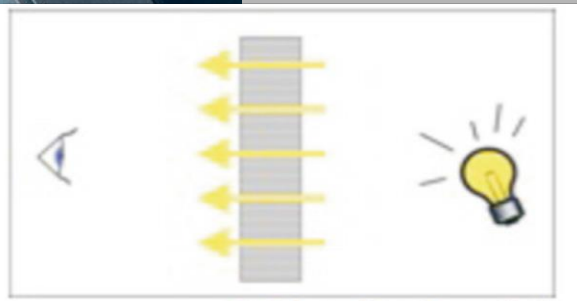
Light Transmitting Concrete

Types of optical fibre;

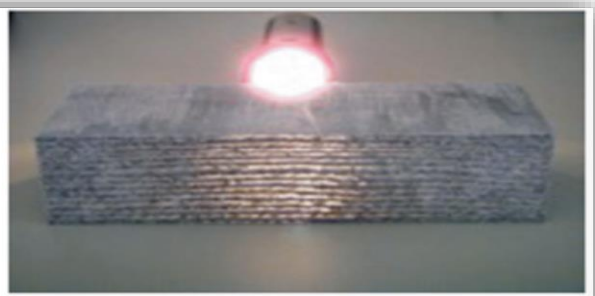
- Multimode graded-index fibre
- Multimode step-index fibre
- Single-mode step-index fibre

WORKING PRINCIPLE
(Total internal reflection)

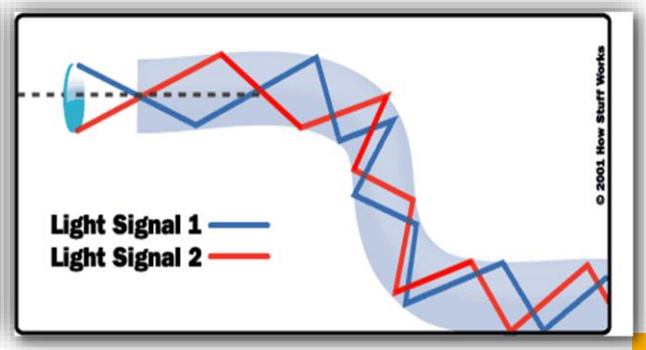
- When a ray of light travels from a denser to a rarer medium such that the angle of incidence is greater than the critical angle, the ray reflects back into the same medium.
- In the optical fiber, the rays undergo a repeated total number of reflections until it emerges out of the other end of the fiber, even if the fiber is bent.



Lighting wire - theoretical



Lighting wire - pratical



MANUFACTURING PROCESS

1. Concrete mixture made up from fine material only was prepared. (No coarse aggregate)

2. The optical fiber was cut into the actual size required.

3. Small layer of the concrete are poured into the mould and on top of each layer, a layer of fibres is infused. Approximately around 2 mm to 5 mm.

4. Finally, the hardened concrete surface was polished.

ADVANTAGES & DISADVANTAGES

Advantages

- Energy-saving can be done by the utilization of transparent concrete in the building.
- It has very good architectural properties for giving a good aesthetical view to the building.
- Less energy consumption.
- Illuminated Pavements.
- Homogeneous in structure.
- Routine maintenance not required.
- The optical fibre can also acts as reinforcement for the concrete.

Disadvantages

- The concrete is very costly because of the optical fibre (About RM 6,117.00/ sq.feet)

BUILDING WITH LIGHT TRANSMITTING CONCRETE APPLICATION

Al-Aziz Mosque, Reem Island, Abu Dhabi

- Al Aziz Mosque on the Al Reem Island in Abu Dhabi was designed by **APG Architecture and Planning Group.**
- The company introduced innovative and new ideas and concepts with the use of light-transmitting concrete technology for the construction of unique and distinguished facades.

RWTH Aachen University, Aachen, Germany

- Designed by **German concrete maker LUCEM**
- LUCEM manufactures panels of concrete which are composed of optical fibres and clear strands of plastic through which light can be passed through
- The building was made up from 136 of these panels which can change colour and can be controlled from an iPhone apps.

CONCLUSIONS

- The Light Transmitting concrete is able to enhance the best architectural features in any building.
- It is practical to areas where light is unable to reach with the appropriate intensity.
- Building and structures can improve aesthetically without compromising on the strength.