1.1 CONSTRUCTION OF OPTICAL FIBER CABLE

An optical fiber is a glass or plastic fiber that carries light along its length. Fiber optics is the overlap of applied science and engineering concerned with the design and application of optical fibers. Optical fibers are widely used in fiber optic communications, which permits transmission over longer distances and at higher bandwidths (data rates) because light has high frequency than any other form of radio signal than other forms of communications. Light is kept in the core of the optical fiber by total internal reflection. This causes the fiber to act as a waveguide. Fibers are used instead of metal wires because signals travel along them with less loss, and they are also immune to electromagnetic interference, which is caused by thunderstorm. Fibers are also used for illumination and are wrapped in bundles so they can be used to carry images, thus allowing viewing in tight spaces. Specially designed fibers are used for a variety of other applications, including sensors and fiber lasers.

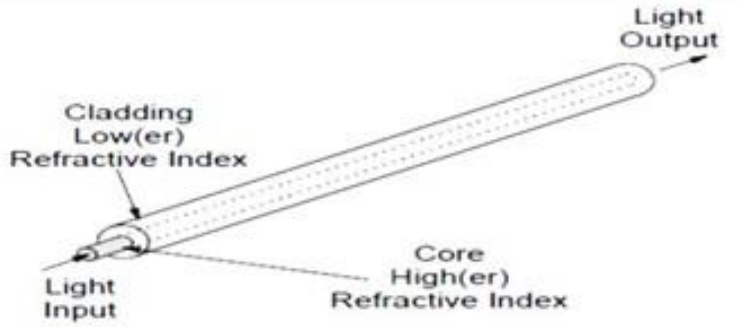

Figure 1.1.1 Construction of Fibre

[Source: "Optical Fibre Communications" by J.M.Senior, Page: 12]

An optical fiber is a very thin strand of silica glass in geometry quite like a human hair. In reality it is a very narrow, very long glass cylinder with special characteristics. When light enters one end of the fiber it travels until it leaves the fiber at the other end. An optical fiber consists of two parts: the core and the cladding. The core is a narrow cylindrical strand of glass and the cladding is a tubular jacket surrounding it. The core has a (slightly) higher refractive index than the cladding. Light travelling along the core is confined by the mirror to stay within it even when the fiber bends around a corner.

A fiber optic cable has an additional coating around the cladding called the jacket. The jacket usually consists of one or more layers of polymer. Its role is to

protect the core and cladding from shocks that might affect their optical or physical properties. It acts as a shock 14 absorber. The jacket also provides protection from abrasions, solvents and other contaminants. The jacket does not have any optical properties that might affect the propagation of light within the fiber optic cable.

Guiding mechanism in optical fiber

Light ray is injected into the fiber optic cable on the right. If the light ray is injected and strikes the core-to-cladding interface at an angle greater than an entity called the critical angle then it is reflected back into the core. Since the angle of incidence is always equal to the angle of reflection the reflected light will again be reflected. The light ray will then continue this bouncing path down the length of the fiber optic cable. If the light ray strikes the core-to-cladding interface at an angle less than the critical angle then it passes into the cladding where it is attenuated very rapidly with propagation distance. Light can be guided down the fiber optic cable if it enters at less than the critical angle.

This angle is fixed by the indices of refraction of the core and cladding and is given by the formula

The critical angle is measured from the cylindrical axis of the core. By way of example, if n1

= 1.446 and n2 = 1.430 then a quick computation will show that the critical angle is 8.53 degrees, a fairly small angle.

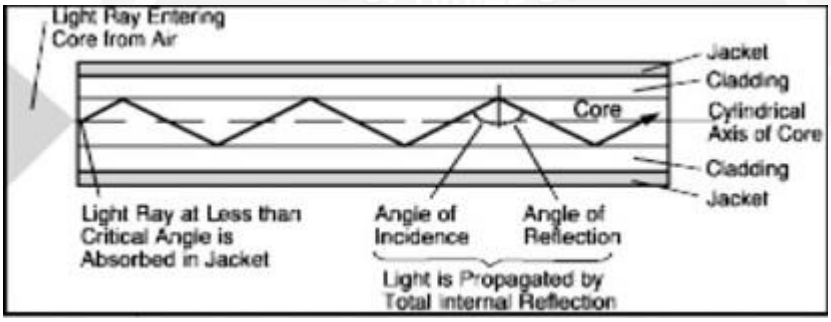

Figure 1.1.2 Mechanism of Light Wave guide Fibre

[Source: "Optical Fibre Communications" by J.M.Senior, Page: 13]

Of course, it be noted that a light ray enters the core from the air outside, to the left of Figure. The refractive index of the air must be taken into account in order to assure that a light ray in the core will be at an angle less than the critical angle. This can be done fairly simply.

Suppose a light ray enters the core from the air at an angle less than an entity called the external acceptance angle It will be guided down the core.

Basic component of optical fiber communication

1 Transmitters - Fiber optic transmitters are devices that include an LED or laser source, and signal conditioning electronics, to inject a signal into fiber. The modulated light may be turned on or off, or may be linearly varied in intensity between two predetermined levels.

2 Fiber – It is the medium to guide the light from the transmitter to receiver.

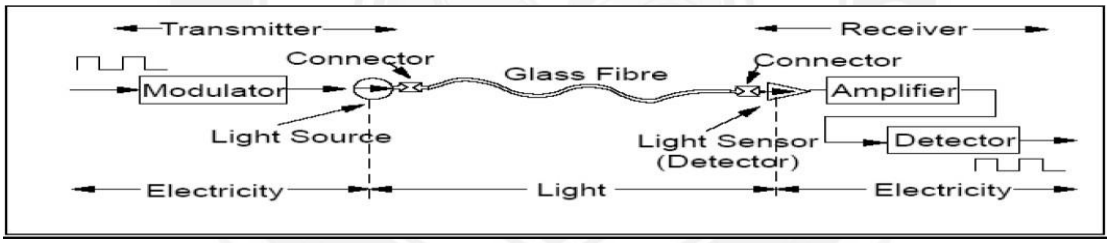

Figure 1.1.3 The basic components of an optical fiber communication

[Source: "Optical Fibre Communications" by J.M.Senior, Page: 14]

3 Receivers – Fiber optic receivers are instruments that convert light into electrical signals. They contain a photodiode semiconductor, signal conditioning circuitry, and an amplifier at the receiver end.