1.3 DIFFERENT TYPES OF FIBERS AND THEIR PROPERTIES

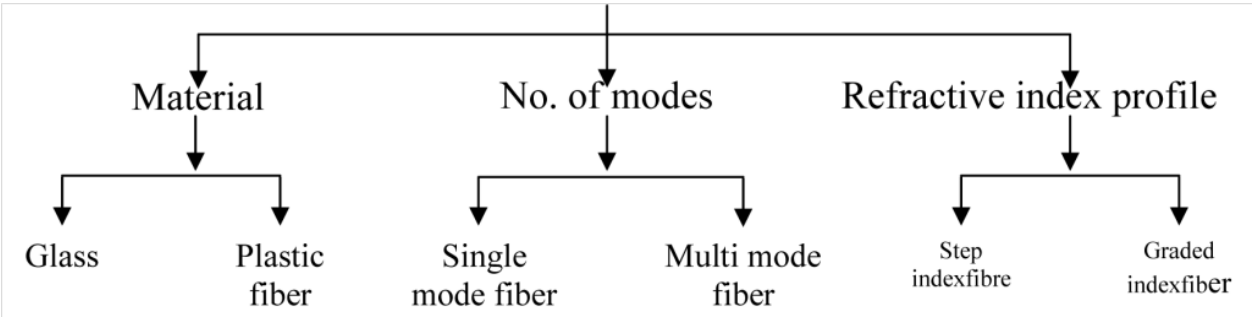

Figure 1.3.1 Different Types of Fibre

[Source: "Optical Fibre Communications" by J.M.Senior, Page: 31]

Glass And Plastic Fibers

Based on materials in which the fibers are made it is classified into two types as follows:

Glass fibers

If the fibers are made up of mixture of metal oxides and silica glasses are called glass fibers. Examples:-

- Core: SiO_2;cladding: P_2O_3– SiO_2
- Core: GeO_2– SiO_2;cladding: SiO_2

Plastic fibers

If the fibers are made up plastics which can be handled without any care due to its toughness and durability it is called plastic fiber.

Examples:-

The plastic fibers are made by any one of the following combinations of core and cladding.

- Core:Polymethylmethacrylate; cladding: co-polymer
- Core: Polystyrene; cladding: Methyl methacrylate

Single and multimode fibers

Mode is described by the nature of propagation of electromagnetic waves in a wave guide. Based on the modes of propagation the fibers are classified into two types viz.

(i) Single mode fibers

(ii) Multi mode fibers

(i) Single mode fibers

1. It has very small core diameter so that it can allow only one mode of propagation and hence called single mode fibers.
2. The cladding diameter must be very large compared to the core diameter.
3. Thus in the case of a single mode fiber, the optical loss is very much reduced.

Structure

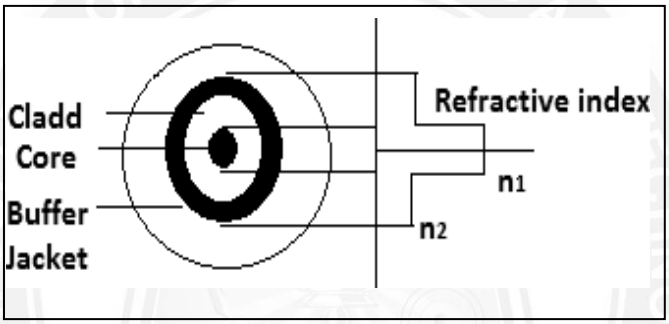

Figure 1.3.2 Structure of Single Mode Fibre

[Source: "Optical Fibre Communications" by J.M.Senior, Page: 34]

Core diameter: 5 – 10 μm

Cladding diameter : Around 125 μm Protective layer: 250 to 1000 μm

Numerical aperture: 0.08 to 0.10 Band width: More than 50 MHz km

(ii) Multi-mode fibers:

1. Here the optical dispersion may occur.
2. They are made by multi-component glass materials.
3. The core diameter is larger than the diameter of the single mode fibers, so that it can allow many modes to propagate through it and hence called as multimode fibers.

Structure:

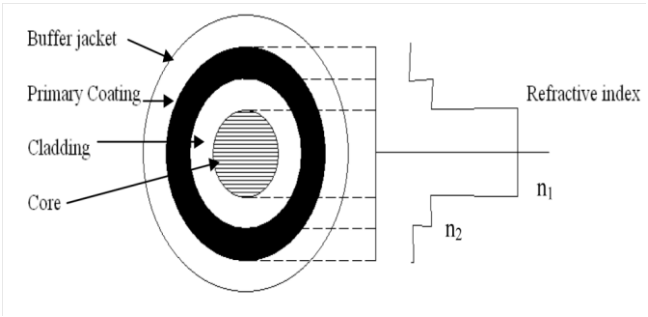

Figure 1.3.3 Structure of Multi Mode Fibre

[Source: "Optical Fibre Communications" by J.M.Senior, Page: 35]

Core diameter:50 – 350 μm Cladding diameter: 125 – 500 μm

Protective layer: 250 to 1100 μm

Numerical aperture: 0.12 to 0.5 Band width:Less than 50 MHz km

Step index and graded index fibers:-

Based on the variation in the refractive index of the core and the cladding, the fibers are classified into two types, viz.

(i) Step index fiber (ii) Graded index fiber

STEP INDEX FIBER

Here the refractive indices of air, cladding and core vary step by step and hence it is called as step index fiber.Thereare two types of step index fibers. They are,

1. Step index single mode fiber –there is dispersion will occur.
2. Step index multi modefiber -- there is intermodal dispersion will occur.

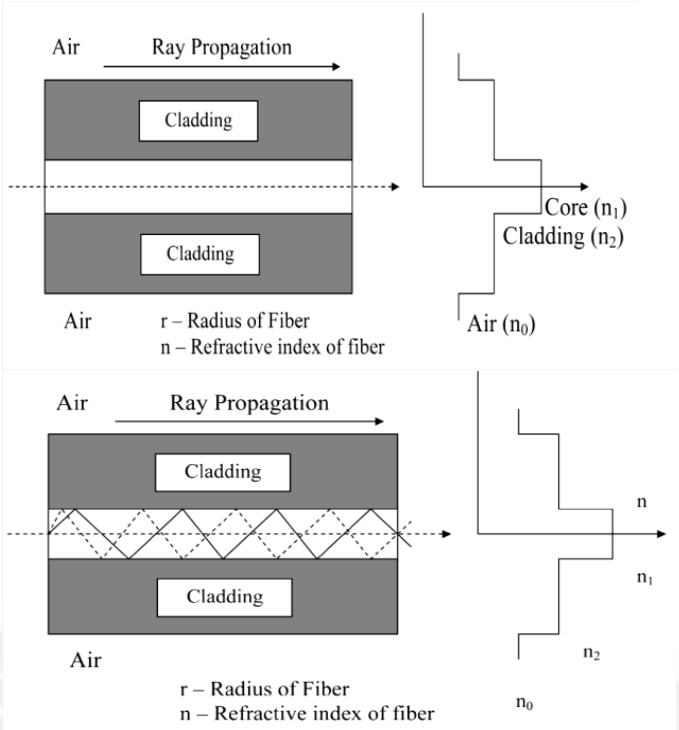

Figure 1.3.4 Structure of Step Index Fibre

[Source: "Optical Fibre Communications" by J.M.Senior, Page: 37]

Graded Index Fiber

Here the refractive index of the core varies radically from the axis of the fiber. The refractive index of the core is large along the fiber axis and it's gradually decreases thus it is called as graded index fiber.

Here the refractive index becomes small at the core – cladding interface. In general the graded index fibers will be of multimode system. The multimode graded index fiber has very less intermodal dispersion compared to multimode step index fiber.