4.4 Modern Construction Materials Used for the Construction of Pavements

Steel slag aggregate is a good example of synthetic aggregates obtained from by- products of industrial processes. It has good binding properties with bitumen due to its high calcium oxide content (NatSteel 1993).

The angular shape of the aggregates helps to form strong interlocking structure. Road paving with steel slag aggregate show good skid resistance mechanical strength able to withstand heavy traffic and surface wearing. Also, many industrial and other waste products like fly-ash, cement kiln dust, incinerated refuse etc. have been successfully used to produce synthetic aggregates.

Mixing bitumen with rubber (natural or crumb form) sometimes poses difficulty. As an alternative approach, tiny crumb rubber pieces can be mixed with aggregates - known as dry- process, this process does not require any modification to the existing batch mixing plant.

Polymer Modified Bitumen is emerging as one of the important construction materials for flexible pavements. Use of plastic waste in the construction of flexible pavement is gaining importance because of the several reasons.

- ✓ The polymer modified bitumen show better properties for road construction & plastics waste, otherwise considered to be a pollution menace, can find its use in this process and this can help solving the problem of pollution because most of the plastic waste is polymers.
- ✓ In the construction of flexible pavements, bitumen plays the role of binding the aggregate together by coating over the aggregate.
- ✓ It also helps to improve the strength of the road. But its resistance towards water is poor. Antistripping agents are being used. A common method to improve the quality of bitumen is by modifying the rheological properties of bitumen by blending with organic synthetic polymers like rubber and plastics.

Geo- textile is any permeable textile material used with foundation, soil, rock, earth, etc. that is an integral part of a constructed project, structure or system.

- ✓ It may be made of synthetic or natural fibers. In contrast; a geo-membrane is a

continuous membrane-type liner or barrier. It must have sufficiently low permeability to control migration of fluid in a constructed project, structure or system.

- ✓ A geo-textile is designed to be permeable to allow the flow of fluids through it or in it, and a geomembrane is designed to restrict the fluid flow.

Separation

In this function, the geo-textile serves to separate two dissimilar materials, eg, two different soils, landfill material and the native soil, stone material and sub-grade soil, old and new pavement, foundation soils and various types of walls, or one of many other similar situations. In some instances, it is difficult to distinguish between the separation and stabilization functions because in both situations the geo-textile is serving as a separator. However, in stabilization some additional phenomena occur.

Stabilization

In this application, the natural soil on which the geo-textile is placed is usually a wet, soft, compressible material, exhibiting very little strength. By acting as a separator, the geo-textile allows water from the soft natural soil to pass from this soil into a free-draining construction soil, which in turn allows consolidation of the natural soil to take place. As a result of the consolidation process, there is a strength gain in the natural soil, which then provides an adequate foundation for construction to take place.

Reinforcement

- ✓ The key difference between stabilization and reinforcement is that stabilization is accomplished by providing for drainage of water from the unstable soil, while in reinforcement the strength characteristics (stress–strain) of the geo-textile provide added strength to the whole system.
- ✓ Another difference is that in stabilization the geo-textile is placed on or around the area being stabilized and thereby also acts as a separator, whereas in the reinforcement application the geotextile is placed within the material being reinforced. This is in line with reinforcement concepts in concrete and other materials.

Filtration

- ✓ Here the prime function is to retain soil or other fine materials, while allowing water to pass through. Again, it is seen that more than one function is being

performed.

- ✓ If there were no drainage of water taking place, movement, and therefore retention of the soil, would not be of concern. Part of the mechanism by which filtration occurs is through the development of a soil filter behind the geo-textile.
- ✓ As the water passes through, soil is filtered out and collects behind the geo-textile. As buildup takes place, a natural soil filter is developed.

Drainage

- ✓ Drainage parallel to the plane of the geo-textile is described. The property called transmissivity is defined as flow parallel to the plane of the geotextile.
- ✓ This type of flow can occur to some extent in all geo-textiles, but is best achieved in needle-punched non-woven materials.
- ✓ This class of geo-textiles can be manufactured in a range of thicknesses such that this characteristic is optimized.

Moisture Barrier

- ✓ When impregnated with an asphaltic emulsion, geo-textiles become impermeable and can then be used as moisture barriers. The primary application for this type of geo- textile is in pavement rehabilitation.

Fiber Reinforced Bituminous Mix

Addition of various kinds of fibers to the binder and aggregates during mix preparation process results in fiber reinforced bituminous mix (FRBM). Fibers are generally blended with bitumen binder before mixing it with the aggregates to achieve complete coating and even distribution throughout the mix.

Bituminous Recycling

In recycling method, bitumen and aggregates are separated out (partly or fully) and used again. The specific benefits of recycling of bituminous pavement can be summarized as:

- ✓ Conservation of energy and construction material.
- ✓ Prevention of undesirable rise in height of finished surface and preservation of the existing road geometrics.
- ✓ Reuse of deteriorated road materials which in turn solves the disposal problem.
- ✓ Solution to the problem of scarcity of good quality material.

- ✓ Preservation of the environment.
- ✓ Reduction in susceptibility to reflection cracking.

Bitumen ages due to oxidation with atmospheric oxygen as a result of which resins get converted into asphaltenes (Petersen, 1984). By this process bitumen loses its ductility and becomes more brittle. Recycling is based on the fact that bitumen obtained from old deteriorated bituminous pavement, may still has its residual properties and recycling helps in restoring those residual properties of the bitumen.

To judge the suitability for use as a recycled material, aggregates are tested for their gradation and bitumen is tested for its engineering properties. The optimum quantity of reclaimed material to be mixed with fresh material is generally determined from mix design process. Fresh thin (soft grade) bitumen having low viscosity can be used to replenish the aged bitumen. Rejuvenators (like road oils and flux oils) are sometimes added for improvement in properties of reclaimed bitumen.

There are four major technologies exist for bituminous pavement recycling :

(i) Hot mix recycling

Here recycled asphalt pavement (RAP) is combined with fresh aggregate and bituminous binder or recycling agent in a hot mix plant. Mix is transported to paving site, placed, and compacted.

(ii) Cold in-place recycling

In this the existing pavement is milled up to a depth of 75 to 100mm, RAP, if necessary and recycling agent in emulsion form is introduced, then compacted.

(iii) Hot in-place recycling

In hot in-place recycling method the existing asphalt surface is heated, scarified to a depth from 20 to 40 mm, scarified material combined with aggregate and/or bituminous binder and/or recycling agent and compacted. New overlay may or may not be provided.

(iv) Full depth reclamation

Here all the bituminous layers and predetermined thickness of underlying material is pulverized, stabilized with additives, and compacted. A surface course is applied over it.