

APPLICATION OF GEOSYNTHETICS AND MODERN MATERIALS UNDER KERALA CONTEXT

K.P. Ahammed Basheer , Superintending Engineer, Irrigation Dept.

1.0 INTRODUCTION

Kerala has been experiencing drastic failures in the behaviour of pavements, coastal erosion structures, embankments, hydraulic structures etc. Although the failures are usually attributed to the heavy rains in the state and left as such the basic defects in the public works scenario is not usually discussed. Although the other states in India are overcoming such situations by adopting modern methods and materials the technical setup in the state is not responding to the modern materials and construction methods basically due to the following defects in the system. The public works scenario in Kerala has been revolving around the same axle and is observed to be very reluctant to adopt any changes .Changes are happening in the technical, social ,financial, political and other spheres but the machinery of the public works is observed to be moulded in rigid and concrete moulds which are not susceptible to any changes. The technical challenges popping up frequently are moulded into the same typical type designs and standard data book patterns resulting in the distorted performances and failures attracting very harsh criticism from the public. The reluctance or the basic defect of the existing system shows an indifferent attitude to any modern methods although the situations warrant for introduction of the new systems. Only the conventional materials and methods of constructions are found adapting to the setup which requires a total revamping.

It is to be accepted that the State is experiencing torrential rains during the monsoons and the monsoons are spread for a major portion of the year. The design approach on the public utilities like pavements, coastal protections and embankments has to be in this context and the required paradigm shift has to be applied. It is a fact that the behaviour of the natural soil is subject to serious behavior problems under hydraulic situations. Adequate filter media separating the natural bed and the structure for preventing behaviour of the soil bed affecting the structure is to be used. The failure of conventional filters in use has been identified as the cause for the total failure in many and the modern materials like geo-synthetics has to be experimented and evaluated for Kerala conditions.

2.0 GEOSYNTHETICS

Geo-synthetic is defined as a planar, polymeric(synthetic or natural) material used in contact with soil, rock or any other geotechnical material in civil engineering applications Geo-textile a generic member of geo-synthetic family is a planar, permeable, polymeric or natural fibre textile material used in contact with soil, rock or any other geotechnical material in civil engineering applications. A geotextile can be woven by interlacing two or more sets of yarns, fibres, filaments, tapes or other elements. It could be nonwoven obtained in the form of manufactured sheet, web or batt of of directionally or randomly oriented fibres, filaments or other elements with either mechanical and /or thermal and/or chemical bonding. It could be also knitted, obtained by interloping one or more yarns, fibres or filaments.

3.0 FUNCTIONS

Geo-synthetics serve the following principal functions:

Separation - in which a geo-synthetic placed between two dissimilar geotechnical materials, prevents intermixing.

Filtration - in which a geo-textile allows passage of fluids from a soil while simultaneously preventing the uncontrolled passage of soil particles.

Drainage - in which a geo-synthetic may collect and transport fluids in its own plane

Reinforcement - in which by virtue of the tensile characteristics, a geo-synthetic resists stresses and contains deformations in geotechnical structures.

Barrier - in which a geo-synthetic acts as a barrier to liquid/gas. In addition, geo-textiles serve the following functions: Protection or cushioning - in which a geo-textile serves as a localized stress reduction layer to prevent or reduce damage to a given surface or layer.

Surface erosion control - in which a geo-textile may prevent the surface erosion of soil particles due to surface water run-off and/or wind forces.

Geo-textiles are available in a variety of structures and polymer compositions designed to serve a wide range of applications involving one or more of the above functions. Depending on the application they need to be strong, durable with chemically durable polymeric materials that are resistant to the effects of ground conditions, weather ageing and construction survivability requirements and resistance to temperature/ultra-violet exposure.

4.0 APPLICATIONS

Table 1 gives a general application summary of the various geo-synthetic products.

4.1 GEOTEXTILES IN PAVEMENTS OVER SOFT SOILS

In pavements, particularly over soft soils, placement of a geo-textile serves principally as a separator, apart from functioning towards lateral restraint, bearing capacity increase and membrane tension support. As a separator it does not allow soft subgrade soil to intrude into the sub base and simultaneously does not allow sub base aggregate to penetrate the soil subgrade. Thus contamination of the sub base (also called fouling) is not permitted. To study these effects, extensive studies have been carried out at IIT Delhi through triaxial testing on composite specimens and model studies. From the model studies, it was evident that up to 88% permanent deformation is reduced due to geo-textile inclusions. Also the apparent resilient modulus shows improvement. The test results also indicate that a geo-synthetic inclusion may save more than 40% of WMM base course thickness. Whereas in soft subgrades (CBR<3%) all the above functions will be acting, in amore finer soil(say CBR >8%), the function of geo-textile is likely to be essentially of separation. The method of installing separation geo-textiles with ease is well described by McKeown and Nelson (1999).

4.2 GEOTEXTILES IN OVERLAYS

Introducing a layer of geo-synthetic at the interface between the old pavement and the new overlay, thought in the early years, was thought to reinforce the overlay, but research has now shown that the benefits are stress relief and water proofing (de Bondt, 1999). Non-woven geo-textiles, which generally have high elongation and low tensile strength, are commonly used to stress relief and hence do not resist the movements that cause crack propagation. To reinforce, the interlayer must hold the crack together and dissipate the crack propagation stress along its length. Many materials are now in vogue to serve this eminently ñ with polyester, fibre glass and polypropylene.

4.3 INDIAN EXPERIENCE

Geo-synthetics have been extensively used in road and airport flexible pavements and in overlays. In unpaved roads(having no blacktop), introducing a very thin non-woven geo-textile is found to be of advantage for soft subgrades primarily through separation (thus minimizing pumping) and partly through reinforcement. The Central Road Research Institute, NewDelhi, has undertaken several trials using geo-textiles for road underlays in the rural and command area roads of Gujarat and Maharashtra, over black cotton soils. In Maharashtra, near Satara geo-textile/geogrid combination has been used in State Highways for overlays in black cotton soil areas. Introducing bitumen impregnated non-woven geo-textiles is also known to improve the pavement behaviour in case of reinforced surface dressing as well as flexible overlays - the improvement primarily being brought about through impermeability. Strips of indigenous bitumen impregnated needle-punched geo-textiles have been successfully used in Madurai and Ahmedabad runways as early as 1985. Their use is believed to have helped in controlling the cracks. After 2 years of installation, only micro-cracks were noticed whereas in untreated sections cracks began to appear. Recently (1995) they have also been used in overlaying the runway at Chandigarh airport. Heavy duty geo-composites can be put to use in strategic locations when heavy vehicles can directly move over them. Geo-synthetics are thus a great boon for ease in construction over soft soils well as for long term performance of road pavements. Geo-synthetics also has been used in the Calicut bye-pass of NH17 It is also widely used for the construction of sea walls by Irrigation Department in Kerala As per Uniyal(2001), Geo-textiles have been used at several airfields during 1995-98 on trial basis to delay reflection cracking. At number of airfields cracks have been stated to have appeared within 2-3 years. It was also stated that this could be due to the fact that the geo-textiles used were in strips of 30 cm and the overlay thickness was thin (4-6 cm).Both these factors did not effectively distribute/dissipate tensile stresses and strains developed in the pavement underneath the resurfacing effectively. According to Uniyal, recently, geo-textile layers have been used at 2 airfields in full width of the runway and the performance is under observation. Non-woven polypropylene geo-textiles have been used (in the year 2000) in the parallel Taxi Track of Delhi airport in widths of 95 to 100 cm over expansion joints, construction joints and crack surfaces while executing a flexible overlay over distressed rigid pavements. In India, geo-textiles are yet to be utilized in a big way for road applications. However, in conjunction with geo-grids, they are used in geo-grid basal mattress in Andhra Pradesh in State Highway projects and as a filter in geo-grid reinforced walls and in edge drain, for a project on NH-8 by NHA1.

Table 1 : GEOSYNTHETIC APPLICATION SUMMARY

Application	Primary function	Products
Sub-grade/Pavement	Stabilization, Separation Reinforcement Filtration	Geo-textile/geo-grid
Railroad Track Bed Stabilization	Drainage Separation Filtration	do

Asphalt Overlay	Stress relieving layer	Waterproofing	do
Soil Reinforcement Embankments	Steep Slopes		Vertical walls
Subsurface Drainage (French Drains)	Filtration		Geo-textile
Land Fills	Separation	Filtration Drainage	Reinforcement Barrier

REFERENCE: Proceedings of the international workshop on Geo-synthetics and modern materials in coastal protection and related applications 6-7 AUGUST 2010 at IIT Chennai