CHAPTER 1 INTRODUCTION

1.1 Background

At the present time, transportation system is a major factor in the economy development of each country. Road transportation, which is a transportation system, is most popular, because it can serve passengers and easily and quickly transport goods. Also, it is a more flexible construction than other transport systems. Flexible pavements, synonymously referred to as asphaltic concrete or hot mix asphalt (HMA) pavements, are major road transportation. Since traffic factors such as heavier loads, higher traffic volume, and higher tire pressure are quantitatively, distress of pavements before a reasonable period is a major problem. An improve pavement exhibiting high performance is required to mitigate this problem. An improvement is defined as an increase in pavement service life and/or a reduction in base course thickness for a new pavement. For a rehabilitation pavement, the improvement is defined as an extension in service life. To this end, there are two mitigating methods proposed: 1) improvement of pavement material by replacing hot-mixed asphalt (HMA) prepared by AC 60 – 70 with polymer-modified asphalt (PMA); and 2) use of geosynthetic reinforcement for reinforcing the pavement material.

Polymer modified asphalt cement (PM-AC) is a mixture of a polymer with the ordinary asphalt cement. Low-temperature properties of the modified bitumens containing styrene butadiene styrene (SBS) were investigated using conventional methods, dynamic mechanical analysis (DMA), bending beam rheometer (BBR) and lap-shear test. The results indicated that SBS polymers improved low-temperature properties of bitumens (Lu et al., 1998 and Khattak et al., 2007). From a laboratory study of modified bitumen containing styrene-butadiene-styrene (SBS) copolymer, SBS modification increases the softening point, reduces the penetration, increases the stiffness (hardness) of the Polymer Modified Bitumens (PMBs) (Sengoz and Isikyakar, 2007). PMBs may be less sensitive to permanent deformation. Chen et al. (2002) reported the development of a procedure to evaluate and optimize a polymer modified asphalt (PMA). Rut depth decreases with increasing polymer percentages. Therefore, polymer modification typically improves thermal contraction resistance, effects of fatigue and rutting resistance (Glover et al., 2005).

Geosynthetics have been proposed and used as reinforcement in the pavement layer of flexible pavements. Field experimental with reinforced pavement was studied in India. Geogrid and geotextile, which are a type of geosynthetics, were used to reinforce overlay pavement. Behaviors of strength and craking were studied. From this previous study, reinforcing pavement with geogrid was increase strength and service life and decrease vertical cracking. Also, reinforcing pavement with geogrid and geotextile was able to decrease different stress between existing and overlayed pavements (Kulkarni et al. 1998). Later, laboratory experiments on reinforced pavement was performed. Ling and Liu (2001) presented a physical model test of new reinforced flexible pavement under applied monotonic and cyclic load in laboratory. Geogrid, which are a type of geosynthetics, was used in this previous study. Reinforcing pavement was able to increase stiffness of relation between load and deformation and strength. In addition, scaled-down physical model tests on new and overlayed reinforced flexible pavement structure were performed by Thaisri (2007). When considering the footing settlement, it was found that the permanent deformation of AC layer decreased when reinforced with geosynthetic. Then, the maximum shear strain distribution of the based layer was uniformly distributed with the average value that was lower than the one when unreinforced.

However, the results of combining the two methods together have been found limitedly in the literature. Also, photogrammetric analysis in PMA pavement model has not been studied to determine strain distribution in subgrade.

1.2 State of study

From many distress problems in flexible pavement in Thailand, an improved pavement exhibiting high performance is required to mitigate this problem. Therefore, new technologies were implemented to improve the performance of pavement. Using polymer modified asphalt (PMA) and geosynthetics, which are the two technologies, were used in this study. Unreinforced and reinforced polymer modified asphalt pavements with geosynthetics were tested with a physical model in laboratory. Parameters, which represent the damage of pavement, were measured. Both new pavements and overlay pavements were tested.

1.3 Objectives of Study

The following objectives:

1. To simulate small-scale unreinforced and reinforced polymer modified asphalt pavements in laboratory.
2. To investigate deformation properties in small-scale new and overlayed pavement with and without reinforcing with geosynthetic in laboratory.
3. To compare deformation properties in small-scale unreinforced and reinforced pavements.
4. To compare deformation properties of polymer modified asphalt pavements and hot mix asphaltic pavements in laboratory.

1.4 Scope and Limitation

1. Small-scale polymer modified asphalt pavement models were tested only in laboratory.
2. Two types of geosynthetics were used in this study; geogrid (PGG 50) and geocomposite (PGM-G 50/50).
3. Cyclic load was applied to polymer modified asphalt pavement in the physical model tests.
4. All the tests were performed in a temperature controlled laboratory (≈ 25 ^{o}C).