CHAPTER 1 INTRODUCTION

1.1 State of problem

Most of roads on Thailand are of flexible pavement type that constructed from hot-mixed asphaltic concrete (HMA). HMA is popularly used as the flexible pavement of a road structure which may due likely to, for example, its good performance, and ease of construction etc. Usually, HMA comprises from: a) asphaltic cement which is a residue of petroleum distillation; and b) aggregate which is one of geomaterials. Since the current volume of traffic has increased greatly, the surface of asphalt concrete pavement that is made from aggregates and 60-70 penetration grade asphalt cement damages before a reasonable period. These damages include rutting and cracking which cause problems on quality of driving that could lead to serious accidents. Therefore, engineers have tried to solve the problem by using Polymer Modified Asphaltic cement (PM-AC) to replace asphalt cement grade 60/70 (AC-60/70) for mixing with aggregate. The consequence is known as polymer modified asphaltic concrete (PMA). Polymer modified asphaltic concrete has more resistance to deformation, more stiffness and more elastic than the ordinary hot-mixed asphalt (HMA) (e.g., Lidong et al.,2008; Pormsort, 1998; Yildirim, 2007).

Typically, PMA and HMA are prepared by compaction to the specified density. As a result, their strength and deformation properties are anisotropic, depending on the direction of external stress application relative to the direction of compaction. That is behaviors of geomaterials have been known to be anisotropic. Therefore, the effect of the direction of compaction should have influence to the strength and deformation behaviors of asphaltic concrete. On the other hand, the strength and deformation behaviors of asphaltic concrete are often assumed isotropic; and therefore, not realistic (e.g., Motola et al.,2006; Wang et al.,2004; Liang et al.,2006). Because the asphaltic concrete is a material that was prepared by the compaction, if the direction of compaction compared to the direction of loading is different, the strength and deformation behaviors of asphaltic concrete would be different.

That behavior could also be observed with other geomaterials. Specimens of cement-mixed gravelly soil were compacted in directions parallel and normal to the direction of axial loading to evaluate the effects of compaction-induced anisotropy on the stress-strain-time behavior of such a material (Kongsukprasert et al. 2005). The test results showed the effects of compaction-induced anisotropy on the stress-strain-time behavior of cement-mixed gravelly soil.

The strength and deformation of HMA and PMA from different directions of compaction are unequal. The investigation of anisotropic behavior is importance for a realistic model of PMA. However, these are no known pavement structural response model based on layered theory that considers the anisotropy of the asphalt concrete materials. Therefore, simulation can be more realistic by incorporating anisotropic behavior of PMA into consideration. This research will explain about the effect of degrees of compaction as well as direction of compaction on the strength and deformation behaviors of PMA prepared at various densities.

The anisotropic strength and deformation behavior of PMA is described. The elastic modulus and Poisson's ratio of rectangular prismatic specimens were systematically investigated in this study to evaluate the effects of direction of compaction by performing a series of unconventional unconfined compression tests on PMA specimens that were compacted in directions parallel and normal to the direction of axial loading.

1.2 Objectives of study

The followings are objectives of this study:

1. To realistically obtain the strength and deformation properties of PMA in the different densities and directions of compaction including: a) horizontal direction; and b) vertical direction.
2. To systematically investigate the small-strain properties of PMA in the horizontal and vertical directions and comparisons with the small-strain properties of HMA for the same direction and density.
3. To systematically investigate the effects of PM-AC on the strength and deformation properties of asphaltic concrete.

1.3 Scope and limitation

In this study, to characterize the strength and deformation behavior of Polymer modified asphalt concrete (PMA), the directions of compaction and densities were varied. In each direction of compaction either normal to or parallel to the direction of compaction, a systematic series of unconventional unconfined compression tests were performed on specimens of PMA as follows: A set of monotonic loading (ML) tests were performed at constant values of stress rate, $\dot{\sigma}$, of 3.556 kPa/min. Then, ML tests intervened by many stages of sustained loadings (SL) each lasted for 180 min and followed by minute-amplitude cycles of unload and reload were performed to investigate the PMA stiffness and deformation parameters (i.e., $E_{eq,v}$, $E_{eq,h}$, $\nu_{eq,vh}$ and $\nu_{eq,hv}$).

The asphaltic concrete used in this study was a mixture between polymer-modified asphaltic cement (PM-AC) and aggregate, which were prepared based on Marshal's method at the optimum asphaltic content (i.e.,5 %) by weight of aggregate. The densities of PMA specimens used in this study were: 1.90 g/cm^3 (less than the density at the optimum asphaltic cement content for 20 %), 2.15 g/cm^3 (less than the density at the optimum asphaltic cement content for 10 %) and 2.37 g/cm^3 (at the optimum asphaltic cement content). The density of each PMA specimen was controlled such that the errors between the measured and target values are less than 1%. All the tests in this study were performed in a temperature-controlled laboratory ($\approx 25\,^{o}C$).