Evaluation for Thermal Conductivity of Saturated Unfrozen Fine Grain Soils
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1. INTRODUCTION
Experimental tests have been performed to measure the thermal conductivity of unsaturated soils, and computational models have been widely used to predict thermal conductivity. However, measured values of the thermal conductivity of unsaturated soils cannot be compared with predicted values because of the gradient in moisture content within unsaturated soils. In addition, there are few studies on thermal conductivity of saturated fine grain soils. Lee et al. (2011) find that thermal conductivity of saturated unfrozen kaolinite strongly depends on dry density and soil components. They reviewed previous researches regarding on prediction of thermal conductivity, and found that six methods generally underestimated thermal conductivities measured during consolidation tests (Fig.1). Even though Lee et al. (2011) provides valuable information on discrepancy between measured and predicted thermal conductivities, there are some limits. First, their study is limited to relatively low dry density, which is less than 1200 kg/m³, because loading system can provide around 700 kPa. Second, only specimens prepared with kaolinite were tested.

In this study, experimental Constant Rate of Strain (CRS) consolidation tests with saturated unfrozen fine grain soils were performed to investigate the effect of dry density and soil components on thermal conductivity. The results were used to evaluate the validity of models employed to calculate thermal conductivity.

2. EXPERIMENTAL PROGRAM
Specimens are prepared with kaolinite only and a mixture of kaolinite and silt. The material is classified according to the ASTM D2487 Unified Soil Classification System as CL to CH depending on silt content. Tested specimens are listed in Table 1.

Table 1 Summary of tested specimens

<table>
<thead>
<tr>
<th>Specimen Name</th>
<th>Weight Fraction (%)</th>
<th>Kaolinite</th>
<th>Silt</th>
</tr>
</thead>
<tbody>
<tr>
<td>K100</td>
<td></td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>K80S20</td>
<td></td>
<td>80</td>
<td>20</td>
</tr>
<tr>
<td>K60S40</td>
<td></td>
<td>60</td>
<td>40</td>
</tr>
</tbody>
</table>

Before starting CRS consolidation tests following ASTM D4186, specimens are consolidated with 5 kPa of seating pressure. During CRS consolidation, thermal conductivities are measured. These measured values are compared to predicted thermal conductivities with six methods. Based on measured and predicted data, prediction models are assessed and the effect of soil minerals is discussed.

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