Evaluation of the Effect of Flowing Water through Embedded Pipe on Rutting of Pavements

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SALY KADHUM

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APPROVED:

Professor Rajib B. Mallick, PhD.,PE, Major Advisor

Professor Tahar El Korchi PhD, Head of Department, Committee Member

Assistant Professor Mingjiang Tao, PhD., PE, Committee Member

Sankha Bhowmick Digitally signed by Sankha Bhowmick DN: cn=Sankha Bhowmick, o=UMass Dartmouth, ou=Mechanical Engineering, email=sbhowmick@umassd.edu, c=US Date: 2011.04.26 21:02:27 -04'00'

Associate Professor Sankha Bhowmick, Committee Member

Mechanical Engineering Department UMASS (Dartmouth)

ABSTRACT

Flexible pavements are layered systems that consist of a sub-grade, sub-base, and the pavement surface layer. Pavement surface layer is a mixture of asphalt binder, coarse, and fine aggregates. The stiffness of asphalt materials is significantly reduced by an increase in temperature. The high heat capacity and the low thermal conductivity of pavement materials result in significant increase in temperature and hence increase in the potential of rutting or permanent deformation in asphalt pavements. Controlling of pavement temperature within a desirable range can be an efficient method to reduce rutting. In this study, the technique of lowering pavement temperature by using a fluid through pipes installed inside the pavement is being investigated. Pavement slabs of hot mix asphalt with and without inserted copper pipe were constructed in the Civil and Environmental Engineering laboratory, and the slabs were tested under high temperature with the Model Mobile Load Simulator 3 (MMLS3). The extraction of heat energy from asphalt pavements was achieved by flowing water through embedded pipe located at 1.5 inches below the surface. This technique resulted in a 10°C decrease in pavement temperature and a reduction of rutting depth from 0.65 inch (significant) to 0.1inch (insignificant). Rut depth and temperature data obtained at different locations along the pavement showed good correlation between surface temperature and rutting depth. The results show that the flowing water through embedded pipes is an effective way to reduce the surface temperature and thus to control rutting depth and prolong the life of pavement.

I dedicate this work to my parents

Mrs. Samira Abbas

and

Mr. Saad Kadhum

And to my children

Ali Al-Ziyadi

Sana Al-Ziyadi

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CHAPTER 1

1.0 INTRODUCTION

Asphalt binder is a very important material in the design and maintenance of asphalt pavements. Asphalt pavements are used for many applications such as parking lots, roads, and landing areas in the airports. Asphalt pavements consist of impervious surfaces that are able to absorb and retain the solar energy. Asphalt binder is a visco-elastic material, which exhibits lower stiffness at high temperature and higher stiffness at lower temperature. At high temperatures, the viscosity of the asphalt binder is decreased and the surface of asphalt pavements show signs of permanent deformation (rutting). The back radiated energy from the asphalt pavements surface increases the surrounding temperature and causes temperature in urban area to be higher than rural areas, and thus results in urban heat island effect (UHIE). The rehabilitation of pavements with rutting is a very expensive process, involving milling and paving, and the increasing temperature in the urban areas leads to an increase of energy consumption to maintain human comfort level, and leads to deterioration of air quantity.

The heat energy transfer from solar radiation to the asphalt pavement surface can be defined by three different mechanisms (Figure 1). These mechanisms are as follows: radiation, or radiant heat transfer which involves the transfer of heat by electromagnetic energy from one body to another without affecting the medium between them; Conduction which is the transfer of thermal energy by direct interactions between adjacent molecules; Convection which involves the transfer of thermal energy through a fluid medium.

The high heat capacity of asphalt allows the pavement to store significant amounts of energy for varying temperatures, and the low thermal conductivity of asphalt slows the transport of the heat transfer from surface to bottom layer of the pavement. The two major factors that lead to

permanent deformation (rutting) of asphalt pavement are high temperature and high volume of traffic. One potential approach to tackle this issue is by reducing the temperature fluctuation in the asphalt pavement.

In recent years, many methodologies have been developed to extend the asphalt pavement life by reducing the maximum pavement temperature. The most effective way to achieve this is the cooling of pavement. The advantage of cooling the pavement is not just limited to reducing the temperature of the pavement surface; it can also help to improve the air quality and increase the comfort level in the surrounding areas.

Cooling pavement can be achieved by controlling the pavement temperature through many different methodologies such as: increasing area of the vegetation, placing ultra thin white topping on asphalt surface, increasing the permeability of the pavement to increase the evaporation rate of water through the pavement, and flowing water through embedding pipes.

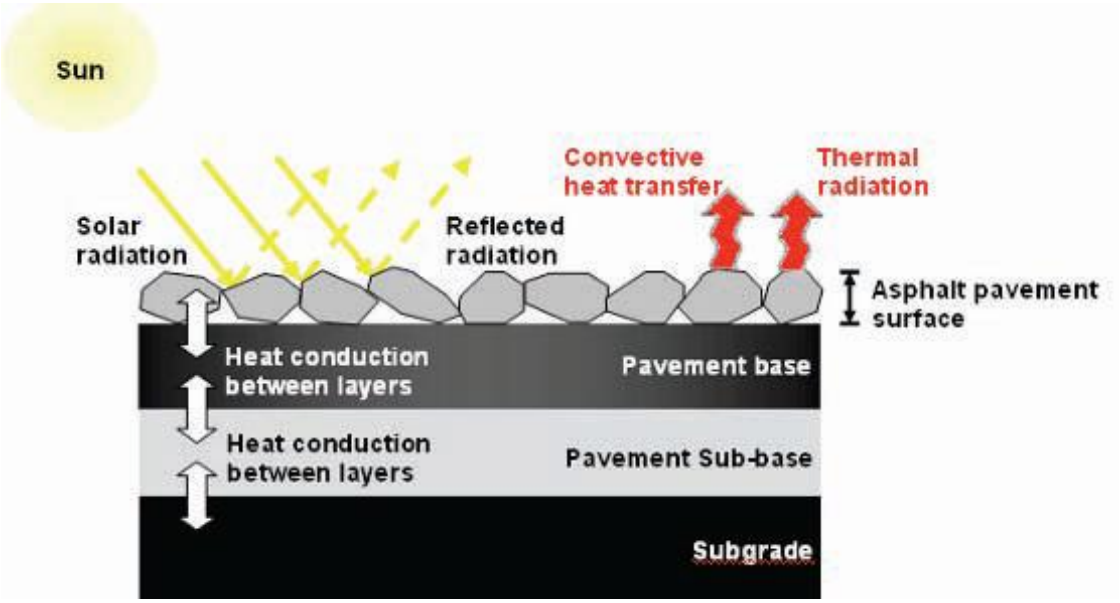


Figure 1: Heat exchange processes in asphalt pavement (www.Nippo-c.co.jp).

In this study, the reduction of asphalt pavement temperature was studied by flowing water through an embedded pipe in a pavement slab.

CHAPTER 2

2.0 OBJECTIVE

The primary objective of this study was to evaluate the effect of flowing water through embedded pipe on rutting of pavements.

CHAPTER 3

3.0 LITERATURE REVIEW

3.1. Introduction

Asphalt is a very common binding material that is used in pavements because of its properties and accessibility. Asphalt has properties of a viscous material, which is a measure of a fluid's resistance to flow; it is measured as the ratio of shear stress to shear rate. When exposed to high temperatures and long periods of loading, asphalt will experience a decrease in viscosity or an increase in fluidity. At low temperature, asphalt acts as an elastic material as well, which means it can deform under the load and return to its original shape after the load is removed. This property helps to reduce fatigue cracking. Therefore, asphalt binder can be considered as a visco-elastic material (Anderson et al, 2000).

Asphalt is black in color, so it is able to absorb and retain most of the sunlight it is exposed to. Most asphalt pavements have a lower albedo of 0.04. This means the asphalt absorbs a lot of the sun radiation and reflects little. However after 5 years the albedo increases to 0.12 because of the exposed aggregates due to weaving of asphalt binder. Due to the temperature retention the viscosity is lowered and the surface shows signs of permanent deformation in the form of rutting. The pavement is not only effected by this temperature retention, the environment is effected as well.

To extend the overall life of an asphalt pavement and to make it more durable in withstanding traffic loading and preventing rutting during periods of high temperatures one method is to cool the pavement. By reducing the surface temperature of the pavement by 10 degrees Celsius failure due to rutting can be significantly delayed, as shown in Figure 2. Cooling

the pavement effectively lowers the temperature of the pavement and therefore reduces transfer of heat to the air.

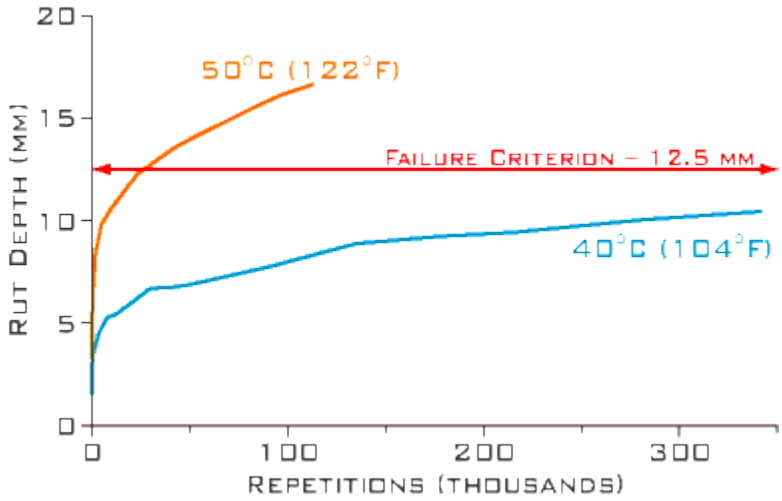


Figure 2: Rutting during high temperature

Source: Dr. John Harvey, Institute of Transportation Studies, and U.C. Berkeley.

The urban heat island effect occurs when the asphalt pavement radiate the absorbed solar energy. This causes an increase in the temperature of the asphalt pavement surface. Cooling the pavement can be used to help limit the impact of the heat island by reducing absorption, retention, and emission of heat. Asphalt should be stiff and elastic at high temperatures to resist rutting and to assure it returns to its original shape after loading is removed.

Chen et al (2009) conducted a small scale study and finite element analysis of flowing water through the pavement and came up with the following recommendation:

- The surface temperature of asphalt pavement can be effectively reduced by flowing water through embedded piping within the pavement structure.
- The reduction in surface temperature is effected by the aggregate and binder used; an aggregate with high thermal conductivity will result in an increased temperature reduction.

- The diameter and length of the embedded piping effects the reduction in surface temperature. Piping with a small diameter and short length leads to an increase in transferred heat from the asphalt pavement to the flowing water in the piping.
- The magnitude of heat extraction from the pavement is affected by the shape of the piping, when a serpentine pattern is applied to the piping the reduction in surface temperature will increase.
- When contact between asphalt binder and the piping is maximized, the heat transfer from the pavement to the flowing water is increased.

Water Retention Pavement

Kubo, et al (2008) has studied the mechanism of reducing temperature by evaporating water that is retained in a porous pavement, as shown in Figure 3.

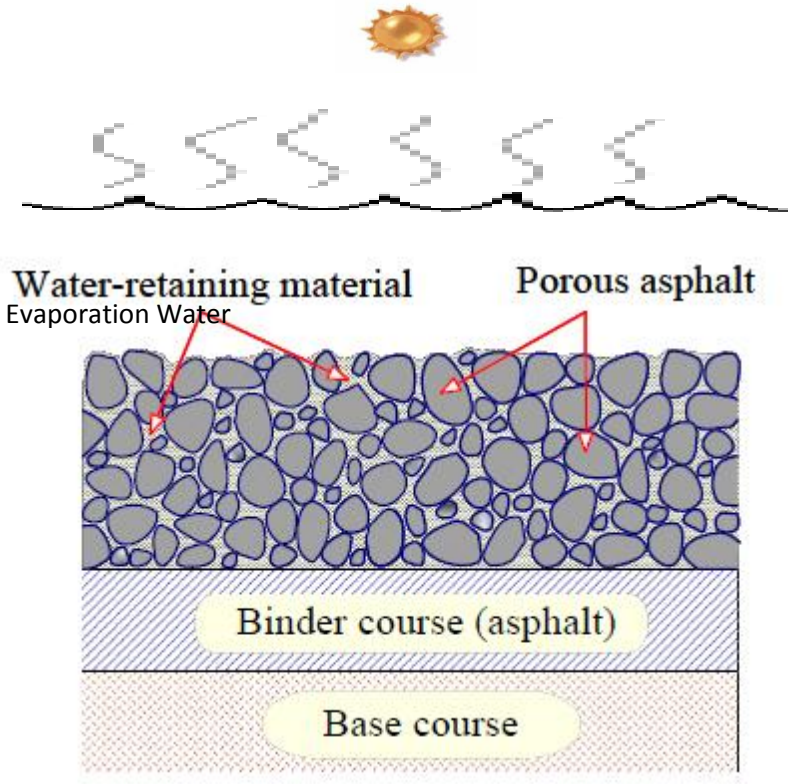


Figure 3: Structure of water retention

Water Retention Experimental Procedure

Specimens of 2m x 2m for the water retention pavement and 2m x 2m for dense graded asphalt were used under the same weather and temperature conditions. During rainfall, the water accumulated in the voids of the pavement and after one day of the rain the temperatures were monitored by thermocouples embedded into the pavement samples.

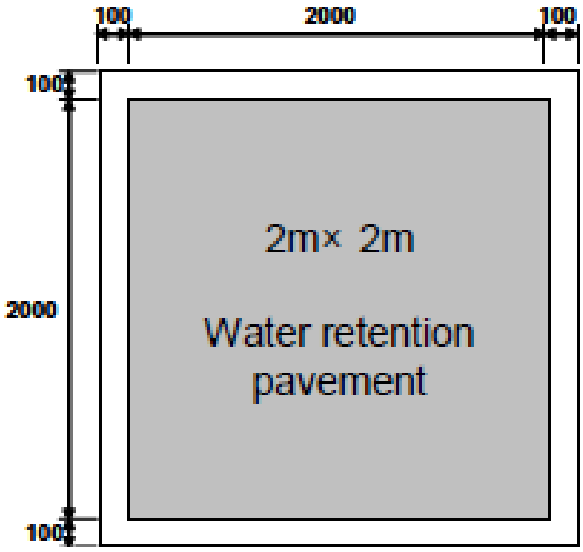


Figure 4: Pavement Specimen

To measure the durability and rutting resistance, the load testing was applied for the water retention pavement specimen by driving 1.5 million repetition 49 KN loads. The test section is shown in Figure 12 (Kubo, et al, 2009).

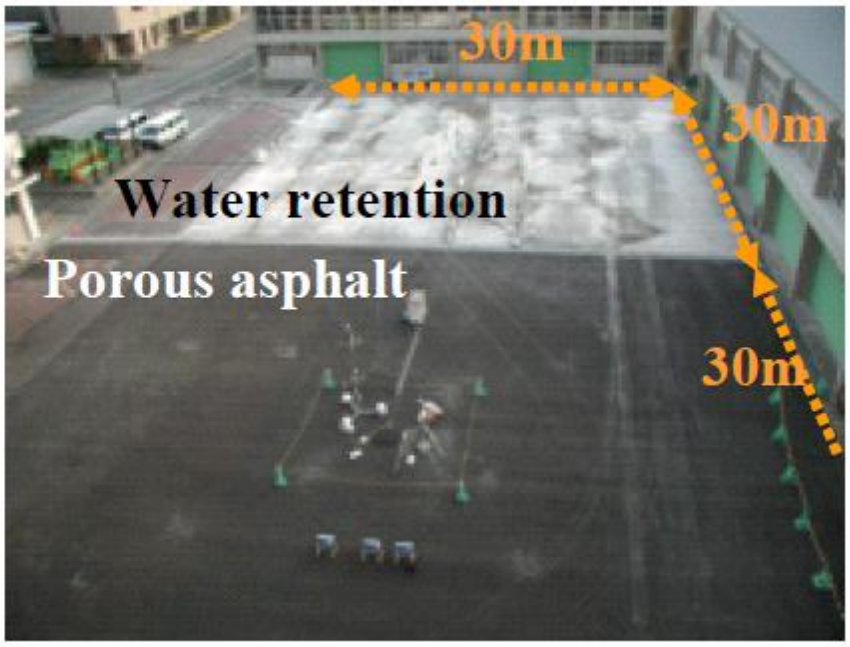


Figure 5: measuring the effects of reducing air temperature

Water Retention Experimental Results and Conclusions

The surface temperature of the water retention pavement after one day of rainfall was up to 16.4^{O}C lower than dense graded asphalt pavement sample. And the depth of rutting was significantly reduced compared with the depth of rutting for dense graded asphalt pavement as shown in Figure 6 and Figure7.

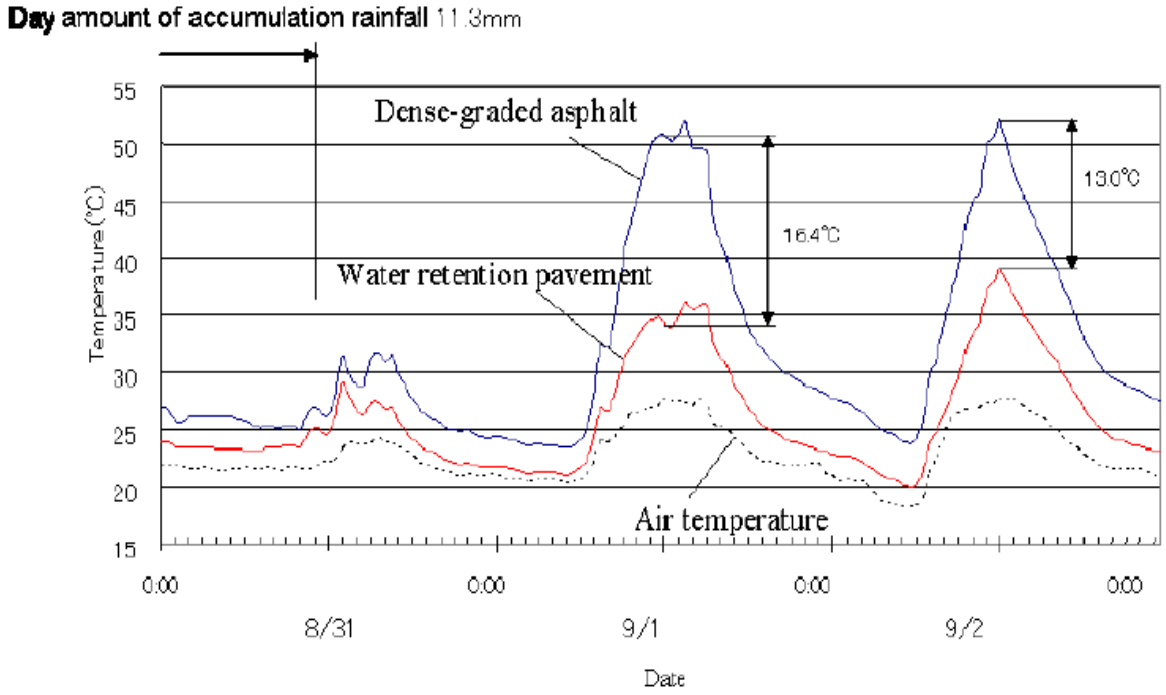


Figure 6: Temperature Characteristics of Water Retention Pavement

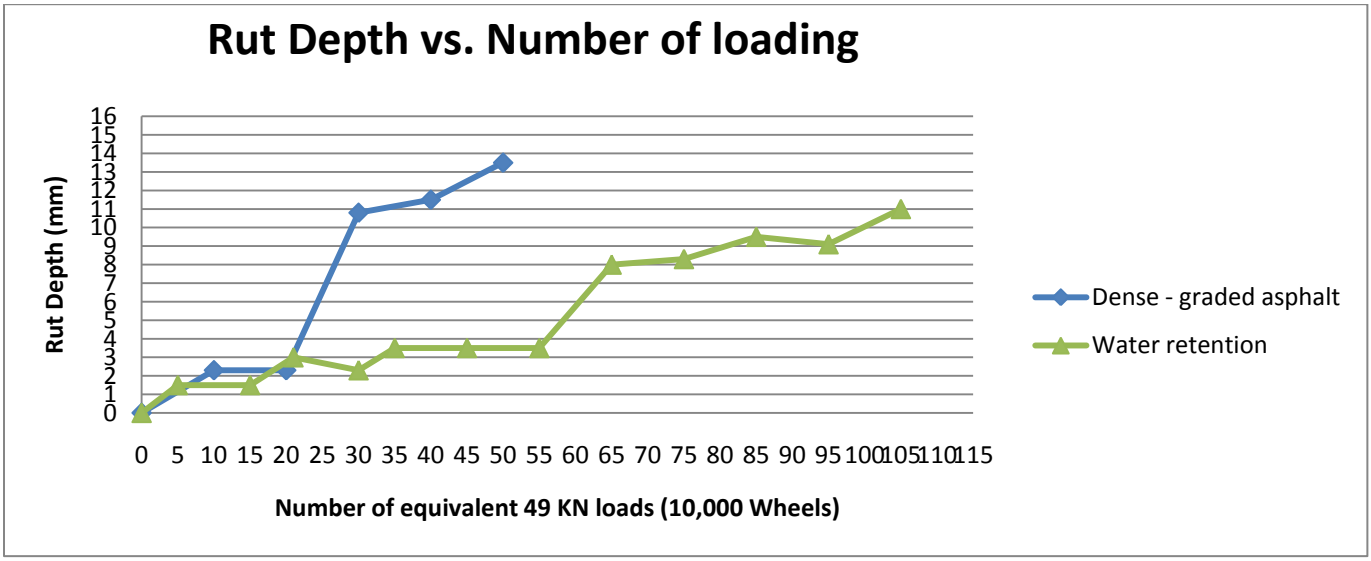


Figure 7: Results of accelerated loading test with loading vehicles

The surface temperature of water retention pavement was cooler than the temperature of the surface of the dense graded pavement by 13^{O}C. Figure 7 shows different reduction of rutting in the pavement.

High building can provide good shading for the pavement during the day times and hence reduce temperature (Cambridge Systematic, Inc. June 2005).

The sky view-factor can be calculated by the ratio of the height of the building to the width of the pavement (H/W). The intensity of heat island can be measured by calculating the difference between an urban area and the rural area.

$$\Delta T_{U-r(\max)} = 7.45 + 3.97(\ln H/W) \quad (4)$$

Where $\Delta T_{U-r(\max)}$ is the measure of the different temperature between an urban area and a nearby rural area

Consider a building with 125 foot height and street 72 foot (four lanes travel and two parking lanes of 12 feet each) wide. The peak different in temperature between urban and rural area is considered as the heat island effect. By using the above equation the difference in temperature is 8.5 °C. For building with 40 foot and the same width street the maximum temperature difference is 4°C (Cambridge Systematic, Inc. June 2005).

The geometric effect is not useful in many cities because the building, take more horizontal space than vertical space, also the heat island affect may be increased because of reduced radiational cooling.

Coating the asphalt pavement with very thin layer of cool, light, reflective surfaces helps to reflect solar energy and prevent heat storage. Ultra-thin white topping (UTW) should not be placed over asphalt pavement that shows signs of deep pavement distress. The thickness of asphalt pavement should be not less than 3 inches. UTW should be placed over an asphalt

pavement that has been milled. White toping thickness range from (2 - 4 inches) as shown in Figure 8 (Cambridge Systematic, Inc. June 2005).

Figure 8: Ultra Thin White Topping

The conclusion regarding the use of UTW is:

- Looks good in appearance and helps the pavement to function 2- 3 times longer than asphalt overlays
- Reduces the temperature of the surface by up to 12.5ºC
- Reduces rutting at high temperature
- Cost compares well against that of asphalt overlay
- UTW causes some visual difficulty during the day.

Another approach is to provide a heat shield to limit the solar radiation that is absorbed by the pavement by coating the surface of asphalt pavement with heat shield materials composed of the hollow ceramic particles and special type of pigment.

The absorption of infrared rays can be controlled by the heat shield materials. This method can be applied on the existing pavement to improve drainage and noise reduction as well as shown in Figure 9 (Kubo, et al, 2008).

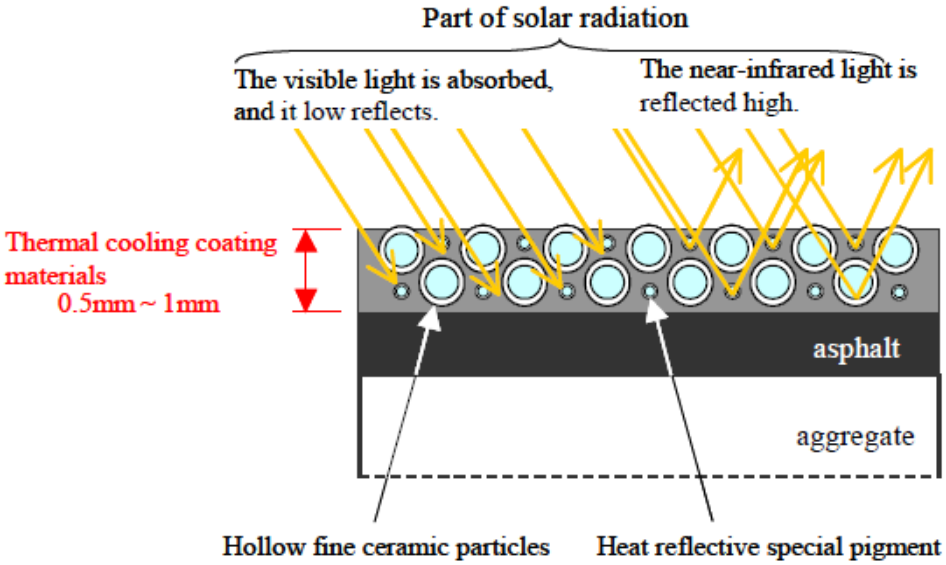


Figure 9: Structure of heat shield pavements

The Figure 10 shows that the open pores in pavement absorbed larger amount of heat energy than the shield method.

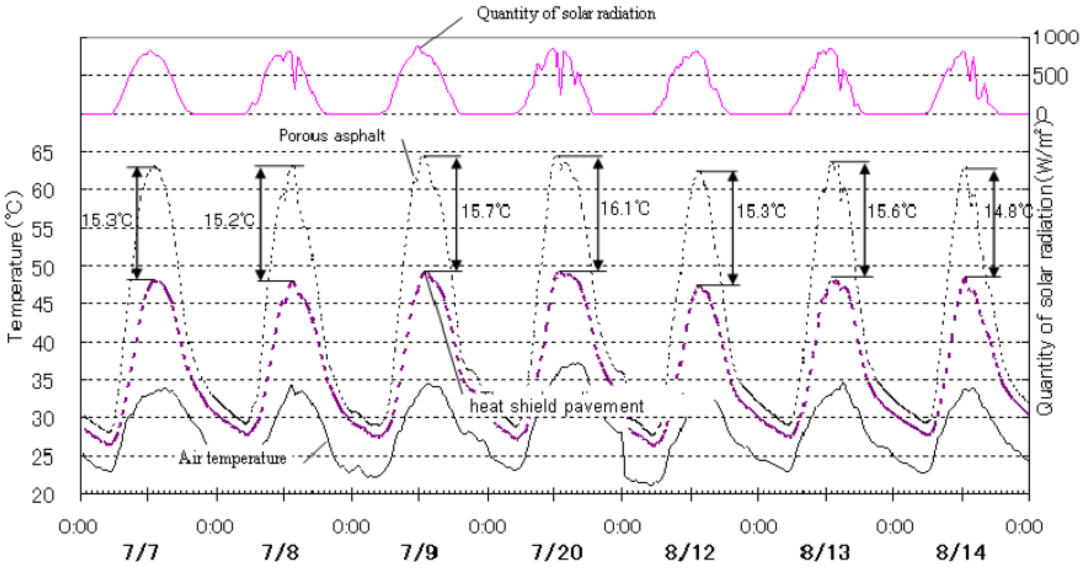


Figure 10: Temperature Characteristics of Heat Shield Pavement, (Kubo, et al, 2008)

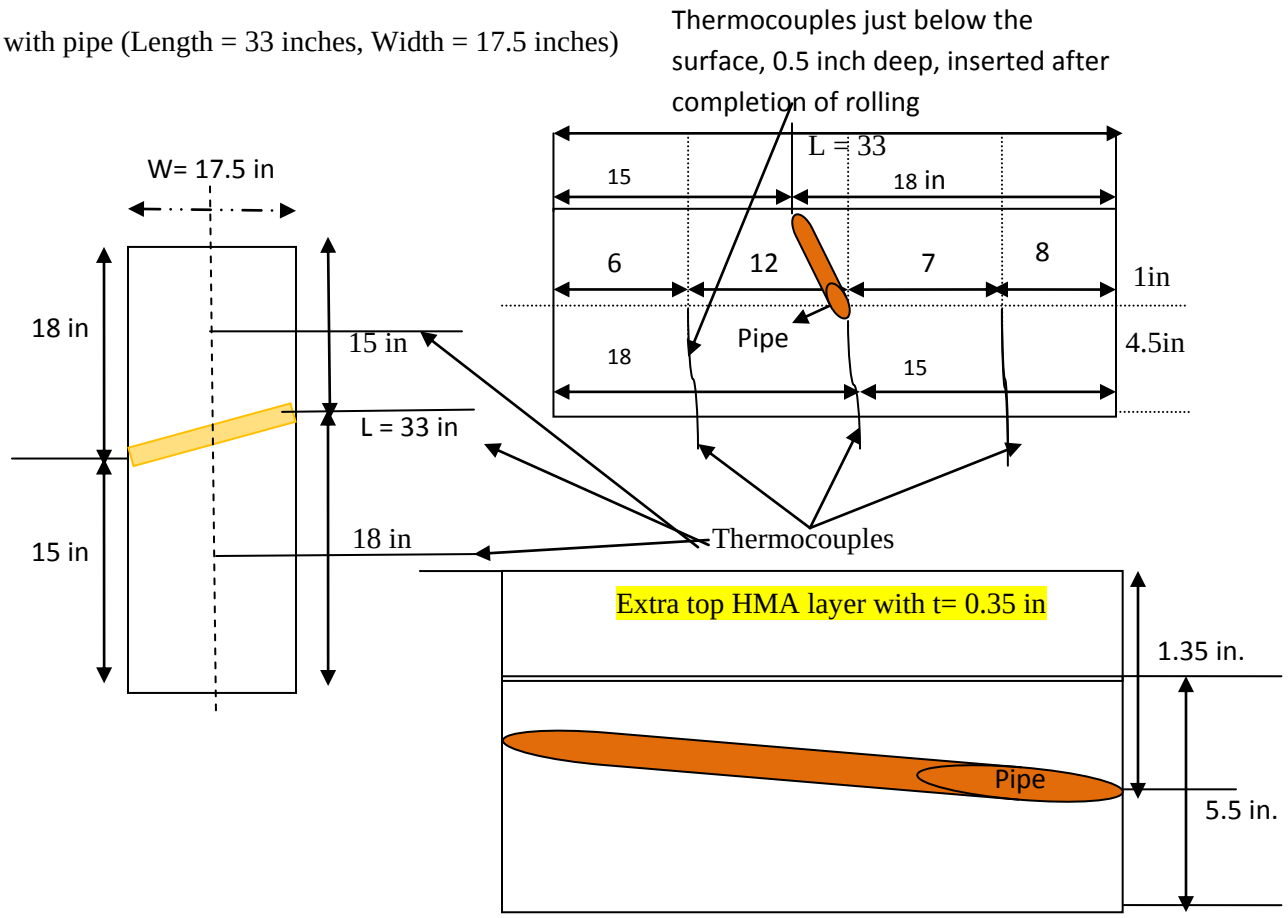
CHAPTER 4

4.0 TEST PLAN

4.1 Introduction

Two pavement slabs were examined under the same accelerated loading and environmental condition, one with and another without pipe with flowing water through it .The schematic of the two slabs are shown in Figure 11.

Slab with pipe (Length = 33 inches, Width = 17.5 inches)



Slab without pipe embedded (Length = 34 inches, width = 17.5 inches)

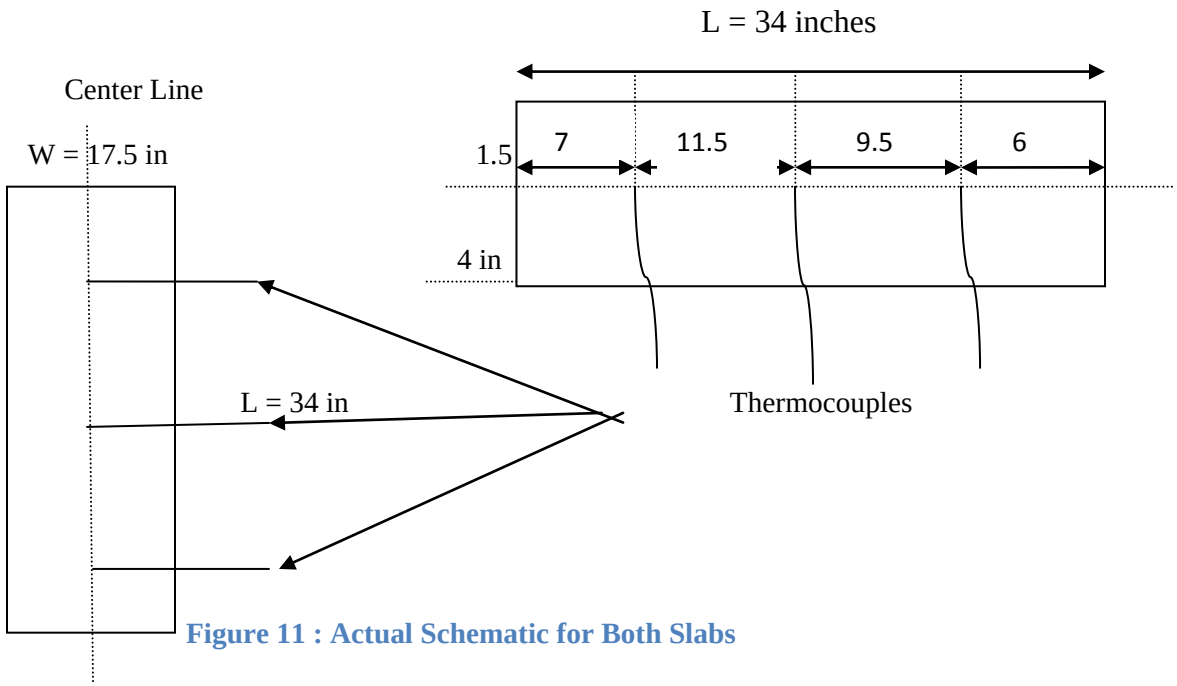


Figure 11 : Actual Schematic for Both Slabs

A flow chart of the work is shown in Figure12

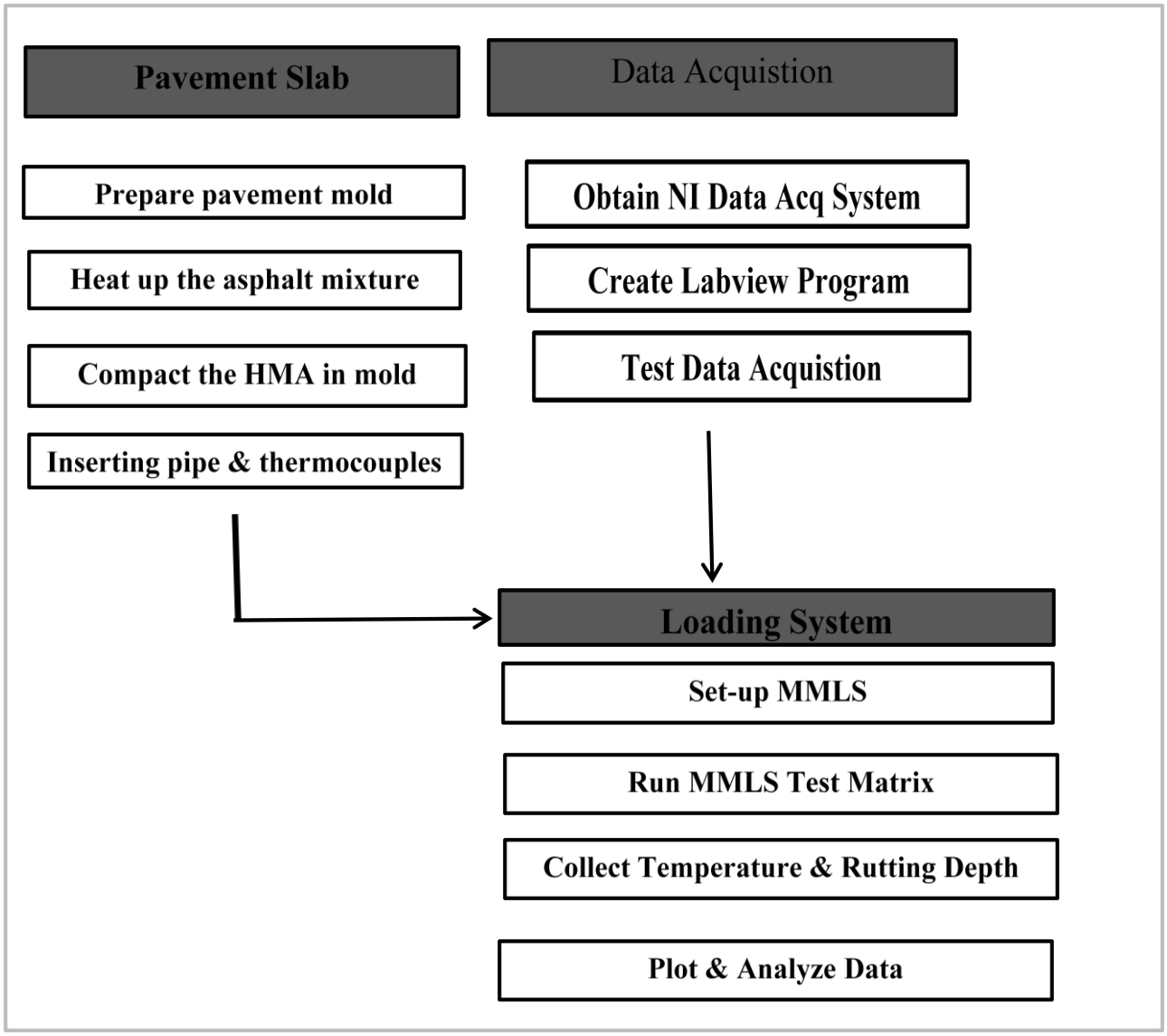


Figure 12: Test plan Schematic

The different parts of two test plan are explained in the next chapter.

CHAPTER 5

Test Set Up

A pavement slab made of hot-mix-asphalt (HMA) was prepared with dimensions of (W=36 inches, L=40 inches, and t=5.5 inches). The compaction mold consists of rubber sheet at the base, steel plate at the middle, and wood board at the top. The compaction of HMA mix in the mold was accomplished by using the rolling machine as shown in Figure 13.

Figure 13: Rolling machine

The slab was divided longitudinally into two halves after the compaction was finished. A copper pipe of ½ inch in diameter and 17.5 inches in length was placed transversely at the middle of the slab length just 1.5 inches below the surface in one half.

The temperature was raised up to 54 ^{O}C by using a hot air coming from HVAC ducts. Air was directed to the pavement slab under an insulating environmental chamber to stimulate high temperature during the summer time as shown in Figure 14.

Figure 14: Hot Air duct under environmental chamber

While the MMLS3 can be placed in an environmental chamber during accelerated loading test, the temperature inside the chamber can be controlled. The chamber was supplied with flexible ducts with size of 150mm (6 inches) that provided hot or cold air to the pavement system. This environmental chamber had been setup to have two diffusers for each duct; one of them blows hot air to pavement and the second balances the system by suction acting as a cold air return.

The temperatures throughout the depth of the asphalt slabs were measured every minute by thermocouples connected to the data acquisition system. The thermocouples that were used were J, and K type. A National Instrument data acquisition system was used.

Six thermocouples were inserted evenly in each pavement slab; three of them were 1.5 inches below the surface and the other three were at surface of the pavement slab. Thermocouples were connected to the data acquisition system to measure the temperature distribution for the slab during eight hours test duration.

The loading equipment comprised of four; 300 mm (12”) rubber pneumatic tires which are 3/10 or approximately one-third the diameter of standard truck tires, Vredestein V-76 4.0 6-ply with pressure of 690 kPa (100 psi) applying a load of 2.2 kN (494.579 lb). The maximum single wheel load repetitions were applied to reach 7200 per hour with speed of 2.6 m/sec (8.5 ft/sec) as shown in Figure 15.

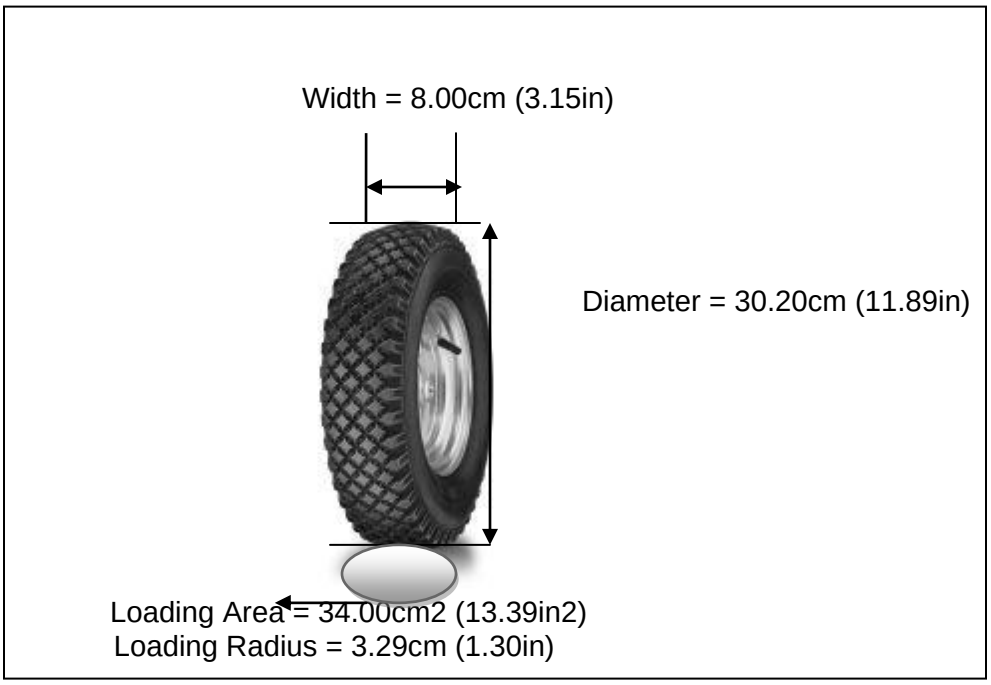


Figure 15 : Vredestein Tire Schematic

The specifications for HMA are as follow

Table 1: Asphalt Mixture Gradation

Sieve Size	Passing %	Master range
AC	6.0	5.5 – 7.0
½	98	95-100
3/8	91	80-100
4	65	50-76
8	44	37-54
16	34	26-40
30	23	17-29
50	15	10-21
100	9	5-16
200	4	2-7

CHAPTER 6

6.0 METHODS

6.1 Preparation of slabs

Preparation of the substructure and compaction platform for the slab was done by cleaning the mold and washing it ready to place the layers of metal and wood. The mold shown in Figure 16 has three layers, the rubber layer at the base, metal (steel plate) in the middle; the steel plate was incorporated into the pavement substructure to stiffen up the base of pavement during testing and compaction, and wood board was laid at the top. The thickness of each layer was less than 1 inch.

Figure 16 : Mold Preparation

An aluminum foil layer was placed on the top of the wood board to prevent the asphalt mixture from coming in direct contact with the wood board and to facilitate the removal of the slab after compaction as shown in Figure 17.

Figure 17 : Foil sheet covered the wood board

A wood frame was inserted on the second part of the mold to make sure the edge of the pavement slab is of uniform shape during the rolling procedure as shown in Figure 18.

Figure 18 : Wood Frame Support Slab's End

To produce a required amount of Hot Mix Asphalt for a slab with dimensions of (Width = 36 inches, Length = 40 inches, and Thickness = 5.5 inches) as shown in Figure 19, tests were

conducted; first the theoretical maximum density (TMD) of the mix was determined using AASHTO test. The required mass of mix was conducted.

The results are shown in Table 2.

Table 2: Calculation of the Average Theoretical Maximum Density

Sample no.	Channel bag g	Large bag g	Dry weight +channel bag g	sample submerged g	Gmm	Average Gmm
sample 1	25.4	44.7	1680.3	872.3	2.182	2.315
sample 2	25.4	44.7	1737.2	986.1	2.448	

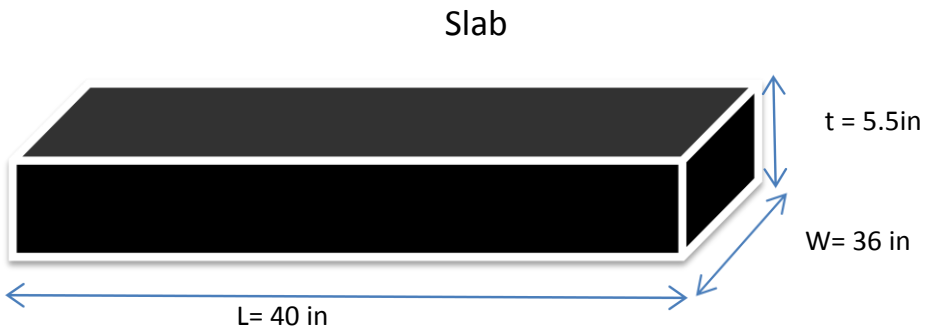


Figure 19: Present the Slab Dimensions

The mass of material that was used for two slabs was calculated as shown in Table 3

Table 3: The mass of materials need to compact the slab

TMD	2.315
93% TMD	2.15295
Slab Dimension	
Length (in)	40
Width (in)	36
Thickness(in)	5.5
Volume (in^3)	7920
Volume (cm^3)	129785.5
Total Mass (g)	279421.8
Total Mass (Kg)	279.42
Bucket weight (empty Kg)	1.12
Bucket weight with mix(kg)	28.54
Net weight of mix (Kg)	27.42
Number of buckets	10.2

$$V = W \times L \times t$$

$$TMD = Density \times 0.93$$

$$Mass = Density \times Volum$$

$$Number\ of\ buckets = \frac{Total\ Mass}{Net\ weight\ of\ mix}$$

6.2 The test setup for the slab

The total amount of HMA needed to compact the slab was 288 Kg and the asphalt mixture was heated up under a constant temperature of 150^{O}C for 4 hours before compaction.

The testing slab was cut longitudinally into two halves by using a metal plate right after compaction. A pipe was inserted along the width of the first half slab as shown in Figure 20.

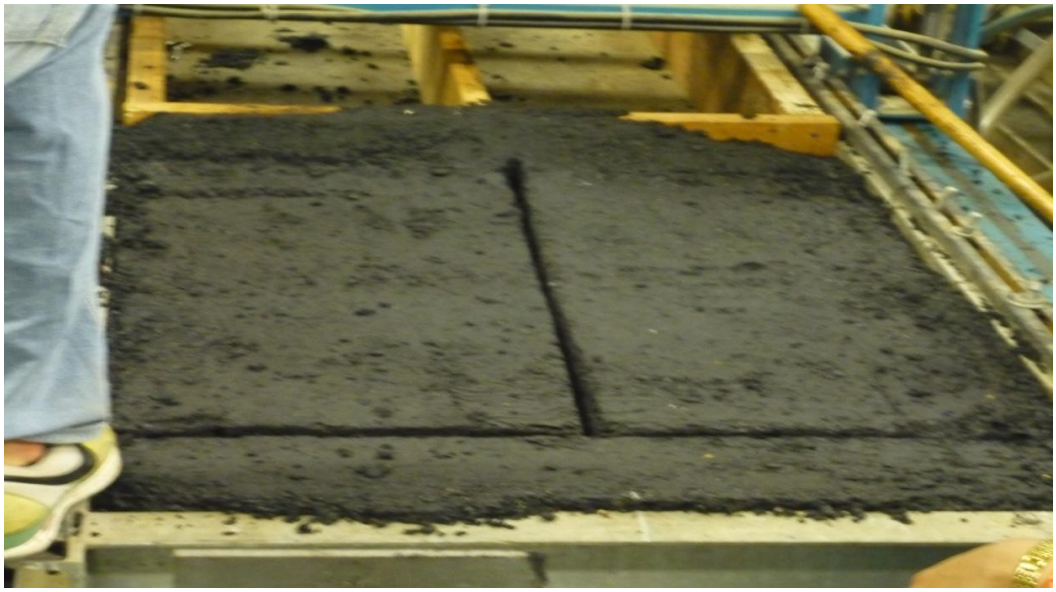


Figure 20: Cutting the Slab Longitudinally Into Two Halves

6.3 Placement of Thermocouples for both halves slab

For the slab with embedded pipe, three thermocouples were inserted evenly at 0.5 inch below the HMA surface. To get accurate reading for the temperature at the pipe location, one of the thermocouples was set at direct contact with the pipe and the other two were inserted along the length of the slab with equal distance from the pipe just 1.5 inches below the surface.

For the slab without the pipe, three thermocouples were inserted at 0.5 inch below the HMA surface and other three thermocouples were inserted evenly at 1.5 inches below the HMA surface. Figure 21shows the placement of thermocouples for the slab without embedded pipe.

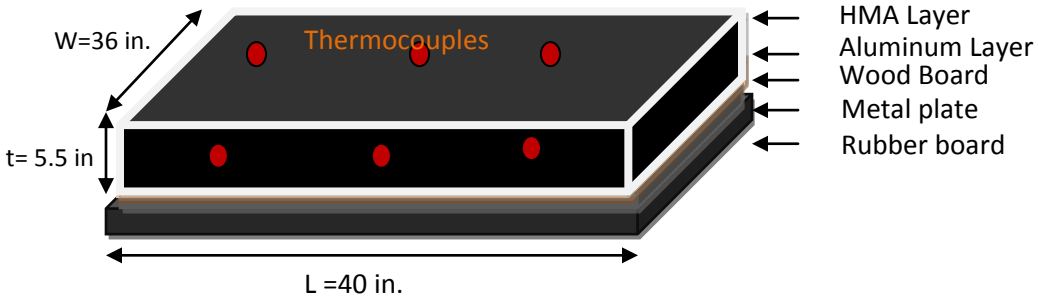


Figure 21: Slab without Pipe

Figure 22 shows the placement of the thermocouples and pipe locations for the slab with embedded pipe.

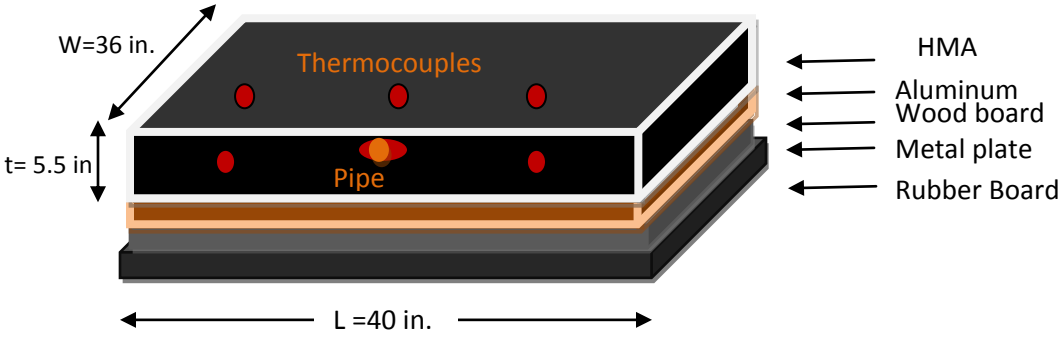


Figure 22: Slab with Embedded Pipe

6.4 Mix Compaction

The rolling machine was cleaned very well during compaction time by brushing with soap water to prevent asphalt mixture from sticking on the surface of the roller. The rolling procedure was stopped when the temperature of the hot mix asphalt reduced to 85 ^{O}C.

The top layer of 1.5 inches thickness was compacted over the layer containing the pipe and the thermocouples. The six thermocouples were inserted just ½ inch below the surface as shown in Figure 23.

Figure 23: Compaction of Hot Mix Asphalt in the Slab

During the rolling procedure of the top layer of the pavement slab, two of the embedded thermocouples were damaged. To solve this problem, two holes were drilled in the same location of the damage thermocouples and the damaged thermocouples were replaced. Surface thermocouples were placed 0.5 inches below the surface.

6.5 Setup for Restraining the Halves Pavement Slabs

Both slabs test (with & without pipe embedded) were restrained by using a wood frame on all four sides to minimize any side warp movement of the slab during the accelerated loading as shown in Figure 24.

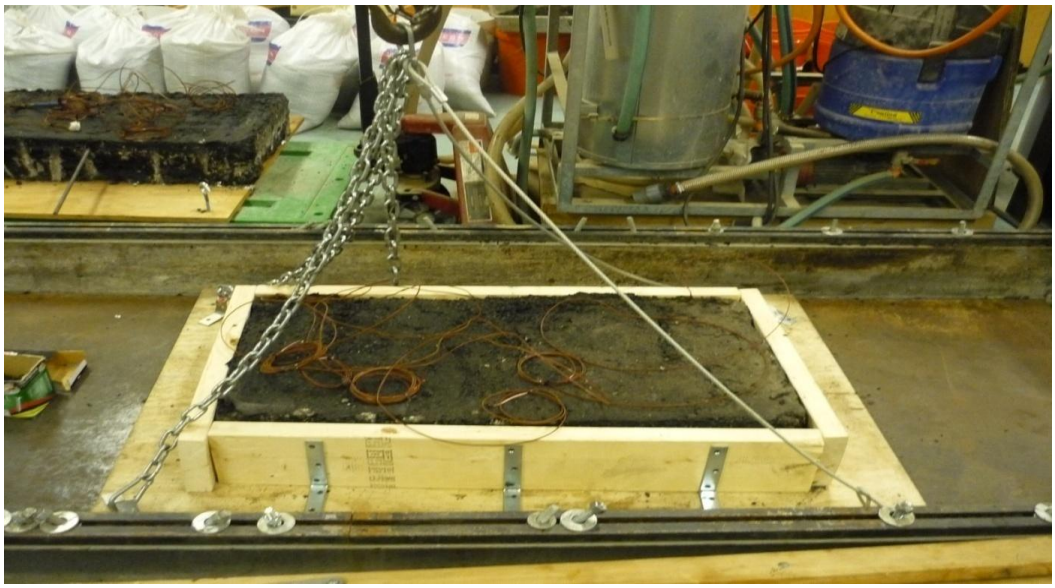


Figure 24 : Restraining Slab

6.6 Deviation of Embedding Pipe

During the compaction procedure of the top layer of the slab, the pipe was slightly displaced. The location at one end side of the pipe was 0.75 inch below the surface while the other end side was 1 inch below the surface.

6.7 Extra Top layer compacted for the Slab with Embedding Pipe

During the compaction procedure, the embedded pipe was moved from its place and moved closer to the surface layer. The decision to add an extra layer of HMA was made to prevent the pipe from getting damaged during loading. The same mix design of HMA was used to compact a 0.35 inch layer on the top of existing layer of HMA. The compaction procedure was done by using a hand compacter to prevent any damage to the existing layer as shown in Figure 25.

Figure 25: Compaction of Extra 0.35 in Layer

Four thermocouples were inserted in the existing surface layer before the compaction started. Two of them were at the inlet side of water and the other two were at the outlet side of water. A long hose was connected to the tap water; and the other end of hose was connected to the one side of pipe which was considered as the inlet side. The other side of pipe was connected to other long hose which was considered as an outlet water side as shown in Figure 26.

Figure 26: Thermocouples, Inlet and Outlet locations for the Slab with Pipe

6.8 Set Up the MMLS3 Machine & Environmental Chamber

The restrain slab was placed under the environmental chamber and the MMLS3 machine was set up for accelerated loading on the surface of the asphalt slab. The first test was performed on the slab without pipe and the maximum temperature was 54 ^{O}C; the accelerated loading was applied with tire pressure of 690 kPa and load of 2.2 KN. For a period of eight hour a loading rate of 7420 single-wheel applications per hour was used to obtain. Figure 27 shows the set up of the environmental chamber.

Figure 27 : Environmental Chamber Set Up

CHAPTER 7

7.0 Test Method

7.1 Testing for the slab without pipe

The restrained slab was placed on the wood board and all six thermocouples were attached to the National Instruments data acquisition system. The MMLS3 was placed properly on the pavement surface. A proper distance between the pavement surface and the tire loading was achieved by lowering the machine until direct contact occurred. The environmental chamber and HVAC system were made ready to start the test under constant temperature of 54^{O}C. The test procedure was run over a period of eight hours with total loading of 52,360 cycles. Figure 28 shows that the MMLS3 was in direct contact with the surface of the pavement slab.

Figure 28: Tire Loading

7.2 Testing for the slab with embedded pipe

The slab was cooled down for two days after finishing the compaction procedure for the extra HMA layer on the top of this existing slab. The final restrained slab was placed on the

wood board in the mold to make it ready for the load. The ten thermocouples were attached to the National Instruments data acquisition system. The same procedure was performed to place the MMLS3, environmental chamber, and HVAC system as before. The test was run for 8 hours. The slab was heated up for 15 hours prior to loading without flowing water or applying load. Before the starting of applying load, the slab was cooled down for one hour by flowing water through an embedded pipe with inlet temperature of 9.9 ^{O}C and water flow rate of 2 L/ min. The water temperature was collected continuously by thermocouple at the center of the water collector until the test was completed.

The water temperature at the inlet and the outlet were measured every two hours during the test period. The results are listed in Table 4. While the inlet temperature remained constant, the outlet temperature decreased over time. This is because as the slab temperature decreases (due to flowing water), the difference between the inlet water temperature and the slab temperature decreases, and hence the amount of heat energy that is extracted by the flowing water is also decreased.

Table 4: Temperature of Flowing Water

Hours from start test	Inlet Temperature ^{O}C	Outlet Temperature ^{O}C
0	9.9	16.9
1	9.9	15.3
2	10.8	14
3	10.8	12.9
5	10.8	12.3
7	9.9	11.6
8	9.9	12.8

The test procedure was finished after 50,500 cycles of loading.

CHAPTER 8

8.0 Statistics – Definition

The important definitions in statistics are:

- The scientific study of numerical data based on variation in nature (Sokal, et al 1981).
- A set of procedures and rules for reducing large masses of data into manageable proportions allowing us to draw conclusions from those data (Bruning, et al 1997).
- Is a collection of methods for planning experiments, obtaining data, and organizing, summarizing, presenting, analyzing, interpreting, and drawing conclusion based on the data (Triola, 2005).

Types of Statistics

- Descriptive – when the number was used to organize and classify the sample.
- Inferential – when draw conclusions or make predictions from a sample to larger population.

Basic Terms

- Population: Are the complete data collections that need to be studied, for example (people, scores). To measure something in a ***population*** it is called a parameter.
- Sample: is a sub collection of elements which have been selected from the population. To measure something in a ***sample*** it is called a statistic.

Measures of Center

There are several different ways to measure the value at the center or at the middle of a data set, so the definitions of measures of center are represented in following meanings:

- Mean is obtained by performing a summation of data value and dividing the total by the number value $\bar{x} = \frac{\sum X}{n}, \quad \mu = \frac{\sum x}{N}$

  n = the numbers of values in a sample.

  N= the number of values in a population.

  $\bar{X}$ is a mean of a set of sample values.

  μ is the mean of all values in a population.

- Median: is the middle value when the original data value arrange in order of increasing
- Mode : is the most frequency data value occurs
- Midrange: The sum of the minimum and maximum values, divided by two.

Measures of Dispersion

- Range: is the difference between highest value and the lowest value in set of data

$$Range = (Highest\ value) - (\ lowest\ value)$$

- Standard Deviation: is the measure of variation of value about the mean.

$$s = \sqrt{\frac{\sum(x - \bar{x})^2}{n - 1}}$$

- The Variance : is the square of the stander deviation

$$s^2 = \sqrt{\frac{\sum(x - \bar{x})^2}{n - 1}}$$

Analysis of Variance (ANOVA)

It is a method to compare group means by analyzing comparisons of variance estimates. ANOVA is based on a comparison of two different estimates of the variance common to the different population. Those estimates are the variance between the sample and the variance within the samples. There are two type of ANOVA

- One -Way ANOVA
- Two -Way ANOVA

In this study only One-Way ANOVA was used.

One-Way ANOVA

In ANOVA two types of Hypotheses are used. The null Hypotheses H_O: $\mu_1=\mu_2=\mu_3$, assumes that all of the means are equal, while the alternative hypothesis is that at least one mean is different

The null assumes no treatment effect and both variance estimates reflect error and their ratio will equal 1. If the ratio of two variance is large than 1, there is a treatment effect. The technique used to compare means of two or more samples is F-Distribution.

$$F = \frac{variance\ between\ samples}{variance\ within\ samples}$$

Logic of ANOVA

$$SST = S\,Error + S\,Treatment$$

S_{Total} is a measure of the total variation

S_{Error} is sum of squares representing the variation that is assumed to be common to all populations being considered

$$S_{\text{Error}} = (n_1 - 1)\,S_1^2 + (n_2 - 1)\,S_2^2$$

$S_{\text{Treatment}}$ is a measure of the variation between the mean samples

$$S_{\text{Treatment}} = n_2(X_1 - X'')^2 + n_2(X_2 - X'')^2$$

In this study, to compare the analysis between two groups, the One-Way ANOVA was used to analyze the result of the rutting test.

Results from two sections across the wheel path for each of the two cases with and without pipe were used to analysis the data value between two groups.

Group 1 was considered as the rutting data of the slab without pipe and group 2 considered rutting data for the slab with embedded pipe.

The result from One-Way ANOVA for both slabs is represented in Table 5.

Table 5: One-Way Analysis for both Slabs

Group 1 Slab without pipe	Group 2 slab with embedded pipe	Number of groups, k
Number of rutting data, n_1	Number of rutting data, n_2	Significant level, α
Total number of rutting data, N		
Calculate mean for slab without pipe X'₁, n_1= 14	$\sum_{i=1}^{i=14} Xi/n_1$	0.396
Calculate mean for slab with embedded pipe X'₂ n_2= 14	$\sum_{i=1}^{i=14} Xi/n_2$	0.065
Calculate the mean for all sample combine X" N = 28	$\sum_{i=1}^{i=28} Xi/N$	0.231
Calculate the variance for slab without pipe S_1^2	$\sum_{i=1}^{i=14} \frac{(Xi - X')^2}{n_1 - 1}$	0.006
Calculate the variance for slab with embedded pipe S_2^2	$\sum_{i=1}^{i=14} \frac{(Xi - X')^2}{n_2 - 1}$	0.0011
Calculate SS Treatment	$n_2(X_1\text{-}X")^2 + n_2(X_2 - X")^2$	0.769
Calculate SS Error	$(n_1 - 1)\, S_1^2 + (n_2 - 1)\, S_2^2$	0.097
Calculate SS Total	SS(treatment) + SS (error)	0.862
Calculate MS Treatment	$\frac{SS\ treatment}{k-1}$	0.769
Calculate MS error	$\frac{SS(error)}{N-k}$	0.0037
Calculate MS total	$\frac{SS\ total}{N-1}$	0.032
Calculate F	$\frac{\text{MS treatment}}{\text{MS error}}$	206.37
Numerator degree	k-1	1
Denominator degree	N-k	26
F distribution from chart with α=0.05 right tail		4.2252 < 206.37 Hence, Significant

The statistical analysis and the two groups of the data that were used for the analysis are shown in Appendix B.

Analysis of Results

Analysis using One-Way ANOVA was conducted using two groups of rutting values. The mean and the variance values of group 1 demonstrated a significant difference in value compared with the mean and variance of group 2. The significant difference means that the flowing of water in the pipe is effective in cooling the slab and thus reducing the rutting in the slab under loading.

CHAPTER 9

9.0 RESULTS

This chapter will present an elucidation and analysis of data obtained from the testing of two pavement slabs under a constant temperature of 54^{O}C. Further result comparisons will be made between slab without embedded pipe and the slab with embedded pipe and the different of pavement performance between those two slabs will be explained.

9.1 Result and Plot for the Slab without Pipe

During the accelerated loading of the slab one of the thermocouple was displaced from its place. It was used for measuring air temperature inside the environmental chamber. Figure 29 shows the schematic of thermocouples for the slab during loading.

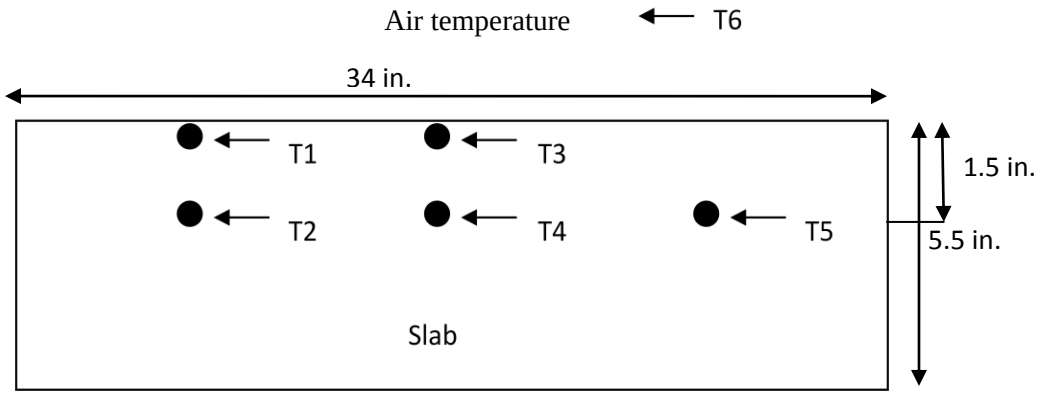


Figure 29 : Schematic for the Slab under the Test

The National Instruments data acquisition system was used to collect the temperature data in every minute for all thermocouples as shown in Figure 30.

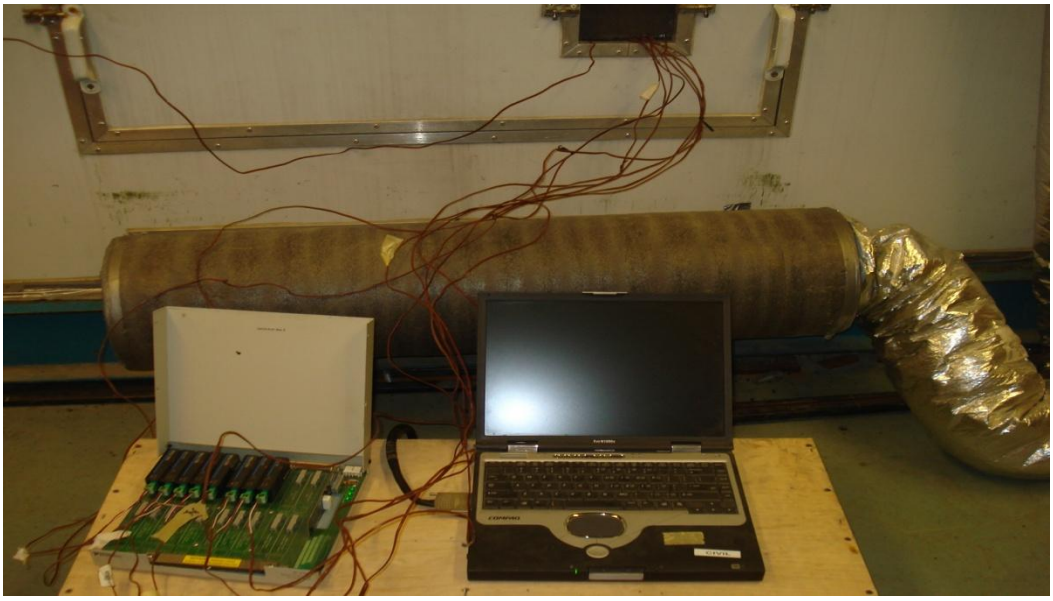


Figure 30: National Instruments data acquisition system

Figure 31 demonstrates that the surface temperature (T1) was the highest temperature and the temperatures at 1.5 inches below the surface (T2, T4, T5) varied between 45°C and 49°C. Table A.1 of Appendix A – Data Tables shows the result, which are plotted in the Figure.

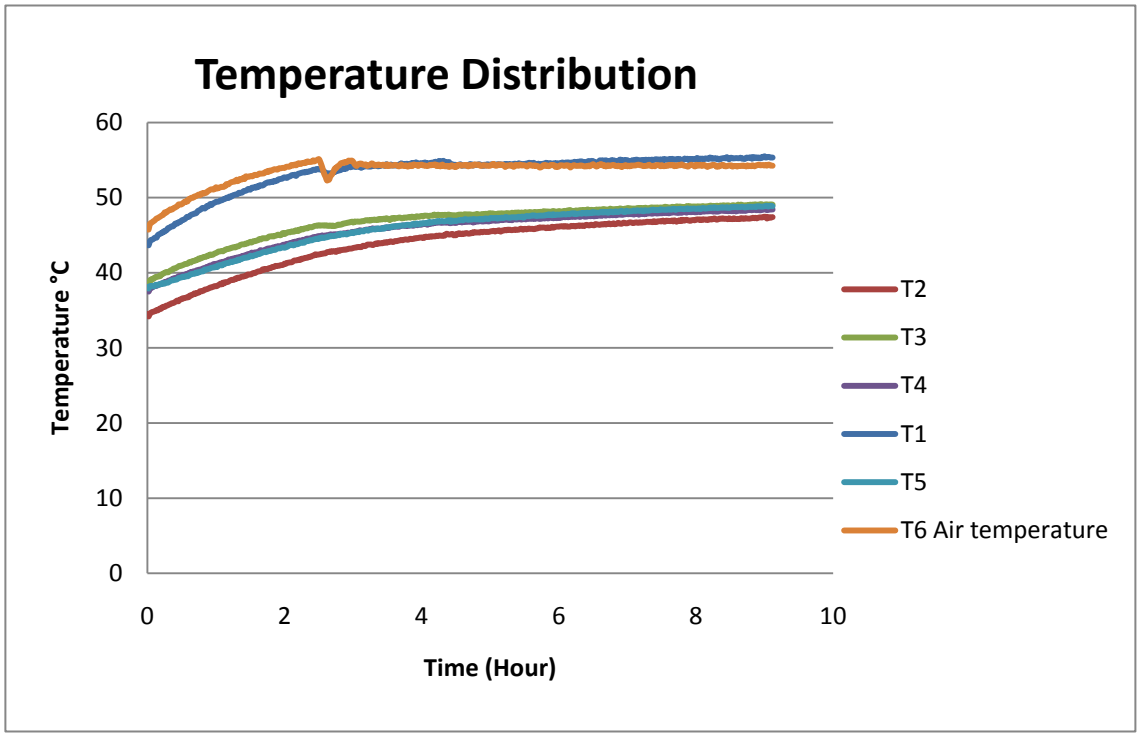


Figure 31: Temperature Distribution for the slab without embedded pipe

The Table 6 shows the temperature at the start and end time of the test.

Table 6: Temperatures Data

Time (mins)	T1	T2	T3	T4	T5	T6 Air Temperature
0 (Start)	43.8	34.5	38.8	37.7	38.1	45.9
549 (end)	55.3	47.4	49.1	48.5	48.8	54.2

9.2 Observation of Rutting for the slab without embedded pipe

The increasing temperature and accelerated loading led to permanent deformation (rutting). The maximum rut depth in the pavement surface was 0.65 inch. The measurement of the maximum rut depth in the pavement surface was conducted by considering ten longitudinal sections in the slab. Each longitudinal section of the rutting path was divided into seven sections along of the wheel path width as shown in Figure 32.

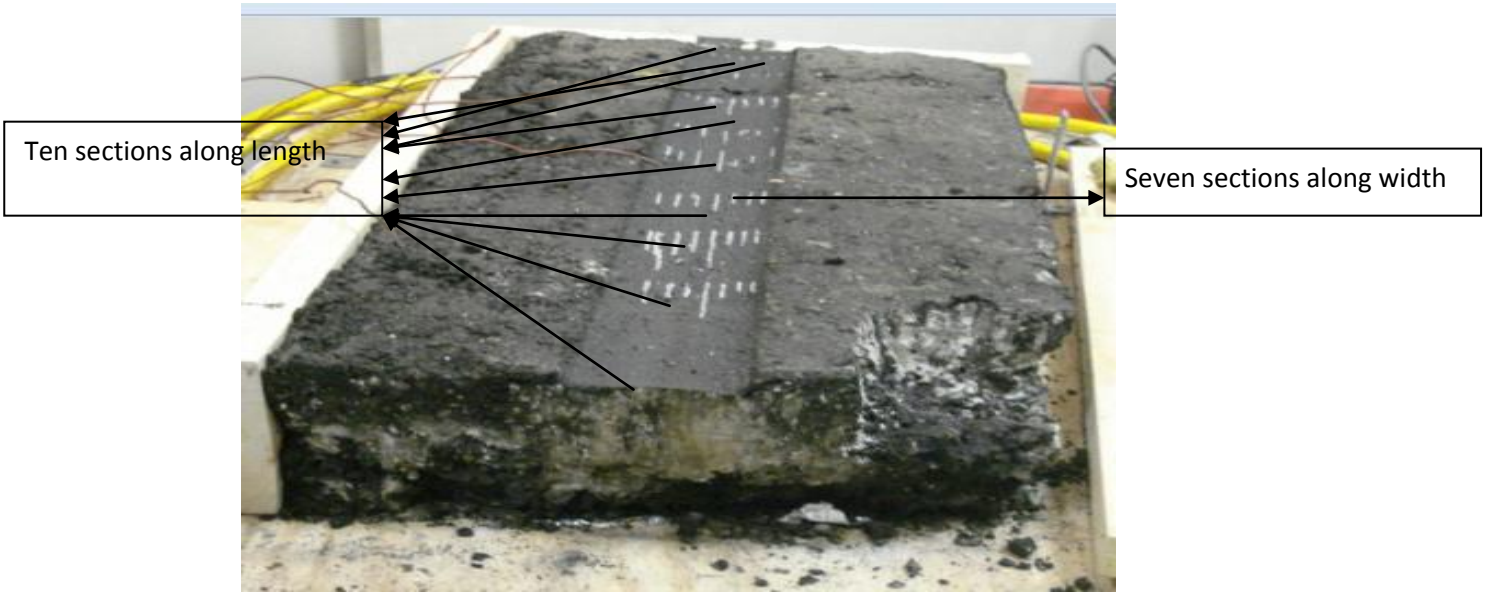


Figure 32: Rutting Division

In each section; the maximum rut depth was at the middle of loading path. The values in Table 7 represent the maximum depth of rutting in the middle of each section.

Table 7: Rut Depth for the Slab without Pipe

Section along length	Section along width	Rut depth, inch
1 (0 inch from end)	1 (0.5 inch from end)	0.32
	2 (1 inch from end)	0.45
	3 (1.5 inches from end)	0.55
	4 (2 inches from end)	0.6
	5 (2.5 inches from end)	0.55
	6 (3 inches from end)	0.45
	7 (3.5 inches from end)	0.35
Section along length	Section along width	Rut depth, inch
2 (4 inches from end)	1 (0.5 inch from end)	0.35
	2 (1 inch from end)	0.47
	3 (1.5 inches from end)	0.5
	4 (2 inches from end)	0.55
	5 (2.5 inches from end)	0.5
	6 (3 inches from end)	0.48
	7 (3.5 inches from end)	0.35
Section along length	Section along width	Rut depth, inch
3 (8 inches from end)	1 (0.5 inch from end)	0.35
	2 (1 inch from end)	0.48
	3 (1.5 inches from end)	0.52
	4 (2 inches from end)	0.6
	5 (2.5 inches from end)	0.55
	6 (3 inches from end)	0.5
	7 (3.5 inches from end)	0.35
Section along length	Section along width	Rut depth, inch
4 (12 inches from end)	1 (0.5 inch from end)	0.35
	2 (1 inch from end)	0.45
	3 (1.5 inches from end)	0.55
	4 (2 inches from end)	0.65
	5 (2.5 inches from end)	0.55
	6 (3 inches from end)	0.45
	7 (3.5 inches from end)	0.35

Table 7: Rut Depth for the Slab without Pipe (continued)

Section along length	Section along width	Rut depth, inch
5 (16 inches from end)	1 (0.5 inch from end)	0.35
	2 (1 inch from end)	0.45
	3 (1.5 inches from end)	0.5
	4 (2 inches from end)	0.55
	5 (2.5 inches from end)	0.45
	6 (3 inches from end)	0.4
	7 (3.5 inches from end)	0.35
Section along length	Section along width	Rut depth, inch
6 (20 inches from end)	1 (0.5 inch from end)	0.25
	2 (1 inch from end)	0.35
	3 (1.5 inches from end)	0.4
	4 (2 inches from end)	0.45
	5 (2.5 inches from end)	0.4
	6 (3 inches from end)	0.35
	7 (3.5 inches from end)	0.3
Section along length	Section along width	Rut depth, inch
7 (24 inch from end)	1 (0.5 inch from end)	0.23
	2 (1 inch from end)	0.3
	3 (1.5 inches from end)	0.35
	4 (2 inches from end)	0.45
	5 (2.5 inches from end)	0.4
	6 (3 inches from end)	0.35
	7 (3.5 inches from end)	0.3
Section along length	Section along width	Rut depth, inch
8 (28 inch from end)	1 (0.5 inch from end)	0.35
	2 (1 inch from end)	0.4
	3 (1.5 inches from end)	0.45
	4 (2 inches from end)	0.5
	5 (2.5 inches from end)	0.45
	6 (3 inches from end)	0.4
	7 (3.5 inches from end)	0.35

Table 7: Rut Depth for the Slab without Pipe (continued)

Section along length	Section along width	Rut depth, inch
9 (32 inch from end)	1 (0.5 inch from end)	0.25
	2 (1 inch from end)	0.3
	3 (1.5 inches from end)	0.35
	4 (2 inches from end)	0.45
	5 (2.5 inches from end)	0.35
	6 (3 inches from end)	0.3
	7 (3.5 inches from end)	0.25
Section along length	Section along width	Rut depth, inch
10 (34 inches from end)	1 (0.5 inch from end)	0.35
	2 (1 inch from end)	0.4
	3 (1.5 inches from end)	0.5
	4 (2 inches from end)	0.65
	5 (2.5 inches from end)	0.55
	6 (3 inches from end)	0. 5
	7 (3.5 inches from end)	0.45

The rutting profile represents in Figure 33.

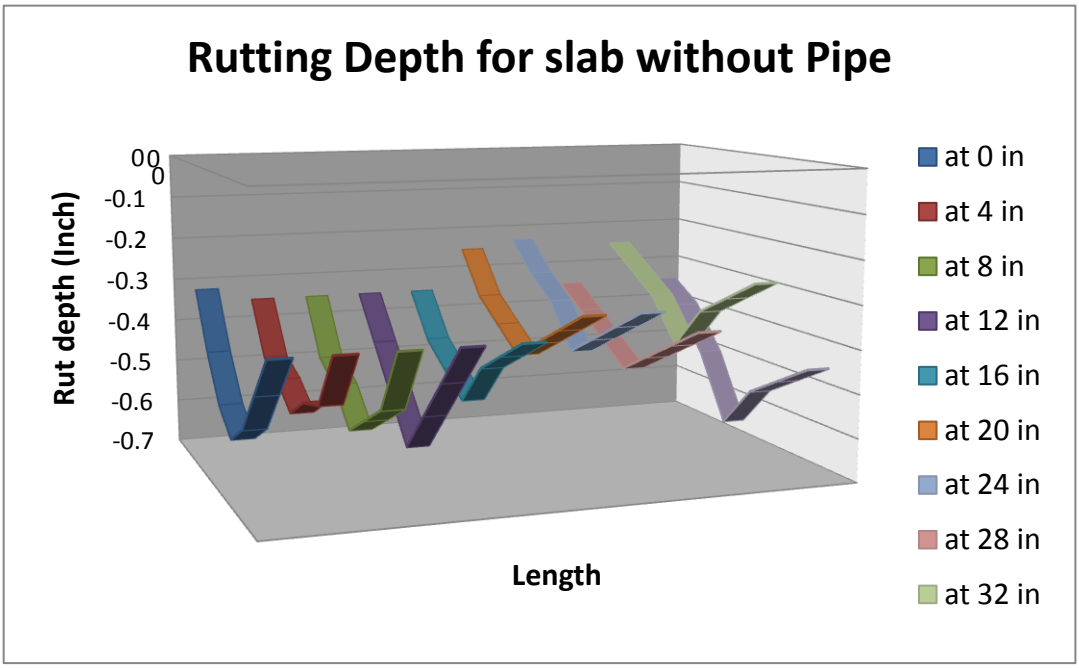


Figure 33 : Rutting profile

The shear deformation of HMA slab under the load caused a deep rutting in the pavement surface; this rutting was caused of pushing the materials away from the wheel path. Figure 34 shows the heaving of materials in both side of asphalt pavement slab and rutting inside the wheel path.

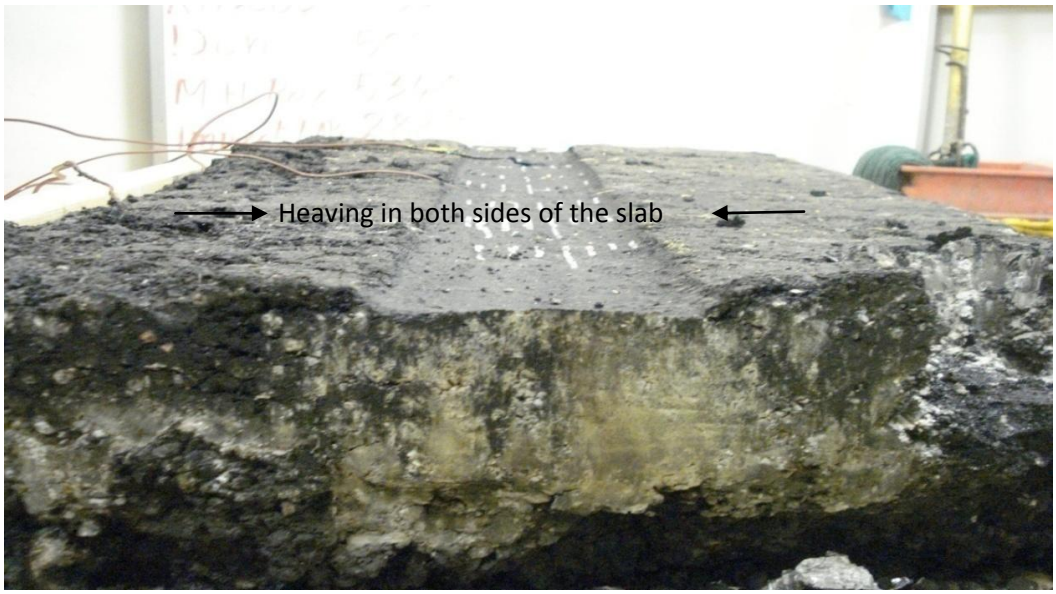


Figure 34: Rutting Inside Wheel Path

9.3 Result and Plot for the Slab with Embedded Pipe

Temperature data was first collected for the slab during the fifteen hours of heating without flow any water. The data reflected the increasing temperature at all depths in the slab and they were in the same range of high temperature before starting the test. The procedure of pumping water through embedded pipe was started one hour before applying load. The water flow rate was set to 2 L/min which showed highest temperature reduction of asphalt pavement at the pipe location; the temperatures dropped off during one hour of pumping water from 46 ^{O}C to 25 ^{O}C.

The outlet temperature of flowing water was higher than inlet temperature. The rise in temperature of outlet water as a result of flowing water through the asphalt pavement was used

as the indicator of efficiency of heat capture. The outlet temperatures were at the same range during the test duration.

Ten thermocouples were distributed to measure the changing temperature at different depths in the slab as shown in Figure 35.

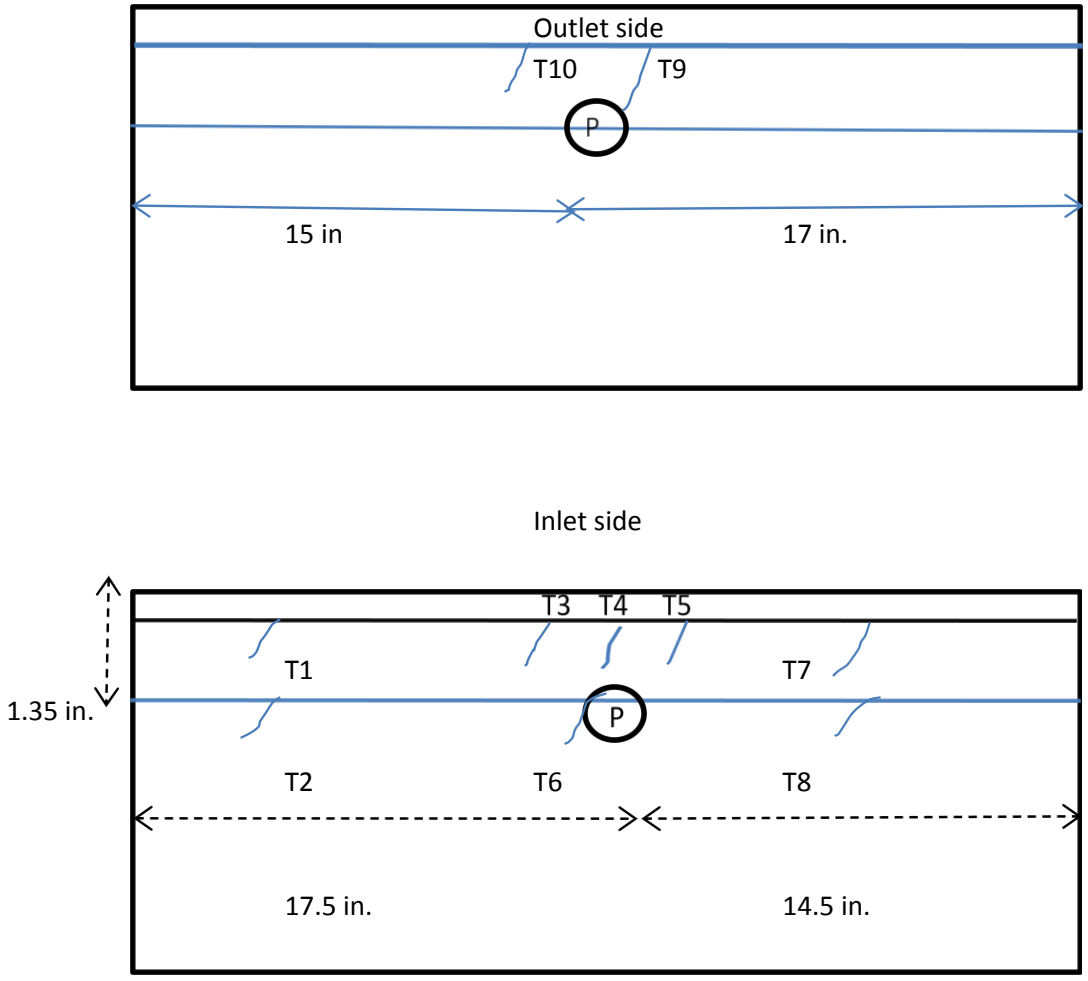


Figure 35: Thermocouples Locations for slab with embedded Pipe

In addition of the maximum reductions in slab's temperature at the pipe location, the three thermocouples (T3, T4, and T5) which were inserted at the inlet side of pumping water

through the pipe also showed the efficiency of the heat transfer. Table A.2 of Appendix A – Data Tables shows the results, which are plotted in Figure 36.

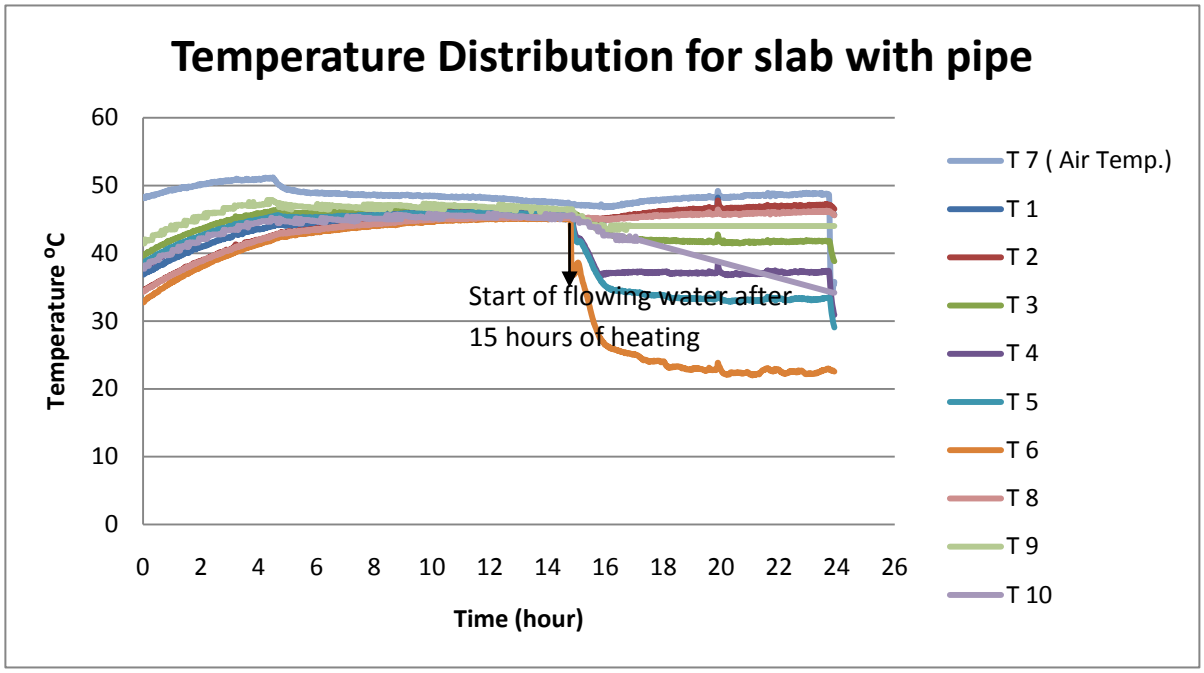


Figure 36: Temperatures Distributions for slab with embedded pipe

9.4 Observation of Rutting for the slab with embedded pipe

The flowing of water through the embedded pipe led to significant reduction of rutting. The rutting measurement locations for the slab are shown in Figure 37.

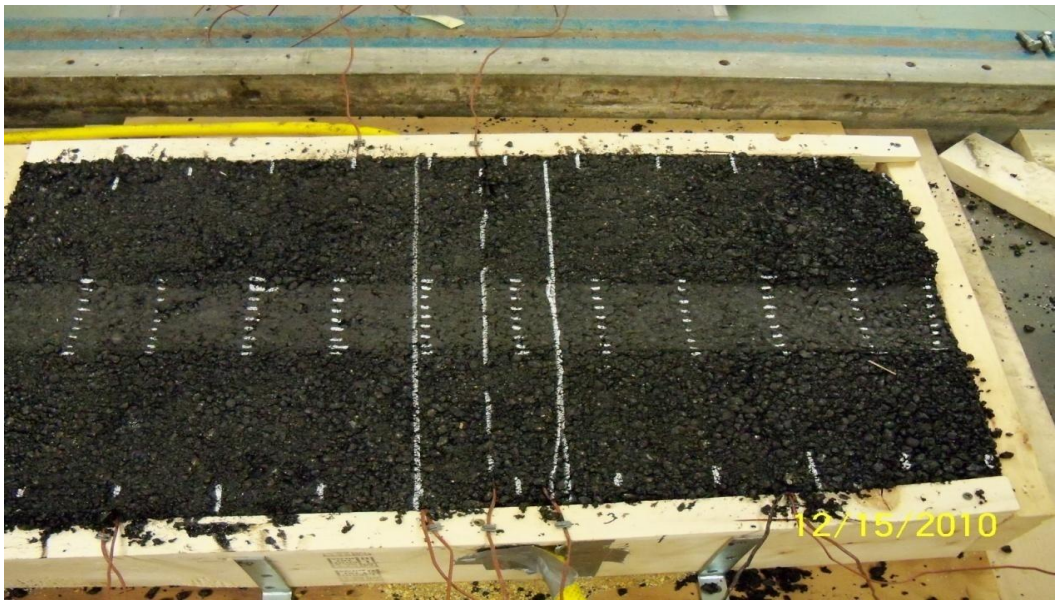


Figure 37: Rutting Path

The depth of rutting above the location of inserted pipe was very small compared with rut depth at other locations. The rut depth above the pipe location was 0.1inch while the rut depth at other locations was 0.55 inch.

The values in Table 8 represent the maximum depth of rutting in the middle of each section.

Table 8: Rut Depths for the Slab with Pipe

Section along length	Section along width	Rut depth, inch
1 (0 inches from end)	1 (0.5 inch from end)	0.45
	2 (1 inch from end)	0.5
	3 (1.5 inches from end)	0.55
	4 (2 inches from end)	0.55
	5 (2.5 inches from end)	0.55
	6 (3 inches from end)	0. 5
	7 (3.5 inches from end)	0.45
Section along length	Section along width	Rut depth, inch
2 (4 inches from end)	1 (0.5 inch from end)	0.1
	2 (1 inch from end)	0.15
	3 (1.5 inches from end)	0.2
	4 (2 inches from end)	0.2
	5 (2.5 inches from end)	0.25
	6 (3 inches from end)	0. 2
	7 (3.5 inches from end)	0.1
Section along length	Section along width	Rut depth, inch
3 (8 inches from end)	1 (0.5 inch from end)	0.05
	2 (1 inch from end)	0.1
	3 (1.5 inches from end)	0.15
	4 (2 inches from end)	0.2
	5 (2.5 inches from end)	0.2
	6 (3 inches from end)	0. 15
	7 (3.5 inches from end)	0.1
Section along length	Section along width	Rut depth, inch
4 (12 inches from end)	1 (0.5 inch from end)	0.15
	2 (1 inch from end)	0.2
	3 (1.5 inches from end)	0.35
	4 (2 inches from end)	0.45
	5 (2.5 inches from end)	0.4
	6 (3 inches from end)	0. 3
	7 (3.5 inches from end)	0.2

Table 8: Rut Depth for the Slab with Pipe (continued)

Section along length	Section along width	Rut depth, inch
5 (16 inches from end) (Pipe Location)	1 (0.5 inch from end)	0.02
	2 (1 inch from end)	0.05
	3 (1.5 inches from end)	0.1
	4 (2 inches from end)	0.1
	5 (2.5 inches from end)	0.05
	6 (3 inches from end)	0. 05
	7 (3.5 inches from end)	0.02
Section along length	Section along width	Rut depth, inch
6 (20 inches from end) (Pipe Location)	1 (0.5 inch from end)	0.02
	2 (1 inch from end)	0.05
	3 (1.5 inches from end)	0.1
	4 (2 inches from end)	0.1
	5 (2.5 inches from end)	0.1
	6 (3 inches from end)	0. 1
	7 (3.5 inches from end)	0.05
Section along length	Section along width	Rut depth, inch
7 (24 inches from end)	1 (0.5 inch from end)	0.25
	2 (1 inch from end)	0.4
	3 (1.5 inches from end)	0.5
	4 (2 inches from end)	0.5
	5 (2.5 inches from end)	0.55
	6 (3 inches from end)	0. 5
	7 (3.5 inches from end)	0.35
Section along length	Section along width	Rut depth, inch
8 (28 inches from end)	1 (0.5 inch from end)	0.4
	2 (1 inch from end)	0.45
	3 (1.5 inches from end)	0.5
	4 (2 inches from end)	0.5
	5 (2.5 inches from end)	0.5
	6 (3 inches from end)	0. 45
	7 (3.5 inches from end)	0.4

Table 8: Rut Depths for the Slab with Pipe (continued)

Section along length	Section along width	Rut depth, inch
9 (32 inches from end)	1 (0.5 inch from end)	0.6
	2 (1 inch from end)	0.65
	3 (1.5 inches from end)	0.7
	4 (2 inches from end)	0.7
	5 (2.5 inches from end)	0.65
	6 (3 inches from end)	0. 6
	7 (3.5 inches from end)	0.5
Section along length	Section along width	Rut depth, inch
10 (33 inches from end)	1 (0.5 inch from end)	0.65
	2 (1 inch from end)	0.8
	3 (1.5 inches from end)	1.0
	4 (2 inches from end)	0.95
	5 (2.5 inches from end)	0.95
	6 (3 inches from end)	0. 75
	7 (3.5 inches from end)	0.65

The end section (section 10) located at 1 inch from the edge of the pavement slab, showed significant deformation. The maximum measured rut depth was 0.95 inch. This difference in value occurred because of the dynamic loading effect, the location where the wheel of MMLS3 machine comes down and hits the slab during accelerated loading. Therefore, the high value in rutting depth was ignored during the evaluation of the effect of flowing water.

The rutting profile presents in Figure 38.

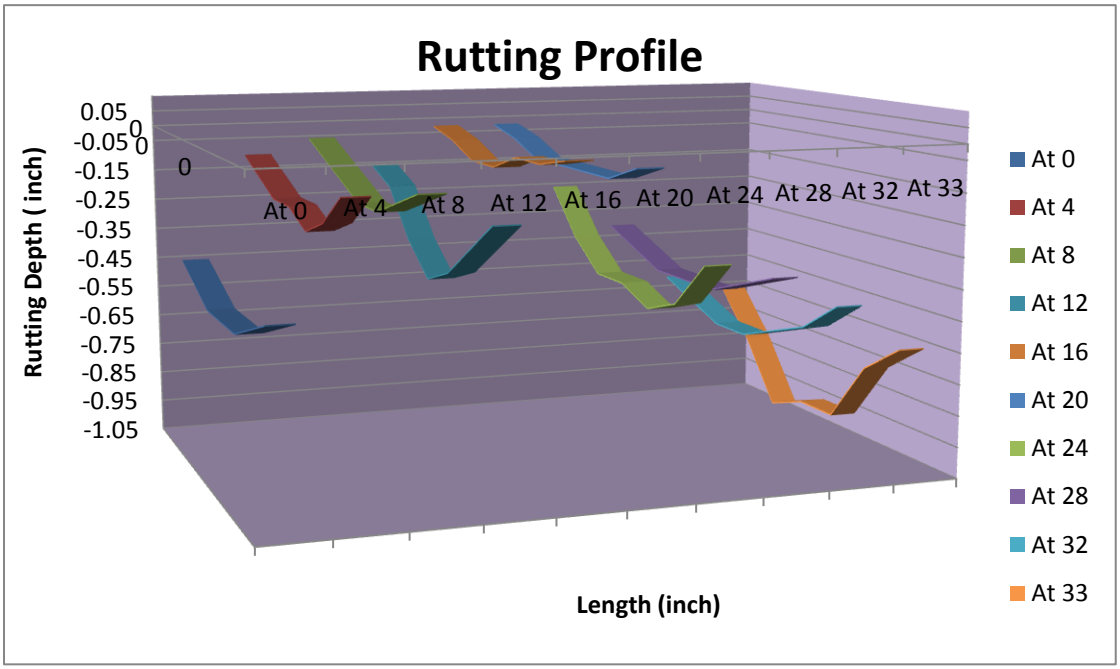


Figure 38: Rutting Profile for slab with Pipe

It is evident therefore that as the surface temperature is decreased by flowing water through the pavement, the rut depths decrease in value. Figure 39 demonstrates the maximum rut depth in each longitudinal section for both slabs.

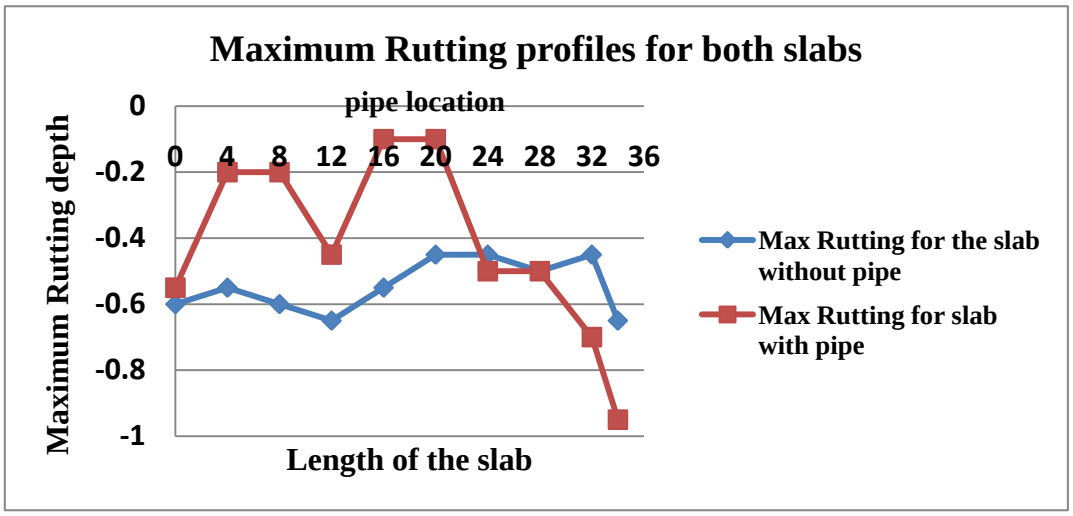


Figure 39: Maximum rut depths for both slabs

The correlation between the increasing surface temperature and rut depth phenomenon for the slab without embedded pipe can be identified by computing the average of the maximum surface temperatures (T1& T3) and the average of the maximum rut depths in two longitudinal sections along the wheel path (section 5 & section 6).

Average Maximum temperature $= \frac{Max\ T1+Max\ T3}{2} = \frac{55.33+49.125}{2} = 52.22°C$

Average Maximum rut depths = $\frac{0.55+0.45}{2} = 0.5\ inch$

The correlation between the reduction in surface temperature and rut depth for the slab with embedded pipe can be identified by computing the average of the maximum surface temperatures (T3, T4, T5, T9, T10) and the average of the maximum rut depths at the pipe location for two longitudinal sections along the wheel path (section 5 & section 6).

Average Maximum temperature $= \frac{Max\ T3+Max\ T4+Max\ T5+Max\ T9+Max\ T10}{5}$

$$= \frac{38.85 + 30.9 + 29.05 + 44.03 + 34.20}{5} = 35.4\ °C$$

Average Maximum rut depths = $\frac{0.1+0.1}{2} = 0.1\ inch$

Figure 40 demonstrates the correlation between the average maximum surface temperatures and the average maximum rut depths for both slabs.

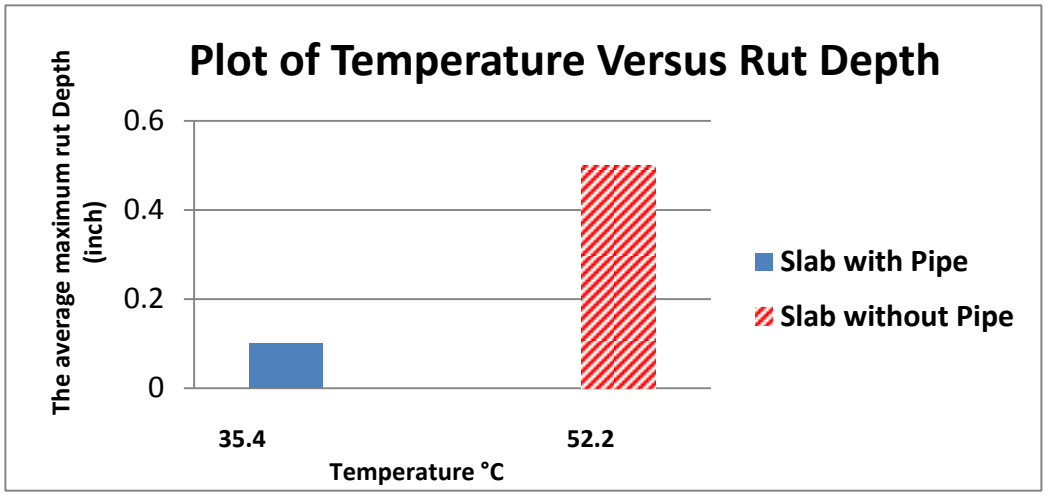


Figure 40: Temperature versus Rut depth

The results show that the flowing of water was effective in decreasing the temperature of the surface of the slab by 10°C.The temperature at the outlet of the water flowing through the slab was higher by 3-7°C compared to the temperature of the inlet during the test. The rise in outlet temperature means that the heat energy is being extracted from the pavement by the flow of water.

For this study, the stiffness of the embedded pipe was considered to have no influence on the overall stiffness of the pavement and thus not affecting the rutting depth. However, the stiffness of the embedded pipe must not be ignored. Stiffer pipes, especially when located close to the surface, will contribute towards the stiffness of the pavement and hence reduce the overall potential of rutting.

CHAPTER 10

10.0 General Conclusion and Recommendation

In this study, based on the observations of two HMA pavement slabs, loading, testing and analysis of data, the following conclusions can be drawn:

1. Loading at high temperature leads to significant rutting.
2. Flow of water through the pavement can reduce the surface temperature of slab significantly
3. A reduction of surface temperature leads to a reduction of rutting
4. The heat energy from a pavement at high temperature can be extracted by flowing water

It is recommended that further tests be done with heat spreader layers to reduce the amount of piping, and also to evaluate the structural contribution of the piping materials.

CHAPTER 11

11.0 References

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Appendix A – Data Tables

A.1 Temperature measurement for the slab without embedded pipe

T1	T2	T3	T4	T5	T6 Air temperature	Time (h)
43.87701	34.5194	38.8064	37.76516	38.10292	45.907127	0
43.65879	34.18928	38.51219	37.48759	37.88943	45.753365	0.016667
44.16288	34.57698	38.90421	37.86209	38.21679	46.456514	0.033333
44.36546	34.67605	39.12424	38.12931	38.22718	46.628547	0.05
44.40823	34.78078	39.08291	38.02305	38.24414	46.704	0.066667
44.47918	34.81002	39.24467	38.14446	38.20278	46.841708	0.083333
44.62769	34.87327	39.26728	38.25455	38.18493	46.916632	0.1
44.68172	34.91952	39.44773	38.24236	38.39468	47.076983	0.116667
44.67844	35.04125	39.45817	38.2528	38.36464	47.225192	0.133333
44.99794	34.9998	39.48645	38.37422	38.32896	47.256609	0.15
45.11491	35.12808	39.56084	38.40252	38.45602	47.373384	0.166667
45.18022	35.26684	39.53171	38.45914	38.50215	47.458738	0.183333
45.2859	35.21406	39.75174	38.55226	38.46649	47.564233	0.2
45.31975	35.41781	39.79784	38.56925	38.63008	47.65846	0.216667
45.50765	35.46974	39.93697	38.64454	38.5596	47.732534	0.233333
45.48508	35.45271	39.96528	38.77165	38.54828	48.028793	0.25
45.63911	35.60366	40.08742	38.77165	38.64055	47.980507	0.266667
45.69877	35.63856	40.09308	38.77084	38.6697	48.080337	0.283333
45.95276	35.6905	40.05184	38.95057	38.68102	48.234064	0.3
45.96968	35.78951	40.17317	38.95624	38.79195	48.293596	0.316667
46.08658	35.83008	40.29529	38.99672	38.88421	48.441673	0.333333
46.18089	35.93476	40.36484	39.13596	38.96598	48.399028	0.35
46.17767	35.96317	40.45139	39.14163	38.9773	48.458556	0.366667
46.26311	36.00943	40.57839	39.28086	39.02343	48.617872	0.383333
46.51941	36.10274	40.57272	39.26875	39.04608	48.660513	0.4
46.56776	36.20173	40.64227	39.32702	39.08089	48.765915	0.416667
46.54198	36.30639	40.73449	39.36106	39.12702	48.842323	0.433333
46.72732	36.20094	40.82746	39.51806	39.27837	49.069976	0.45
46.74425	36.38754	40.93177	39.55286	39.3075	49.106977	0.466667
46.81273	36.46868	40.90267	39.58124	39.3593	49.064347	0.483333
46.99484	36.49219	40.97788	39.60962	39.38277	49.129494	0.5
47.01178	36.62527	41.02399	39.72613	39.49282	49.22923	0.516667
47.10283	36.60821	41.09919	39.68491	39.43456	49.410985	0.533333
47.18011	36.66015	41.1744	39.76661	39.48069	49.405355	0.55
47.35653	36.70717	41.1744	39.8298	39.56808	49.558946	0.566667
47.47331	36.7648	41.21484	39.795	39.51549	49.484967	0.583333

A.1 Temperature measurement for the slab without embedded pipe (continued)

T1	T2	T3	T4	T5	T6	Time(h)
47.54988	36.97407	41.43548	39.93988	39.75338	49.814638	0.616667
47.69239	36.96838	41.36524	40.11387	39.76472	49.953733	0.633333
47.76646	37.0552	41.53976	40.04428	39.84642	49.98508	0.65
47.80914	37.11926	41.54473	40.17778	39.84565	49.98508	0.666667
47.88321	37.25876	41.61424	40.18914	39.90956	50.149877	0.683333
47.90015	37.20039	41.61424	40.22394	39.89745	50.166772	0.7
47.99115	37.29932	41.74192	40.32264	40.04228	50.240717	0.716667
48.21331	37.3285	41.74192	40.33969	39.9727	50.337187	0.733333
48.293	37.39255	41.91002	40.40359	40.08274	50.411123	0.75
48.37834	37.5555	41.86959	40.40927	40.10052	50.311484	0.766667
48.48374	37.52064	41.9618	40.46749	40.17009	50.501954	0.783333
48.62616	37.57899	41.9852	40.48454	40.18143	50.587149	0.8
48.63432	37.61954	42.10717	40.61233	40.20488	50.518855	0.816667
48.54899	37.7533	42.08377	40.61802	40.43702	50.655439	0.833333
48.68263	37.78247	42.17666	40.66986	40.41358	50.626591	0.85
48.89026	37.82232	42.17599	40.79195	40.4306	50.723058	0.866667
48.82755	37.88065	42.3093	40.76285	40.51719	50.870888	0.883333
49.00947	37.95607	42.29728	40.90199	40.51152	50.956071	0.9
49.15747	38.04356	42.43693	40.96019	40.59316	51.055657	0.916667
49.01512	38.04287	42.39016	40.96587	40.65631	51.109515	0.933333
49.18008	38.12466	42.39584	41.0525	40.67974	51.092608	0.95
49.27977	38.15382	42.48871	41.1575	40.71452	51.078201	0.966667
49.34811	38.2413	42.5759	41.07591	40.7202	51.211597	0.983333
49.45343	38.21146	42.63402	41.16887	40.8366	51.390688	1
49.45908	38.25269	42.71486	41.21503	40.7493	51.200323	1.016667
49.47603	38.35725	42.81972	41.19162	40.95867	51.322436	1.033333
49.55001	38.44471	42.83677	41.31936	41.00479	51.322436	1.05
49.64659	38.54925	42.8595	41.38322	41.02253	51.396324	1.066667
49.65224	38.4618	42.91192	41.35983	40.97002	51.461455	1.083333
49.72621	38.68864	42.85382	41.45277	41.13252	51.410126	1.1
49.83716	38.57773	42.99276	41.45277	41.10343	51.504034	1.116667
49.83151	38.75263	43.02181	41.52232	41.23115	51.520951	1.133333
49.97378	38.74693	43.15506	41.60957	41.27159	51.802068	1.15
50.00203	38.77541	43.13738	41.58618	41.30068	51.759494	1.166667
49.95375	38.83371	43.20116	41.77204	41.30068	51.78515	1.183333
50.16689	38.95598	43.20747	41.72526	41.38157	51.938518	1.2
50.12426	39.01426	43.31166	41.68417	41.4752	52.026756	1.216667
50.20386	39.07254	43.31734	41.86433	41.40498	52.080595	1.233333

A.1 Temperature measurement for the slab without embedded pipe (continued)

T1	T2	T3	T4	T5	T6	Time(h)
50.3687	39.11307	43.39817	41.93956	41.527	52.171362	1.266667
50.41697	39.24102	43.37543	41.91617	41.59084	52.165723	1.283333
50.43958	39.19984	43.50235	42.0034	41.57311	52.392897	1.3
50.48785	39.36261	43.51433	42.03247	41.7476	52.188278	1.316667
50.65571	39.32208	43.54906	42.06723	41.66604	52.384169	1.333333
50.6244	39.35691	43.68226	42.11399	41.80507	52.489287	1.35
50.65571	39.45	43.74033	42.09061	41.79371	52.404173	1.366667
50.69267	39.49053	43.78642	42.24734	41.8923	52.478011	1.383333
50.85746	39.49053	43.78074	42.16014	41.9618	52.653867	1.4
50.90572	39.57792	43.80977	42.31117	41.9618	52.469286	1.416667
50.92268	39.56018	43.90196	42.29918	42.04267	52.829713	1.433333
51.01355	39.69949	43.87292	42.40345	42.0136	52.767172	1.45
51.15268	39.78686	43.9657	42.47866	42.05403	52.789738	1.466667
51.14137	39.76344	44.02318	42.47297	42.11151	52.781042	1.483333
51.05314	39.78054	44.12791	42.38578	42.27958	52.886129	1.5
51.30047	39.79826	44.02318	42.6701	42.2044	52.854863	1.516667
51.32875	39.92615	44.13928	42.64105	42.19303	52.846175	1.533333
51.32875	39.96667	44.22009	42.61768	42.27958	52.973837	1.55
51.41395	39.94895	44.19107	42.71055	42.34339	53.042004	1.566667
51.32576	40.05972	44.26676	42.64046	42.34339	53.010743	1.583333
51.52179	40.12305	44.29521	42.72763	42.44195	53.016389	1.6
51.42794	40.18698	44.39365	42.77378	42.49375	53.118432	1.616667
51.6183	40.19268	44.49209	42.89569	42.48743	53.2122	1.633333
51.66656	40.2389	44.42836	43.01133	42.5923	53.192238	1.65
51.60967	40.34335	44.53818	42.93614	42.63273	53.203533	1.666667
51.63798	40.46549	44.6076	42.92988	42.7199	53.220478	1.683333
51.7318	40.38957	44.57858	42.92418	42.7597	53.243075	1.7
51.89652	40.49402	44.60705	43.05748	42.7597	53.396322	1.716667
51.93345	40.50543	44.58373	43.13267	42.73633	53.396322	1.733333
52.02997	40.47061	44.64745	43.20786	42.85763	53.543906	1.75
52.03563	40.59845	44.78682	43.22551	42.86962	53.433219	1.766667
52.02136	40.61557	44.83861	43.25401	42.91513	53.617693	1.783333
52.11221	40.63269	44.84431	43.23066	42.90375	53.577807	1.8
52.08095	40.76108	44.88471	43.29445	43.02564	53.631655	1.816667
52.18606	40.77821	44.82669	43.36965	43.0484	53.711091	1.833333
52.14347	40.78962	44.8904	43.38105	43.03702	53.790522	1.85
52.25991	40.92314	44.9308	43.36965	43.06607	53.773567	1.866667
52.23432	40.88834	44.9826	43.49721	43.17029	53.747981	1.883333

A.1 Temperature measurement for the slab without embedded pipe (continued)

T1	T2	T3	T4	T5	T6	Time(h)
52.46426	40.93456	45.05201	43.53143	43.25114	53.901186	1.916667
52.46426	40.98079	44.994	43.52573	43.25114	53.918143	1.933333
52.51251	41.0213	45.0344	43.55996	43.30923	53.918143	1.95
52.53243	41.02701	45.24883	43.65899	43.36104	53.960682	1.966667
52.66018	41.09091	45.30062	43.72847	43.35535	53.966335	1.983333
52.70276	41.2187	45.14991	43.71085	43.32631	53.952066	2
52.67151	41.18961	45.27162	43.76891	43.39009	54.074028	2.016667
52.62326	41.29973	45.31772	43.85601	43.43621	54.122221	2.033333
52.74534	41.33453	45.41042	43.81506	43.55806	54.122221	2.05
52.80782	41.36362	45.40472	43.88505	43.6799	54.116566	2.066667
52.85607	41.38699	45.39902	43.95452	43.65656	54.210246	2.083333
52.98103	41.39271	45.50311	43.90216	43.74936	54.35776	2.1
53.0037	41.46854	45.49741	44.05301	43.6799	54.272698	2.116667
52.99237	41.5963	45.45702	44.00637	43.64517	54.315229	2.133333
53.05761	41.6368	45.55541	44.13439	43.79035	54.425859	2.15
52.88441	41.6368	45.66519	44.05872	43.79035	54.298271	2.166667
53.08029	41.68925	45.5958	44.19194	43.79604	54.431512	2.183333
53.18533	41.67783	45.55541	44.15721	43.83646	54.584661	2.2
53.22223	41.77649	45.75787	44.29042	43.91729	54.553441	2.216667
53.27336	41.72976	45.72887	44.20335	43.99926	54.474041	2.233333
53.31593	41.86892	45.82725	44.2557	43.993	54.564749	2.25
53.35849	41.88086	45.76927	44.3832	44.05105	54.638493	2.266667
53.38117	41.91564	45.87952	44.32515	43.993	54.587368	2.283333
53.34427	41.99093	45.90851	44.41792	44.12049	54.720604	2.3
53.45208	41.96185	45.94272	44.51068	44.20701	54.646864	2.316667
53.42653	42.04857	45.91421	44.5397	44.21326	54.828284	2.333333
53.45776	42.05479	46.03538	44.5397	44.23034	54.774444	2.35
53.54289	42.142	46.09905	44.55112	44.33449	54.74889	2.366667
53.53155	42.13578	46.04679	44.59725	44.3231	54.791417	2.383333
53.62802	42.22249	46.07577	44.61485	44.32256	54.782844	2.4
53.70748	42.29255	46.13944	44.73044	44.40962	54.972835	2.416667
53.71315	42.31541	46.22022	44.73044	44.4381	54.825372	2.433333
53.67626	42.46073	46.2492	44.67812	44.49044	54.921748	2.45
53.82097	42.3964	46.26677	44.80559	44.53085	54.989816	2.466667
53.7784	42.40832	46.31857	44.82318	44.47851	55.074864	2.483333
53.8011	42.43738	46.26061	44.89216	44.61167	55.137266	2.5
53.74151	42.46024	46.31857	44.85173	44.56556	54.836693	2.516667
53.75854	42.52408	46.28959	44.89216	44.664	54.442434	2.533333

A.1 Temperature measurement for the slab without embedded pipe (continued)

T1	T2	T3	T4	T5	T6	Time(h)
53.53151	42.57029	46.31241	44.85127	44.62307	53.454961	2.566667
53.43217	42.57601	46.26016	44.90313	44.66918	53.03483	2.583333
53.3158	42.60507	46.31768	44.97873	44.7386	52.733887	2.6
53.242	42.73274	46.30055	44.93785	44.72151	52.296553	2.616667
53.24768	42.7618	46.22503	45.00158	44.79093	52.344824	2.633333
53.22213	42.77942	46.27728	45.00729	44.87796	52.395969	2.65
53.24768	42.84896	46.28827	45.1176	44.83134	52.84462	2.666667
53.242	42.78513	46.21318	45.07146	44.89557	53.006476	2.683333
53.25904	42.87802	46.29441	45.00158	44.88366	53.244908	2.7
53.42082	42.85468	46.23074	45.10618	44.88366	53.565646	2.716667
53.40663	42.8723	46.23074	45.10618	44.91267	53.891992	2.733333
53.55989	42.76751	46.28256	45.05388	44.93028	53.908994	2.75
53.58828	42.9066	46.3348	45.12332	45.01109	54.135967	2.766667
53.57692	42.98232	46.42745	45.1176	45.11002	54.229608	2.783333
53.73585	42.9066	46.38091	45.18132	44.994	54.34591	2.8
53.66207	43.0052	46.40418	45.19275	45.18512	54.547285	2.816667
53.89476	43.02853	46.43886	45.16946	45.15042	54.615363	2.833333
53.9118	43.04614	46.54335	45.21033	45.09241	54.640903	2.85
53.82948	43.08663	46.54335	45.26262	45.16233	54.714644	2.866667
53.91461	43.05186	46.60129	45.22175	45.16803	54.66078	2.883333
53.85502	43.11568	46.61271	45.25647	45.09863	54.760061	2.9
54.05648	43.12757	46.67065	45.32018	45.15042	54.777052	2.916667
54.06783	43.1971	46.67065	45.32018	45.24313	54.947177	2.933333
54.07918	43.20854	46.74001	45.28547	45.23743	54.873446	2.95
54.0423	43.21426	46.74001	45.3259	45.32392	54.92452	2.966667
54.14446	43.23713	46.80937	45.44189	45.35343	54.930184	2.983333
54.15014	43.29522	46.68207	45.31404	45.26643	54.771388	3
54.13878	43.32426	46.82079	45.44761	45.39383	54.518956	3.016667
54.08206	43.35331	46.81508	45.45332	45.39383	54.320365	3.033333
54.11326	43.36475	46.80324	45.5056	45.38762	54.215396	3.05
54.12462	43.44615	46.83221	45.55174	45.49221	54.385581	3.066667
54.26367	43.39951	46.79182	45.5746	45.39902	54.513213	3.083333
54.13598	43.43427	46.81467	45.65586	45.52071	54.507544	3.1
53.96861	43.39907	46.8265	45.5746	45.52641	54.555756	3.116667
54.14735	43.5324	46.88974	45.58603	45.56062	54.450804	3.133333
54.12751	43.5962	46.86077	45.61503	45.50263	54.388394	3.15
54.14456	43.54427	46.92442	45.67873	45.61861	54.399736	3.166667
54.21832	43.57903	46.99377	45.71344	45.68229	54.42527	3.183333

A.1 Temperature measurement for the slab without embedded pipe (continued)

T1	T2	T3	T4	T5	T6	Time(h)
54.13888	43.75325	46.95338	45.66689	45.59531	54.277761	3.216667
54.1332	43.74753	47.01131	45.80041	45.688	54.320311	3.233333
54.1332	43.75897	46.94196	45.79429	45.74598	54.382723	3.25
54.17008	43.7471	47.0517	45.77142	45.74598	54.555756	3.266667
54.32896	43.67759	47.03417	45.91636	45.80396	54.530222	3.283333
54.22401	43.73566	47.06313	45.79429	45.82677	54.382723	3.3
54.24106	43.82806	47.08599	45.84655	45.76309	54.27209	3.316667
54.24106	43.89799	47.0052	45.88126	45.80396	54.388394	3.333333
54.22969	43.81089	47.06313	45.81756	45.87904	54.303297	3.35
54.16162	43.95605	47.13248	45.84655	45.91421	54.419599	3.366667
54.28931	43.90943	47.06313	45.84043	45.81014	54.371382	3.383333
54.22401	43.91516	47.17287	45.87514	45.86194	54.328835	3.4
54.37152	43.95033	47.09742	45.8637	45.86194	54.291957	3.416667
54.30914	43.92088	47.16144	45.95638	45.97789	54.385581	3.433333
54.30914	44.03127	47.19612	45.95638	45.85624	54.371382	3.45
54.22401	44.037	47.10923	46.02007	45.97789	54.223869	3.466667
54.46233	43.99039	47.27118	45.9621	46.05914	54.27209	3.483333
54.30637	44.07747	47.16106	46.02007	46.05866	54.430941	3.5
54.34325	44.04844	47.19002	45.93845	46.05866	54.204002	3.516667
54.26949	44.13552	47.01053	46.04295	46.00687	54.357188	3.533333
54.42269	44.17027	47.22469	46.10092	46.08195	54.320311	3.55
54.26949	44.11794	47.23613	46.04867	46.1746	54.28059	3.566667
54.366	44.08319	47.29976	46.11808	46.15702	54.286264	3.583333
54.27243	44.16987	47.16677	46.11236	46.1917	54.351517	3.6
54.33481	44.22219	47.2708	46.17604	46.14515	54.36002	3.616667
54.28656	44.19889	47.28224	46.13562	46.22639	54.323143	3.633333
54.26949	44.24509	47.29976	46.15316	46.21498	54.212506	3.65
54.41132	44.28637	47.34587	46.10092	46.24966	54.169951	3.666667
54.37444	44.31499	47.35196	46.21113	46.26677	54.238038	3.683333
54.57587	44.37303	47.2708	46.22828	46.26677	54.422426	3.7
54.47094	44.31499	47.24756	46.28052	46.30146	54.269243	3.716667
54.34894	44.3673	47.3112	46.26298	46.31903	54.269243	3.733333
54.50781	44.40777	47.36339	46.28052	46.29005	54.201158	3.75
54.45682	44.43679	47.30548	46.21074	46.34801	54.311795	3.766667
54.51919	44.40818	47.36339	46.31522	46.38269	54.189811	3.783333
54.3915	44.3906	47.37483	46.23972	46.38269	54.13307	3.8
54.49075	44.46009	47.43274	46.25726	46.37128	54.291939	3.816667
54.49075	44.52997	47.32872	46.32094	46.31332	54.328817	3.833333

A.1 Temperature measurement for the slab without embedded pipe (continued)

T1	T2	T3	T4	T5	T6	Time(h)
54.55313	44.48911	47.45597	46.24583	46.44064	54.223855	3.866667
54.64393	44.52425	47.36339	46.32094	46.51616	54.433772	3.883333
54.41132	44.60517	47.36339	46.3034	46.37128	54.340166	3.9
54.7063	44.57044	47.49065	46.43076	46.53897	54.371368	3.916667
54.45957	44.61662	47.5196	46.32094	46.53897	54.291939	3.933333
54.3915	44.62234	47.46169	46.37852	46.42307	54.21818	3.95
54.57882	44.67465	47.46741	46.4075	46.49243	54.377043	3.966667
54.44544	44.6861	47.54247	46.3728	46.59121	54.340166	3.983333
54.57882	44.65708	47.55999	46.4075	46.52756	54.40257	4
54.61569	44.70366	47.49065	46.48871	46.56794	54.311795	4.016667
54.63549	44.62234	47.58894	46.45973	46.63159	54.277761	4.033333
54.67805	44.77314	47.61181	46.52912	46.57935	54.303288	4.05
54.52488	44.80215	47.60037	46.47117	46.60262	54.204002	4.066667
54.60431	44.74413	47.58894	46.37852	46.60832	54.240882	4.083333
54.55038	44.7907	47.54247	46.52912	46.75318	54.240882	4.1
54.57019	44.84261	47.58894	46.50015	46.643	54.362869	4.116667
54.64393	44.77886	47.60609	46.51196	46.73561	54.308964	4.133333
54.62981	44.85445	47.61789	46.63321	46.69524	54.388394	4.15
54.6808	44.843	47.60609	46.55238	46.74177	54.340166	4.166667
54.62687	44.843	47.75656	46.70333	46.78215	54.413919	4.183333
54.79141	44.84872	47.62933	46.66255	46.77074	54.413919	4.2
54.63824	44.93575	47.64684	46.64501	46.82822	54.204002	4.216667
54.60137	44.87162	47.73905	46.66827	46.89186	54.277761	4.233333
54.89357	44.9472	47.69866	46.73765	46.80496	54.314639	4.25
54.67237	44.94148	47.69866	46.67971	46.86289	54.167122	4.266667
54.82553	44.91819	47.68723	46.63929	46.8686	54.215355	4.283333
54.71492	44.91819	47.7101	46.65074	46.89186	54.411099	4.3
54.91064	44.97048	47.68115	46.72012	46.83438	54.283437	4.316667
54.7263	44.92964	47.71582	46.67971	46.83963	54.18983	4.333333
54.75748	45.11512	47.69866	46.66218	46.88616	54.178475	4.35
54.66668	45.19641	47.66399	46.66218	46.89757	54.243744	4.366667
54.66668	45.11512	47.73905	46.67971	46.9612	54.116067	4.383333
54.73199	45.0804	47.73333	46.76053	46.97261	54.18983	4.4
54.37464	45.09719	47.63469	46.58063	46.78126	54.113259	4.416667
54.4427	45.14947	47.66364	46.71404	46.97261	54.311823	4.433333
54.42563	45.15558	47.66364	46.72548	46.83963	54.243744	4.45
54.22987	44.97544	47.62863	46.63857	46.88571	54.116067	4.466667
54.39445	45.08001	47.65758	46.6443	46.94321	54.22671	4.483333

A.1 Temperature measurement for the slab without embedded pipe (continued)

T1	T2	T3	T4	T5	T6	Time(h)
54.33207	45.1903	47.62897	46.71404	46.93224	54.32318	4.516667
54.32638	45.17886	47.72154	46.82991	46.9612	54.263589	4.533333
54.40583	45.25442	47.73905	46.76053	47.01298	54.374223	4.55
54.4427	45.16741	47.74477	46.82419	46.97261	54.300468	4.566667
54.25263	45.14413	47.73298	46.69079	47.04195	54.257912	4.583333
54.2697	45.22503	47.62325	46.77198	46.97261	54.331668	4.6
54.28108	45.16703	47.768	46.89357	47.10031	54.320315	4.616667
54.31796	45.22503	47.79088	46.74909	47.14639	54.294791	4.633333
54.2697	45.28304	47.69225	46.80095	47.11742	54.374223	4.65
54.30658	45.23648	47.76765	46.85316	47.07091	54.195507	4.666667
54.28678	45.19603	47.77337	46.77198	47.04195	54.18983	4.683333
54.47116	45.21931	47.72154	46.80095	47.11742	54.354379	4.7
54.30089	45.27731	47.76765	46.82991	47.08846	54.263589	4.716667
54.43428	45.25976	47.67508	46.83564	47.08276	54.280623	4.733333
54.26401	45.40439	47.73298	46.67327	47.15253	54.274945	4.75
54.38602	45.33531	47.73298	46.80667	47.15209	54.428131	4.766667
54.33776	45.38721	47.73298	46.77198	47.10602	54.411099	4.783333
54.37464	45.35821	47.83127	46.81239	47.12883	54.391255	4.8
54.40014	45.36394	47.80804	46.80667	47.11172	54.371415	4.816667
54.4427	45.35821	47.73298	46.83564	47.14595	54.41397	4.833333
54.41721	45.35821	47.74442	46.91074	47.07662	54.260781	4.85
54.29519	45.45093	47.75015	46.84136	47.17491	54.229581	4.866667
54.32638	45.38148	47.83127	46.81811	47.09987	54.266461	4.883333
54.23282	45.43948	47.75587	46.81811	47.11699	54.340217	4.9
54.39172	45.45093	47.81376	46.85281	47.20958	54.29198	4.916667
54.28678	45.41621	47.85415	46.84708	47.23854	54.260781	4.933333
54.42859	45.44521	47.82521	46.86425	47.16921	54.303339	4.95
54.42859	45.42193	47.81376	46.82956	47.20958	54.235262	4.966667
54.38033	45.44521	47.92954	46.83529	47.16307	54.235262	4.983333
54.39172	45.49138	47.88882	46.98012	47.27891	54.266461	5
54.43998	45.5261	47.91777	46.92791	47.29645	54.399815	5.016667
54.40879	45.53183	47.85415	46.93398	47.25608	54.399815	5.033333
54.43998	45.57837	47.8831	46.97439	47.28504	54.504759	5.05
54.36053	45.47993	47.78482	46.93364	47.27363	54.294865	5.066667
54.35484	45.54937	47.81948	46.91074	47.314	54.252304	5.083333
54.45136	45.56692	47.83093	47.0148	47.20387	54.283502	5.1
54.35484	45.6249	47.90632	46.93364	47.25608	54.436691	5.116667
54.43998	45.63063	47.8656	46.99729	47.29075	54.331742	5.133333

A.1 Temperature measurement for the slab without embedded pipe (continued)

T1	T2	T3	T4	T5	T6	Time(h)
54.37761	45.58982	47.91777	46.98584	47.34866	54.382774	5.166667
54.389	45.6249	47.87738	47.0899	47.27891	54.394134	5.183333
54.40608	45.61881	47.89454	47.04949	47.30786	54.283502	5.2
54.49962	45.70579	47.89454	47.04949	47.40615	54.082056	5.216667
54.42587	45.63635	47.85988	47.07846	47.41756	54.266461	5.233333
54.37761	45.73478	47.95243	47.05522	47.35437	54.263668	5.25
54.47685	45.69434	47.89454	47.0899	47.34866	54.294865	5.266667
54.37192	45.73478	47.90027	47.00302	47.29645	54.252304	5.283333
54.45136	45.6768	47.91777	47.09563	47.36007	54.345897	5.3
54.40879	45.66535	47.99855	46.97978	47.39473	54.303339	5.316667
54.46275	45.70579	47.94066	47.07239	47.37148	54.116146	5.333333
54.51373	45.70579	47.94638	47.12459	47.39473	54.15582	5.35
54.51373	45.7695	48.02176	47.11887	47.36578	54.36862	5.366667
54.45408	45.69434	47.96388	47.06667	47.33682	54.326061	5.383333
54.47685	45.72333	48.01604	47.12459	47.4294	54.26935	5.4
54.58747	45.72906	48.02176	47.12459	47.45835	54.257986	5.416667
54.47685	45.82175	47.88882	47.15355	47.42369	54.405496	5.433333
54.49962	45.86792	48.02176	47.06667	47.41228	54.306228	5.45
54.46275	45.76377	47.9871	47.14783	47.49301	54.283502	5.466667
54.389	45.73478	47.90632	47.10708	47.32541	54.331742	5.483333
54.45136	45.84466	48.02176	47.18824	47.4351	54.294865	5.5
54.5308	45.81567	48.07965	47.0899	47.52196	54.263668	5.516667
54.5365	45.76377	47.96388	47.18251	47.55662	54.141663	5.533333
54.59615	45.86219	47.9696	47.19396	47.53908	54.252304	5.55
54.64142	45.87973	48.07965	47.24043	47.52767	54.362938	5.566667
54.59045	45.8332	48.0736	47.165	47.56804	54.343106	5.583333
54.47414	45.83893	48.05643	47.28657	47.59699	54.257986	5.6
54.54789	45.84466	48.03321	47.18824	47.65489	54.289183	5.616667
54.64441	45.78668	48.06215	47.2172	47.6084	54.226788	5.633333
54.49962	45.86219	48.10287	47.14783	47.62594	54.306228	5.65
54.47414	45.85038	48.05611	47.23438	47.57374	54.232471	5.666667
54.40608	45.91409	48.0736	47.2401	47.56191	54.229693	5.683333
54.53379	45.92554	48.09078	47.20542	47.59658	54.164393	5.7
54.44026	46.02968	48.06788	47.15928	47.59087	54.022546	5.716667
54.49692	46.0125	48.11972	47.17073	47.61982	54.02823	5.733333
54.42317	46.00677	48.03321	47.19969	47.60269	54.113365	5.75
54.5224	46.01823	48.16042	47.32125	47.61411	54.292082	5.766667
54.49962	46.0125	48.19509	47.22292	47.63164	54.340328	5.783333

A.1 Temperature measurement for the slab without embedded pipe (continued)

T1	T2	T3	T4	T5	T6	Time(h)
54.64441	45.91981	48.17187	47.33876	47.70096	54.323277	5.816667
54.43456	46.02968	48.14293	47.23438	47.6663	54.241063	5.833333
54.51971	45.99497	48.15438	47.2401	47.78169	54.190047	5.85
54.60485	45.937	48.12544	47.3327	47.68343	54.246748	5.866667
54.55658	46.0007	48.10796	47.33843	47.75274	54.363068	5.883333
54.50262	46.12236	48.1776	47.36739	47.64877	54.320505	5.9
54.53379	46.0007	48.22371	47.24583	47.79922	54.357383	5.916667
54.59077	46.03541	48.18905	47.29197	47.71238	54.294999	5.933333
54.5311	46.10484	48.15438	47.33843	47.68343	54.093539	5.95
54.59647	46.13382	48.1369	47.25156	47.74092	54.161617	5.966667
54.5425	46.13955	48.15438	47.3327	47.73521	54.093539	5.983333
54.5311	46.12809	48.21799	47.29197	47.73521	54.167302	6
54.59915	46.1746	48.18332	47.36739	47.73521	54.30345	6.016667
54.51401	46.1746	48.15438	47.3152	47.77027	54.309135	6.033333
54.68999	46.20358	48.16584	47.43102	47.74663	54.30345	6.05
54.59345	46.12236	48.21226	47.44852	47.83347	54.260888	6.066667
54.59345	46.1746	48.2412	47.37311	47.7874	54.224008	6.083333
54.67859	46.20931	48.22371	47.42498	47.75845	54.31482	6.1
54.67289	46.12236	48.2641	47.4657	47.79311	54.292082	6.116667
54.69267	46.15134	48.31052	47.37311	47.84529	54.30345	6.133333
54.6615	46.12843	48.22371	47.4832	47.78169	54.224008	6.15
54.64441	46.15742	48.35694	47.48893	47.851	54.014086	6.166667
54.67559	46.24402	48.20654	47.41957	47.90889	54.150247	6.183333
54.67559	46.1864	48.24693	47.55829	47.92031	54.241063	6.2
54.73524	46.23829	48.20654	47.47716	47.82817	54.326191	6.216667
54.7805	46.16314	48.21226	47.4253	47.93213	54.283627	6.233333
54.69537	46.20358	48.31052	47.45425	47.79922	54.235377	6.25
54.66989	46.25009	48.20654	47.52361	47.85671	54.229693	6.266667
54.79758	46.23291	48.28159	47.52361	47.86813	54.241063	6.283333
54.73224	46.30232	48.32801	47.43102	47.90318	54.241063	6.3
54.84285	46.24436	48.34519	47.44821	47.90889	54.30345	6.316667
54.7748	46.26189	48.32801	47.58152	47.851	54.246748	6.333333
54.79459	46.28514	48.28159	47.58152	47.9782	54.246748	6.35
54.69808	46.20393	48.3684	47.4832	47.94395	54.167302	6.366667
54.73495	46.30267	48.29335	47.45425	47.93213	54.161617	6.383333
54.69808	46.37173	48.27618	47.49466	47.88035	54.204183	6.4
54.76613	46.34275	48.43802	47.4832	48.01936	54.167302	6.416667
54.89381	46.30267	48.37443	47.59329	47.915	54.277942	6.433333

A.1 Temperature measurement for the slab without embedded pipe (continued)

T1	T2	T3	T4	T5	T6	Time(h)
54.6726	46.38925	48.37443	47.51788	47.94395	54.30345	6.466667
54.90519	46.36028	48.3684	47.58152	48.07113	54.360154	6.483333
54.79459	46.32557	48.35694	47.54684	47.9843	54.462325	6.5
54.79189	46.31985	48.35694	47.49466	48.0479	54.30345	6.516667
54.70107	46.47618	48.34519	47.58152	48.00754	54.246748	6.533333
54.66989	46.42968	48.42626	47.53538	48.01936	54.136107	6.55
54.72385	46.41823	48.35122	47.57006	47.99042	54.320505	6.566667
54.82876	46.38353	48.41481	47.61047	48.00183	54.277942	6.583333
54.97053	46.37173	48.41481	47.62224	48.0483	54.450957	6.6
54.70107	46.44721	48.35694	47.56434	48.10618	54.462325	6.616667
54.97053	46.43576	48.44375	47.65692	48.01936	54.38289	6.633333
54.92797	46.42396	48.47841	47.62224	48.10007	54.235377	6.65
54.83146	46.49943	48.46123	47.68586	48.03077	54.31482	6.666667
54.97892	46.4125	48.4323	47.59329	48.11189	54.155932	6.683333
54.8911	46.48763	48.42054	47.66837	48.05972	54.241063	6.7
54.7805	46.49943	48.40909	47.69732	47.9843	54.320505	6.716667
54.81737	46.5631	48.43802	47.63369	48.07154	54.252434	6.733333
54.73794	46.44721	48.54199	47.66264	48.15224	54.215554	6.75
55.0047	46.49336	48.44947	47.70877	48.1176	54.320505	6.766667
54.79189	46.51661	48.44947	47.63942	48.05972	54.331877	6.783333
54.96783	46.57455	48.40909	47.77239	48.05972	54.357383	6.8
54.88841	46.44721	48.47268	47.69159	48.16366	54.229693	6.816667
54.84015	46.52233	48.48413	47.63942	48.1176	54.252434	6.833333
54.86293	46.52806	48.48413	47.69159	48.15795	54.178674	6.85
54.82607	46.64395	48.42054	47.73772	48.08255	54.269494	6.866667
55.03586	46.55131	48.55344	47.72627	48.16937	54.172988	6.883333
55.06134	46.52233	48.55344	47.81311	48.1926	54.246748	6.9
54.93366	46.51627	48.51306	47.71481	48.25618	54.062342	6.916667
54.93935	46.60925	48.42626	47.7145	48.1233	54.226927	6.933333
55.0047	46.67292	48.49558	47.77239	48.10578	54.221241	6.95
54.84015	46.58601	48.54199	47.77239	48.08255	54.337563	6.966667
55.0047	46.58028	48.55344	47.82456	48.26189	54.289313	6.983333
54.97353	46.58601	48.61131	47.80707	48.1983	54.167302	7
54.85724	46.64968	48.61131	47.77812	48.15184	54.263807	7.016667
54.82037	46.70189	48.57092	47.83601	48.1926	54.167302	7.033333
54.7835	46.6901	48.57665	47.77812	48.1926	54.289313	7.05
54.97353	46.6554	48.49558	47.82456	48.20972	54.25812	7.066667
54.96783	46.59173	48.54772	47.76094	48.2676	54.277942	7.083333

A.1 Temperature measurement for the slab without embedded pipe (continued)

T1	T2	T3	T4	T5	T6	Time(h)
55.02447	46.67865	48.55344	47.87642	48.21583	54.289313	7.116667
55.05564	46.70189	48.58238	47.88214	48.29653	54.34325	7.133333
55.02447	46.64395	48.62848	47.87069	48.31405	54.368754	7.15
54.98191	46.66113	48.57665	47.7145	48.25618	54.385814	7.166667
54.93366	46.71907	48.64023	47.86496	48.25047	54.317747	7.183333
54.98761	46.67292	48.61131	47.85923	48.31976	54.312059	7.2
55.01878	46.67865	48.62878	47.84778	48.2676	54.252434	7.216667
54.98761	46.72514	48.57092	47.88245	48.18689	54.195734	7.233333
54.87701	46.71335	48.62878	47.77812	48.31405	54.238302	7.25
55.06134	46.74232	48.66344	47.89995	48.31405	54.215554	7.266667
54.98761	46.78274	48.58841	47.85923	48.25618	54.275181	7.283333
55.02447	46.77129	48.59413	47.88245	48.28512	54.269494	7.3
55.04156	46.76556	48.62306	47.89963	48.2676	54.385814	7.316667
54.98761	46.77129	48.65771	47.94034	48.34299	54.263807	7.333333
55.06703	46.77701	48.69809	47.85923	48.3487	54.201422	7.35
55.02447	46.71907	48.68061	47.86496	48.41227	54.195734	7.366667
55.0047	46.86392	48.62848	47.89963	48.38334	54.269494	7.383333
55.08412	46.78847	48.69207	48.00395	48.33689	54.172988	7.4
55.10959	46.73086	48.63421	47.90536	48.38334	54.320505	7.416667
55.0925	46.83495	48.69809	47.87642	48.32547	54.337563	7.433333
54.98191	46.82922	48.66916	47.92285	48.36622	54.337563	7.45
55.08681	46.85819	48.66916	47.90536	48.3544	54.277942	7.466667
55.03856	46.83495	48.69809	47.94607	48.45873	54.178674	7.483333
55.07273	46.83495	48.66916	47.89391	48.41227	54.337563	7.5
54.95644	46.94509	48.69809	47.96325	48.40657	54.226927	7.516667
55.15215	46.80598	48.7442	47.96325	48.38905	54.190047	7.533333
55.10959	46.81171	48.7906	47.9343	48.41227	54.226927	7.55
55.02447	46.93364	48.75595	48.00968	48.37192	54.280869	7.566667
55.07273	46.88716	48.7442	48.06756	48.4355	54.226927	7.583333
55.06134	46.91006	48.66344	47.91712	48.41798	54.348937	7.6
55.15215	46.86392	48.68634	47.9343	48.46404	54.337563	7.616667
55.08412	46.89288	48.70954	47.9747	48.39476	54.286557	7.633333
55.17192	46.94509	48.77885	47.99792	48.4294	54.360312	7.65
55.10959	46.8235	48.75565	48.02686	48.5219	54.323435	7.666667
55.03017	46.97405	48.62276	48.03259	48.48156	54.181606	7.683333
55.07842	46.89861	48.69207	47.99792	48.36543	54.309312	7.7
55.12668	46.78274	48.84243	47.98043	48.44082	54.218486	7.716667
55.04726	46.91579	48.80205	47.95722	48.49907	54.286557	7.733333

A.1 Temperature measurement for the slab without embedded pipe (continued)

T1	T2	T3	T4	T5	T6	Time(h)
55.06134	46.97978	48.81923	48.00365	48.52761	54.300685	7.766667
55.07273	46.86964	48.77885	47.9747	48.51049	54.42269	7.783333
54.98761	47.0431	48.77885	48.00365	48.49337	54.391501	7.8
55.04726	46.96227	48.72672	48.10193	48.48156	54.292245	7.816667
55.21179	46.93903	48.7671	48.13087	48.46404	54.24399	7.833333
55.12098	47.01987	48.75565	48.02686	48.53942	54.212798	7.85
55.18901	47.03738	48.88853	48.00365	48.528	54.181606	7.866667
55.12098	46.96799	48.81923	48.18875	48.56835	54.12766	7.883333
54.97923	46.94476	48.8599	48.10193	48.46975	54.255366	7.9
55.16923	46.89861	48.84815	48.09047	48.53332	54.334811	7.916667
55.01609	46.97372	48.7442	48.04405	48.52761	54.383066	7.933333
55.13807	47.00268	48.81923	48.11941	48.53332	54.323435	7.95
55.13807	47.00841	48.82525	48.09047	48.55654	54.261055	7.966667
55.13807	46.97372	48.82495	48.04405	48.53332	54.150414	7.983333
55.14377	47.06061	48.81923	48.0555	48.49259	54.383066	8
55.29121	47.08957	48.82495	48.0555	48.54474	54.309312	8.016667
55.05865	47.08957	48.84815	48.10193	48.53903	54.246934	8.033333
55.18063	47.02592	48.76138	48.09017	48.57367	54.326382	8.05
55.18633	47.08957	48.82495	48.0555	48.48117	54.371688	8.066667
55.17493	47.00268	48.84214	48.14232	48.56796	54.224175	8.083333
55.1947	47.11281	48.87708	48.16554	48.62582	54.297933	8.1
55.11528	47.08957	48.8367	48.12484	48.59728	54.371688	8.116667
55.22017	47.07239	48.83097	48.15981	48.53371	54.261055	8.133333
55.21179	47.08957	48.84243	48.18272	48.56835	54.218486	8.15
55.18331	47.00268	48.85388	48.15408	48.57977	54.08234	8.166667
55.14645	47.08957	48.8828	48.2002	48.62621	54.224175	8.183333
55.33644	47.14177	48.91173	48.17699	48.6087	54.266744	8.2
55.30528	47.07812	48.94638	48.20593	48.69548	54.241244	8.216667
55.17493	47.12999	48.8828	48.17699	48.65475	54.326382	8.233333
55.21749	47.12426	48.90571	48.13057	48.64904	54.383066	8.25
55.25435	47.23438	48.88853	48.15981	48.72441	54.309312	8.266667
55.16923	47.13572	48.87135	48.15981	48.65514	54.309312	8.283333
55.23726	47.06634	48.94065	48.11339	48.64943	54.113532	8.3
55.17493	47.08957	48.88853	48.17126	48.6087	54.229865	8.316667
55.05865	47.16468	48.84815	48.15378	48.64333	54.130602	8.333333
55.18331	47.19937	48.94638	48.22914	48.67226	54.289504	8.35
55.17762	47.15895	48.94065	48.25235	48.65475	54.320691	8.366667
55.23425	47.23438	48.94638	48.25235	48.74192	54.278123	8.383333

A.1 Temperature measurement for the slab without embedded pipe (continued)

T1	T2	T3	T4	T5	T6	Time(h)
55.25703	47.165	48.95239	48.21768	48.67836	54.212798	8.416667
55.24564	47.18218	48.94667	48.22914	48.67265	54.173174	8.433333
55.39876	47.15928	48.93492	48.24662	48.74192	54.198674	8.45
55.20309	47.12459	48.99277	48.17729	48.65514	54.246934	8.466667
55.11798	47.24616	48.92347	48.28129	48.63192	54.289504	8.483333
55.26272	47.15928	48.89455	48.33343	48.68407	54.261055	8.5
55.31936	47.165	48.93492	48.18875	48.77085	54.297933	8.516667
55.23425	47.12459	48.98704	48.21768	48.7248	54.124912	8.533333
55.23425	47.24616	48.98704	48.18302	48.75944	54.224175	8.55
55.24564	47.17679	48.9292	48.3045	48.74192	54.218486	8.566667
55.26542	47.14783	48.94667	48.14835	48.77695	54.212798	8.583333
55.25972	47.14783	48.99277	48.25235	48.71339	54.139036	8.6
55.24564	47.17106	49.07953	48.2641	48.74802	54.238302	8.616667
55.25703	47.12459	48.98704	48.24662	48.74192	54.195734	8.633333
55.31667	47.23471	49.06808	48.27556	48.74802	54.255366	8.65
55.1947	47.25761	49.04488	48.22341	48.78836	54.218486	8.666667
55.21749	47.18824	48.96385	48.33916	48.77085	54.292245	8.683333
55.16354	47.17073	48.91173	48.27556	48.73622	54.241244	8.7
55.16354	47.26906	48.98132	48.22341	48.68407	54.229865	8.716667
55.32237	47.22292	48.99277	48.26381	48.74192	54.150414	8.733333
55.31667	47.21114	48.99277	48.31625	48.75334	54.309312	8.75
55.28551	47.19969	48.95239	48.33916	48.82261	54.184556	8.766667
55.35353	47.19969	49.06206	48.40848	48.77046	54.252625	8.783333
55.35922	47.24583	49.05061	48.33916	48.8051	54.184556	8.8
55.17493	47.25728	49.05061	48.31022	48.75905	54.295194	8.816667
55.41585	47.32125	49.07953	48.37955	48.78836	54.283813	8.833333
55.33644	47.25188	49.03314	48.36809	48.79368	54.173174	8.85
55.29958	47.31552	49.11418	48.36237	48.75334	54.235554	8.866667
55.36191	47.23438	48.9753	48.3045	48.85763	54.315001	8.883333
55.26842	47.28657	49.06206	48.36809	48.8169	54.334811	8.9
55.34783	47.33843	49.07953	48.35634	48.86904	54.400135	8.916667
55.24865	47.36166	49.03916	48.28702	48.82261	54.320691	8.933333
55.27981	47.35593	49.14309	48.34489	48.8169	54.315001	8.95
55.43863	47.35593	49.06206	48.35634	48.79978	54.351879	8.966667
55.35353	47.43707	48.99277	48.40848	48.83402	54.309312	8.983333
55.51234	47.43135	49.06779	48.42596	48.86333	54.292245	9
55.34214	47.43707	49.10272	48.39703	48.90406	54.371688	9.016667
55.3676	47.21147	49.10845	48.3277	48.92157	54.255366	9.033333

A.1 Temperature measurement for the slab without embedded pipe (continued)

T1	T2	T3	T4	T5	T6	Time(h)
55.42154	47.36771	49.08526	48.40276	48.87514	54.397189	9.066667
55.34214	47.30407	49.097	48.3913	48.90406	54.278123	9.083333
55.34214	47.37344	49.097	48.44917	48.90977	54.272433	9.1
55.33644	47.39634	49.06808	48.40878	48.85763	54.252625	9.116667
55.46678	47.30407	49.097	48.3913	48.97332	54.351879	9.133333
55.33074	47.44313	49.12592	48.46062	48.82261	54.184556	9.15

A.2 Temperature measurement for the slab with embedded pipe

T1	T2	T3	T4	T5	T6	T7(Air)	T8	T9	T10	Time(h)
36.884	34.472	39.603	37.803	38.499	32.773	48.234	34.315	41.477	37.748	0.000
36.895	34.414	39.714	37.931	38.580	32.808	48.135	34.420	41.477	37.748	0.031
37.082	34.607	39.894	37.937	38.598	32.937	48.280	34.472	41.477	37.748	0.047
37.083	34.735	39.941	37.978	38.697	33.031	48.274	34.566	42.072	38.253	0.064
37.235	34.636	39.900	38.153	38.831	33.101	48.158	34.525	41.979	38.253	0.081
37.159	34.712	39.865	38.177	38.796	33.189	48.396	34.566	41.979	38.160	0.097
37.154	34.800	39.976	38.229	38.866	33.271	48.436	34.654	41.979	38.160	0.114
37.201	34.736	40.110	38.206	38.878	33.277	48.425	34.788	41.979	38.160	0.131
37.212	34.847	40.052	38.281	38.989	33.324	48.460	34.800	41.979	38.160	0.147
37.271	34.917	40.238	38.282	39.001	33.506	48.326	34.794	41.979	38.160	0.164
37.271	34.911	40.191	38.293	38.960	33.471	48.413	34.894	41.885	38.160	0.181
37.370	35.022	40.162	38.386	39.071	33.476	48.419	34.911	41.885	38.160	0.197
37.334	34.946	40.168	38.375	39.129	33.564	48.344	34.952	41.979	38.757	0.214
37.410	34.970	40.290	38.538	39.169	33.582	48.442	34.981	41.979	38.757	0.231
37.409	35.133	40.290	38.544	39.216	33.669	48.471	34.981	41.979	38.757	0.247
37.438	35.133	40.308	38.637	39.286	33.716	48.540	35.005	41.979	38.757	0.264
37.490	35.098	40.343	38.584	39.286	33.740	48.540	35.110	41.979	38.757	0.281
37.525	35.197	40.558	38.579	39.251	33.751	48.523	35.157	41.979	38.850	0.297
37.630	35.326	40.505	38.730	39.373	33.850	48.592	35.074	41.979	38.757	0.314
37.566	35.326	40.494	38.789	39.385	33.798	48.592	35.162	42.667	38.757	0.331
37.723	35.215	40.470	38.771	39.355	33.880	48.563	35.261	42.667	38.850	0.347
37.600	35.343	40.558	38.730	39.466	33.938	48.673	35.320	42.667	38.850	0.364
37.804	35.390	40.645	38.905	39.501	34.078	48.505	35.284	42.667	38.850	0.381
37.798	35.495	40.645	38.928	39.541	34.037	48.615	35.354	42.667	38.850	0.397
37.827	35.513	40.721	38.986	39.559	34.189	48.638	35.448	42.667	38.943	0.414
37.903	35.554	40.802	39.015	39.652	34.177	48.707	35.442	42.667	38.943	0.431
37.856	35.542	40.895	39.045	39.734	34.160	48.765	35.571	42.760	39.036	0.447
37.850	35.600	40.831	38.969	39.809	34.201	48.707	35.483	42.760	39.036	0.464
37.977	35.705	40.884	39.108	39.786	34.305	48.702	35.553	42.760	39.036	0.481
38.041	35.635	40.971	39.219	39.750	34.335	48.730	35.623	42.760	39.129	0.497
38.059	35.758	40.959	39.108	39.861	34.323	48.788	35.734	42.760	39.036	0.514
38.141	35.775	40.953	39.277	39.884	34.358	48.753	35.669	42.760	39.036	0.531
38.106	35.851	41.000	39.231	39.960	34.499	48.811	35.816	42.854	39.036	0.547
38.386	35.916	41.046	39.388	39.954	34.668	48.863	35.891	42.760	39.632	0.564
38.317	35.851	41.157	39.400	40.007	34.651	48.887	35.938	42.760	39.632	0.581
38.452	35.957	41.204	39.516	40.048	34.698	48.869	35.956	42.760	39.632	0.597
38.342	36.015	41.221	39.476	40.042	34.727	48.887	35.973	42.760	39.632	0.614
38.301	36.033	41.239	39.499	40.129	34.739	48.956	35.909	43.355	39.632	0.631
38.283	36.044	41.198	39.487	40.187	34.768	48.962	35.944	42.760	39.632	0.647

A.2 Temperature measurement for the slab with embedded pipe (continued)

T1	T2	T3	T4	T5	T6	T7(Air)	T8	T9	T10	Time(h)
38.475	36.068	41.273	39.575	40.123	34.809	48.933	36.055	42.854	39.725	0.664
38.422	36.033	41.378	39.563	40.193	34.867	49.008	36.131	42.854	39.725	0.681
38.376	36.185	41.268	39.656	40.251	34.925	48.979	36.142	42.854	39.725	0.697
38.369	36.179	41.384	39.772	40.193	34.920	49.060	36.090	42.854	39.725	0.714
38.550	36.278	41.396	39.767	40.298	35.013	49.048	36.300	42.948	39.725	0.731
38.620	36.360	41.460	39.831	40.368	35.078	49.123	36.230	43.542	39.725	0.747
38.784	36.319	41.465	39.848	40.391	35.200	49.048	36.288	43.449	39.725	0.764
38.621	36.442	41.553	39.965	40.362	35.171	49.164	36.335	43.542	39.725	0.781
38.732	36.395	41.553	39.959	40.519	35.206	49.164	36.323	43.542	39.725	0.797
38.761	36.418	41.617	39.936	40.542	35.259	49.216	36.452	43.449	39.725	0.814
38.749	36.500	41.739	39.947	40.583	35.300	49.222	36.382	43.542	39.725	0.831
38.848	36.541	41.669	40.069	40.688	35.288	49.135	36.440	43.542	39.818	0.847
38.953	36.535	41.832	40.046	40.688	35.411	49.268	36.563	43.542	39.818	0.864
38.902	36.617	41.843	40.110	40.711	35.428	49.378	36.592	43.542	39.725	0.881
38.866	36.640	41.663	40.186	40.653	35.434	49.332	36.568	43.542	39.818	0.897
38.883	36.704	41.791	40.128	40.729	35.633	49.337	36.598	43.542	39.818	0.914
38.999	36.792	41.867	40.151	40.740	35.557	49.349	36.703	43.542	39.818	0.931
38.999	36.780	41.826	40.244	40.874	35.597	49.355	36.720	43.542	39.818	0.947
39.046	36.716	41.867	40.244	40.839	35.738	49.279	36.743	44.137	39.818	0.964
39.086	36.838	41.995	40.238	40.857	35.656	49.418	36.825	43.542	39.818	0.981
39.192	36.827	41.983	40.326	40.880	35.796	49.274	36.854	43.542	39.911	0.997
39.162	36.926	41.995	40.378	40.926	35.813	49.435	36.901	43.542	40.508	1.014
39.168	36.926	42.076	40.454	40.897	35.796	49.291	36.866	43.542	40.508	1.031
39.196	36.856	42.070	40.343	41.025	35.801	49.314	36.959	43.542	40.508	1.047
39.225	37.031	42.076	40.500	41.031	35.942	49.401	36.901	43.542	40.508	1.064
39.213	37.084	42.070	40.471	41.025	35.854	49.435	37.023	44.137	40.508	1.081
39.301	37.130	42.175	40.582	41.048	36.047	49.383	37.082	44.137	40.414	1.097
39.359	37.113	42.215	40.587	41.031	36.082	49.441	37.088	43.542	40.414	1.114
39.417	37.142	42.233	40.576	41.200	36.100	49.435	37.134	44.137	40.414	1.131
39.470	37.177	42.198	40.622	41.264	36.041	49.493	37.111	44.230	40.414	1.147
39.476	37.171	42.274	40.599	41.205	36.170	49.441	37.128	44.230	40.414	1.164
39.412	37.264	42.215	40.715	41.165	36.123	49.470	37.163	44.230	40.414	1.181
39.522	37.299	42.274	40.744	41.258	36.228	49.499	37.227	44.230	40.414	1.197
39.511	37.282	42.361	40.814	41.275	36.310	49.551	37.227	44.230	41.010	1.214
39.563	37.334	42.320	40.750	41.426	36.269	49.568	37.257	44.137	40.414	1.231
39.539	37.416	42.436	40.785	41.386	36.339	49.504	37.356	44.230	40.414	1.247
39.656	37.387	42.454	40.896	41.415	36.450	49.487	37.461	44.230	40.414	1.264
39.639	37.416	42.425	40.867	41.380	36.444	49.516	37.461	44.230	40.414	1.281
39.691	37.527	42.465	40.861	41.415	36.438	49.585	37.414	44.230	41.010	1.297

A.2 Temperature measurement for the slab with embedded pipe (continued)

T1	T2	T3	T4	T5	T6	T7(Air)	T8	T9	T10	Time(h)
39.744	37.539	42.494	40.890	41.542	36.496	49.568	37.484	44.137	41.010	1.314
39.726	37.591	42.512	40.983	41.484	36.508	49.736	37.525	44.230	41.010	1.331
39.721	37.591	42.587	41.053	41.444	36.578	49.678	37.565	44.230	41.010	1.347
39.761	37.562	42.611	41.035	41.601	36.578	49.753	37.601	44.230	41.010	1.364
39.872	37.650	42.657	41.053	41.606	36.625	49.730	37.653	44.230	41.010	1.381
39.883	37.778	42.686	41.157	41.606	36.712	49.782	37.577	44.230	41.103	1.397
39.994	37.708	42.669	41.111	41.705	36.695	49.678	37.682	44.230	41.010	1.414
39.947	37.719	42.756	41.152	41.723	36.776	49.614	37.770	44.824	41.010	1.431
40.098	37.935	42.797	41.285	41.763	36.846	49.643	37.793	44.824	41.010	1.447
40.221	38.040	42.808	41.297	41.664	36.893	49.724	37.799	44.731	41.010	1.464
40.297	37.982	42.843	41.338	41.746	36.910	49.649	37.903	44.137	41.010	1.481
40.164	38.023	42.895	41.303	41.740	36.928	49.764	37.898	44.731	41.010	1.497
40.164	38.000	42.913	41.338	41.792	36.957	49.591	37.985	44.824	41.513	1.514
40.130	38.035	42.942	41.268	41.833	36.981	49.707	37.904	44.731	41.513	1.531
40.181	37.994	42.826	41.425	41.868	36.957	49.701	37.991	44.731	40.917	1.547
40.059	38.017	42.861	41.396	41.856	37.086	49.851	37.956	44.731	41.513	1.564
40.082	38.058	42.988	41.425	41.984	37.057	49.839	38.009	44.731	41.010	1.581
40.186	38.157	42.977	41.495	41.990	37.127	49.805	38.073	44.731	41.606	1.597
40.267	38.134	42.919	41.524	42.031	37.231	49.839	38.038	44.731	41.513	1.614
40.308	38.192	42.977	41.524	41.862	37.185	49.759	38.119	44.731	41.606	1.631
40.325	38.192	42.965	41.541	42.002	37.383	49.764	38.259	44.731	41.513	1.647
40.500	38.250	43.099	41.629	42.077	37.337	49.840	38.289	44.731	41.513	1.664
40.373	38.349	43.157	41.658	42.043	37.436	49.805	38.289	44.731	41.606	1.681
40.419	38.320	43.209	41.623	42.089	37.325	49.811	38.219	44.731	41.513	1.697
40.530	38.384	43.145	41.786	42.188	37.413	49.857	38.248	44.731	41.513	1.714
40.577	38.495	43.238	41.681	42.211	37.483	49.955	38.359	45.324	41.606	1.731
40.741	38.559	43.354	41.803	42.252	37.576	49.967	38.464	44.731	41.606	1.747
40.660	38.554	43.267	41.949	42.159	37.512	49.903	38.493	44.731	41.606	1.764
40.759	38.548	43.314	41.891	42.159	37.542	49.903	38.499	45.324	41.513	1.781
40.631	38.501	43.296	41.827	42.287	37.600	49.955	38.435	44.731	41.513	1.797
40.642	38.647	43.325	41.914	42.200	37.699	50.013	38.551	44.731	41.513	1.814
40.561	38.519	43.383	41.827	42.322	37.647	49.967	38.522	45.324	41.606	1.831
40.758	38.548	43.395	41.768	42.322	37.682	49.932	38.511	44.731	41.606	1.847
40.724	38.583	43.465	41.896	42.339	37.728	49.967	38.586	45.324	41.606	1.864
40.857	38.629	43.453	41.885	42.368	37.722	50.059	38.592	45.418	41.606	1.881
40.887	38.740	43.465	42.036	42.467	37.851	50.140	38.679	45.324	41.606	1.897
40.824	38.734	43.488	42.065	42.450	37.758	50.152	38.738	45.324	41.606	1.914
40.893	38.839	43.534	42.013	42.409	37.944	50.192	38.738	45.418	42.201	1.931
40.923	38.816	43.424	42.042	42.520	37.793	50.129	38.790	45.324	42.201	1.947

A.2 Temperature measurement for the slab with embedded pipe (continued)

T1	T2	T3	T4	T5	T6	T7(Air)	T8	T9	T10	Time(h)
40.836	38.752	43.517	42.059	42.462	38.003	50.013	38.790	45.324	42.201	1.964
40.911	38.863	43.581	42.123	42.531	37.985	50.152	38.796	45.324	42.201	1.981
41.051	38.857	43.581	42.181	42.578	37.968	50.181	38.784	45.324	42.201	1.997
40.934	38.805	43.575	42.175	42.584	38.026	50.256	38.814	45.418	42.108	2.014
40.981	38.880	43.598	42.181	42.589	38.032	50.129	38.866	45.418	42.201	2.031
40.980	38.991	43.645	42.234	42.607	38.096	50.146	38.907	45.324	42.201	2.047
41.020	39.061	43.674	42.292	42.671	38.177	50.146	38.959	45.324	42.201	2.064
41.020	38.956	43.714	42.228	42.740	38.125	50.175	38.913	45.324	42.108	2.081
41.031	38.997	43.796	42.315	42.682	38.224	50.186	39.041	45.324	42.201	2.097
41.083	39.055	43.685	42.303	42.781	38.247	50.204	39.087	45.324	42.201	2.114
41.113	39.102	43.720	42.280	42.746	38.183	50.215	39.064	45.918	42.201	2.131
41.171	39.125	43.784	42.396	42.764	38.305	50.296	39.105	45.324	42.201	2.147
41.136	39.142	43.854	42.414	42.862	38.352	50.175	39.157	45.324	42.201	2.164
41.136	39.195	43.825	42.472	42.787	38.364	50.291	39.175	45.918	42.108	2.181
41.165	39.148	43.842	42.466	42.868	38.335	50.273	39.250	45.324	42.201	2.197
41.222	39.171	43.923	42.483	42.903	38.439	50.319	39.215	45.418	42.201	2.214
41.222	39.189	43.877	42.559	42.949	38.387	50.285	39.256	45.918	42.201	2.231
41.344	39.340	44.005	42.547	42.978	38.445	50.400	39.256	46.011	42.796	2.247
41.309	39.335	43.958	42.547	42.903	38.492	50.314	39.326	45.918	42.704	2.264
41.355	39.381	43.906	42.559	42.949	38.515	50.337	39.326	45.918	42.704	2.281
41.512	39.451	44.057	42.576	43.019	38.579	50.354	39.349	45.918	42.611	2.297
41.361	39.503	44.080	42.611	43.065	38.654	50.348	39.378	45.918	42.704	2.314
41.407	39.434	44.127	42.710	42.949	38.660	50.377	39.390	45.918	42.704	2.331
41.472	39.457	44.098	42.733	43.083	38.678	50.510	39.349	45.918	42.704	2.347
41.536	39.579	44.208	42.844	43.048	38.742	50.446	39.483	45.918	42.704	2.364
41.560	39.585	44.063	42.797	43.135	38.760	50.440	39.565	45.918	42.704	2.381
41.583	39.591	44.202	42.785	43.211	38.737	50.498	39.565	46.011	42.796	2.397
41.682	39.672	44.278	42.849	43.274	38.871	50.556	39.623	45.918	42.796	2.414
41.683	39.637	44.289	42.873	43.309	38.935	50.469	39.623	46.011	42.796	2.431
41.677	39.643	44.318	42.896	43.158	38.935	50.539	39.658	46.011	42.796	2.447
41.595	39.620	44.283	42.838	43.298	38.935	50.568	39.728	46.011	42.796	2.464
41.659	39.748	44.324	42.873	43.286	39.022	50.579	39.699	45.918	42.796	2.481
41.764	39.777	44.365	43.105	43.315	39.040	50.521	39.693	46.011	42.796	2.497
41.828	39.806	44.411	42.931	43.379	39.051	50.487	39.786	46.011	42.796	2.514
41.863	39.882	44.388	43.035	43.414	39.046	50.446	39.757	46.011	42.796	2.531
41.840	39.853	44.440	43.041	43.431	39.063	50.510	39.809	46.011	42.796	2.547
41.858	39.853	44.336	43.105	43.501	39.051	50.579	39.774	46.011	42.796	2.564
41.974	39.975	44.510	43.105	43.489	39.081	50.573	39.891	46.011	42.796	2.581
41.963	40.034	44.452	43.175	43.402	39.191	50.562	39.967	46.011	42.796	2.597

A.2 Temperature measurement for the slab with embedded pipe (continued)

T1	T2	T3	T4	T5	T6	T7(Air)	T8	T9	T10	Time(h)
41.904	39.871	44.423	43.111	43.484	39.145	50.620	39.879	46.011	42.796	2.614
41.881	39.946	44.446	43.123	43.548	39.168	50.597	39.885	46.011	42.796	2.631
41.957	40.028	44.533	43.221	43.501	39.226	50.556	39.967	46.011	42.796	2.647
41.986	40.191	44.562	43.163	43.548	39.273	50.579	39.955	46.011	42.889	2.664
41.980	40.109	44.527	43.291	43.513	39.343	50.706	40.013	46.011	42.889	2.681
42.154	40.133	44.684	43.245	43.594	39.395	50.637	40.048	46.011	42.796	2.697
42.067	40.092	44.556	43.216	43.547	39.307	50.492	40.048	46.011	42.889	2.714
42.130	40.127	44.550	43.198	43.721	39.360	50.643	40.019	46.011	42.889	2.731
42.129	40.138	44.608	43.285	43.716	39.395	50.602	40.205	46.011	42.889	2.747
42.135	40.167	44.585	43.326	43.611	39.476	50.631	40.182	46.011	42.889	2.764
42.065	40.266	44.661	43.349	43.652	39.499	50.625	40.298	46.698	43.484	2.781
42.176	40.296	44.690	43.343	43.710	39.569	50.666	40.199	46.698	42.889	2.797
42.123	40.371	44.753	43.419	43.762	39.453	50.735	40.287	46.698	43.484	2.814
42.251	40.278	44.719	43.372	43.745	39.546	50.631	40.321	46.698	43.484	2.831
42.221	40.400	44.730	43.413	43.716	39.616	50.631	40.333	46.605	43.391	2.847
42.414	40.499	44.806	43.500	43.779	39.633	50.770	40.356	46.698	43.391	2.864
42.368	40.546	44.870	43.517	43.768	39.634	50.764	40.379	46.605	43.391	2.881
42.339	40.476	44.753	43.523	43.768	39.733	50.718	40.327	46.605	43.391	2.897
42.333	40.424	44.887	43.506	43.838	39.663	50.723	40.339	46.698	43.391	2.914
42.345	40.464	44.846	43.448	43.913	39.721	50.770	40.415	46.605	43.391	2.931
42.286	40.482	44.939	43.517	43.832	39.686	50.683	40.484	46.698	43.391	2.947
42.326	40.523	44.899	43.529	43.965	39.796	50.746	40.444	46.698	43.391	2.964
42.302	40.511	44.870	43.535	43.948	39.761	50.700	40.525	46.605	43.391	2.981
42.342	40.557	44.875	43.558	44.011	39.779	50.740	40.473	46.698	43.391	2.997
42.399	40.592	44.933	43.726	43.994	39.866	50.752	40.484	46.698	43.484	3.014
42.341	40.587	44.899	43.709	43.976	39.912	50.712	40.572	46.698	43.484	3.031
42.457	40.645	45.015	43.662	44.029	39.860	50.717	40.507	46.605	43.484	3.047
42.358	40.732	45.009	43.773	44.034	39.918	50.792	40.624	46.698	43.484	3.064
42.497	40.738	44.951	43.633	44.029	39.953	50.717	40.618	46.698	43.484	3.081
42.520	40.779	45.026	43.668	44.040	40.046	50.804	40.676	46.698	43.484	3.097
42.665	40.761	45.026	43.813	44.098	40.005	50.827	40.717	46.605	43.484	3.114
42.765	40.936	45.067	43.749	44.156	40.035	50.833	40.752	46.698	43.484	3.131
42.759	40.843	45.084	43.796	44.139	40.052	50.792	40.758	46.605	43.484	3.147
43.062	41.035	45.218	43.982	44.174	40.163	50.821	40.886	47.104	43.577	3.164
43.232	41.145	45.334	43.982	44.319	40.117	50.896	40.770	46.918	43.577	3.181
43.270	41.320	45.490	44.115	44.279	40.280	50.931	40.828	46.918	43.577	3.197
43.098	41.267	45.345	44.104	44.325	40.222	50.966	40.956	46.918	43.484	3.214
42.982	41.122	45.293	44.011	44.320	40.245	51.024	40.927	46.918	43.484	3.231
42.824	40.983	45.281	43.965	44.331	40.280	50.798	41.055	47.011	43.484	3.247

A.2 Temperature measurement for the slab with embedded pipe (continued)

T1	T2	T3	T4	T5	T6	T7(Air)	T8	T9	T10	Time(h)
42.718	41.169	45.270	44.023	44.267	40.292	50.920	40.939	47.011	43.484	3.264
42.769	41.076	45.299	43.959	44.348	40.332	50.856	40.968	47.104	44.078	3.281
42.728	41.041	45.281	43.999	44.383	40.315	50.799	40.974	47.104	43.484	3.297
42.808	41.058	45.200	44.156	44.314	40.414	50.810	41.026	47.104	44.078	3.314
42.959	41.087	45.281	44.063	44.372	40.367	50.897	40.974	47.104	43.985	3.331
42.848	41.099	45.380	43.959	44.429	40.396	50.833	41.102	47.104	43.985	3.347
42.888	41.145	45.235	44.168	44.372	40.396	50.793	41.108	47.104	43.985	3.364
42.888	41.116	45.287	44.173	44.366	40.483	50.862	41.113	47.104	44.078	3.381
42.841	41.238	45.316	44.162	44.418	40.582	50.752	41.055	47.104	43.985	3.397
42.881	41.221	45.374	44.133	44.412	40.472	50.723	41.079	47.011	43.985	3.414
42.806	41.186	45.270	44.057	44.435	40.472	50.810	41.113	47.104	43.985	3.431
42.974	41.250	45.374	44.185	44.424	40.570	50.862	41.294	47.104	43.985	3.447
42.934	41.331	45.368	44.220	44.435	40.605	50.810	41.282	47.104	43.985	3.464
43.038	41.337	45.427	44.162	44.505	40.646	50.781	41.253	47.104	43.985	3.481
43.218	41.384	45.508	44.197	44.505	40.652	50.781	41.317	47.104	43.985	3.497
43.370	41.576	45.455	44.272	44.534	40.710	50.827	41.311	47.104	43.985	3.514
43.516	41.640	45.612	44.400	44.569	40.769	50.874	41.306	47.104	43.985	3.531
43.408	41.605	45.606	44.371	44.557	40.787	50.949	41.480	47.104	43.985	3.547
43.205	41.518	45.467	44.249	44.552	40.746	50.931	41.416	47.104	43.985	3.564
43.210	41.518	45.537	44.377	44.610	40.810	51.012	41.457	47.104	44.487	3.581
43.180	41.616	45.589	44.469	44.668	40.880	50.845	41.515	47.104	44.394	3.597
43.203	41.582	45.577	44.377	44.662	40.781	50.943	41.486	47.011	44.394	3.614
43.162	41.616	45.531	44.330	44.517	40.827	50.787	41.439	47.011	43.800	3.631
43.220	41.599	45.560	44.342	44.691	40.862	50.949	41.451	47.104	44.394	3.647
43.278	41.541	45.600	44.342	44.679	40.908	50.862	41.498	47.604	44.302	3.664
43.259	41.616	45.583	44.411	44.789	40.960	50.827	41.562	47.011	44.302	3.681
43.253	41.657	45.589	44.394	44.720	41.065	50.804	41.463	47.011	44.394	3.697
43.300	41.616	45.595	44.458	44.830	40.955	50.827	41.526	47.011	44.394	3.714
43.317	41.744	45.647	44.481	44.772	41.013	50.839	41.631	47.011	44.302	3.731
43.398	41.692	45.664	44.458	44.795	41.065	50.850	41.631	47.011	44.302	3.747
43.323	41.750	45.624	44.481	44.760	41.013	50.856	41.672	47.011	44.394	3.764
43.357	41.715	45.699	44.469	44.754	41.024	50.862	41.689	47.011	44.394	3.781
43.299	41.837	45.653	44.527	44.801	41.117	50.983	41.602	47.011	44.394	3.797
43.421	41.733	45.728	44.469	44.777	41.082	50.868	41.701	47.604	44.394	3.814
43.496	41.867	45.705	44.545	44.789	41.106	50.792	41.706	47.011	44.394	3.831
43.514	41.744	45.757	44.556	44.824	41.117	50.798	41.712	47.011	44.394	3.847
43.467	41.884	45.664	44.574	44.777	41.181	50.868	41.869	47.011	44.487	3.864
43.444	41.931	45.786	44.719	44.934	41.274	50.873	41.840	47.011	44.487	3.881
43.607	41.983	45.740	44.614	44.864	41.205	50.914	41.834	47.104	44.487	3.897

A.2 Temperature measurement for the slab with embedded pipe (continued)

T1	T2	T3	T4	T5	T6	T7(Air)	T8	T9	T10	Time(h)
43.759	42.000	45.740	44.556	44.934	41.240	51.000	41.869	47.104	44.487	3.914
43.585	41.832	45.925	44.672	44.922	41.292	50.885	41.881	47.104	44.487	3.931
43.550	41.936	45.954	44.690	44.963	41.403	50.972	41.974	47.104	44.487	3.947
43.533	41.994	45.838	44.771	44.905	41.321	50.914	41.927	47.104	44.580	3.964
43.568	41.983	45.844	44.730	44.928	41.321	50.983	41.945	47.104	44.487	3.981
43.579	42.018	45.827	44.614	44.928	41.368	50.966	41.922	47.104	44.580	3.997
43.544	42.064	45.873	44.696	45.015	41.333	51.035	41.962	47.198	44.580	4.014
43.556	42.035	45.879	44.649	44.980	41.461	50.868	42.021	47.104	44.580	4.031
43.514	42.047	45.850	44.771	44.975	41.449	50.879	41.922	47.198	44.672	4.047
43.630	42.018	45.896	44.725	44.986	41.490	50.920	42.096	47.198	44.672	4.064
43.607	42.047	45.925	44.788	45.067	41.426	50.977	42.026	47.198	44.672	4.081
43.601	42.041	45.920	44.812	45.015	41.554	50.873	42.015	47.198	44.672	4.097
43.647	42.175	45.925	44.806	45.096	41.484	51.006	42.044	47.198	44.765	4.114
43.624	42.117	45.960	44.806	45.021	41.548	50.966	42.137	47.198	44.765	4.131
43.595	42.169	45.983	44.841	45.102	41.554	51.058	42.189	47.291	44.765	4.147
43.595	42.210	45.931	44.794	45.096	41.623	51.064	42.143	47.291	44.765	4.164
43.792	42.245	46.059	44.800	45.096	41.606	51.104	42.172	47.198	44.765	4.181
43.705	42.215	45.954	44.788	45.027	41.658	50.995	42.207	47.291	44.765	4.197
43.734	42.221	46.030	44.864	45.131	41.705	51.087	42.329	47.291	44.765	4.214
43.774	42.250	46.140	44.899	45.178	41.670	51.174	42.259	47.291	44.765	4.231
43.739	42.280	46.036	44.951	45.207	41.664	51.139	42.189	47.291	44.765	4.247
43.821	42.343	46.123	44.893	45.201	41.653	51.047	42.329	47.291	44.672	4.264
43.792	42.274	46.094	44.986	45.125	41.740	51.110	42.311	47.291	44.672	4.281
43.873	42.320	46.152	44.904	45.206	41.763	51.139	42.247	47.884	44.765	4.297
43.867	42.384	46.076	44.991	45.270	41.821	51.110	42.346	47.291	44.765	4.314
43.826	42.402	46.047	45.003	45.195	41.798	51.139	42.328	47.291	44.765	4.331
43.948	42.396	46.140	45.026	45.264	41.803	51.000	42.334	47.884	44.672	4.347
43.907	42.518	46.152	45.061	45.288	41.867	51.122	42.427	47.291	44.672	4.364
43.948	42.402	46.140	45.044	45.386	41.769	51.156	42.340	47.884	44.672	4.381
43.936	42.530	46.152	45.142	45.357	41.908	51.162	42.520	47.884	44.672	4.397
44.174	42.559	46.250	45.160	45.322	41.902	51.046	42.520	47.884	44.672	4.414
43.994	42.599	46.239	45.102	45.404	41.891	51.110	42.462	47.884	45.266	4.431
43.994	42.611	46.198	45.229	45.369	41.920	51.058	42.491	47.884	45.174	4.447
43.983	42.565	46.331	45.131	45.398	41.966	51.162	42.520	47.884	45.174	4.464
44.041	42.553	46.279	45.212	45.444	41.966	51.098	42.613	47.790	45.174	4.481
44.006	42.669	46.198	45.276	45.421	42.106	51.202	42.584	47.790	45.081	4.497
44.076	42.634	46.320	45.229	45.427	42.054	51.023	42.596	47.697	45.081	4.514
44.006	42.704	46.331	45.252	45.479	42.112	50.891	42.642	47.697	45.081	4.531
44.128	42.675	46.384	45.235	45.514	42.141	50.919	42.735	47.604	44.988	4.547

A.2 Temperature measurement for the slab with embedded pipe (continued)

T1	T2	T3	T4	T5	T6	T7(Air)	T8	T9	T10	Time(h)
44.134	42.727	46.331	45.270	45.479	42.164	50.792	42.706	47.604	44.988	4.564
44.151	42.745	46.349	45.264	45.589	42.193	50.729	42.736	47.510	44.988	4.581
44.145	42.826	46.372	45.299	45.560	42.193	50.654	42.794	47.510	45.081	4.597
44.192	42.826	46.378	45.328	45.543	42.344	50.469	42.829	47.510	45.081	4.614
44.197	42.896	46.343	45.357	45.531	42.333	50.377	42.829	47.417	45.081	4.631
44.192	42.896	46.285	45.328	45.578	42.257	50.342	42.771	47.417	44.487	4.647
44.186	42.820	46.244	45.258	45.502	42.222	50.226	42.818	47.417	44.487	4.664
44.140	42.849	46.291	45.212	45.612	42.304	50.169	42.853	47.417	44.487	4.681
44.227	42.884	46.325	45.276	45.450	42.379	50.082	42.864	46.825	44.580	4.697
44.209	42.849	46.256	45.194	45.537	42.397	50.094	42.882	47.417	45.174	4.714
44.198	42.948	46.314	45.276	45.508	42.397	50.001	42.975	47.324	44.487	4.731
44.239	42.989	46.256	45.235	45.537	42.484	50.001	42.975	47.324	45.081	4.747
44.210	43.111	46.238	45.293	45.485	42.513	49.961	42.952	47.324	44.988	4.764
44.280	42.977	46.308	45.316	45.451	42.519	49.822	43.022	47.324	44.988	4.781
44.245	43.128	46.169	45.293	45.451	42.479	49.759	42.970	47.324	44.896	4.797
44.193	43.052	46.169	45.264	45.393	42.426	49.736	42.981	46.732	44.896	4.814
44.297	43.041	46.082	45.293	45.375	42.426	49.747	42.889	46.732	44.896	4.831
44.176	43.017	46.064	45.195	45.352	42.485	49.661	42.976	47.232	44.804	4.847
44.274	42.971	46.070	45.183	45.352	42.485	49.689	42.993	47.232	44.804	4.864
44.170	43.052	46.105	45.183	45.306	42.525	49.562	42.975	47.232	44.804	4.881
44.088	43.052	46.076	45.311	45.439	42.491	49.661	42.975	47.232	44.711	4.897
44.199	43.041	46.059	45.154	45.387	42.514	49.545	43.045	47.232	44.711	4.914
44.135	42.948	46.024	45.137	45.312	42.491	49.516	42.952	47.232	44.711	4.931
44.094	43.105	46.030	45.224	45.341	42.549	49.447	42.935	47.232	44.711	4.947
44.175	43.046	46.012	45.073	45.317	42.432	49.371	42.940	46.639	44.711	4.964
44.111	43.052	45.925	45.160	45.195	42.543	49.487	42.935	47.139	44.711	4.981
44.210	43.070	46.030	45.079	45.294	42.514	49.406	43.080	47.139	44.711	4.997
44.216	43.250	46.122	45.154	45.306	42.647	49.452	43.068	47.139	44.711	5.014
44.239	43.139	46.064	45.206	45.358	42.752	49.447	42.998	47.139	44.711	5.031
44.204	43.227	46.058	45.201	45.352	42.682	49.447	43.144	46.546	44.711	5.047
44.222	43.151	45.960	45.143	45.404	42.642	49.447	43.155	47.139	44.711	5.064
44.199	43.087	46.047	45.137	45.352	42.653	49.360	43.173	47.139	44.711	5.081
44.106	43.215	45.954	45.166	45.259	42.636	49.348	43.045	47.046	44.619	5.097
44.152	43.215	45.983	45.160	45.225	42.694	49.308	43.144	47.139	44.619	5.114
44.210	43.110	45.989	45.079	45.172	42.671	49.239	43.121	46.453	44.619	5.131
44.053	43.186	45.890	45.166	45.283	42.665	49.285	43.127	47.046	44.619	5.147
44.169	43.122	46.006	45.218	45.271	42.717	49.348	43.074	47.046	44.619	5.164
44.123	43.215	45.896	45.137	45.387	42.700	49.377	43.103	47.046	44.619	5.181
44.181	43.145	45.879	45.143	45.283	42.758	49.279	43.092	47.046	44.527	5.197

A.2 Temperature measurement for the slab with embedded pipe (continued)

T1	T2	T3	T4	T5	T6	T7(Air)	T8	T9	T10	Time(h)
44.245	43.099	45.972	45.131	45.207	42.717	49.169	43.110	47.046	44.527	5.214
44.158	43.174	45.861	45.143	45.225	42.764	49.233	43.103	47.046	44.619	5.231
44.169	43.151	45.989	45.073	45.225	42.752	49.296	43.260	47.046	44.527	5.247
44.251	43.238	46.006	45.108	45.358	42.642	49.314	43.173	47.046	45.121	5.264
44.193	43.227	45.931	45.154	45.318	42.822	49.227	43.179	46.953	44.527	5.281
44.204	43.157	45.937	45.102	45.184	42.764	49.175	43.226	46.953	45.121	5.297
44.251	43.232	45.972	45.119	45.283	42.805	49.117	43.243	46.953	45.121	5.314
44.199	43.261	45.890	45.119	45.341	42.805	49.169	43.220	46.953	44.527	5.331
44.228	43.331	45.861	45.183	45.144	42.810	49.146	43.139	46.953	44.527	5.347
44.204	43.290	45.890	45.166	45.190	42.810	49.112	43.220	46.953	45.029	5.364
44.222	43.256	45.937	45.195	45.289	42.822	49.094	43.249	46.953	44.435	5.381
44.257	43.436	45.908	45.166	45.236	42.880	49.135	43.319	46.953	44.435	5.397
44.251	43.337	45.896	45.177	45.248	42.874	49.117	43.214	46.953	45.029	5.414
44.193	43.337	45.943	45.056	45.213	42.892	49.065	43.214	46.953	44.435	5.431
44.222	43.331	45.943	45.114	45.242	42.892	49.007	43.226	46.953	45.029	5.447
44.304	43.343	45.885	45.236	45.167	42.909	49.031	43.330	46.953	44.435	5.464
44.176	43.302	45.913	45.154	45.231	42.845	49.042	43.232	46.953	45.029	5.481
44.170	43.285	45.885	45.120	45.312	42.892	49.065	43.296	46.953	44.435	5.497
44.211	43.354	45.908	45.114	45.242	42.938	49.019	43.365	46.953	44.937	5.514
44.269	43.325	45.960	45.137	45.306	42.967	49.048	43.342	46.861	44.937	5.531
44.257	43.314	45.942	45.143	45.219	42.886	49.140	43.336	46.861	44.937	5.547
44.362	43.383	45.989	45.114	45.242	42.915	49.008	43.336	46.861	44.937	5.564
44.228	43.389	45.937	45.120	45.277	42.950	49.042	43.255	46.861	44.937	5.581
44.321	43.383	45.937	45.212	45.283	42.921	49.008	43.354	46.861	44.937	5.597
44.274	43.511	45.792	45.288	45.266	42.944	49.008	43.319	46.861	44.937	5.614
44.257	43.441	45.908	45.189	45.138	43.002	48.944	43.360	46.861	44.937	5.631
44.321	43.366	45.861	45.207	45.266	42.921	48.985	43.406	46.861	44.937	5.647
44.205	43.441	45.884	45.247	45.283	42.927	48.944	43.354	46.861	44.937	5.664
44.251	43.465	45.821	45.131	45.260	42.950	48.915	43.383	46.861	44.937	5.681
44.356	43.459	45.861	45.178	45.196	43.002	49.008	43.412	46.861	44.937	5.697
44.199	43.447	45.913	45.056	45.248	43.002	48.956	43.407	46.861	44.937	5.714
44.309	43.517	45.919	45.195	45.231	42.979	48.967	43.331	46.861	44.937	5.731
44.339	43.476	45.954	45.189	45.295	43.032	48.967	43.453	46.861	44.846	5.747
44.275	43.505	45.890	45.137	45.243	43.037	48.944	43.361	46.769	44.846	5.764
44.275	43.430	45.873	45.137	45.306	43.026	48.904	43.471	46.769	44.846	5.781
44.170	43.482	45.884	45.149	45.225	43.084	48.834	43.448	46.769	44.846	5.797
44.170	43.529	45.844	45.195	45.243	42.968	48.898	43.413	46.769	44.846	5.814
44.344	43.575	45.873	45.131	45.266	43.102	48.910	43.459	46.769	44.846	5.831
44.321	43.517	45.942	45.247	45.249	43.165	48.910	43.460	46.769	44.754	5.847

A.2 Temperature measurement for the slab with embedded pipe (continued)

T1	T2	T3	T4	T5	T6	T7(Air)	T8	T9	T10	Time(h)
44.298	43.523	45.815	45.166	45.243	43.067	48.956	43.524	46.769	44.846	5.864
44.240	43.575	45.838	45.236	45.202	43.108	48.921	43.454	46.769	44.846	5.881
44.263	43.581	45.838	45.230	45.255	43.032	48.945	43.466	46.769	44.846	5.897
44.321	43.581	45.937	45.207	45.237	43.201	48.916	43.536	46.769	44.846	5.914
44.397	43.523	45.954	45.230	45.284	43.154	48.916	43.495	46.676	44.754	5.931
44.322	43.604	46.035	45.335	45.319	43.160	49.009	43.426	46.676	44.754	5.947
44.357	43.627	46.006	45.329	45.255	43.172	48.910	43.600	46.676	44.754	5.964
44.438	43.720	45.983	45.271	45.301	43.195	48.853	43.484	46.676	44.754	5.981
44.317	43.657	45.919	45.207	45.296	43.120	48.963	43.472	46.676	44.754	5.997
44.311	43.662	45.896	45.219	45.267	43.120	48.963	43.530	47.269	44.754	6.014
44.346	43.558	45.948	45.161	45.307	43.242	48.847	43.542	46.676	44.754	6.031
44.294	43.575	45.931	45.260	45.278	43.184	48.997	43.490	47.269	44.662	6.047
44.427	43.610	45.989	45.161	45.255	43.213	48.864	43.577	46.676	44.662	6.064
44.328	43.645	45.873	45.190	45.191	43.172	48.835	43.577	46.676	44.662	6.081
44.305	43.680	45.873	45.190	45.278	43.109	48.853	43.426	46.676	44.662	6.097
44.363	43.622	45.914	45.260	45.244	43.155	48.841	43.577	46.584	44.662	6.114
44.392	43.715	45.902	45.347	45.238	43.277	48.859	43.559	46.584	44.662	6.131
44.346	43.622	45.867	45.271	45.238	43.190	48.922	43.600	46.676	44.662	6.147
44.392	43.610	45.954	45.190	45.342	43.202	48.882	43.664	46.584	45.256	6.164
44.456	43.697	45.896	45.312	45.371	43.225	48.992	43.542	47.177	44.571	6.181
44.381	43.691	45.977	45.294	45.261	43.271	48.957	43.617	47.177	45.165	6.197
44.439	43.639	46.035	45.207	45.313	43.289	48.847	43.693	47.177	45.165	6.214
44.416	43.651	46.035	45.242	45.342	43.318	48.818	43.612	46.584	45.165	6.231
44.473	43.662	45.867	45.231	45.348	43.323	48.807	43.635	46.584	44.571	6.247
44.433	43.691	45.977	45.242	45.273	43.405	48.945	43.722	46.584	45.165	6.264
44.386	43.796	45.937	45.294	45.383	43.335	48.836	43.641	46.584	44.571	6.281
44.323	43.686	45.960	45.283	45.348	43.318	48.922	43.740	47.177	45.073	6.297
44.451	43.732	46.053	45.347	45.366	43.365	48.813	43.769	46.584	44.571	6.314
44.404	43.802	45.954	45.382	45.261	43.411	48.905	43.712	46.584	45.165	6.331
44.369	43.657	45.879	45.347	45.343	43.405	48.836	43.764	46.492	45.165	6.347
44.404	43.709	45.937	45.248	45.348	43.336	48.859	43.683	47.085	45.165	6.364
44.381	43.808	45.972	45.422	45.395	43.336	48.871	43.671	46.492	45.073	6.381
44.340	43.715	45.827	45.271	45.314	43.347	48.813	43.682	46.492	45.073	6.397
44.427	43.732	45.948	45.242	45.314	43.289	48.807	43.624	47.085	45.073	6.414
44.473	43.674	45.972	45.260	45.383	43.382	48.882	43.700	47.085	45.073	6.431
44.479	43.709	45.983	45.237	45.348	43.382	48.790	43.746	46.492	45.073	6.447
44.415	43.761	46.001	45.208	45.412	43.342	48.882	43.828	47.085	45.073	6.464
44.444	43.721	45.891	45.219	45.302	43.411	48.842	43.723	47.085	45.073	6.481
44.369	43.819	45.902	45.283	45.314	43.394	48.813	43.747	47.085	45.073	6.497

A.2 Temperature measurement for the slab with embedded pipe (continued)

T1	T2	T3	T4	T5	T6	T7(Air)	T8	T9	T10	Time(h)
44.421	43.808	45.943	45.300	45.372	43.411	48.749	43.712	47.085	45.073	6.514
44.485	43.808	46.059	45.318	45.267	43.411	48.842	43.764	47.085	45.073	6.531
44.502	43.779	45.966	45.335	45.325	43.446	48.877	43.834	46.993	44.982	6.547
44.480	43.831	45.978	45.364	45.349	43.382	48.900	43.805	47.085	44.982	6.564
44.543	43.802	46.053	45.254	45.383	43.487	48.842	43.892	46.993	44.982	6.581
44.433	43.860	45.989	45.341	45.418	43.476	48.911	43.828	46.993	44.982	6.597
44.549	43.814	46.047	45.388	45.442	43.534	48.860	43.834	46.993	44.982	6.614
44.567	43.872	45.954	45.388	45.430	43.476	48.889	43.858	46.993	44.982	6.631
44.439	43.924	45.995	45.336	45.401	43.476	48.877	43.782	46.993	44.982	6.647
44.457	43.947	46.082	45.289	45.395	43.418	48.935	43.828	46.993	44.982	6.664
44.463	43.819	45.943	45.336	45.390	43.493	48.761	43.817	46.993	44.982	6.681
44.480	43.854	45.949	45.388	45.390	43.516	48.808	43.864	46.993	44.982	6.697
44.544	43.907	46.007	45.376	45.390	43.540	48.802	43.898	46.993	44.982	6.714
44.433	43.878	45.943	45.405	45.506	43.580	48.866	43.823	46.993	44.891	6.731
44.486	43.924	45.960	45.376	45.494	43.488	48.779	43.916	46.901	44.982	6.747
44.532	43.930	46.018	45.452	45.541	43.488	48.854	43.864	46.993	44.982	6.764
44.561	43.872	45.989	45.313	45.413	43.627	48.785	43.945	46.993	44.891	6.781
44.503	43.970	46.030	45.371	45.448	43.517	48.860	43.893	46.993	44.891	6.797
44.678	43.918	46.157	45.452	45.471	43.703	48.791	43.963	46.993	44.891	6.814
44.503	43.970	46.024	45.452	45.448	43.621	48.762	43.923	46.993	44.891	6.831
44.568	44.034	46.065	45.446	45.523	43.581	48.733	43.940	46.901	44.891	6.847
44.503	44.029	46.088	45.469	45.472	43.523	48.797	43.836	46.901	44.891	6.864
44.556	44.000	46.024	45.464	45.564	43.581	48.774	44.015	46.901	44.891	6.881
44.602	44.017	46.042	45.446	45.460	43.569	48.751	43.865	46.901	44.891	6.897
44.579	44.017	46.013	45.412	45.391	43.593	48.774	43.975	46.901	44.891	6.914
44.678	43.971	46.129	45.441	45.454	43.674	48.757	43.964	46.901	44.891	6.931
44.574	44.000	46.047	45.522	45.536	43.680	48.785	44.063	46.901	44.891	6.947
44.649	44.017	46.053	45.400	45.420	43.744	48.832	43.975	46.901	44.891	6.964
44.603	43.977	46.094	45.435	45.460	43.587	48.820	44.022	46.901	44.891	6.981
44.574	44.098	45.995	45.435	45.530	43.709	48.809	43.987	46.901	44.891	6.997
44.609	44.040	46.001	45.510	45.478	43.622	48.792	44.011	46.901	44.891	7.014
44.591	44.087	45.984	45.394	45.541	43.645	48.739	43.993	46.901	44.891	7.031
44.522	44.046	46.048	45.406	45.420	43.651	48.849	43.987	46.901	44.891	7.047
44.650	44.011	46.088	45.487	45.460	43.692	48.722	44.051	46.901	45.485	7.064
44.650	44.058	46.007	45.482	45.455	43.704	48.803	44.005	46.809	44.891	7.081
44.679	44.064	46.088	45.511	45.495	43.744	48.745	44.086	46.901	44.891	7.097
44.749	44.052	46.065	45.493	45.495	43.710	48.624	44.022	46.809	44.891	7.114
44.674	44.064	46.111	45.499	45.478	43.658	48.682	44.016	46.901	44.891	7.131
44.627	44.052	46.094	45.528	45.530	43.733	48.682	43.987	46.901	44.891	7.147

A.2 Temperature measurement for the slab with embedded pipe (continued)

T1	T2	T3	T4	T5	T6	T7(Air)	T8	T9	T10	Time(h)
44.691	44.087	46.025	45.528	45.519	43.762	48.566	44.057	46.809	44.891	7.164
44.755	44.128	46.083	45.499	45.502	43.757	48.613	44.080	46.809	44.800	7.181
44.674	44.145	46.048	45.523	45.357	43.739	48.723	44.016	46.809	44.800	7.197
44.697	44.180	46.077	45.552	45.450	43.774	48.659	44.028	46.809	45.393	7.214
44.662	44.111	46.129	45.540	45.496	43.821	48.688	44.075	46.809	45.393	7.231
44.570	44.145	46.048	45.482	45.519	43.734	48.636	44.081	46.809	45.303	7.247
44.668	44.041	46.019	45.529	45.531	43.768	48.694	44.157	46.809	45.303	7.264
44.529	44.157	46.013	45.453	45.450	43.792	48.665	44.105	46.809	45.303	7.281
44.691	44.128	46.007	45.453	45.485	43.821	48.636	44.087	46.809	44.709	7.297
44.622	44.157	46.100	45.529	45.537	43.722	48.712	44.064	46.809	45.303	7.314
44.604	44.111	46.065	45.413	45.485	43.775	48.665	44.117	46.809	44.709	7.331
44.697	44.082	46.106	45.552	45.473	43.879	48.613	44.186	46.718	45.303	7.347
44.691	44.186	46.036	45.488	45.490	43.775	48.619	44.128	46.809	45.393	7.364
44.703	44.204	46.019	45.459	45.502	43.716	48.677	44.122	46.718	45.303	7.381
44.691	44.204	46.066	45.494	45.514	43.943	48.718	44.198	46.809	45.393	7.397
44.662	44.186	46.054	45.581	45.560	43.868	48.753	44.199	46.809	45.393	7.414
44.698	44.175	46.100	45.552	45.526	43.856	48.660	44.141	46.809	44.800	7.431
44.733	44.140	46.187	45.593	45.584	43.868	48.678	44.193	46.809	45.393	7.447
44.663	44.198	46.158	45.523	45.601	43.874	48.631	44.106	46.809	45.303	7.464
44.669	44.233	46.043	45.535	45.509	43.857	48.620	44.077	46.809	45.303	7.481
44.617	44.192	46.025	45.529	45.613	43.792	48.706	44.199	46.718	45.212	7.497
44.750	44.209	46.060	45.599	45.596	43.909	48.666	44.222	46.718	45.212	7.514
44.773	44.157	46.089	45.651	45.474	43.897	48.660	44.274	46.718	45.303	7.531
44.675	44.326	46.072	45.605	45.613	43.897	48.637	44.153	46.718	45.303	7.547
44.745	44.204	45.985	45.570	45.515	43.898	48.735	44.211	46.718	45.212	7.564
44.745	44.192	46.124	45.530	45.567	43.921	48.695	44.257	46.718	45.212	7.581
44.751	44.239	46.188	45.553	45.625	43.886	48.718	44.159	46.718	45.212	7.597
44.780	44.187	46.164	45.553	45.578	43.950	48.562	44.234	46.718	45.212	7.614
44.693	44.239	46.118	45.599	45.596	43.944	48.701	44.188	47.219	45.212	7.631
44.710	44.250	46.118	45.501	45.636	43.869	48.649	44.223	46.626	45.212	7.647
44.738	44.239	46.170	45.611	45.619	43.961	48.655	44.205	46.626	45.121	7.664
44.773	44.222	46.147	45.594	45.590	43.950	48.592	44.240	46.626	45.121	7.681
44.756	44.303	46.072	45.565	45.538	43.979	48.534	44.223	46.626	45.121	7.697
44.709	44.297	46.107	45.541	45.544	43.915	48.667	44.304	47.219	45.121	7.714
44.709	44.314	46.101	45.582	45.480	43.863	48.597	44.171	46.626	45.212	7.731
44.825	44.309	46.159	45.547	45.544	43.974	48.568	44.241	46.626	45.212	7.747
44.890	44.338	46.165	45.530	45.544	44.055	48.546	44.212	47.219	45.121	7.764
44.792	44.384	46.136	45.565	45.567	43.968	48.603	44.194	46.626	45.212	7.781
44.850	44.454	46.142	45.646	45.585	43.991	48.650	44.229	47.219	45.212	7.797

A.2 Temperature measurement for the slab with embedded pipe (continued)

T1	T2	T3	T4	T5	T6	T7(Air)	T8	T9	T10	Time(h)
44.815	44.309	46.153	45.629	45.585	44.008	48.650	44.235	46.626	45.121	7.814
44.769	44.378	46.095	45.571	45.602	43.939	48.650	44.328	46.626	45.212	7.831
44.716	44.431	46.165	45.542	45.567	43.933	48.552	44.340	47.219	45.121	7.847
44.798	44.326	46.101	45.565	45.480	44.037	48.534	44.235	46.626	45.212	7.864
44.856	44.338	46.095	45.606	45.579	44.061	48.604	44.265	46.626	45.121	7.881
44.873	44.419	46.223	45.658	45.568	44.067	48.609	44.403	47.219	45.121	7.897
44.804	44.309	46.217	45.612	45.568	44.084	48.610	44.276	46.534	45.121	7.914
44.967	44.402	46.235	45.681	45.574	44.125	48.610	44.363	47.127	45.121	7.931
44.892	44.425	46.107	45.728	45.568	44.056	48.685	44.323	47.219	45.121	7.947
44.858	44.414	46.229	45.636	45.563	44.114	48.651	44.375	46.626	45.121	7.964
44.846	44.449	46.235	45.670	45.644	44.097	48.673	44.392	47.127	45.121	7.981
44.951	44.536	46.241	45.717	45.546	44.096	48.610	44.311	47.127	45.121	7.997
44.939	44.408	46.258	45.740	45.702	44.196	48.680	44.468	46.534	45.121	8.014
44.945	44.536	46.200	45.699	45.656	44.184	48.697	44.352	46.534	45.121	8.031
44.841	44.420	46.230	45.630	45.685	44.190	48.639	44.468	47.127	45.121	8.047
44.886	44.414	46.142	45.676	45.540	44.085	48.547	44.410	47.127	45.121	8.064
44.741	44.397	46.137	45.682	45.702	44.004	48.564	44.277	47.127	45.121	8.081
44.846	44.438	46.142	45.682	45.656	44.109	48.547	44.352	47.127	45.121	8.097
44.783	44.391	46.177	45.677	45.656	44.098	48.674	44.428	46.534	45.121	8.114
44.846	44.472	46.229	45.676	45.650	44.161	48.506	44.521	47.127	45.121	8.131
44.817	44.501	46.177	45.676	45.668	44.057	48.559	44.382	47.127	45.121	8.147
44.910	44.455	46.166	45.705	45.627	44.051	48.559	44.376	46.534	45.121	8.164
45.061	44.478	46.264	45.717	45.639	44.185	48.634	44.405	46.534	45.121	8.181
44.992	44.490	46.253	45.665	45.610	44.225	48.536	44.469	46.534	45.121	8.197
45.010	44.513	46.218	45.822	45.645	44.132	48.634	44.376	47.127	45.121	8.214
44.876	44.496	46.166	45.706	45.604	44.139	48.680	44.423	47.127	45.121	8.231
44.939	44.490	46.102	45.677	45.633	44.161	48.611	44.388	47.127	45.121	8.247
44.934	44.583	46.224	45.764	45.691	44.191	48.507	44.475	47.127	45.121	8.264
44.969	44.560	46.201	45.764	45.709	44.156	48.594	44.376	46.534	45.121	8.281
44.795	44.519	46.213	45.689	45.767	44.104	48.623	44.411	46.534	45.121	8.297
44.847	44.374	46.131	45.700	45.668	44.190	48.501	44.451	46.534	45.121	8.314
44.876	44.537	46.247	45.752	45.657	44.197	48.582	44.475	46.534	45.121	8.331
44.843	44.532	46.236	45.799	45.657	44.191	48.537	44.527	46.534	45.121	8.347
44.941	44.525	46.207	45.683	45.720	44.226	48.484	44.544	47.127	45.121	8.364
44.992	44.520	46.247	45.799	45.727	44.249	48.548	44.388	47.127	45.030	8.381
44.969	44.404	46.178	45.764	45.686	44.209	48.617	44.505	47.127	45.030	8.397
44.998	44.502	46.265	45.741	45.715	44.220	48.559	44.464	47.127	45.624	8.414
44.998	44.589	46.201	45.718	45.547	44.197	48.583	44.464	47.127	45.624	8.431
44.941	44.537	46.184	45.776	45.692	44.145	48.571	44.458	47.127	45.030	8.447

A.2 Temperature measurement for the slab with embedded pipe (continued)

T1	T2	T3	T4	T5	T6	T7(Air)	T8	T9	T10	Time(h)
44.964	44.444	46.190	45.689	45.727	44.209	48.559	44.406	47.127	45.030	8.464
44.941	44.566	46.184	45.695	45.582	44.214	48.582	44.522	47.127	45.030	8.481
44.905	44.532	46.213	45.712	45.697	44.255	48.502	44.458	47.036	45.030	8.497
44.963	44.543	46.265	45.689	45.709	44.260	48.432	44.516	47.127	45.624	8.514
44.888	44.514	46.282	45.683	45.732	44.307	48.600	44.534	47.127	45.624	8.531
45.044	44.444	46.219	45.765	45.715	44.296	48.646	44.493	46.534	45.030	8.547
44.923	44.508	46.207	45.770	45.721	44.348	48.595	44.569	47.036	45.030	8.564
45.003	44.519	46.253	45.718	45.761	44.197	48.595	44.587	47.036	45.030	8.581
44.870	44.386	46.265	45.706	45.732	44.238	48.589	44.523	47.036	45.030	8.597
44.922	44.502	46.132	45.822	45.686	44.209	48.537	44.523	47.036	45.121	8.614
44.869	44.589	46.178	45.729	45.686	44.296	48.566	44.523	47.127	45.030	8.631
44.875	44.589	46.184	45.747	45.715	44.308	48.577	44.540	47.127	45.030	8.647
44.881	44.490	46.201	45.793	45.727	44.267	48.444	44.534	47.127	45.624	8.664
44.898	44.496	46.183	45.700	45.686	44.325	48.566	44.552	47.127	45.624	8.681
44.950	44.537	46.212	45.741	45.628	44.290	48.577	44.523	47.127	45.030	8.697
44.881	44.577	46.253	45.671	45.698	44.313	48.618	44.592	47.127	45.624	8.714
44.956	44.577	46.131	45.781	45.645	44.139	48.566	44.505	47.127	45.121	8.731
44.869	44.548	46.172	45.741	45.622	44.325	48.467	44.569	47.127	45.030	8.747
44.944	44.496	46.172	45.805	45.767	44.371	48.554	44.581	47.127	45.624	8.764
44.944	44.554	46.207	45.712	45.720	44.319	48.617	44.645	47.127	45.714	8.781
44.962	44.542	46.189	45.723	45.691	44.383	48.456	44.708	47.127	45.030	8.797
44.938	44.565	46.195	45.833	45.698	44.325	48.566	44.639	47.127	45.714	8.814
44.886	44.577	46.212	45.723	45.680	44.226	48.479	44.645	47.127	45.121	8.831
44.990	44.571	46.282	45.689	45.784	44.412	48.525	44.610	47.127	45.121	8.847
44.984	44.542	46.311	45.660	45.720	44.330	48.421	44.599	47.127	45.624	8.864
45.048	44.641	46.276	45.816	45.669	44.406	48.514	44.622	47.036	45.121	8.881
45.095	44.763	46.212	45.863	45.732	44.429	48.525	44.599	47.127	45.624	8.897
45.060	44.635	46.294	45.793	45.703	44.400	48.531	44.593	47.127	45.624	8.914
45.002	44.746	46.276	45.845	45.866	44.337	48.566	44.669	47.127	45.030	8.931
45.084	44.641	46.276	45.816	45.803	44.366	48.647	44.680	47.036	45.624	8.947
45.038	44.636	46.381	45.828	45.698	44.476	48.543	44.692	47.036	45.624	8.964
45.021	44.612	46.329	45.817	45.826	44.488	48.642	44.692	47.036	45.624	8.981
44.992	44.548	46.404	45.805	45.809	44.454	48.596	44.745	47.036	45.624	8.997
45.010	44.740	46.323	45.904	45.844	44.535	48.619	44.768	47.036	45.624	9.014
44.963	44.717	46.375	45.933	45.815	44.408	48.602	44.820	47.036	45.624	9.031
45.120	44.787	46.416	45.881	45.896	44.460	48.568	44.739	47.036	45.624	9.047
44.999	44.827	46.289	45.765	45.827	44.448	48.585	44.791	47.036	45.624	9.064
45.004	44.764	46.341	45.876	45.879	44.472	48.539	44.740	47.036	45.624	9.081
45.033	44.712	46.300	45.928	45.822	44.478	48.643	44.688	47.036	45.624	9.097

A.2 Temperature measurement for the slab with embedded pipe (continued)

T1	T2	T3	T4	T5	T6	T7(Air)	T8	T9	T10	Time(h)
45.109	44.677	46.335	45.980	45.810	44.571	48.632	44.757	47.036	45.533	9.114
45.161	44.747	46.289	45.853	45.897	44.484	48.632	44.752	46.945	45.533	9.131
45.162	44.747	46.341	45.899	45.810	44.490	48.684	44.718	47.036	45.533	9.147
45.104	44.741	46.289	45.940	45.886	44.519	48.580	44.764	46.945	45.443	9.164
45.052	44.683	46.283	45.929	45.845	44.461	48.603	44.746	46.945	45.533	9.181
45.035	44.729	46.353	45.807	45.816	44.549	48.528	44.839	46.945	45.443	9.197
45.046	44.753	46.376	45.981	45.805	44.572	48.516	44.781	46.945	45.443	9.214
45.116	44.724	46.330	45.894	45.776	44.461	48.499	44.752	46.945	45.443	9.231
45.058	44.684	46.319	45.993	45.805	44.543	48.575	44.793	46.945	45.443	9.247
45.087	44.771	46.324	45.871	45.770	44.577	48.476	44.793	46.853	45.443	9.264
45.076	44.747	46.376	45.900	45.961	44.607	48.477	44.916	46.945	45.352	9.281
45.082	44.718	46.342	45.969	45.823	44.572	48.552	44.846	46.853	45.352	9.297
45.024	44.776	46.267	45.778	45.829	44.433	48.477	44.916	46.853	45.352	9.314
45.012	44.707	46.296	45.889	45.788	44.567	48.419	44.846	46.853	45.352	9.331
45.012	44.742	46.313	45.848	45.869	44.543	48.523	44.899	46.853	45.352	9.347
45.116	44.718	46.394	45.848	45.794	44.584	48.477	44.863	46.853	45.352	9.364
45.105	44.811	46.232	45.900	45.858	44.549	48.506	44.800	46.853	45.352	9.381
45.053	44.863	46.348	45.819	45.881	44.590	48.477	44.938	46.853	45.352	9.397
45.129	44.759	46.400	45.848	45.858	44.642	48.511	44.823	46.853	45.352	9.414
45.117	44.806	46.325	45.970	45.864	44.659	48.575	44.870	46.853	45.262	9.431
45.064	44.753	46.226	45.929	45.817	44.590	48.541	44.882	46.762	45.352	9.447
45.082	44.765	46.220	45.854	45.806	44.544	48.506	44.812	46.762	45.352	9.464
45.018	44.724	46.307	45.825	45.887	44.584	48.541	44.859	46.762	45.352	9.481
45.006	44.777	46.389	45.941	45.887	44.584	48.541	44.853	46.762	45.352	9.497
45.111	44.771	46.302	45.929	45.823	44.579	48.541	44.848	46.762	45.352	9.514
45.111	44.835	46.319	45.912	45.887	44.538	48.529	44.906	46.762	45.352	9.531
45.053	44.829	46.377	45.912	45.887	44.562	48.605	44.831	46.762	45.352	9.547
45.169	44.759	46.389	45.941	45.841	44.689	48.524	44.889	46.762	45.352	9.564
45.036	44.812	46.354	45.861	45.899	44.550	48.535	44.906	46.762	45.352	9.581
44.996	44.788	46.360	45.791	45.968	44.672	48.507	44.918	46.853	45.443	9.597
44.984	44.777	46.279	45.861	45.853	44.579	48.397	44.889	46.853	45.443	9.614
44.995	44.812	46.371	45.854	45.864	44.608	48.402	44.894	46.762	45.352	9.631
45.151	44.841	46.371	45.832	45.853	44.510	48.442	44.865	46.762	45.352	9.647
45.048	44.847	46.395	45.890	45.812	44.533	48.391	44.865	46.762	45.352	9.664
45.077	44.870	46.441	45.855	45.864	44.591	48.449	44.998	46.762	45.352	9.681
45.193	44.812	46.406	45.936	45.812	44.562	48.443	44.865	47.355	45.262	9.697
45.071	44.789	46.233	45.907	45.830	44.649	48.414	44.853	46.762	45.262	9.714
45.124	44.859	46.360	45.878	45.917	44.632	48.535	44.877	46.762	45.262	9.731
45.193	44.835	46.360	45.930	45.824	44.701	48.542	44.883	46.762	45.262	9.747

A.2 Temperature measurement for the slab with embedded pipe (continued)

T1	T2	T3	T4	T5	T6	T7(Air)	T8	T9	T10	Time(h)
45.066	44.824	46.401	45.983	45.888	44.754	48.484	44.947	46.762	45.262	9.764
45.117	44.864	46.273	45.826	45.888	44.620	48.437	44.941	47.264	45.262	9.781
45.094	44.870	46.413	45.843	45.917	44.707	48.490	44.877	47.355	45.262	9.797
45.059	44.859	46.337	45.803	46.004	44.701	48.518	44.930	46.762	45.262	9.814
45.187	44.946	46.378	46.029	45.963	44.661	48.444	44.964	46.671	45.262	9.831
45.164	44.836	46.268	45.977	45.859	44.638	48.467	44.947	46.762	45.262	9.847
45.146	44.905	46.268	45.977	45.952	44.655	48.507	44.907	46.671	45.855	9.864
45.245	44.772	46.436	46.012	45.854	44.742	48.398	44.925	46.671	45.855	9.881
45.071	44.940	46.314	45.995	45.941	44.621	48.513	45.018	47.264	45.855	9.897
45.100	44.865	46.395	46.001	46.016	44.731	48.508	45.024	46.671	45.765	9.914
45.193	44.935	46.343	46.053	45.970	44.783	48.548	44.931	47.264	45.765	9.931
45.222	44.975	46.361	45.949	46.057	44.691	48.468	44.943	47.264	45.765	9.947
45.217	44.859	46.401	46.047	45.877	44.766	48.479	44.920	46.671	45.765	9.964
45.211	44.894	46.379	46.007	45.877	44.686	48.445	44.978	46.671	45.765	9.981
45.118	44.958	46.373	45.949	46.028	44.691	48.421	44.954	46.671	45.171	9.997
45.147	44.836	46.384	45.966	45.999	44.657	48.526	44.942	46.671	45.171	10.014
45.205	44.830	46.401	45.972	45.901	44.697	48.456	44.902	47.264	45.171	10.031
45.124	44.888	46.326	45.914	45.930	44.657	48.496	44.966	46.580	45.171	10.047
45.118	44.871	46.408	45.839	45.964	44.744	48.410	45.041	46.671	45.171	10.064
45.101	44.906	46.373	45.943	45.941	44.691	48.526	45.082	47.264	45.765	10.081
45.212	44.964	46.350	45.978	45.877	44.726	48.503	45.012	47.264	45.765	10.097
45.154	44.900	46.465	45.984	46.011	44.825	48.457	45.094	47.264	45.765	10.114
45.207	44.982	46.460	46.036	45.965	44.744	48.451	45.100	47.173	45.675	10.131
45.242	44.964	46.535	46.025	46.006	44.855	48.428	45.106	47.173	45.765	10.147
45.172	44.901	46.512	46.089	45.919	44.820	48.394	45.072	47.173	45.675	10.164
45.196	45.052	46.425	46.095	45.972	44.797	48.504	45.008	46.580	45.675	10.181
45.230	45.011	46.321	45.996	46.001	44.786	48.475	44.951	47.173	45.171	10.197
45.225	45.023	46.426	46.066	46.007	44.885	48.394	44.957	47.173	45.765	10.214
45.167	44.942	46.362	45.968	46.025	44.827	48.360	45.020	47.173	45.675	10.231
45.283	44.913	46.356	46.049	45.943	44.885	48.470	45.020	46.580	45.675	10.247
45.179	44.942	46.466	45.974	45.920	44.832	48.331	45.020	46.580	45.081	10.264
45.086	44.982	46.356	45.968	46.036	44.873	48.366	45.073	46.580	45.675	10.281
45.172	44.988	46.345	45.974	45.938	44.815	48.446	45.044	47.173	45.675	10.297
45.167	45.011	46.380	45.986	45.949	44.868	48.314	45.038	47.173	45.675	10.314
45.161	45.046	46.403	45.980	45.967	44.856	48.348	45.073	46.489	45.675	10.331
45.092	45.035	46.305	45.957	45.972	44.763	48.325	45.114	47.082	45.675	10.347
45.231	45.017	46.403	45.986	45.972	44.867	48.372	45.085	47.173	45.081	10.364
45.190	44.977	46.293	45.974	45.926	44.873	48.400	45.090	47.173	45.675	10.381
45.237	45.024	46.380	45.951	45.955	44.827	48.400	45.148	47.082	45.585	10.397

A.2 Temperature measurement for the slab with embedded pipe (continued)

T1	T2	T3	T4	T5	T6	T7(Air)	T8	T9	T10	Time(h)
45.225	45.058	46.374	45.980	45.955	44.862	48.418	45.155	46.489	45.585	10.414
45.167	44.960	46.316	46.009	45.868	44.978	48.390	45.155	47.082	45.585	10.431
45.185	44.954	46.357	46.021	45.868	44.880	48.274	45.074	47.082	45.585	10.447
45.237	45.053	46.357	46.044	45.979	44.892	48.332	45.115	47.082	45.585	10.464
45.278	44.989	46.374	46.004	45.956	44.950	48.333	45.057	47.082	45.585	10.481
45.290	44.972	46.444	46.050	45.962	44.921	48.315	45.080	47.082	45.585	10.497
45.198	45.018	46.352	46.073	45.933	44.799	48.344	45.057	47.082	45.585	10.514
45.164	44.989	46.450	45.905	46.020	44.828	48.275	45.057	47.082	45.675	10.531
45.175	45.030	46.387	46.057	45.892	44.863	48.333	45.046	47.082	45.585	10.547
45.181	45.047	46.352	45.934	45.921	44.863	48.303	45.068	47.082	45.585	10.564
45.222	45.059	46.398	46.016	45.852	44.880	48.304	45.010	47.082	45.585	10.581
45.239	45.019	46.422	46.045	45.812	44.834	48.333	45.063	47.082	45.585	10.597
45.210	45.013	46.381	45.935	45.933	44.834	48.263	45.057	47.082	45.585	10.614
45.204	45.123	46.445	46.051	45.968	44.846	48.298	45.104	47.082	45.585	10.631
45.187	45.065	46.410	45.976	45.974	44.904	48.344	45.110	47.082	45.585	10.647
45.129	45.013	46.341	45.888	45.899	44.893	48.321	45.145	47.082	45.585	10.664
45.146	44.984	46.341	45.947	45.876	44.841	48.426	45.064	47.082	45.585	10.681
45.210	44.973	46.387	45.958	45.945	44.957	48.270	45.000	47.082	45.585	10.697
45.210	44.938	46.329	46.080	45.916	44.875	48.339	45.029	47.082	45.585	10.714
45.268	45.013	46.405	46.028	45.922	44.968	48.270	45.162	47.082	45.585	10.731
45.285	45.118	46.335	46.051	45.864	44.829	48.281	45.030	46.992	45.585	10.747
45.210	45.037	46.399	46.011	45.888	44.865	48.310	45.116	47.082	45.585	10.764
45.303	45.002	46.416	46.017	45.981	44.934	48.316	45.087	47.082	45.585	10.781
45.229	45.083	46.492	46.029	45.946	44.911	48.224	45.081	46.992	45.585	10.797
45.182	45.042	46.440	46.035	45.964	44.964	48.334	45.204	47.082	45.585	10.814
45.304	45.083	46.312	46.041	46.028	44.952	48.409	45.163	46.992	45.585	10.831
45.241	45.066	46.463	45.977	45.964	44.981	48.322	45.146	46.992	45.495	10.847
45.224	45.014	46.399	46.006	45.883	44.970	48.265	45.128	46.992	45.495	10.864
45.264	45.038	46.348	46.006	45.999	44.889	48.277	45.105	46.992	45.585	10.881
45.143	45.060	46.354	45.954	45.883	44.872	48.207	45.112	46.992	45.495	10.897
45.247	44.951	46.353	45.966	45.982	44.935	48.334	45.083	46.992	45.495	10.914
45.211	44.968	46.353	45.994	45.866	44.900	48.265	45.146	46.992	45.585	10.931
45.142	45.060	46.353	46.006	45.941	44.860	48.340	45.199	46.992	45.585	10.947
45.188	44.973	46.411	46.018	45.935	44.906	48.340	45.123	46.992	45.585	10.964
45.263	45.055	46.388	46.058	45.941	44.941	48.265	45.100	46.992	45.495	10.981
45.234	45.055	46.342	45.994	45.936	44.848	48.288	45.077	46.992	45.495	10.997
45.246	45.060	46.400	46.041	45.999	44.935	48.346	45.123	46.992	45.585	11.014
45.153	45.119	46.441	46.000	45.913	44.988	48.358	45.204	46.992	45.495	11.031
45.252	45.165	46.435	46.105	45.977	44.999	48.387	45.095	46.992	45.585	11.047

A.2 Temperature measurement for the slab with embedded pipe (continued)

T1	T2	T3	T4	T5	T6	T7(Air)	T8	T9	T10	Time(h)
45.304	45.125	46.475	46.024	46.046	44.907	48.422	45.154	46.992	45.495	11.064
45.223	45.119	46.366	45.984	45.965	45.011	48.295	45.129	46.992	45.495	11.081
45.183	45.079	46.388	46.088	45.919	44.878	48.277	45.141	46.992	45.495	11.097
45.218	45.084	46.308	45.989	45.913	44.913	48.272	45.199	46.992	45.495	11.114
45.212	45.009	46.319	45.949	45.977	44.901	48.300	45.100	46.992	45.495	11.131
45.206	45.137	46.441	46.018	45.954	44.907	48.277	45.187	46.992	45.495	11.147
45.230	45.102	46.342	46.036	46.029	44.959	48.300	45.187	46.992	45.495	11.164
45.206	45.137	46.360	46.094	45.856	44.942	48.306	45.112	46.992	45.495	11.181
45.305	45.079	46.366	46.007	45.943	44.913	48.272	45.199	46.992	45.495	11.197
45.363	45.044	46.406	45.943	45.965	44.872	48.387	45.088	46.992	45.585	11.214
45.282	44.945	46.360	45.903	45.896	44.959	48.387	45.222	46.992	45.585	11.231
45.178	45.061	46.383	46.076	45.960	44.971	48.231	45.154	46.992	45.585	11.247
45.213	45.119	46.424	45.961	45.994	45.012	48.278	45.130	46.992	45.585	11.264
45.323	45.195	46.377	46.117	45.948	44.971	48.243	45.154	46.992	45.585	11.281
45.225	45.050	46.470	46.054	45.919	44.948	48.209	45.270	46.992	45.585	11.297
45.236	45.073	46.331	46.135	45.948	44.977	48.203	45.177	46.992	45.585	11.314
45.300	45.131	46.326	46.042	46.047	45.006	48.319	45.212	46.992	45.495	11.331
45.213	45.114	46.401	46.071	45.897	44.960	48.238	45.195	46.992	45.585	11.347
45.341	45.085	46.326	45.990	45.966	45.023	48.272	45.113	46.992	45.585	11.364
45.207	45.091	46.343	45.990	45.885	44.995	48.336	45.154	46.992	45.585	11.381
45.259	45.091	46.442	46.025	45.879	44.995	48.423	45.137	46.992	45.585	11.397
45.235	45.114	46.395	46.083	45.966	45.053	48.330	45.154	46.992	45.495	11.414
45.334	45.108	46.465	46.078	46.163	45.018	48.377	45.213	46.992	45.495	11.431
45.282	45.155	46.401	46.112	46.025	45.053	48.296	45.242	46.992	45.495	11.447
45.264	45.219	46.453	46.118	45.920	45.065	48.290	45.231	46.992	45.405	11.464
45.334	45.190	46.372	46.014	46.094	45.024	48.227	45.178	46.901	45.405	11.481
45.219	45.143	46.378	46.014	46.025	45.019	48.296	45.086	46.901	45.405	11.497
45.271	45.143	46.314	46.003	46.030	45.024	48.227	45.283	46.992	45.405	11.514
45.213	45.167	46.355	46.020	45.874	44.903	48.210	45.184	46.901	45.405	11.531
45.370	45.091	46.401	46.101	45.909	45.059	48.216	45.225	46.901	45.405	11.547
45.242	45.097	46.430	46.084	45.938	45.013	48.227	45.289	46.901	45.405	11.564
45.213	45.143	46.407	46.078	46.025	45.048	48.285	45.196	46.901	45.405	11.581
45.347	45.138	46.482	46.026	45.967	45.013	48.268	45.232	46.901	45.405	11.597
45.289	45.120	46.506	46.055	45.967	45.036	48.297	45.295	46.901	45.405	11.614
45.295	45.149	46.494	46.107	45.950	45.019	48.262	45.249	46.901	45.405	11.631
45.324	45.156	46.385	46.130	46.031	45.077	48.396	45.237	46.901	45.405	11.647
45.196	45.144	46.437	46.101	46.002	44.996	48.280	45.185	46.901	45.405	11.664
45.283	45.196	46.379	46.142	46.078	45.003	48.269	45.244	46.901	45.405	11.681
45.191	45.196	46.356	46.021	46.003	45.003	48.182	45.244	46.901	45.405	11.697

A.2 Temperature measurement for the slab with embedded pipe (continued)

T1	T2	T3	T4	T5	T6	T7(Air)	T8	T9	T10	Time(h)
45.283	45.190	46.373	46.073	46.003	45.020	48.187	45.232	46.901	45.405	11.714
45.203	45.167	46.477	46.026	46.049	45.020	48.228	45.285	46.901	45.405	11.731
45.278	45.156	46.553	46.055	46.020	45.165	48.142	45.285	46.810	45.405	11.747
45.342	45.185	46.390	46.056	45.951	45.078	48.206	45.366	46.810	45.405	11.764
45.343	45.179	46.437	46.067	46.073	45.003	48.275	45.349	46.810	45.405	11.781
45.255	45.150	46.443	46.114	46.009	45.102	48.287	45.268	46.901	45.405	11.797
45.232	45.185	46.356	46.062	45.992	45.102	48.293	45.233	46.810	45.405	11.814
45.249	45.150	46.368	46.154	45.992	45.049	48.246	45.216	46.810	45.315	11.831
45.331	45.203	46.454	46.103	46.050	45.143	48.148	45.302	46.810	45.315	11.847
45.279	45.168	46.408	46.138	45.986	45.032	48.142	45.232	46.810	45.315	11.864
45.232	45.145	46.542	45.981	46.003	45.119	48.165	45.261	46.810	45.315	11.881
45.296	45.186	46.380	46.091	45.957	45.073	48.235	45.326	46.810	45.315	11.897
45.222	45.197	46.432	46.045	45.992	45.131	48.241	45.321	46.810	45.315	11.914
45.227	45.139	46.408	46.011	46.061	45.207	48.200	45.280	46.810	45.315	11.931
45.251	45.203	46.206	46.045	46.044	45.027	48.154	45.332	46.810	45.908	11.947
45.268	45.099	46.426	46.051	45.923	45.062	48.097	45.280	46.810	45.315	11.964
45.308	45.157	46.374	46.062	46.027	45.091	48.235	45.257	46.810	45.315	11.981
45.267	45.139	46.328	46.138	45.998	45.143	48.183	45.286	46.810	45.315	11.997
45.273	45.133	46.391	46.033	45.981	45.074	48.218	45.402	46.810	45.315	12.014
45.227	45.139	46.438	46.022	46.033	45.149	48.120	45.310	46.810	45.315	12.031
45.238	45.174	46.380	45.999	45.975	45.085	48.125	45.281	46.810	45.405	12.047
45.296	45.145	46.328	45.975	45.981	45.039	48.050	45.281	46.810	45.405	12.064
45.256	45.104	46.432	46.016	45.981	45.120	48.068	45.292	46.810	45.315	12.081
45.355	45.111	46.438	46.132	45.964	45.074	48.045	45.245	46.810	45.315	12.097
45.304	45.134	46.392	46.063	45.964	45.133	48.010	45.292	46.810	45.908	12.114
45.247	45.203	46.456	45.959	45.941	45.087	48.166	45.315	46.810	45.315	12.131
45.335	45.117	46.334	46.081	45.901	45.087	48.109	45.234	46.810	45.818	12.147
45.400	45.146	46.276	46.122	46.000	45.012	48.149	45.299	46.720	45.818	12.164
45.332	45.262	46.346	46.134	45.971	45.059	48.161	45.246	46.720	45.818	12.181
45.253	45.275	46.399	46.047	46.012	45.088	48.190	45.252	46.720	45.818	12.197
45.353	45.183	46.458	46.076	45.909	44.973	48.190	45.253	46.629	45.225	12.214
45.395	45.212	46.354	46.077	45.834	45.020	48.023	45.293	46.720	45.818	12.231
45.299	45.247	46.430	46.060	46.002	45.067	48.104	45.270	46.629	45.818	12.247
45.341	45.185	46.424	46.124	45.910	45.137	48.070	45.235	46.720	45.729	12.264
45.291	45.243	46.419	46.125	45.957	45.103	48.070	45.178	46.629	45.729	12.281
45.321	45.244	46.419	46.062	45.870	45.173	48.077	45.213	46.629	45.639	12.297
45.422	45.182	46.461	46.051	45.854	45.116	48.054	45.254	47.222	45.639	12.314
45.416	45.257	46.438	46.109	45.924	45.191	48.083	45.365	47.132	45.639	12.331
45.335	45.223	46.334	46.127	45.883	45.110	48.072	45.302	47.132	45.639	12.347

A.2 Temperature measurement for the slab with embedded pipe (continued)

T1	T2	T3	T4	T5	T6	T7(Air)	T8	T9	T10	Time(h)
45.318	45.171	46.421	46.122	45.930	45.163	48.136	45.302	46.539	45.639	12.364
45.272	45.235	46.439	46.122	45.924	45.100	48.073	45.337	47.132	45.639	12.381
45.283	45.271	46.387	46.047	45.954	45.158	48.068	45.286	46.539	45.639	12.397
45.365	45.132	46.463	46.088	45.890	45.135	48.045	45.321	47.132	45.639	12.414
45.361	45.196	46.452	46.036	45.915	45.223	48.051	45.286	47.132	45.639	12.431
45.281	45.191	46.423	46.031	45.944	45.130	48.097	45.304	47.132	45.639	12.447
45.280	45.249	46.302	46.112	45.967	45.009	48.052	45.270	46.539	45.639	12.464
45.252	45.255	46.331	46.112	46.031	45.119	48.138	45.241	47.132	45.639	12.481
45.276	45.140	46.331	46.026	45.921	45.102	48.046	45.270	46.448	45.639	12.497
45.264	45.221	46.314	46.078	45.800	45.096	47.989	45.264	46.448	45.639	12.514
45.311	45.262	46.297	46.056	45.893	45.085	48.047	45.201	46.448	45.639	12.531
45.405	45.194	46.379	46.051	45.899	45.126	48.093	45.271	46.448	45.639	12.547
45.325	45.257	46.345	46.051	45.871	45.133	48.030	45.306	47.041	45.549	12.564
45.401	45.223	46.374	46.115	45.907	45.145	48.060	45.203	47.041	45.549	12.581
45.344	45.183	46.362	46.017	45.901	45.128	48.043	45.319	47.041	45.549	12.597
45.380	45.177	46.270	46.006	45.832	45.180	48.026	45.284	47.041	45.549	12.614
45.317	45.247	46.375	46.076	45.873	45.181	48.031	45.238	47.041	45.639	12.631
45.195	45.207	46.265	46.053	45.972	45.060	48.003	45.348	47.041	45.549	12.647
45.288	45.196	46.283	46.024	45.874	45.101	48.044	45.343	47.041	45.549	12.664
45.311	45.115	46.359	45.984	45.937	45.234	47.981	45.332	46.448	45.549	12.681
45.272	45.318	46.388	45.956	45.891	45.084	47.969	45.343	47.041	45.549	12.697
45.221	45.179	46.376	45.956	45.920	45.090	48.039	45.332	46.951	45.549	12.714
45.251	45.169	46.290	46.101	45.834	45.096	47.964	45.338	46.951	45.549	12.731
45.319	45.221	46.296	46.072	45.863	45.160	47.941	45.287	46.951	45.460	12.747
45.272	45.111	46.285	46.020	45.863	45.154	47.929	45.229	46.951	45.460	12.764
45.225	45.233	46.291	46.002	45.974	45.078	47.953	45.292	46.951	45.460	12.781
45.319	45.250	46.314	45.998	45.957	45.103	48.005	45.317	46.951	45.460	12.797
45.348	45.240	46.326	46.137	45.882	45.132	47.959	45.242	46.358	45.460	12.814
45.209	45.216	46.234	46.079	45.842	45.109	47.971	45.322	46.951	45.460	12.831
45.274	45.176	46.303	46.062	45.854	45.109	47.937	45.358	46.951	45.460	12.847
45.182	45.100	46.309	45.975	45.755	45.069	47.920	45.305	46.951	45.460	12.864
45.180	45.095	46.344	45.993	45.784	45.069	47.920	45.195	46.951	45.460	12.881
45.208	45.245	46.333	45.981	45.911	45.145	47.897	45.358	46.268	45.460	12.897
45.337	45.176	46.251	46.022	45.929	45.190	47.897	45.236	46.861	45.460	12.914
45.279	45.112	46.326	46.051	45.865	45.190	47.961	45.207	46.861	45.460	12.931
45.308	45.223	46.344	46.039	45.773	45.197	47.990	45.295	46.951	45.460	12.947
45.244	45.228	46.292	45.952	45.854	45.151	47.926	45.330	46.861	45.460	12.964
45.256	45.217	46.252	46.017	45.889	45.116	47.863	45.319	46.861	45.460	12.981
45.367	45.206	46.304	46.035	45.889	45.122	47.881	45.302	46.951	45.460	12.997

A.2 Temperature measurement for the slab with embedded pipe (continued)

T1	T2	T3	T4	T5	T6	T7(Air)	T8	T9	T10	Time(h)
45.362	45.200	46.426	46.011	45.837	45.169	47.887	45.278	46.861	45.460	13.014
45.235	45.137	46.299	45.960	45.756	45.145	47.817	45.249	46.861	45.370	13.031
45.241	45.212	46.213	46.018	45.867	45.152	47.881	45.307	46.861	45.370	13.047
45.264	45.178	46.282	45.960	45.849	45.100	47.852	45.197	46.861	45.460	13.064
45.247	45.282	46.259	45.908	45.861	45.146	47.741	45.331	46.861	45.460	13.081
45.213	45.195	46.208	45.995	45.821	45.072	47.840	45.331	46.861	45.370	13.097
45.219	45.155	46.381	45.984	45.861	45.164	47.771	45.331	46.861	45.370	13.114
45.283	45.167	46.230	46.036	45.769	45.106	47.818	45.303	46.861	45.460	13.131
45.138	45.219	46.399	45.978	45.839	45.200	47.656	45.372	46.861	45.370	13.147
45.167	45.109	46.242	45.978	45.851	45.165	47.754	45.395	46.861	45.370	13.164
45.138	45.173	46.173	45.949	45.874	45.160	47.691	45.448	46.861	45.370	13.181
45.166	45.173	46.219	45.880	45.880	45.101	47.611	45.344	46.861	45.370	13.197
45.333	45.138	46.231	46.002	45.770	45.160	47.738	45.327	46.771	45.370	13.214
45.253	45.109	46.173	45.949	45.770	45.119	47.784	45.392	46.771	45.370	13.231
45.207	45.249	46.202	46.014	45.747	45.160	47.831	45.293	46.771	45.370	13.247
45.302	45.145	46.225	46.032	45.725	45.085	47.657	45.218	46.771	45.370	13.264
45.134	45.168	46.238	45.928	45.719	45.155	47.762	45.305	46.861	45.370	13.281
45.181	45.232	46.226	45.904	45.776	45.103	47.675	45.374	46.861	45.370	13.297
45.174	45.168	46.110	45.968	45.748	45.028	47.698	45.247	46.771	45.370	13.314
45.168	45.198	46.110	45.899	45.760	45.115	47.640	45.351	46.771	45.281	13.331
45.226	45.174	46.226	45.991	45.742	45.091	47.675	45.380	46.771	45.281	13.347
45.145	45.145	46.197	45.870	45.713	45.115	47.687	45.311	46.771	45.281	13.364
45.232	45.180	46.226	45.904	45.684	45.160	47.664	45.219	46.771	45.281	13.381
45.238	45.152	46.105	45.962	45.731	45.109	47.647	45.317	46.771	45.281	13.397
45.203	45.134	46.140	45.933	45.754	45.074	47.635	45.357	46.771	45.281	13.414
45.268	45.187	46.088	45.951	45.702	45.127	47.624	45.363	46.178	45.370	13.431
45.281	45.291	46.187	45.992	45.829	45.058	47.687	45.317	46.771	45.281	13.447
45.247	45.216	46.210	46.016	45.801	45.121	47.710	45.306	46.771	45.281	13.464
45.217	45.100	46.147	45.999	45.703	45.087	47.636	45.213	46.771	45.281	13.481
45.251	45.212	46.153	45.888	45.697	45.139	47.641	45.340	46.771	45.192	13.497
45.305	45.216	46.141	45.917	45.697	45.116	47.775	45.352	46.771	45.281	13.514
45.144	45.165	46.217	45.895	45.802	45.180	47.706	45.358	46.681	45.281	13.531
45.266	45.217	46.199	45.982	45.762	45.175	47.752	45.312	46.771	45.281	13.547
45.220	45.177	46.170	46.005	45.710	45.117	47.700	45.312	46.681	45.281	13.564
45.238	45.212	46.194	45.947	45.715	45.192	47.723	45.207	46.771	45.281	13.581
45.232	45.160	46.136	45.988	45.796	45.169	47.613	45.330	46.681	45.192	13.597
45.146	45.149	46.241	45.925	45.791	45.047	47.752	45.272	46.681	45.281	13.614
45.267	45.201	46.142	45.890	45.780	45.059	47.694	45.347	46.681	45.192	13.631
45.297	45.172	46.102	45.960	45.757	45.135	47.614	45.388	46.681	45.281	13.647

A.2 Temperature measurement for the slab with embedded pipe (continued)

T1	T2	T3	T4	T5	T6	T7(Air)	T8	T9	T10	Time(h)
45.279	45.196	46.184	45.948	45.786	45.054	47.556	45.348	46.681	45.192	13.664
45.204	45.079	46.154	45.960	45.728	45.152	47.683	45.255	46.681	45.281	13.681
45.163	45.114	46.085	45.856	45.665	45.170	47.609	45.261	46.681	45.281	13.697
45.146	45.097	46.160	45.926	45.636	45.246	47.661	45.192	46.681	45.281	13.714
45.222	45.108	46.149	45.822	45.648	45.147	47.661	45.237	46.088	45.281	13.731
45.212	45.080	46.131	45.960	45.764	45.147	47.672	45.251	46.088	45.281	13.747
45.218	45.167	46.167	45.955	45.706	45.118	47.661	45.320	46.681	45.281	13.764
45.247	45.214	46.161	45.943	45.740	45.044	47.586	45.274	46.088	45.281	13.781
45.149	45.092	46.254	45.950	45.648	45.165	47.673	45.257	46.681	45.192	13.797
45.149	45.150	46.167	45.880	45.671	45.171	47.702	45.263	46.681	45.281	13.814
45.258	45.179	46.249	45.828	45.695	45.165	47.593	45.379	46.681	45.192	13.831
45.137	45.145	46.231	45.910	45.672	45.125	47.680	45.299	46.681	45.192	13.847
45.190	45.145	46.225	45.904	45.678	45.148	47.639	45.223	46.681	45.192	13.864
45.091	45.203	46.133	45.893	45.696	45.190	47.634	45.195	46.681	45.192	13.881
45.120	45.215	46.209	45.898	45.748	45.207	47.686	45.323	46.681	45.192	13.897
45.218	45.152	46.272	46.009	45.789	45.149	47.669	45.370	46.681	45.785	13.914
45.219	45.187	46.255	45.923	45.760	45.120	47.698	45.266	46.681	45.785	13.931
45.226	45.216	46.146	45.876	45.749	45.098	47.571	45.312	46.681	45.192	13.947
45.132	45.205	46.168	45.894	45.708	45.138	47.589	45.266	46.591	45.785	13.964
45.079	45.134	46.204	45.917	45.662	45.185	47.578	45.272	46.591	45.192	13.981
45.259	45.193	46.187	45.912	45.668	45.092	47.600	45.301	46.591	45.192	13.997
45.296	45.171	46.192	45.900	45.628	44.989	47.612	45.243	46.681	45.192	14.014
45.273	45.171	46.239	45.947	45.698	45.151	47.624	45.336	46.591	45.192	14.031
45.099	45.136	46.188	45.878	45.727	45.129	47.648	45.278	46.591	45.192	14.047
45.130	45.240	46.170	45.994	45.693	45.216	47.608	45.238	46.591	45.102	14.064
45.159	45.212	46.211	45.867	45.716	45.158	47.544	45.267	46.591	45.696	14.081
45.135	45.212	46.130	45.872	45.745	45.067	47.551	45.355	46.591	45.696	14.097
45.123	45.212	46.084	45.855	45.658	45.118	47.504	45.314	46.591	45.696	14.114
45.169	45.143	46.119	45.907	45.745	45.135	47.649	45.308	46.591	45.013	14.131
45.151	45.154	46.090	45.896	45.740	45.077	47.516	45.238	46.591	45.102	14.147
45.167	45.201	46.234	45.844	45.682	45.094	47.533	45.227	46.591	45.696	14.164
45.226	45.212	46.136	45.925	45.698	45.140	47.487	45.319	46.591	45.607	14.181
45.192	45.119	46.119	45.913	45.624	45.129	47.562	45.319	46.501	45.607	14.197
45.174	45.161	46.107	45.897	45.775	45.123	47.527	45.325	46.591	45.607	14.214
45.174	45.148	46.165	45.913	45.717	45.205	47.516	45.343	46.591	45.607	14.231
45.156	45.206	46.136	45.873	45.596	45.141	47.540	45.274	46.501	45.013	14.247
45.209	45.079	46.102	45.798	45.700	45.096	47.620	45.292	46.501	45.607	14.264
45.152	45.120	46.125	45.914	45.688	45.096	47.563	45.275	46.591	45.607	14.281
45.065	45.090	46.136	45.891	45.596	45.136	47.511	45.199	46.501	45.607	14.297

A.2 Temperature measurement for the slab with embedded pipe (continued)

T1	T2	T3	T4	T5	T6	T7(Air)	T8	T9	T10	Time(h)
45.204	45.103	46.119	45.897	45.659	45.119	47.540	45.245	46.501	45.607	14.314
45.153	45.190	46.114	45.932	45.723	45.107	47.557	45.216	46.501	45.607	14.331
45.153	45.062	46.125	45.897	45.735	45.096	47.482	45.251	46.501	45.607	14.347
45.193	45.062	46.125	45.880	45.608	45.090	47.482	45.344	46.501	45.607	14.364
45.153	45.120	45.992	45.880	45.659	45.044	47.511	45.326	46.501	45.607	14.381
45.089	45.190	46.068	45.845	45.550	45.096	47.494	45.193	46.501	45.607	14.397
45.049	45.178	46.160	45.811	45.642	45.113	47.488	45.280	46.501	45.607	14.414
45.118	45.196	46.108	45.764	45.694	45.154	47.413	45.251	46.501	45.013	14.431
45.194	45.109	46.080	45.793	45.671	45.171	47.488	45.321	46.501	45.607	14.447
45.155	45.197	46.086	45.845	45.666	45.068	47.488	45.332	46.501	45.607	14.464
45.185	45.162	46.080	45.828	45.736	45.138	47.372	45.350	46.501	45.607	14.481
45.035	45.145	46.080	45.789	45.614	45.207	47.483	45.177	46.501	45.607	14.497
45.162	45.111	46.080	45.759	45.638	45.091	47.401	45.229	46.501	45.607	14.514
45.226	45.116	46.080	45.852	45.672	45.016	47.488	45.293	46.501	45.607	14.531
45.081	45.093	46.011	45.835	45.609	45.161	47.431	45.293	46.501	45.607	14.547
45.040	45.029	46.028	45.852	45.632	45.080	47.448	45.206	46.501	45.607	14.564
45.108	45.174	46.080	45.898	45.620	45.155	47.350	45.345	46.501	45.607	14.581
45.009	45.087	46.011	45.788	45.631	45.097	47.356	45.258	46.501	45.607	14.597
45.101	45.046	45.994	45.754	45.620	45.051	47.344	45.287	46.501	45.518	14.614
45.001	45.075	46.022	45.770	45.649	45.033	47.437	45.253	46.501	45.518	14.631
45.083	45.074	46.011	45.747	45.631	45.184	47.426	45.265	46.412	45.518	14.647
45.106	45.133	46.011	45.823	45.730	45.074	47.455	45.306	46.501	45.518	14.664
45.117	45.081	45.993	45.846	45.609	45.103	47.455	45.266	46.412	45.518	14.681
45.146	45.075	46.000	45.840	45.656	45.144	47.461	45.266	46.501	45.518	14.697
45.048	45.162	46.121	45.916	45.673	45.214	47.502	45.347	46.501	45.518	14.714
45.101	45.133	46.092	45.865	45.720	45.191	47.392	45.289	46.412	45.518	14.731
45.117	45.087	45.971	45.783	45.657	45.035	47.276	45.295	46.412	45.607	14.747
45.019	45.116	46.000	45.783	45.644	45.099	47.305	45.249	46.412	45.607	14.764
45.043	45.139	46.005	45.772	45.575	45.121	47.294	45.220	46.501	45.607	14.781
45.106	45.145	46.063	45.760	45.604	43.629	47.265	45.272	46.501	45.607	14.797
44.961	45.035	46.000	45.766	45.581	38.963	47.160	45.249	46.501	45.518	14.814
45.109	45.052	45.958	45.551	45.168	37.161	47.189	45.295	46.501	45.607	14.831
44.980	45.057	45.917	45.139	44.599	36.880	47.188	45.277	46.501	45.607	14.847
44.996	45.010	45.987	44.767	44.053	36.839	47.154	45.276	45.908	45.607	14.864
44.988	45.096	45.998	44.152	43.466	36.978	47.130	45.247	45.908	45.013	14.881
45.004	45.102	45.870	43.721	43.053	36.825	47.147	45.305	45.908	45.013	14.897
44.956	45.043	45.881	43.343	42.669	37.023	47.292	45.230	45.908	45.013	14.914
44.994	45.065	45.886	43.128	42.343	36.981	47.280	45.305	45.908	45.013	14.931
45.005	45.111	45.897	42.848	42.099	37.098	47.153	45.189	45.315	45.013	14.947

A.2 Temperature measurement for the slab with embedded pipe (continued)

T1	T2	T3	T4	T5	T6	T7(Air)	T8	T9	T10	Time(h)
45.091	45.099	45.787	42.662	41.918	37.262	47.129	45.322	45.315	45.013	14.964
44.981	45.092	45.700	42.406	41.888	37.711	47.100	45.187	45.315	45.013	14.981
45.043	45.087	45.624	42.376	41.720	38.160	47.076	45.274	45.315	45.102	14.997
44.967	45.097	45.641	42.225	41.736	38.485	47.134	45.187	45.315	45.102	15.014
44.973	45.038	45.687	42.155	41.597	38.555	47.145	45.093	45.405	45.102	15.031
44.926	45.055	45.501	42.177	41.712	38.659	47.092	45.144	45.405	45.102	15.047
45.023	45.096	45.471	42.107	41.735	38.524	47.121	45.301	45.405	45.102	15.064
45.051	45.067	45.349	42.205	41.798	38.355	47.166	45.219	45.405	44.508	15.081
44.877	45.002	45.406	42.136	41.804	38.017	47.120	45.179	45.405	44.508	15.097
44.935	45.106	45.371	42.193	41.780	37.678	47.108	45.254	45.405	44.598	15.114
45.107	45.059	45.284	42.088	41.780	37.264	47.032	45.213	45.405	44.598	15.131
44.962	44.966	45.336	41.943	41.663	36.761	47.142	45.242	45.405	44.687	15.147
45.072	45.018	45.260	41.925	41.599	36.579	47.165	45.247	44.901	44.687	15.164
44.904	45.029	45.271	41.744	41.447	36.322	47.067	45.090	45.495	44.598	15.181
45.025	45.058	45.248	41.703	41.249	36.001	47.130	45.200	45.495	44.598	15.197
44.984	45.046	45.207	41.546	41.162	35.679	47.100	45.212	44.901	44.598	15.214
44.839	45.022	45.265	41.406	40.970	35.539	47.147	45.199	44.901	44.598	15.231
44.984	45.149	45.131	41.347	40.889	35.276	47.124	45.241	44.901	44.598	15.247
44.977	45.126	45.073	41.231	40.773	35.036	47.042	45.246	44.901	44.598	15.264
44.988	45.103	45.050	41.115	40.638	34.715	47.088	45.222	44.901	44.598	15.281
44.931	45.050	45.067	40.905	40.324	34.585	47.135	45.141	44.901	44.598	15.297
44.833	45.102	45.038	40.689	40.352	34.264	47.047	45.147	44.901	44.598	15.314
44.896	45.085	45.026	40.620	40.131	34.099	47.076	45.194	44.901	44.598	15.331
44.954	45.102	44.985	40.538	39.991	33.778	47.094	45.223	44.901	44.598	15.347
44.982	45.067	44.979	40.398	39.962	33.584	47.071	45.212	44.811	44.508	15.364
44.929	45.073	44.880	40.299	39.729	33.221	47.094	45.223	44.811	44.508	15.381
44.917	45.125	44.817	40.095	39.555	33.004	47.123	45.293	44.811	44.598	15.397
44.917	45.044	44.759	40.002	39.502	32.665	47.059	45.207	44.901	44.508	15.414
45.056	45.073	44.817	39.821	39.333	32.361	47.059	45.254	44.217	44.508	15.431
44.940	45.084	44.741	39.751	39.164	32.173	47.106	45.225	44.217	43.914	15.447
45.009	45.038	44.648	39.500	38.989	31.810	47.054	45.185	44.307	43.914	15.464
44.922	44.967	44.607	39.309	38.831	31.539	47.048	45.172	44.217	43.914	15.481
45.008	45.038	44.584	39.192	38.732	31.264	47.071	45.190	44.217	43.914	15.497
44.893	45.043	44.613	39.034	38.598	30.971	46.990	45.214	44.217	43.914	15.514
44.829	45.118	44.636	38.854	38.317	30.718	46.979	45.185	44.217	43.914	15.531
44.882	45.037	44.566	38.644	38.184	30.425	47.042	45.179	44.217	43.914	15.547
44.916	45.031	44.502	38.603	37.998	30.214	47.042	45.197	44.217	43.914	15.564
44.904	45.060	44.461	38.376	37.793	29.938	47.031	45.110	44.217	43.914	15.581
44.916	45.002	44.374	38.271	37.642	29.650	46.927	45.220	44.217	43.825	15.597

A.2 Temperature measurement for the slab with embedded pipe (continued)

T1	T2	T3	T4	T5	T6	T7(Air)	T8	T9	T10	Time(h)
44.974	45.054	44.265	38.096	37.595	29.551	46.968	45.185	44.217	43.825	15.614
44.945	45.100	44.195	37.886	37.472	29.317	47.026	45.139	44.127	43.825	15.631
45.027	45.054	44.242	37.804	37.316	29.140	47.031	45.197	44.217	43.825	15.647
44.963	45.008	44.143	37.676	37.106	28.982	47.014	45.174	43.622	43.825	15.664
44.864	44.956	44.096	37.554	37.041	28.782	47.027	45.134	43.622	43.825	15.681
44.962	45.089	44.108	37.373	36.925	28.571	47.027	45.220	43.622	43.825	15.697
44.904	45.049	44.021	37.262	36.756	28.371	46.951	45.169	44.127	43.825	15.714
44.887	45.089	44.027	37.140	36.674	28.411	46.934	45.000	43.532	43.231	15.731
44.940	44.997	44.027	36.982	36.493	28.089	47.020	45.100	43.532	43.825	15.747
44.869	44.991	43.928	36.906	36.452	27.853	46.929	45.082	43.532	43.825	15.764
44.881	45.095	43.853	36.696	36.306	27.753	46.911	45.145	43.532	43.231	15.781
44.910	44.956	43.858	36.550	36.288	27.494	46.997	45.129	43.532	43.231	15.797
44.927	45.008	43.772	36.503	36.136	27.524	46.905	45.118	44.127	43.231	15.814
44.817	44.973	43.765	36.479	35.908	27.417	47.148	45.048	44.217	43.231	15.831
44.898	45.049	43.673	36.737	35.815	27.294	47.247	45.116	44.127	43.231	15.847
44.940	45.112	43.638	36.848	35.803	27.211	47.108	45.013	43.532	43.231	15.864
44.871	45.142	43.603	37.017	35.734	27.053	46.934	45.128	44.127	43.231	15.881
44.976	45.061	43.540	37.023	35.535	27.029	47.027	45.144	43.532	43.231	15.897
45.004	45.043	43.551	37.034	35.570	26.858	46.887	45.069	43.532	42.636	15.914
44.952	45.183	43.342	37.035	35.517	26.852	46.846	45.138	44.127	42.636	15.931
44.917	45.125	43.365	37.081	35.330	26.811	46.911	45.127	44.127	42.636	15.947
44.875	45.165	43.208	37.098	35.254	26.529	46.783	45.051	43.532	42.636	15.964
44.771	45.002	43.028	36.831	35.200	26.516	46.812	44.964	43.532	42.636	15.981
44.887	45.025	43.039	36.999	35.165	26.481	46.997	45.063	43.532	42.725	15.997
44.911	45.107	43.034	37.058	35.148	26.422	46.939	45.035	43.532	42.725	16.014
45.021	45.165	42.993	37.134	35.049	26.440	46.899	45.045	43.532	42.725	16.031
44.946	45.217	42.970	37.111	35.002	26.358	46.940	44.965	43.532	42.725	16.047
45.010	45.235	42.930	37.099	34.950	26.234	46.812	45.011	43.532	42.725	16.064
44.912	45.148	42.982	36.960	34.810	26.304	46.985	45.035	43.532	42.636	16.081
44.911	45.212	42.889	37.134	34.927	26.269	46.957	44.937	43.532	42.636	16.097
45.044	45.073	42.802	37.088	34.833	26.217	46.962	45.100	43.532	42.636	16.114
45.050	45.206	42.762	37.053	34.828	26.046	47.003	45.013	43.532	42.636	16.131
45.131	45.253	42.820	37.111	34.782	26.129	46.900	44.967	43.532	42.636	16.147
45.057	45.207	42.750	37.111	34.752	26.112	46.865	45.100	43.532	42.636	16.164
45.109	45.224	42.838	37.118	34.595	26.012	46.871	44.966	44.127	42.636	16.181
45.150	45.311	42.710	37.042	34.770	25.906	46.836	45.024	43.532	42.636	16.197
45.122	45.260	42.664	37.095	34.759	25.954	46.929	45.140	43.532	42.636	16.214
45.001	45.231	42.629	37.112	34.579	25.989	46.958	44.989	43.532	42.636	16.231
45.129	45.242	42.577	37.095	34.642	25.902	46.831	45.129	43.532	42.636	16.247

A.2 Temperature measurement for the slab with embedded pipe (continued)

T1	T2	T3	T4	T5	T6	T7(Air)	T8	T9	T10	Time(h)
45.141	45.231	42.583	37.095	34.578	25.854	46.976	45.101	44.127	42.636	16.264
45.147	45.196	42.565	37.095	34.578	25.884	47.069	45.014	43.532	42.636	16.281
45.147	45.381	42.606	37.066	34.578	25.913	46.965	45.113	43.532	42.636	16.297
45.030	45.260	42.524	37.106	34.543	25.866	46.930	45.084	43.532	42.546	16.314
45.163	45.242	42.524	37.060	34.461	25.753	46.959	45.095	44.127	42.546	16.331
45.227	45.336	42.466	37.077	34.561	25.784	46.994	45.153	44.127	42.546	16.347
45.139	45.312	42.373	37.060	34.572	25.754	47.052	45.170	43.532	41.951	16.364
45.174	45.358	42.408	37.153	34.619	25.753	47.075	45.084	43.532	42.636	16.381
45.179	45.369	42.437	37.166	34.519	25.736	47.070	45.078	43.532	42.546	16.397
45.266	45.225	42.408	37.119	34.455	25.630	47.052	45.113	44.127	42.546	16.414
45.243	45.358	42.432	37.124	34.443	25.665	46.988	45.102	44.127	42.546	16.431
45.266	45.329	42.350	37.153	34.415	25.606	47.121	45.172	43.532	41.951	16.447
45.203	45.364	42.478	37.171	34.409	25.671	47.122	45.132	43.532	41.951	16.464
45.266	45.341	42.304	37.095	34.367	25.554	47.093	45.154	43.532	41.951	16.481
45.262	45.307	42.350	37.113	34.421	25.566	47.140	45.236	44.127	42.546	16.497
45.285	45.434	42.368	37.096	34.468	25.525	47.164	45.150	44.127	42.546	16.514
45.308	45.376	42.333	37.120	34.381	25.561	47.170	45.185	44.127	41.951	16.531
45.336	45.434	42.176	37.125	34.451	25.467	47.048	45.213	44.127	42.546	16.547
45.452	45.486	42.339	37.213	34.509	25.455	47.349	45.191	44.127	41.951	16.564
45.342	45.417	42.229	37.178	34.480	25.461	47.123	45.173	44.037	41.951	16.581
45.313	45.486	42.269	37.160	34.427	25.426	47.141	45.150	44.127	41.951	16.597
45.336	45.463	42.257	37.242	34.340	25.426	47.273	45.259	44.037	42.546	16.614
45.429	45.567	42.124	37.218	34.363	25.413	47.117	45.179	44.037	42.041	16.631
45.360	45.509	42.222	37.061	34.310	25.425	47.250	45.097	43.532	42.041	16.647
45.331	45.550	42.182	37.201	34.403	25.272	47.244	45.178	44.037	41.951	16.664
45.447	45.481	42.292	37.224	34.286	25.354	47.360	45.253	44.127	42.041	16.681
45.436	45.573	42.182	37.189	34.368	25.325	47.360	45.253	44.127	42.041	16.697
45.477	45.544	42.235	37.201	34.299	25.354	47.250	45.213	43.442	41.951	16.714
45.454	45.545	42.298	37.196	34.217	25.278	47.355	45.202	44.127	42.041	16.731
45.454	45.539	42.218	37.149	34.299	25.231	47.239	45.202	44.037	41.951	16.747
45.466	45.602	42.276	37.214	34.293	25.290	47.338	45.238	44.037	41.951	16.764
45.396	45.632	42.218	37.278	34.328	25.236	47.350	45.244	44.037	41.951	16.781
45.431	45.661	42.159	37.126	34.293	25.237	47.350	45.244	44.037	41.951	16.797
45.413	45.539	42.241	37.272	34.252	25.273	47.419	45.279	44.127	41.951	16.814
45.524	45.737	42.229	37.254	34.399	25.273	47.356	45.302	44.127	42.546	16.831
45.500	45.580	42.177	37.243	34.300	25.243	47.362	45.315	44.127	41.951	16.847
45.518	45.586	42.206	37.184	34.294	25.160	47.368	45.280	44.037	41.951	16.864
45.320	45.621	42.154	37.190	34.276	25.149	47.333	45.262	44.037	41.951	16.881
45.465	45.661	42.096	37.161	34.223	25.096	47.322	45.279	44.037	41.951	16.897

A.2 Temperature measurement for the slab with embedded pipe (continued)

T1	T2	T3	T4	T5	T6	T7(Air)	T8	T9	T10	Time(h)
45.546	45.632	42.050	37.155	34.269	25.131	47.263	45.238	44.037	41.951	16.914
45.483	45.638	42.096	37.254	34.176	25.131	47.356	45.296	44.037	41.951	16.931
45.594	45.638	42.201	37.290	34.258	25.055	47.524	45.302	44.037	41.951	16.947
45.495	45.754	42.166	37.290	34.235	25.131	47.454	45.203	44.037	41.862	16.964
45.595	45.789	42.166	37.226	34.230	25.178	47.431	45.301	44.037	41.862	16.981
45.594	45.650	42.038	37.214	34.247	25.079	47.455	45.377	44.037	41.951	16.997
45.657	45.801	42.155	37.255	34.282	25.102	47.449	45.308	44.037	41.951	17.014
45.571	45.795	42.189	37.267	34.294	25.079	47.449	45.302	44.037	42.457	17.031
45.595	45.766	42.091	37.255	34.241	25.008	47.501	45.285	44.037	42.457	17.047
45.642	45.761	42.126	37.232	34.230	25.049	47.541	45.290	44.037	41.862	17.064
45.660	45.761	42.050	37.313	34.171	24.973	47.513	45.290	44.037	41.862	17.081
45.573	45.790	42.009	37.138	34.148	24.961	47.426	45.209	44.037	41.862	17.097
45.659	45.773	42.131	37.290	34.106	24.937	47.500	45.365	44.037	41.951	17.114
45.683	45.755	41.998	37.232	34.212	24.913	47.448	45.329	44.037	41.951	17.131
45.712	45.698	42.073	37.290	34.224	24.790	47.524	45.336	44.037	41.951	17.147
45.689	45.824	42.114	37.279	34.230	24.795	47.668	45.343	44.037	41.951	17.164
45.654	45.779	42.004	37.226	34.183	24.701	47.553	45.342	44.037	41.951	17.181
45.770	45.703	42.026	37.319	34.230	24.607	47.576	45.401	44.037	41.951	17.197
45.543	45.801	42.027	37.313	34.101	24.642	47.704	45.343	44.037	41.951	17.214
45.687	45.842	41.945	37.273	34.142	24.537	47.693	45.435	44.037	41.951	17.231
45.740	45.819	42.085	37.262	34.068	24.466	47.595	45.396	44.037	41.860	17.247
45.814	45.853	41.987	37.308	34.068	24.466	47.704	45.396	44.037	41.840	17.264
45.739	45.860	42.027	37.256	33.991	24.325	47.629	45.367	44.037	41.821	17.281
45.727	45.755	42.079	37.203	33.927	24.248	47.588	45.454	44.037	41.802	17.297
45.762	45.969	41.987	37.139	34.008	24.230	47.675	45.395	44.037	41.783	17.314
45.832	45.882	41.992	37.267	33.950	24.348	47.681	45.441	44.037	41.763	17.331
45.711	45.946	42.027	37.203	33.933	24.289	47.762	45.447	44.037	41.744	17.347
45.850	45.923	41.981	37.162	33.961	24.283	47.740	45.431	44.037	41.725	17.364
45.843	45.866	42.004	37.116	34.001	24.319	47.711	45.396	44.037	41.705	17.381
45.821	45.824	42.016	37.220	33.844	24.212	47.716	45.367	44.037	41.686	17.397
45.814	45.935	41.998	37.151	33.832	24.201	47.693	45.402	44.037	41.667	17.414
45.837	45.981	41.987	37.151	33.984	24.219	47.768	45.454	44.037	41.647	17.431
45.947	45.923	41.963	37.185	33.873	24.130	47.768	45.378	44.037	41.628	17.447
45.774	45.940	42.015	37.057	33.844	24.106	47.832	45.367	44.037	41.609	17.464
45.872	45.940	41.963	37.255	33.885	24.171	47.803	45.431	44.037	41.590	17.481
45.936	46.051	41.987	37.121	33.844	23.983	47.699	45.443	44.037	41.570	17.497
45.959	46.022	41.905	37.168	33.849	24.088	47.670	45.436	44.037	41.551	17.514
45.977	46.017	42.021	37.209	33.897	24.053	47.768	45.547	44.037	41.532	17.531
45.937	46.046	42.039	37.203	33.897	24.042	47.797	45.536	44.037	41.512	17.547

A.2 Temperature measurement for the slab with embedded pipe (continued)

T1	T2	T3	T4	T5	T6	T7(Air)	T8	T9	T10	Time(h)
45.734	46.022	42.015	37.139	33.791	24.083	47.786	45.490	44.037	41.493	17.564
45.792	46.022	41.911	37.121	33.827	24.129	47.850	45.403	44.037	41.474	17.581
45.803	46.004	42.021	37.220	33.774	24.083	47.839	45.466	44.037	41.455	17.597
45.872	46.004	41.998	37.075	33.827	24.083	47.746	45.367	44.037	41.435	17.614
45.948	46.051	41.934	37.180	33.874	24.130	47.902	45.582	44.037	41.416	17.631
45.885	46.091	41.981	37.128	33.845	24.154	47.862	45.450	44.037	41.397	17.647
45.896	46.034	41.911	37.099	33.775	24.013	47.822	45.601	44.037	41.377	17.664
45.930	46.133	41.899	37.186	33.722	24.184	47.851	45.555	44.037	41.358	17.681
45.838	46.121	41.941	37.128	33.815	24.113	47.742	45.451	44.037	41.339	17.697
45.947	46.097	41.888	37.122	33.815	24.143	47.811	45.543	44.037	41.319	17.714
45.942	46.034	41.848	37.163	33.863	24.089	47.867	45.613	44.037	41.300	17.731
45.936	46.097	42.010	37.256	33.815	24.084	47.949	45.584	44.037	41.281	17.747
46.075	46.115	41.952	37.198	33.786	24.119	47.816	45.613	44.037	41.262	17.764
46.046	46.150	41.888	37.198	33.832	24.178	47.903	45.670	44.037	41.242	17.781
46.005	46.155	41.917	37.239	33.856	24.165	47.880	45.607	44.037	41.223	17.797
46.058	46.208	41.912	37.117	33.839	24.119	47.822	45.461	44.037	41.204	17.814
45.959	46.074	41.929	37.280	33.822	24.154	47.804	45.553	44.037	41.184	17.831
45.947	46.097	42.009	37.175	33.839	24.171	47.896	45.473	44.037	41.165	17.847
46.069	46.242	41.975	37.233	33.815	24.148	47.839	45.501	44.037	41.146	17.864
45.930	46.167	41.882	37.164	33.832	24.042	47.757	45.437	44.037	41.127	17.881
46.115	46.155	41.841	37.198	33.815	23.988	47.937	45.581	44.037	41.107	17.897
45.959	46.201	41.998	37.209	33.838	23.929	47.855	45.523	44.037	41.088	17.914
45.982	46.120	41.875	37.238	33.815	24.047	47.924	45.605	44.037	41.069	17.931
46.121	46.138	41.951	37.273	33.791	24.006	47.924	45.592	44.037	41.049	17.947
46.092	46.056	41.904	37.179	33.849	23.947	47.866	45.562	44.037	41.030	17.964
46.099	46.126	41.910	37.313	33.849	24.017	47.947	45.517	44.037	41.011	17.981
46.116	46.276	41.933	37.261	33.744	24.069	47.907	45.579	44.037	40.992	17.997
46.200	46.225	42.021	37.226	33.727	24.076	47.958	45.585	44.037	40.972	18.014
46.097	46.242	41.958	37.262	33.791	23.923	47.894	45.503	44.037	40.953	18.031
46.085	46.225	41.945	37.232	33.756	23.899	47.918	45.549	44.037	40.934	18.047
46.136	46.254	41.841	37.272	33.744	23.716	47.894	45.537	44.037	40.914	18.064
46.144	46.191	41.887	37.337	33.762	23.528	47.964	45.560	44.037	40.895	18.081
46.057	46.213	41.829	37.249	33.679	23.439	47.928	45.571	44.037	40.876	18.097
46.144	46.219	41.881	37.226	33.627	23.332	47.934	45.617	44.037	40.856	18.114
46.173	46.208	41.957	37.319	33.674	23.379	48.003	45.566	44.037	40.837	18.131
46.120	46.266	41.864	37.115	33.539	23.390	47.991	45.531	44.037	40.818	18.147
46.061	46.202	41.824	37.243	33.649	23.172	48.003	45.513	44.037	40.799	18.164
46.177	46.150	41.899	37.132	33.596	23.171	47.974	45.571	44.037	40.779	18.181
46.065	46.190	41.794	37.021	33.509	23.142	48.003	45.584	44.037	40.760	18.197

A.2 Temperature measurement for the slab with embedded pipe (continued)

T1	T2	T3	T4	T5	T6	T7(Air)	T8	T9	T10	Time(h)
46.059	46.196	41.794	37.097	33.450	23.247	47.956	45.624	44.037	40.741	18.214
46.140	46.317	41.794	37.079	33.485	23.166	48.049	45.624	44.037	40.721	18.231
46.100	46.283	41.828	36.962	33.497	23.125	48.020	45.630	44.037	40.702	18.247
46.094	46.218	41.945	37.015	33.433	23.166	47.997	45.619	44.037	40.683	18.264
46.193	46.276	41.904	37.114	33.358	23.172	48.072	45.630	44.037	40.664	18.281
46.229	46.265	41.794	36.951	33.415	23.184	47.986	45.630	44.037	40.644	18.297
46.131	46.283	41.887	37.004	33.398	23.255	48.045	45.567	44.037	40.625	18.314
46.183	46.375	41.835	37.021	33.363	23.349	47.974	45.595	44.037	40.606	18.331
46.149	46.329	41.904	37.027	33.381	23.285	48.055	45.584	44.037	40.586	18.347
46.226	46.289	41.887	37.039	33.334	23.202	48.078	45.613	44.037	40.567	18.364
46.121	46.278	41.922	37.068	33.357	23.272	48.113	45.606	44.037	40.548	18.381
46.196	46.300	41.904	37.004	33.427	23.255	48.090	45.601	44.037	40.528	18.397
46.294	46.452	41.992	37.109	33.398	23.261	47.980	45.619	44.037	40.509	18.414
46.389	46.406	41.870	37.173	33.416	23.327	48.090	45.642	44.037	40.490	18.431
46.292	46.382	41.766	37.063	33.399	23.345	48.102	45.723	44.037	40.471	18.447
46.327	46.349	41.883	37.121	33.411	23.352	48.103	45.695	44.037	40.451	18.464
46.176	46.487	41.877	37.081	33.446	23.345	48.079	45.619	44.037	40.432	18.481
46.296	46.320	41.807	37.109	33.353	23.274	48.096	45.677	44.037	40.413	18.497
46.267	46.395	41.895	37.151	33.428	23.280	48.096	45.746	44.037	40.393	18.514
46.279	46.407	41.836	37.134	33.487	23.291	47.992	45.590	44.037	40.374	18.531
46.183	46.401	41.848	37.087	33.376	23.315	48.068	45.562	44.037	40.355	18.547
46.215	46.349	41.744	36.994	33.341	23.286	47.987	45.677	44.037	40.336	18.564
46.232	46.430	41.795	37.075	33.422	23.262	48.062	45.735	44.037	40.316	18.581
46.289	46.349	41.801	37.151	33.387	23.190	48.062	45.793	44.037	40.297	18.597
46.301	46.389	41.801	37.180	33.381	23.102	48.045	45.706	44.037	40.278	18.614
46.261	46.430	41.778	37.011	33.405	23.221	48.115	45.707	44.037	40.258	18.631
46.214	46.418	41.708	37.092	33.352	23.020	48.108	45.706	44.037	40.239	18.647
46.167	46.377	41.888	37.087	33.370	23.090	48.166	45.672	44.037	40.220	18.664
46.282	46.359	41.754	37.109	33.323	23.102	48.212	45.804	44.037	40.200	18.681
46.333	46.452	41.702	37.056	33.422	23.054	48.131	45.734	44.037	40.181	18.697
46.253	46.440	41.882	37.109	33.334	23.089	48.229	45.694	44.037	40.162	18.714
46.346	46.388	41.736	37.056	33.380	23.030	48.182	45.653	44.037	40.143	18.731
46.335	46.399	41.765	37.068	33.270	22.995	48.118	45.740	44.037	40.123	18.747
46.244	46.382	41.783	37.087	33.392	23.043	48.188	45.723	44.037	40.104	18.764
46.349	46.464	41.765	37.074	33.422	22.884	48.194	45.804	44.037	40.085	18.781
46.349	46.406	41.778	37.109	33.317	22.919	48.206	45.787	44.037	40.065	18.797
46.355	46.458	41.783	37.098	33.375	22.913	48.206	45.769	44.037	40.046	18.814
46.304	46.366	41.865	37.098	33.317	22.919	48.194	45.664	44.037	40.027	18.831
46.305	46.440	41.743	37.028	33.358	22.896	48.113	45.681	44.037	40.008	18.847

A.2 Temperature measurement for the slab with embedded pipe (continued)

T1	T2	T3	T4	T5	T6	T7(Air)	T8	T9	T10	Time(h)
46.305	46.429	41.743	36.963	33.281	22.847	48.118	45.733	44.037	39.988	18.864
46.315	46.475	41.702	37.051	33.327	22.842	48.055	45.733	44.037	39.969	18.881
46.263	46.440	41.794	37.138	33.299	22.853	48.222	45.716	44.037	39.950	18.897
46.379	46.510	41.876	37.162	33.282	22.894	48.274	45.769	44.037	39.930	18.914
46.420	46.568	41.772	37.098	33.375	22.866	48.234	45.798	44.037	39.911	18.931
46.443	46.510	41.748	37.109	33.311	22.930	48.136	45.885	44.037	39.892	18.947
46.310	46.516	41.690	37.098	33.370	22.866	48.223	45.838	44.037	39.872	18.964
46.378	46.418	41.743	37.016	33.334	22.871	48.211	45.758	44.037	39.853	18.981
46.302	46.441	41.749	37.047	33.283	22.808	48.234	45.614	44.037	39.834	18.997
46.324	46.516	41.812	37.104	33.364	23.030	48.205	45.758	44.037	39.815	19.014
46.395	46.626	41.743	37.110	33.318	23.072	48.229	45.700	44.037	39.795	19.031
46.447	46.575	41.807	37.057	33.376	23.073	48.176	45.816	44.037	39.776	19.047
46.477	46.540	41.773	37.093	33.376	23.009	48.246	45.758	44.037	39.757	19.064
46.310	46.477	41.831	37.070	33.259	23.086	48.259	45.735	44.037	39.737	19.081
46.338	46.523	41.767	37.047	33.336	23.056	48.259	45.684	44.037	39.718	19.097
46.431	46.436	41.756	37.186	33.365	22.951	48.264	45.764	44.037	39.699	19.114
46.373	46.511	41.680	37.128	33.213	23.097	48.259	45.782	44.037	39.680	19.131
46.372	46.540	41.691	37.058	33.254	23.027	48.206	45.771	44.037	39.660	19.147
46.279	46.535	41.715	37.017	33.329	23.049	48.132	45.817	44.037	39.641	19.164
46.353	46.488	41.784	37.192	33.318	23.109	48.305	45.714	44.037	39.622	19.181
46.342	46.563	41.807	37.117	33.307	23.032	48.271	45.644	44.037	39.602	19.197
46.284	46.476	41.720	36.988	33.318	22.949	48.149	45.759	44.037	39.583	19.214
46.381	46.423	41.656	37.087	33.265	23.009	48.276	45.764	44.037	39.564	19.231
46.381	46.452	41.790	37.087	33.265	22.937	48.236	45.724	44.037	39.545	19.247
46.467	46.574	41.679	37.087	33.370	22.990	48.178	45.811	44.037	39.525	19.264
46.329	46.481	41.690	37.092	33.289	22.926	48.189	45.782	44.037	39.506	19.281
46.334	46.510	41.667	37.138	33.300	22.926	48.188	45.759	44.037	39.487	19.297
46.415	46.510	41.672	37.151	33.294	22.954	48.264	45.759	44.037	39.467	19.314
46.381	46.544	41.840	37.092	33.247	22.943	48.264	45.746	44.037	39.448	19.331
46.406	46.579	41.656	37.034	33.258	22.913	48.166	45.746	44.037	39.429	19.347
46.396	46.539	41.696	37.198	33.289	22.867	48.259	45.770	44.037	39.409	19.364
46.402	46.498	41.731	37.074	33.288	22.784	48.333	45.730	44.037	39.390	19.381
46.354	46.539	41.660	37.092	33.264	22.777	48.194	45.730	44.037	39.371	19.397
46.436	46.638	41.643	37.069	33.317	22.736	48.259	45.799	44.037	39.352	19.414
46.400	46.701	41.672	37.022	33.205	22.766	48.206	45.793	44.037	39.332	19.431
46.487	46.661	41.667	37.151	33.334	22.688	48.183	45.793	44.037	39.313	19.447
46.458	46.568	41.707	37.039	33.334	22.771	48.275	45.863	44.037	39.294	19.464
46.503	46.563	41.672	37.109	33.334	22.712	48.252	45.846	44.037	39.274	19.481
46.492	46.504	41.678	37.027	33.246	22.705	48.293	45.898	44.037	39.255	19.497

A.2 Temperature measurement for the slab with embedded pipe (continued)

T1	T2	T3	T4	T5	T6	T7(Air)	T8	T9	T10	Time(h)
46.473	46.649	41.765	37.034	33.288	22.783	48.311	45.841	44.037	39.197	19.547
46.620	46.737	41.883	37.274	33.325	22.920	48.445	46.034	44.037	39.178	19.564
46.578	46.854	41.908	37.363	33.474	23.142	48.442	46.067	44.037	39.159	19.581
46.482	46.762	41.851	37.265	33.423	22.979	48.460	45.920	44.037	39.139	19.597
46.605	46.677	41.817	37.255	33.401	22.921	48.328	45.909	44.037	39.120	19.614
46.533	46.648	41.741	37.133	33.365	22.833	48.248	45.909	44.037	39.101	19.631
46.406	46.671	41.759	37.215	33.231	22.867	48.358	45.804	44.037	39.081	19.647
46.434	46.711	41.712	37.069	33.259	22.825	48.289	45.716	44.037	39.062	19.664
46.468	46.572	41.735	37.068	33.235	22.855	48.294	45.803	44.037	39.043	19.681
46.485	46.618	41.711	37.172	33.223	22.754	48.253	45.744	44.037	39.024	19.697
46.543	46.572	41.682	37.103	33.188	22.838	48.328	45.784	44.037	39.004	19.714
46.469	46.612	41.589	37.149	33.170	22.848	48.253	45.720	44.037	38.985	19.731
46.538	46.710	41.746	37.038	33.286	22.842	48.219	45.771	44.037	38.966	19.747
46.434	46.577	41.705	37.090	33.216	22.842	48.270	45.800	44.037	38.946	19.764
46.463	46.589	41.659	37.114	33.193	22.824	48.334	45.811	44.037	38.927	19.781
46.516	46.601	41.740	37.038	33.216	22.854	48.304	45.822	44.037	38.908	19.797
46.469	46.577	41.734	37.125	33.257	22.765	48.356	45.775	44.037	38.889	19.814
46.512	46.571	41.676	37.130	33.274	22.876	48.269	45.815	44.037	38.869	19.831
46.402	46.675	41.711	37.120	33.327	22.906	48.298	45.815	44.037	38.850	19.847
46.908	46.723	41.876	37.378	33.440	23.132	48.525	46.008	44.037	38.831	19.864
48.238	47.816	42.799	38.414	34.062	23.869	49.219	46.478	44.037	38.811	19.881
47.590	47.694	42.512	38.167	33.986	23.747	49.058	46.352	44.037	38.792	19.897
46.855	47.308	42.308	37.776	33.657	23.365	48.740	46.189	44.037	38.773	19.914
46.754	47.002	42.036	37.509	33.541	23.218	48.594	45.896	44.037	38.753	19.931
46.788	46.969	41.961	37.440	33.558	23.241	48.428	46.035	44.037	38.734	19.947
46.609	46.842	41.787	37.301	33.452	23.075	48.481	45.805	44.037	38.715	19.964
46.435	46.674	41.780	37.236	33.352	22.808	48.487	45.802	44.037	38.696	19.981
46.378	46.747	41.680	37.130	33.217	22.742	48.313	45.748	44.037	38.676	19.997
46.436	46.654	41.668	37.059	33.192	22.658	48.279	45.758	44.037	38.657	20.014
46.478	46.624	41.556	37.051	33.162	22.438	48.267	45.726	44.037	38.638	20.031
46.318	46.500	41.561	37.034	33.073	22.419	48.231	45.725	44.037	38.618	20.047
46.442	46.510	41.507	36.985	33.076	22.359	48.207	45.782	44.037	38.599	20.064
46.421	46.548	41.929	36.978	33.133	22.345	48.275	45.670	44.037	38.580	20.081
46.424	46.536	41.562	36.925	33.003	22.231	48.238	45.807	44.037	38.561	20.097
46.503	46.581	41.498	36.941	33.014	22.200	48.262	45.690	44.037	38.541	20.114
46.484	46.591	41.509	36.906	33.042	22.193	48.215	45.722	44.037	38.522	20.131
46.390	46.630	41.647	36.806	33.030	22.174	48.191	45.692	44.037	38.503	20.147

A.2 Temperature measurement for the slab with embedded pipe (continued)

T1	T2	T3	T4	T5	T6	T7(Air)	T8	T9	T10	Time(h)
46.376	46.617	41.582	36.903	33.028	22.132	48.329	45.714	44.037	38.483	20.164
46.368	46.552	41.575	36.815	32.963	22.178	48.229	45.765	44.037	38.464	20.181
46.501	46.603	41.661	36.861	32.968	22.101	48.252	45.838	44.037	38.445	20.197
46.563	46.695	41.673	36.964	32.950	22.189	48.227	45.850	44.037	38.425	20.214
46.430	46.613	41.631	36.754	32.930	22.188	48.302	45.745	44.037	38.406	20.231
46.417	46.588	41.531	36.870	32.936	22.140	48.237	45.835	44.037	38.387	20.247
46.440	46.663	41.629	36.805	32.982	22.139	48.346	45.753	44.037	38.368	20.264
46.410	46.610	41.524	36.798	32.853	22.137	48.172	45.742	44.037	38.348	20.281
46.467	46.708	41.605	36.822	32.853	22.197	48.275	45.707	44.037	38.329	20.297
46.512	46.672	41.611	36.827	32.946	22.433	48.350	45.823	44.037	38.310	20.314
46.454	46.759	41.633	36.908	32.946	22.415	48.402	45.719	44.037	38.290	20.331
46.592	46.660	41.499	36.931	32.857	22.432	48.240	45.776	44.037	38.271	20.347
46.539	46.712	41.689	36.895	32.933	22.426	48.309	45.747	44.037	38.252	20.364
46.574	46.676	41.521	36.906	33.049	22.395	48.331	45.763	44.037	38.233	20.381
46.556	46.745	41.474	36.801	32.914	22.413	48.290	45.791	44.037	38.213	20.397
46.661	46.617	41.572	36.929	32.948	22.311	48.364	45.813	44.037	38.194	20.414
46.550	46.710	41.635	36.916	32.983	22.399	48.415	45.801	44.037	38.175	20.431
46.520	46.680	41.554	36.893	33.029	22.381	48.329	45.812	44.037	38.155	20.447
46.531	46.732	41.583	37.003	32.988	22.386	48.369	45.823	44.037	38.136	20.464
46.588	46.702	41.600	36.996	33.016	22.315	48.345	45.887	44.037	38.117	20.481
46.565	46.737	41.518	37.066	33.046	22.374	48.299	45.869	44.037	38.097	20.497
46.529	46.661	41.628	36.949	33.074	22.397	48.315	45.868	44.037	38.078	20.514
46.552	46.689	41.557	37.041	33.045	22.438	48.343	45.775	44.037	38.059	20.531
46.592	46.730	41.603	36.884	32.927	22.467	48.367	45.769	44.037	38.040	20.547
46.598	46.695	41.609	37.011	32.956	22.419	48.377	45.820	44.037	38.020	20.564
46.471	46.567	41.573	36.942	32.991	22.442	48.342	45.819	44.037	38.001	20.581
46.482	46.682	41.608	36.993	32.885	22.406	48.365	45.766	44.037	37.982	20.597
46.465	46.739	41.468	36.923	33.018	22.388	48.335	45.782	44.037	37.962	20.614
46.546	46.594	41.526	36.817	33.000	22.392	48.311	45.643	44.037	37.943	20.631
46.516	46.669	41.530	36.916	32.988	22.428	48.345	45.815	44.037	37.924	20.647
46.515	46.622	41.472	36.897	33.098	22.428	48.345	45.809	44.037	37.905	20.664
46.532	46.721	41.553	36.874	33.028	22.286	48.373	45.802	44.037	37.885	20.681
46.467	46.743	41.518	36.891	33.027	22.344	48.320	45.779	44.037	37.866	20.697
46.507	46.633	41.552	36.902	32.998	22.343	48.447	45.726	44.037	37.847	20.714
46.554	46.719	41.616	36.919	33.090	22.384	48.325	45.760	44.037	37.827	20.731
46.532	46.679	41.598	36.948	32.979	22.253	48.492	45.818	44.037	37.808	20.747
46.507	46.708	41.546	36.942	33.084	22.282	48.463	45.945	44.037	37.789	20.764
46.548	46.742	41.517	37.006	33.148	22.347	48.382	45.822	44.037	37.770	20.781
46.692	46.701	41.626	36.947	33.107	22.335	48.595	45.817	44.037	37.750	20.797

A.2 Temperature measurement for the slab with embedded pipe (continued)

T1	T2	T3	T4	T5	T6	T7(Air)	T8	T9	T10	Time(h)
46.594	46.770	41.696	37.017	33.089	22.370	48.520	45.793	44.037	37.731	20.814
46.536	46.782	41.719	36.964	33.106	22.370	48.549	45.862	44.037	37.712	20.831
46.564	46.735	41.736	36.981	33.065	22.381	48.479	45.856	44.037	37.692	20.847
46.570	46.741	41.655	36.928	33.053	22.381	48.566	45.810	44.037	37.673	20.864
46.680	46.695	41.695	37.074	33.141	22.399	48.628	45.856	44.037	37.654	20.881
46.548	46.804	41.684	37.039	33.171	22.529	48.595	45.972	44.037	37.634	20.897
46.680	46.827	41.725	37.081	33.147	22.452	48.606	45.937	44.037	37.615	20.914
46.593	46.798	41.702	37.051	33.176	22.422	48.600	45.861	44.037	37.596	20.931
46.686	46.757	41.672	37.016	33.100	22.351	48.628	45.867	44.037	37.577	20.947
46.593	46.879	41.782	37.039	33.135	22.304	48.536	45.971	44.037	37.557	20.964
46.570	46.671	41.508	36.922	32.994	22.138	48.500	45.878	44.037	37.538	20.981
46.616	46.798	41.654	36.957	33.157	22.250	48.518	45.913	44.037	37.519	20.997
46.546	46.838	41.723	37.050	33.134	22.209	48.524	45.867	44.037	37.499	21.014
46.620	46.786	41.653	37.096	33.174	22.108	48.535	45.872	44.037	37.480	21.031
46.596	46.791	41.635	36.968	33.116	22.160	48.604	45.867	44.037	37.461	21.047
46.671	46.802	41.723	36.950	33.068	22.071	48.557	45.948	44.037	37.442	21.064
46.630	46.681	41.728	36.967	33.010	21.988	48.552	45.942	44.037	37.422	21.081
46.578	46.819	41.682	36.973	32.963	22.171	48.494	45.831	44.037	37.403	21.097
46.653	46.877	41.542	36.944	33.045	22.089	48.441	46.004	44.037	37.384	21.114
46.630	46.819	41.728	36.961	32.968	22.111	48.637	45.877	44.037	37.364	21.131
46.665	46.790	41.716	36.955	33.073	22.171	48.574	45.923	44.037	37.345	21.147
46.693	46.831	41.571	36.913	32.985	22.111	48.550	45.963	44.037	37.326	21.164
46.779	46.778	41.593	36.977	33.014	22.140	48.544	45.957	44.037	37.306	21.181
46.593	46.876	41.657	36.919	33.014	22.099	48.509	45.905	44.037	37.287	21.197
46.680	46.754	41.605	37.042	33.043	22.199	48.526	45.847	44.037	37.268	21.214
46.552	46.847	41.668	36.907	32.990	22.146	48.509	45.922	44.037	37.249	21.231
46.609	46.794	41.720	36.953	32.955	22.187	48.648	46.002	44.037	37.229	21.247
46.678	46.840	41.645	36.988	33.089	22.216	48.496	45.944	44.037	37.210	21.264
46.643	46.835	41.673	36.941	32.966	22.287	48.619	45.904	44.037	37.191	21.281
46.654	46.898	41.702	37.051	33.001	22.275	48.480	45.967	44.037	37.171	21.297
46.671	46.863	41.592	36.917	32.971	22.145	48.554	45.966	44.037	37.152	21.314
46.845	46.944	41.586	36.998	33.047	22.328	48.618	45.908	44.037	37.133	21.331
46.708	46.881	41.627	37.004	32.977	22.374	48.513	45.961	44.037	37.114	21.347
46.707	46.851	41.632	36.957	33.104	22.439	48.577	45.954	44.037	37.094	21.364
46.631	46.822	41.620	37.009	32.964	22.551	48.530	45.878	44.037	37.075	21.381
46.678	46.786	41.631	36.968	33.034	22.586	48.599	45.907	44.037	37.056	21.397
46.615	46.891	41.678	36.940	33.069	22.718	48.606	45.925	44.037	37.036	21.414
46.684	46.844	41.794	37.085	33.122	22.769	48.645	45.964	44.037	37.017	21.431
46.661	46.844	41.695	37.003	33.086	22.758	48.616	45.918	44.037	36.998	21.447

A.2 Temperature measurement for the slab with embedded pipe (continued)

T1	T2	T3	T4	T5	T6	T7(Air)	T8	T9	T10	Time(h)
46.747	46.850	41.619	37.044	33.139	22.769	48.667	45.992	44.037	36.978	21.464
46.713	46.914	41.718	37.079	33.190	22.798	48.540	45.946	44.037	36.959	21.481
46.743	46.931	41.683	37.102	33.197	22.875	48.563	45.830	44.037	36.940	21.497
46.736	46.803	41.660	37.066	33.243	22.838	48.447	45.881	44.037	36.921	21.514
46.805	46.977	41.665	37.183	33.225	22.998	48.556	45.984	44.037	36.901	21.531
46.823	46.925	41.711	37.212	33.190	22.944	48.654	45.920	44.037	36.882	21.547
46.876	47.001	41.753	37.358	33.324	23.003	48.533	45.920	44.037	36.863	21.564
46.896	46.943	41.712	37.282	33.331	22.910	48.596	45.920	44.037	36.843	21.581
46.816	47.164	41.969	37.452	33.595	23.045	48.735	46.059	44.037	36.824	21.597
46.795	47.089	41.766	37.482	33.479	23.012	48.932	46.085	44.037	36.805	21.614
46.737	47.026	41.883	37.354	33.457	23.019	48.732	45.959	44.037	36.786	21.631
46.725	46.881	41.778	37.349	33.404	22.882	48.748	45.959	44.037	36.766	21.647
46.734	46.893	41.650	37.302	33.538	22.853	48.714	46.028	44.037	36.747	21.664
46.681	46.852	41.702	37.319	33.432	22.899	48.783	45.923	44.037	36.728	21.681
46.518	46.735	41.562	37.079	33.186	22.680	48.396	45.720	44.037	36.708	21.697
46.807	46.938	41.666	37.341	33.414	22.798	48.667	45.963	44.037	36.689	21.714
46.710	46.984	41.806	37.388	33.425	22.775	48.765	45.940	44.037	36.670	21.731
46.831	46.915	41.835	37.377	33.456	22.746	48.841	46.115	44.037	36.650	21.747
46.663	46.996	41.789	37.366	33.339	22.787	48.726	46.075	44.037	36.631	21.764
46.651	46.885	41.782	37.260	33.326	22.610	48.657	45.947	44.037	36.612	21.781
46.639	46.885	41.724	37.190	33.286	22.568	48.633	45.946	44.037	36.593	21.797
46.819	46.961	41.916	37.289	33.379	22.758	48.824	46.075	44.037	36.573	21.814
46.787	46.926	41.847	37.336	33.345	22.835	48.818	46.030	44.037	36.554	21.831
46.788	47.066	41.848	37.332	33.335	22.942	48.802	46.066	44.037	36.535	21.847
46.825	47.062	41.820	37.490	33.400	22.962	48.797	46.096	44.037	36.515	21.864
46.542	46.743	41.663	37.128	33.008	22.649	48.444	45.812	44.037	36.496	21.881
46.679	46.888	41.749	37.298	33.254	22.873	48.740	45.928	44.037	36.477	21.897
46.742	46.917	41.738	37.251	33.329	22.825	48.543	45.898	44.037	36.458	21.914
46.566	46.800	41.720	37.198	33.288	22.830	48.583	45.892	44.037	36.438	21.931
46.710	46.956	41.813	37.186	33.317	22.912	48.600	45.966	44.037	36.419	21.947
46.843	46.846	41.836	37.325	33.445	22.871	48.680	46.007	44.037	36.400	21.964
46.767	46.857	41.765	37.296	33.357	22.846	48.744	46.001	44.037	36.380	21.981
46.686	46.903	41.765	37.254	33.304	22.864	48.720	45.878	44.037	36.361	21.997
46.731	46.914	41.719	37.260	33.309	22.704	48.760	45.918	44.037	36.342	22.014
46.686	46.897	41.736	37.207	33.273	22.721	48.638	45.859	44.037	36.323	22.031
46.615	46.885	41.683	37.207	33.302	22.579	48.649	45.881	44.037	36.303	22.047
46.606	46.897	41.690	37.231	33.296	22.461	48.615	45.968	44.037	36.284	22.064
46.859	47.087	41.892	37.341	33.349	22.567	48.690	46.026	44.037	36.265	22.081
46.855	46.949	41.834	37.277	33.308	22.455	48.753	45.893	44.037	36.245	22.097

A.2 Temperature measurement for the slab with embedded pipe (continued)

T1	T2	T3	T4	T5	T6	T7(Air)	T8	T9	T10	Time(h)
46.715	46.972	41.787	37.283	33.203	22.378	48.655	45.968	44.037	36.226	22.114
46.680	46.914	41.764	37.207	33.173	22.401	48.661	45.957	44.037	36.207	22.131
46.736	46.902	41.706	37.130	33.207	22.412	48.661	46.159	44.037	36.187	22.147
46.683	46.942	41.711	37.112	33.113	22.288	48.665	45.996	44.037	36.168	22.164
46.700	46.959	41.798	37.082	33.159	22.216	48.555	46.001	44.037	36.149	22.181
46.752	46.947	41.780	37.187	33.066	22.274	48.578	45.925	44.037	36.130	22.197
46.740	46.883	41.763	37.070	33.019	22.245	48.623	45.889	44.037	36.110	22.214
46.773	46.923	41.745	37.151	32.983	22.268	48.599	45.953	44.037	36.091	22.231
46.732	46.929	41.634	37.093	33.106	22.268	48.686	46.033	44.037	36.072	22.247
46.605	47.015	41.721	37.052	33.146	22.303	48.553	45.993	44.037	36.052	22.264
46.801	47.027	41.756	37.110	33.123	22.327	48.570	46.080	44.037	36.033	22.281
46.732	47.015	41.715	37.069	33.088	22.392	48.639	46.080	44.037	36.014	22.297
46.744	46.974	41.709	37.134	33.093	22.427	48.622	46.091	44.037	35.995	22.314
46.673	47.021	41.662	37.086	33.134	22.420	48.604	45.999	44.037	35.975	22.331
46.690	46.968	41.639	37.080	33.157	22.402	48.512	46.033	44.037	35.956	22.347
46.661	46.823	41.749	37.150	33.046	22.615	48.615	45.969	44.037	35.937	22.364
46.777	46.933	41.714	37.214	33.087	22.609	48.684	46.043	44.037	35.917	22.381
46.788	46.997	41.760	37.254	33.151	22.556	48.650	46.027	44.037	35.898	22.397
46.788	47.003	41.691	37.266	33.145	22.620	48.673	46.003	44.037	35.879	22.414
46.747	46.996	41.691	37.161	33.256	22.550	48.569	46.009	44.037	35.859	22.431
46.759	46.927	41.748	37.213	33.296	22.597	48.557	46.049	44.037	35.840	22.447
46.683	46.955	41.766	37.213	33.261	22.614	48.574	46.020	44.037	35.821	22.464
46.769	46.978	41.753	37.207	33.161	22.495	48.765	45.997	44.037	35.802	22.481
46.850	47.001	41.800	37.254	33.266	22.589	48.729	46.059	44.037	35.782	22.497
47.018	47.094	41.707	37.254	33.296	22.537	48.765	46.106	44.037	35.763	22.514
46.846	47.094	41.731	37.271	33.343	22.507	48.776	46.210	44.037	35.744	22.531
46.911	47.152	41.794	37.387	33.284	22.601	48.787	46.025	44.037	35.724	22.547
46.830	47.106	41.789	37.347	33.308	22.596	48.700	46.042	44.037	35.705	22.564
46.863	47.065	41.742	37.265	33.372	22.483	48.758	46.036	44.037	35.686	22.581
46.864	47.042	41.742	37.265	33.255	22.454	48.654	46.076	44.037	35.667	22.597
46.893	46.955	41.823	37.271	33.325	22.595	48.717	46.018	44.037	35.647	22.614
46.876	47.065	41.742	37.288	33.324	22.524	48.618	46.034	44.037	35.628	22.631
46.801	47.012	41.695	37.264	33.300	22.453	48.647	46.041	44.037	35.609	22.647
46.973	47.007	41.776	37.147	33.242	22.735	48.687	46.044	44.037	35.589	22.664
46.817	46.995	41.805	37.246	33.347	22.705	48.715	46.026	44.037	35.570	22.681
46.967	46.995	41.787	37.258	33.259	22.676	48.739	46.044	44.037	35.551	22.697
46.810	47.116	41.764	37.339	33.364	22.546	48.842	46.090	44.037	35.531	22.714
46.840	46.971	41.741	37.263	33.318	22.587	48.750	46.073	44.037	35.512	22.731
46.921	47.046	41.868	37.380	33.340	22.617	48.797	46.056	44.037	35.493	22.747

A.2 Temperature measurement for the slab with embedded pipe (continued)

T1	T2	T3	T4	T5	T6	T7(Air)	T8	T9	T10	Time(h)
46.906	47.093	41.857	37.246	33.329	22.718	48.640	46.003	44.037	35.474	22.764
46.855	47.099	41.794	37.269	33.329	22.706	48.732	46.130	44.037	35.454	22.781
46.994	46.983	41.793	37.287	33.212	22.682	48.848	46.096	44.037	35.435	22.797
46.884	46.949	41.863	37.327	33.241	22.587	48.813	46.101	44.037	35.416	22.814
46.894	46.995	41.700	37.216	33.381	22.534	48.772	46.113	44.037	35.396	22.831
46.910	47.024	41.816	37.344	33.392	22.516	48.899	46.171	44.037	35.377	22.847
46.713	46.988	41.770	37.309	33.304	22.403	48.778	46.130	44.037	35.358	22.864
46.885	47.029	41.775	37.245	33.298	22.332	48.853	46.148	44.037	35.339	22.881
47.000	46.947	41.780	37.302	33.222	22.237	48.830	46.119	44.037	35.319	22.897
46.838	47.029	41.862	37.203	33.251	22.201	48.842	46.068	44.037	35.300	22.914
46.775	46.988	41.931	37.233	33.222	22.201	48.882	46.067	44.037	35.281	22.931
46.843	47.022	41.768	37.197	33.216	22.172	48.951	46.067	44.037	35.261	22.947
46.768	46.964	41.925	37.262	33.152	22.266	48.789	46.101	44.037	35.242	22.964
46.785	47.068	41.856	37.267	33.327	22.255	48.830	46.142	44.037	35.223	22.981
46.848	47.034	41.867	37.255	33.269	22.184	48.864	46.200	44.037	35.203	22.997
46.922	46.976	41.843	37.226	33.152	22.242	48.916	46.089	44.037	35.184	23.014
46.852	46.993	41.878	37.121	33.192	22.237	48.789	46.118	44.037	35.165	23.031
46.881	47.183	41.913	37.173	33.291	22.325	48.806	46.171	44.037	35.146	23.047
46.951	47.085	41.826	37.232	33.187	22.337	48.817	46.136	44.037	35.126	23.064
46.841	47.062	41.791	37.151	33.163	22.272	48.743	46.118	44.037	35.107	23.081
46.859	47.010	41.826	37.214	33.174	22.260	48.760	46.147	44.037	35.088	23.097
46.881	47.143	41.831	37.284	33.046	22.296	48.830	46.078	44.037	35.068	23.114
46.992	46.987	41.890	37.197	33.163	22.225	48.864	46.078	44.037	35.049	23.131
46.975	47.033	41.774	37.168	33.192	22.219	48.812	46.148	44.037	35.030	23.147
46.906	47.073	41.808	37.214	33.069	22.190	48.748	46.113	44.037	35.011	23.164
46.980	47.120	41.785	37.186	33.175	22.231	48.719	46.242	44.037	34.991	23.181
47.015	47.114	41.820	37.238	33.169	22.266	48.916	46.097	44.037	34.972	23.197
46.883	47.062	41.803	37.145	33.134	22.302	48.818	46.155	44.037	34.953	23.214
46.912	47.120	41.867	37.192	33.216	22.297	48.789	46.271	44.037	34.933	23.231
46.888	47.137	41.844	37.134	33.222	22.326	48.772	46.213	44.037	34.914	23.247
46.992	47.080	41.739	37.186	33.140	22.267	48.911	46.155	44.037	34.895	23.264
47.010	47.120	41.820	37.244	33.146	22.356	48.836	46.138	44.037	34.875	23.281
46.900	47.178	41.797	37.099	33.199	22.415	48.830	46.189	44.037	34.856	23.297
46.976	47.045	41.861	37.192	33.134	22.308	48.830	46.149	44.037	34.837	23.314
46.900	47.143	41.803	37.174	33.175	22.433	48.807	46.166	44.037	34.818	23.331
46.970	47.172	41.768	37.198	33.204	22.415	48.806	46.206	44.037	34.798	23.347
47.016	47.097	41.896	37.244	33.257	22.432	48.818	46.184	44.037	34.779	23.364
47.009	47.166	41.838	37.267	33.193	22.509	48.795	46.218	44.037	34.760	23.381
46.911	47.114	41.809	37.145	33.169	22.485	48.772	46.092	44.037	34.740	23.397

A.2 Temperature measurement for the slab with embedded pipe (continued)

T1	T2	T3	T4	T5	T6	T7(Air)	T8	T9	T10	Time(h)
46.939	47.190	41.873	37.233	33.187	22.539	48.865	46.179	44.037	34.721	23.414
46.888	47.154	41.826	37.209	33.270	22.598	48.871	46.208	44.037	34.702	23.431
46.870	47.039	41.820	37.209	33.210	22.581	48.750	46.173	44.037	34.683	23.447
46.928	47.091	41.791	37.326	33.322	22.716	48.935	46.191	44.037	34.663	23.464
46.678	47.102	41.744	37.168	33.227	22.609	48.605	46.091	44.037	34.644	23.481
46.823	47.200	41.873	37.331	33.322	22.752	48.698	46.237	44.037	34.625	23.497
46.951	47.120	41.762	37.238	33.281	22.723	48.808	46.260	44.037	34.605	23.514
46.865	47.051	41.780	37.378	33.387	22.811	48.802	46.075	44.037	34.586	23.531
46.980	47.097	41.802	37.373	33.287	22.758	48.699	46.226	44.037	34.567	23.547
46.934	47.207	41.809	37.262	33.422	22.782	48.739	46.208	44.037	34.548	23.564
46.922	47.085	41.838	37.367	33.363	22.758	48.739	46.086	44.037	34.528	23.581
46.928	47.212	41.867	37.250	33.392	22.829	48.681	46.173	44.037	34.509	23.597
46.980	47.056	41.867	37.396	33.393	22.835	48.820	46.110	44.037	34.490	23.614
47.086	47.271	41.850	37.432	33.428	22.877	48.768	46.231	44.037	34.470	23.631
46.960	47.271	41.862	37.403	33.405	22.960	48.756	46.301	44.037	34.451	23.647
46.932	47.185	41.734	37.386	33.370	22.948	48.809	46.198	44.037	34.432	23.664
46.839	47.202	41.810	37.409	33.435	22.996	48.711	46.209	44.037	34.412	23.681
46.878	47.098	41.827	37.391	33.464	23.013	48.687	46.185	44.037	34.393	23.697
46.942	47.133	41.827	37.426	33.475	22.878	48.716	46.099	44.037	34.374	23.714
46.861	47.196	41.821	37.327	33.470	22.984	48.664	46.192	44.037	34.355	23.731
46.878	47.127	41.833	36.609	33.457	22.860	45.762	46.221	44.037	34.335	23.747
46.930	47.127	41.525	35.773	33.335	22.871	40.662	46.203	44.037	34.316	23.764
46.682	46.988	41.140	34.727	32.637	22.835	36.113	46.082	44.037	34.297	23.781
46.496	47.034	40.704	33.948	31.928	22.752	35.113	46.023	44.037	34.277	23.797
46.385	46.877	40.232	33.386	31.306	22.692	35.229	45.918	44.037	34.258	23.814
46.176	46.888	39.964	32.777	30.841	22.668	35.264	45.912	44.037	34.239	23.831
46.007	46.888	39.707	32.290	30.442	22.673	34.896	45.894	44.037	34.220	23.847
45.944	46.777	39.392	31.932	29.978	22.745	34.615	45.864	44.037	34.200	23.864
45.915	46.714	39.171	31.545	29.597	22.679	35.568	45.738	44.037	34.200	23.881
45.649	46.621	38.938	31.141	29.362	22.609	35.358	45.743	44.037	34.200	23.897
45.713	46.541	38.851	30.900	29.057	22.568	35.802	45.599	44.037	34.200	23.914

Appendix B. ANOVA

One –Way ANOVA Analysis	n1		n2	
	slab without pipe		slab with pipe	
Rutting depth locations	at 16 in.	at 20 in.	at 16 in	at 20 in .
1	0.35	0.25	0.02	0.02
2	0.45	0.35	0.05	0.05
3	0.5	0.4	0.1	0.1
4	0.55	0.45	0.1	0.1
5	0.45	0.4	0.05	0.1
6	0.4	0.35	0.05	0.1
7	0.35	0.3	0.02	0.05
Mean slab without pipe,x'1	**0.396429**			
Mean slab with pipe, x'2	**0.065**			
n1, n2	**14**			
N	**28**			
k	**2**			
X''= ∑_xi/N,i=1-28	**0.230714**			
df	**13**			
variance1	**0.006332**			
variance2	**0.001119**			
α at the right tail	0.05			
SS total=∑(xi-x'')^2				
(x1-x'')^2	0.014229			
(x2-x'')^2	0.048086			
(x3-x'')^2	0.072515			
(x4-x'')^2	0.101943			
(x5-x'')^2	0.048086			
(x6-x'')^2	0.028658			
(x7-x'')^2	0.014229			
(x8-x'')^2	0.000372			
(x9-x'')^2	0.014229			
(x10-x'')^2	0.028658			
(x11-x'')^2	0.048086			
(x12-x'')^2	0.028658			
(x13-x'')^2	0.014229			
(x14-x'')^2	0.004801			
(x15-x'')^2	0.044401			
(x16-x'')^2	0.032658			

Appendix B.ANOVA (continued)

(x17-x'')^2	0.017086
(x18-x'')^2	0.017086
(x19-x'')^2	0.032658
(x20-x'')^2	0.032658
(x21-x'')^2	0.044401
(x22-x'')^2	0.044401
(x23-x'')^2	0.032658
(x24-x'')^2	0.017086
(x25-x'')^2	0.017086
(x26-x'')^2	0.017086
(x27-x'')^2	0.017086
(x28-x'')^2	0.032658
SS total=	**0.865786**
SStreatment =n1(x1'-x'')^2+n2(x2'-x'')^2	**0.768914**
SS erorr=(n1-1)S1^2+(n2-1)S2^2	**0.096871**
MS treatment= SStreatment/k-1	**0.768914**
MS error= SS error/N-k	**0.003726**
MS total = SS total/ N-1	**0.032066**
F = MS treatment/ MS error	**206.3743**
numerator degree = k-1	**1**
denominator= N-k	**26**
F distribution =	**4.2252**