

Discussion: Dr. N. W. McLeod's Paper  
on Rational Asphalt Specifications - C.T.A.A., 1981

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Dr. McLeod's paper contains much of the necessary components required for the rational approach to the specification and selection of paving asphalts. It can be seen that there are means available to select the most suitable material to cope with low temperatures, low and high volume traffic and with high service temperatures.

Confirmation of the temperature extremes which may be anticipated, at least on the Canadian prairies, and the attenuation of these extremes in lower pavement layers due to the relatively poor thermal conductivity of asphalt, is presented in this discussion in a series of charts and graphs.

This data is a summary of readings recorded at the Ste. Anne Test Road which was constructed and instrumented as a joint project of Shell Canada and the Manitoba Highways Department. The Test Road results have been widely reported upon during the past several years at this and other conferences. It was at the time and may still be the most thoroughly instrumented and observed test road built to study the effects of asphalt type on low temperature performance. A wide range of asphalts were used and the data proved that the low temperature properties of paving mixtures were almost exclusively imposed by the asphalt binder. Mix modification through the addition of fines had no effect and subgrade type only influenced crack spacing where cracks occurred.

The Manitoba experiment was a direct extension of several field trials, over a period of years, using 150/200, 200/300 and 300/400 asphalt cements and SC-5 liquid asphalt binders as well as trials with sawn joints and thick pavements. The only real success was with the SC-5 although cracking does occur after several years but with no affect on performance. The main thrust of these experiments was to reduce pavement cracking while using the lower viscosity and waxy crudes available.

Recently our approach has been changed toward asphalt cements of high penetration and higher viscosity to avoid use of SC-5 and thus conserve the energy available in the cutter stock.

The Test Road experiments also indicated that lower pavement layers containing asphalt of high temperature susceptibility could be protected by surface layers of pavement containing asphalt binder of low temperature susceptibility. The temperature data indicates that a similar approach could be employed to resist high temperature rutting.

It is hoped that work such as that undertaken by Saskatchewan, Shell Canada and Manitoba employing blown asphalts can continue so that a greater understanding of these asphalts can be gained. Experience to date indicates an improvement in low temperature performance of thin pavements (100 mm) even with low penetration asphalts. More research is needed before blown and blended asphalts can be suitably described in specifications to provide required properties.

Dr. McLeod is to be congratulated on his fine presentation which should provide strong support for the Canadian General Standards Board Specification which is to be discussed following this conference.

It is recognized that no single specification will satisfy the national needs due to climatic, traffic, soil, aggregate, equipment, budget and material availability differences. Our aim should be to provide a broad range of products with selection criteria which can account for regional differences and preferences.

We must not, however, lose sight of testing accuracy, a matter which will be covered in the report on the national asphalt and asphalt mix exchange. Nor should we attempt the introduction of new sophisticated testing methods and equipment for other than research purposes at this time.

Improvement and expansion of penetration and viscosity testing is a first priority and then comparisons of these values with pavement performance can lead to better selection of asphalt binders consistent with the other factors. This is not all that is required for all asphalts but is certainly an attainable first step.

Table 1. St. Anne Test Road Annual Summary May 1968 to April 1969 Temperatures in °F.

TR1

Level	Ambient		Pavement		Base Course			Clay Subgrade			
	3'0"	0'0"	0'2"	0'4"	1'6"	3'6"	5'6"	7'6"	9'6"	11'6"	12'6"
Range	3'0"	0'0"	0'2"	0'4"	1'6"	3'6"	5'6"	7'6"	9'6"	11'6"	12'6"
Maximum	88.0	120.2	—	92.0	77.2	69.2	—	51.0	—	48.5	—
Mean	33.9	41.7	—	42.0	42.2	40.1	—	40.2	—	39.4	—
Minimum	-41.0	-24.5	—	-12.0	-3.0	14.0	—	28.0	—	29.5	—

TR2

Level	Ambient		Pavement		Clay Subgrade						
	3'0"	0'0"	0'4"	0'7"	0'10"	2'0"	4'0"	6'0"	8'0"	10'0"	12'0"
Range	3'0"	0'0"	0'4"	0'7"	0'10"	2'0"	4'0"	6'0"	8'0"	10'0"	12'0"
Maximum	90.5	115.5	100.0	91.5	80.0	71.0	61.0	53.5	52.0	49.5	48.5
Mean	35.2	43.7	43.3	42.8	42.7	42.4	42.0	41.9	41.8	41.9	41.9
Minimum	-39.0	-21.0	-13.5	-10.5	-2.0	8.0	22.0	30.0	32.0	32.5	35.0

TR3

Level	Ambient		Pavement		Base	Sand Subgrade						
	3'0"	0'0"	0'2"	0'4"		1'7.5"	3'7"	5'6"	7'6"	9'7.5"	11'7.5"	12'0"
Range	3'0"	0'0"	0'2"	0'4"	Base	1'7.5"	3'7"	5'6"	7'6"	9'7.5"	11'7.5"	12'0"
Maximum	90.2	120.2	108.0	92.2	75.0	66.8	60.0	57.0	55.0	52.0	—	—
Mean	34.0	42.9	42.2	42.5	41.6	40.9	40.6	40.5	40.2	40.2	—	—
Minimum	-40.5	-21.0	-19.5	-16.0	1.0	11.0	22.0	28.0	29.0	31.0	—	—

Table 2. St. Anne Test Road Monthly Summary January 1968 to December 1968 Temperatures in °F

Level	TRL 4" Asphalt		16" Base Course		Clay Subgrade						
	Ambient		Pavement		Base Course		Clay Subgrade				
Month	3'0"	0'0"	0'2"	0'4"	1'6"	3'6"	5'6"	7'6"	9'6"	11'6"	12'6"
January	38.0	36.0	—	28.0	20.0	27.0	38.5	42.5	44.0	45.0	—
(max.)	-1.6	1.3	—	3.3	8.3	19.6	31.7	38.1	40.5	42.2	—
mean min.)	-45.0	-37.0	—	-24.5	-5.5	16.0	28.0	35.0	37.5	39.5	—
February	31.0	37.0	—	22.5	17.0	20.0	30.0	36.0	39.0	41.0	—
	-0.7	4.6	—	6.3	9.6	16.7	27.5	33.5	36.6	38.4	—
	-35.5	-23.0	—	-12.5	1.5	13.5	25.5	31.0	34.5	36.5	—
March	57.0	—	—	46.5	34.5	25.5	29.3	34.0	36.5	38.5	—
	24.5	—	—	27.0	24.2	21.7	27.4	32.4	35.2	37.1	—
	-21.0	—	—	7.0	14.0	16.0	25.4	31.0	32.0	36.0	—
April	74.0	102.0	—	—	—	—	—	—	—	—	—
	38.4	47.1	—	—	—	—	—	—	—	—	—
	1.0	13.0	—	—	—	—	—	—	—	—	—
May	79.5	101.8	—	74.0	61.0	44.8	43.0	36.2	—	38.0	39.0
	49.0	59.6	—	56.7	52.8	38.3	35.9	34.0	—	36.0	37.0
	17.5	30.5	—	39.0	43.6	28.0	29.5	32.0	—	35.0	36.0
June	87.2	112.3	—	86.2	72.0	58.8	49.8	41.8	39.0	39.8	39.5
	59.3	72.2	—	69.0	64.2	52.1	43.2	39.0	38.2	36.9	37.5
	32.0	44.0	—	56.0	51.0	39.5	39.0	36.0	35.5	36.0	35.0

Table 2 (cont'd.) St. Anne Test Road Monthly Summary January 1968 to December 1968 Temperatures in °F

Level	TRL 4" Asphalt			16" Base Course			Clay Subgrade				
	Ambient	Pavement		Base Course			Clay Subgrade				
Month	3'0"	0'0"	0'2"	0'4"	1'6"	3'6"	5'6"	7'6"	9'6"	11'6"	12'6"
July	88.0	120.2	—	92.0	77.2	69.2	53.8	47.0	43.0	41.2	41.5
	63.7	78.5	—	76.0	72.3	61.6	49.8	44.6	41.2	39.7	39.9
	37.8	46.0	—	55.8	61.5	55.0	45.5	41.5	39.2	38.0	37.0
August	85.0	112.0	—	88.2	77.0	67.2	59.5	50.0	46.0	45.0	44.0
	59.9	70.6	—	70.0	69.2	63.2	54.2	49.0	44.7	43.0	41.8
	34.0	45.0	—	55.2	62.2	60.0	53.0	47.0	43.0	41.0	37.8
September	84.0	101.5	—	80.0	74.0	64.0	57.5	51.0	50.0	47.0	—
	55.7	62.8	—	63.2	65.0	60.2	54.8	50.1	46.9	45.2	—
	32.3	39.5	—	49.0	52.0	56.0	53.5	50.0	45.0	44.0	—
October	67.5	76.0	—	61.0	61.5	58.0	55.0	50.5	—	48.5	—
	40.8	44.7	—	46.7	50.0	52.8	52.0	49.6	—	46.4	—
	19.5	26.0	—	35.5	40.5	47.0	48.0	48.0	—	45.0	—
November	48.0	52.0	—	45.0	49.0	52.0	51.0	48.5	—	47.0	—
	25.5	27.7	—	31.4	36.6	42.5	43.8	45.9	—	44.8	—
	-4.5	5.5	—	19.5	30.0	37.0	38.0	42.0	—	42.0	—
December	35.0	35.0	—	29.5	32.0	49.0	43.0	46.5	43.5	43.0	—
	3.2	6.6	—	12.6	19.3	31.3	37.1	40.4	41.6	41.0	—
	-33.0	-21.0	—	-8.0	0.5	19.0	33.0	37.0	40.0	38.0	—

Table 3. St. Anne Test Road Monthly Summary 1969 Temperatures in °F

Level	TR1 4" Asphalt			16" Base Course			Clay Subgrade				
	Ambient	Pavement		Base Course			Clay Subgrade				
Month	3'0"	0'0"	0'2"	0'4"	1'6"	3'6"	5'6"	7'6"	9'6"	11'6"	12'6"
January (max. mean min.)	25.5	20.0	—	16.5	14.0	30.0	—	39.0	40.5	40.5	—
	-8.2	-3.6	—	0.2	4.6	20.6	—	36.0	39.4	38.1	—
	-41.0	-23.5	—	-12.0	-2.0	16.0	—	32.0	37.5	35.5	—
February	39.5	45.5	—	27.0	23.5	22.0	—	39.0	38.0	38.0	—
	6.6	10.9	—	11.3	11.0	17.0	—	32.3	36.0	35.3	—
	-37.5	-24.5	—	-12.0	-3.0	14.0	—	28.5	—	—	—
March	39.5	55.0	—	30.0	27.0	25.0	—	—	35.0	35.0	—
	11.2	22.0	—	22.7	22.6	23.1	—	31.0	33.9	32.7	—
	-23.0	-6.5	—	10.0	17.0	21.5	—	24.5	32.5	29.5	—
April	67.0	90.5	—	64.5	58.0	33.5	—	32.0	33.0	35.0	—
	40.3	48.6	—	44.1	38.5	26.2	—	30.8	33.0	33.3	—
	-4.0	9.0	—	19.5	20.0	25.0	—	22.0	32.0	30.0	—
May	86.0	114.0	—	92.0	68.0	47.5	—	33.5	33.5	34.5	—
	48.8	60.4	—	58.4	54.9	39.6	—	31.4	33.0	34.2	—
	17.0	31.0	—	43.0	44.5	31.0	—	30.0	32.0	32.5	—
June	79.5	106.0	—	78.0	68.0	54.0	—	40.0	37.0	—	—
	51.9	65.3	—	63.1	60.3	50.5	—	37.2	35.1	35.4	—
	24.0	35.0	—	44.0	52.5	42.0	—	33.5	30.0	34.0	—

Table 3 (Cont'd.) St. Anne Test Road Monthly Summary 1969 Temperatures in °F

Level	TR1 4" Asphalt			16" Base Course			Clay Subgrade					
	Ambient	0'0"	Pavement	0'2"	0'4"	1'6"	3'6"	5'6"	7'6"	9'6"	11'6"	12'6"
Month	3'0"	0'0"		0'2"	0'4"	1'6"	3'6"	5'6"	7'6"	9'6"	11'6"	12'6"
July	93.0	122.0	—	93.0	79.0	65.5	55.0	51.0	44.0	44.5	—	—
	63.1	78.0	—	75.0	71.0	52.5	49.9	42.7	38.6	39.4	—	—
	27.0	49.0	—	58.0	44.0	42.0	42.5	37.0	37.0	35.0	—	—
August	89.5	119.0	—	91.0	93.0	75.0	58.5	52.0	45.0	—	—	—
	66.7	81.2	—	77.9	81.1	67.2	53.6	47.7	42.3	—	—	—
	38.0	56.0	—	66.0	74.0	62.5	50.0	45.0	40.0	—	—	—
September	81.0	101.5	—	80.5	—	72.0	62.5	57.0	46.0	—	—	—
	52.1	63.5	—	62.5	—	66.6	55.1	51.0	45.4	—	—	—
	24.0	36.0	—	44.0	—	61.5	50.0	42.0	40.0	—	—	—
October	54.0	—	—	51.0	59.0	58.0	58.5	57.0	—	—	—	—
	33.7	—	—	39.3	47.9	44.1	48.4	49.6	—	—	—	—
	10.0	—	—	29.0	36.5	32.0	32.0	46.0	—	—	—	—
November	56.0	55.0	—	43.0	—	—	53.0	47.0	48.0	47.0	—	—
	23.7	26.8	—	29.2	—	—	38.9	45.1	44.9	44.2	—	—
	0.0	3.0	—	16.0	—	—	26.0	43.5	44.0	39.5	—	—
December	44.5	39.0	—	28.0	29.5	—	—	46.0	—	45.5	—	—
	14.0	14.9	—	17.0	22.2	—	—	42.5	42.7	41.3	—	—
	0.0	0.0	—	1.0	9.5	—	—	39.0	41.0	36.0	—	—



Table 4. St. Anne Test Road Monthly Summary 1968 Temperatures in °F

Level	TR2 10" Asphalt		Clay Subgrade					Clay Subgrade				
	Ambient		0'0"	0'4"	0'7"	0'10"	2'0"	4'0"	6'0"	8'0"	10'0"	12'0"
Range	3'0"		0'0"	0'4"	0'7"	0'10"	2'0"	4'0"	6'0"	8'0"	10'0"	12'0"
January	37.8		37.8	—	—	—	—	—	—	—	—	—
(max.	-1.4		3.2	—	—	—	—	—	—	—	—	—
mean min.)	-45.0		-37.0	—	—	—	—	—	—	—	—	—
February	30.4		40.5	29.4	24.8	20.0	18.8	27.5	35.5	38.9	40.6	42.4
	-0.7		8.0	9.2	9.4	11.3	15.6	25.3	33.9	26.7	38.9	40.6
	-35.2		-18.5	-10.5	-6.5	1.6	10.6	23.5	32.2	35.0	37.2	39.0
March	56.5		77.0	55.6	48.5	37.0	28.8	28.0	32.5	35.2	37.5	39.4
	24.3		31.8	30.5	29.0	26.3	24.4	26.1	31.6	34.0	36.3	37.9
	-21.0		-4.2	6.4	11.2	16.0	17.6	24.0	31.2	33.2	35.5	37.0
April	75.0		109.8	—	—	—	—	—	—	—	—	—
	38.9		43.3	—	—	—	—	—	—	—	—	—
	0.0		12.0	—	—	—	—	—	—	—	—	—
May	80.5		105.0	81.8	74.8	65.2	55.8	45.8	39.8	38.2	38.0	38.0
	49.8		60.6	58.9	57.3	55.0	49.4	40.3	36.3	35.9	36.2	36.7
	18.2		31.2	37.0	39.5	43.8	44.0	31.2	32.3	33.5	35.0	36.0
June	90.0		116.0	94.0	85.6	75.0	66.0	54.0	45.5	43.0	41.0	40.2
	60.0		72.3	70.4	68.9	66.4	60.4	49.8	42.6	40.4	39.3	38.9
	32.8		45.5	54.0	56.0	57.5	55.0	45.8	39.8	38.0	37.2	37.0

Table 4 (Cont'd.) St. Anne Test Road Monthly Summary 1968 Temperatures in °F

Level	TR2 10" Asphalt		Clay Subgrade					Clay Subgrade				
	Ambient		Pavement									
Range	3'0"	0'0"	0'4"	0'7"	0'10"	2'0"	4'0"	6'0"	8'0"	10'0"	12'0"	
July	90.5	116.5	100.0	91.5	80.0	71.0	60.0	51.0	48.0	45.5	44.0	
	64.6	78.6	76.8	75.3	73.1	68.0	57.2	48.0	45.2	43.3	42.2	
	38.0	45.2	52.0	55.0	60.0	61.2	54.0	45.8	43.0	41.0	40.2	
August	85.5	113.5	94.5	87.0	78.0	70.6	61.0	53.5	50.6	48.5	47.0	
	60.5	71.2	70.3	69.5	68.7	66.1	59.4	52.4	49.3	47.2	45.6	
	34.0	45.0	51.5	55.0	60.2	62.5	57.8	51.0	47.6	45.2	44.0	
September	86.5	103.0	86.3	80.0	72.0	65.0	58.5	53.0	52.0	49.5	48.0	
	56.0	63.6	63.2	62.8	62.5	61.5	57.6	52.8	50.6	48.9	47.6	
	31.0	36.8	46.0	48.0	53.0	56.5	56.0	52.0	50.0	48.0	46.5	
October	67.0	78.0	65.0	61.0	60.5	57.5	57.5	53.0	51.0	49.5	48.5	
	40.9	45.3	45.9	46.2	47.6	50.1	52.2	51.2	50.0	48.9	48.0	
	20.0	26.0	31.5	34.5	39.5	43.5	48.0	49.5	49.0	48.5	47.5	
November	48.0	53.0	45.5	45.0	45.0	45.0	48.0	49.5	49.0	48.5	48.0	
	26.4	28.8	30.3	30.9	33.3	37.9	44.1	47.1	47.3	47.4	47.1	
	-1.5	7.5	14.5	18.5	27.5	33.0	40.0	45.0	46.0	46.5	46.5	
December	38.0	38.0	33.0	31.5	30.0	33.0	40.5	45.0	46.0	46.5	46.5	
	5.4	9.7	12.9	14.4	19.2	27.2	36.6	42.2	43.6	44.6	44.9	
	-31.0	-18.0	-10.0	-6.0	3.5	17.5	32.5	39.5	41.5	42.5	43.5	

Table 5. St. Anne Test Road Monthly Summary 1969 Temperatures in °F

Level	TR2 10" Asphalt			Clay Subgrade								
	Ambient	0'0"	Pavement	0'4"	0'7"	0'10"	2'0"	4'0"	6'0"	8'0"	10'0"	12'0"
Range	3'0"	0'0"	0'4"	0'7"	0'10"	2'0"	4'0"	6'0"	8'0"	10'0"	12'0"	
January	28.0	24.0	21.0	19.5	17.0	18.0	32.5	39.5	41.5	43.0	43.5	
	-6.1	-0.3	1.7	2.6	6.2	13.6	27.9	36.6	39.0	40.9	41.8	
	-39.0	-20.5	-13.0	-10.0	-1.5	10.0	24.0	33.5	36.5	38.5	40.0	
February	43.0	51.0	37.5	33.5	31.5	24.0	31.5	34.5	37.0	38.5	40.0	
	8.9	14.5	14.2	13.6	13.4	15.3	23.1	31.7	34.5	36.9	38.2	
	-36.0	-21.0	-13.5	-10.0	-2.0	8.0	22.0	30.5	33.0	35.5	—	
March	41.0	63.0	45.5	38.5	30.0	28.0	28.0	31.0	33.5	36.0	37.0	
	13.2	26.2	25.7	25.2	25.1	25.2	26.5	30.7	33.5	36.0	36.1	
	-21.0	-4.0	7.0	11.0	19.0	23.0	25.0	30.0	32.0	34.0	35.0	
April	73.5	96.0	74.0	66.0	59.0	99.0	31.0	32.0	33.5	34.5	36.0	
	43.0	53.3	49.7	47.2	42.4	54.3	29.0	31.2	32.8	34.1	35.2	
	-2.0	11.0	19.0	21.0	23.0	25.0	25.0	30.5	32.0	33.5	35.0	
May	90.0	116.5	95.0	85.0	72.0	60.0	46.0	40.0	40.0	—	36.0	
	51.6	63.9	61.6	60.0	56.8	49.9	38.8	34.8	34.4	34.9	35.3	
	19.5	33.5	41.5	39.5	38.5	43.0	31.0	32.0	33.0	34.5	35.0	
June	82.0	119.0	88.0	79.0	70.0	61.0	52.0	45.5	42.0	40.5	39.5	
	54.6	68.0	66.2	64.9	63.0	58.5	49.0	41.6	39.2	38.2	37.5	
	26.0	34.0	44.5	47.5	52.5	54.5	46.0	38.5	35.5	32.5	32.5	

Table 5 (Cont'd.) St. Anne Test Road Monthly Summary 1969 Temperatures in °F

Level	TR2 10" Asphalt		Clay Subgrade			Clay Subgrade					
	Ambient		Pavement								
Range	3'0"	0'0"	0'4"	0'7"	0'10"	2'0"	4'0"	6'0"	8'0"	10'0"	12'0"
July	98.0	125.0	103.0	94.0	81.0	71.0	67.5	—	46.0	—	42.5
	65.6	78.5	76.6	75.0	72.1	65.9	54.8	46.5	43.5	41.7	40.5
	36.5	—	57.5	59.0	54.0	52.0	45.0	42.0	41.5	40.0	39.0
August	95.0	119.0	100.0	92.0	84.0	74.5	63.0	54.0	50.5	47.5	46.0
	69.3	81.0	79.6	78.4	76.3	71.3	60.5	51.3	47.8	45.4	43.8
	40.0	55.0	58.0	66.0	70.5	69.0	57.5	49.0	42.5	43.0	42.0
September	95.3	102.5	87.5	81.9	75.9	72.5	69.5	64.6	51.9	49.9	48.8
	54.7	63.7	63.6	63.7	64.4	64.5	60.7	54.3	51.2	48.9	47.2
	26.5	36.1	42.9	—	50.0	54.5	54.5	51.0	50.0	42.5	45.5
October	56.2	66.0	55.5	54.0	90.4	54.5	56.9	53.9	52.7	50.9	80.5
	35.8	39.7	40.6	41.2	43.1	46.7	51.2	51.4	50.4	49.4	48.3
	11.9	17.8	25.0	28.2	30.9	32.9	45.8	48.8	48.9	41.9	47.1
November	58.2	59.8	48.5	45.2	43.0	47.0	45.8	48.8	48.9	48.8	48.0
	25.5	28.2	29.5	30.6	32.9	37.3	43.2	46.4	46.9	47.2	47.0
	-9.6	3.0	11.8	15.3	23.0	29.8	39.0	44.0	45.0	46.0	46.0
December	46.8	43.0	33.5	31.2	28.6	31.4	39.0	44.0	45.0	46.0	46.0
	13.2	16.4	18.1	19.3	22.3	28.3	36.6	41.8	43.3	44.4	44.7
	-18.0	-7.5	0.0	3.0	8.0	23.0	34.0	36.0	37.7	39.0	39.2

Table 6. St. Anne Test Road Monthly Summary 1968 Temperatures in °F

Month	TR3 4" Pavement		6" Base Course		Sand Subgrade			Clay Subgrade				
	Level	Ambient	Pavement	Pavement	Base	Base	Base	Clay Subgrade	Clay Subgrade	Clay Subgrade	Clay Subgrade	
		3'0"	0'0"	0'2"	0'4"	1'7.5"	3'7"	5'6"	7'6"	9'7.5"	11'7.5"	12'0"
January		35.8	39.8	—	—	—	—	—	—	—	—	—
(max.)		-1.8	3.6	—	—	—	—	—	—	—	—	—
mean min.)		-46.0	-31.8	—	—	—	—	—	—	—	—	—
February		30.0	41.0	32.0	25.0	20.7	21.3	29.9	31.0	34.0	37.2	27.5
		-0.9	8.4	8.5	10.0	13.3	18.7	26.2	30.4	32.8	35.9	26.0
		-35.5	-18.0	-15.3	-6.3	5.2	14.9	24.8	29.7	28.3	30.5	24.5
March		58.4	76.4	63.2	48.2	34.5	30.0	29.0	30.0	32.6	35.7	29.0
		24.2	31.8	30.9	29.7	27.1	26.7	27.9	29.9	31.6	34.4	27.7
		-21.2	-0.4	4.5	13.0	19.0	20.8	25.6	25.9	26.6	33.8	25.3
April		76.0	103.5	—	—	—	—	—	—	—	—	—
		38.4	47.4	—	—	—	—	—	—	—	—	—
		1.0	14.0	—	—	—	—	—	—	—	—	—
May		79.4	103.5	88.9	74.2	58.2	48.0	40.0	36.0	34.0	34.0	40.0
		49.2	59.8	56.4	54.4	48.7	41.0	33.2	30.9	31.2	33.0	33.2
		18.0	29.6	32.0	37.5	42.0	35.6	29.0	29.5	30.8	32.5	29.0
June		90.2	118.8	104.0	87.5	70.0	60.3	51.8	46.8	42.8	39.8	51.8
		59.0	71.5	70.2	68.0	61.9	54.0	45.6	41.4	38.3	36.6	45.6
		32.0	45.2	50.0	54.2	54.2	48.0	40.0	36.0	34.0	33.5	40.0

Table 6 (Cont'd.) St. Anne Test Road Monthly Summary 1968 Temperatures in °F

Level	TR3 4" Pavement			6" Base Course		Sand Subgrade					
	Ambient	Pavement		Base		Clay Subgrade					
Month	3'0"	0'0"	0'2"	0'4"	1'7.5"	3'7"	5'6"	7'6"	9'7.5"	11'7.5"	12'0"
July	89.5	120.2	108.0	92.2	75.0	66.0	59.0	54.8	50.0	48.4	—
	63.6	77.4	76.5	74.8	69.9	63.5	55.5	50.9	46.6	43.0	—
	37.2	44.8	47.8	53.5	59.5	58.3	51.8	46.8	42.8	39.8	—
August	86.0	112.5	102.0	88.0	73.8	66.8	60.0	57.0	54.0	50.5	—
	59.5	69.8	69.6	69.1	66.6	63.4	58.7	55.5	52.0	48.3	—
	33.0	8.0	47.0	54.0	61.0	60.5	57.0	50.0	50.0	46.0	—
September	88.0	102.5	95.5	80.5	68.0	62.5	58.0	55.5	53.0	50.5	—
	54.8	62.8	62.4	62.3	61.2	60.1	57.3	55.2	52.8	50.1	—
	32.0	39.5	42.0	47.0	53.5	56.0	55.5	54.5	52.0	49.5	—
October	67.0	77.5	71.0	62.0	58.5	56.5	56.0	55.0	55.0	52.0	—
	40.3	45.3	45.5	46.4	48.0	50.7	52.0	52.2	51.5	50.1	—
	19.5	26.5	29.5	34.5	40.5	44.5	45.5	49.0	49.5	49.0	—
November	46.5	52.5	47.5	45.5	44.0	45.0	47.5	49.5	49.5	49.5	—
	25.2	28.8	29.2	31.1	34.2	39.0	42.9	44.7	46.1	46.9	—
	-3.5	7.5	10.0	18.0	29.0	34.0	38.5	40.5	42.5	44.0	—
December	36.0	38.0	35.0	29.0	29.5	34.5	38.5	41.0	43.0	44.5	—
	3.8	9.5	10.1	14.0	21.7	30.0	34.9	38.1	39.5	41.7	—
	-32.0	-17.5	-16.5	-8.0	6.5	20.5	30.5	35.0	36.0	38.5	—

Table 7. St. Anne Test Road Monthly Summary 1969 Temperatures in °F

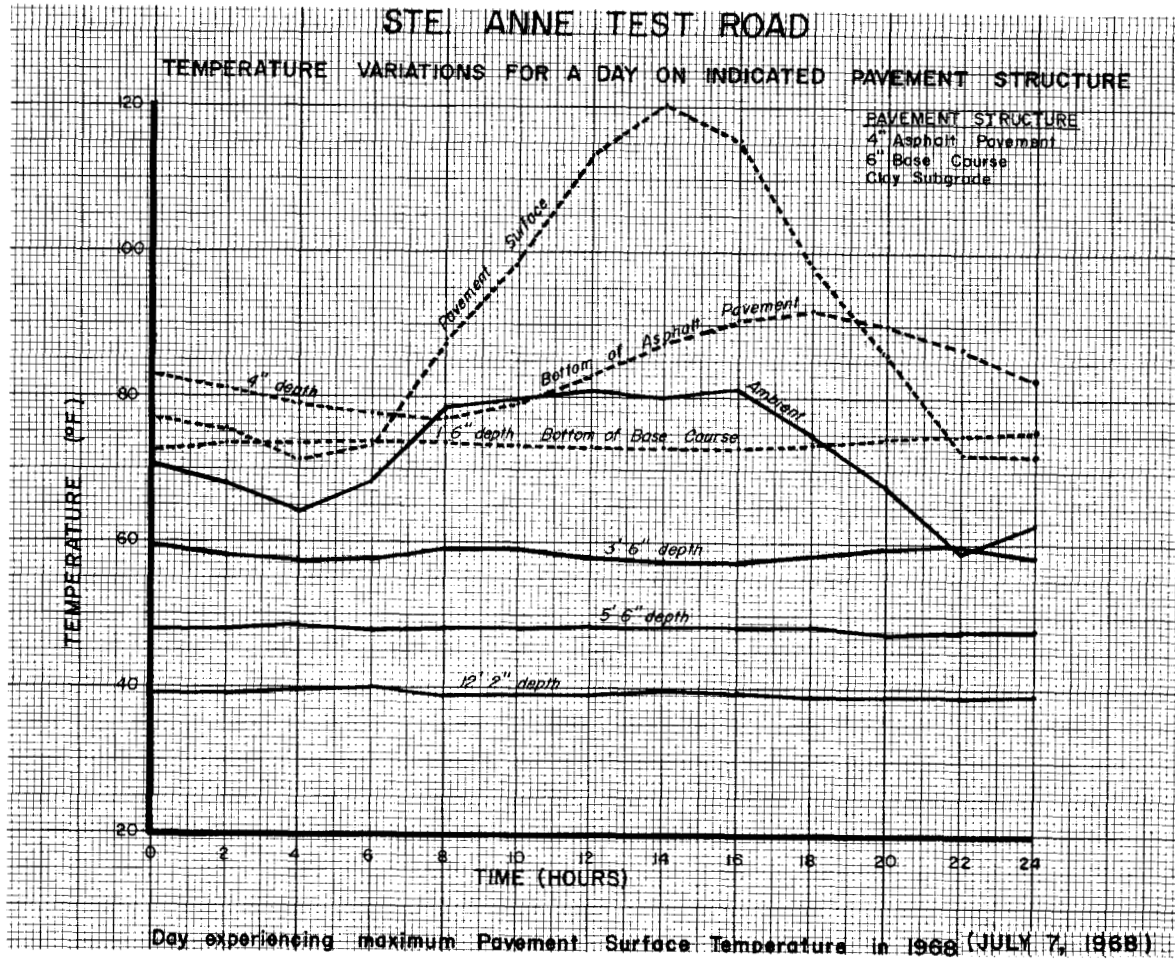
Level	TR3 4" Pavement			6" Base Course			Sand Subgrade				
	Ambient	Pavement		Pavement	Base		Sand Subgrade				
Month	3'0"	0'0"	0'2"	0'4"	1'7.5"	3'7"	5'6"	7'6"	9'7.5"	11'7.5"	12'0"
January	27.5	23.0	21.0	19.0	16.5	20.5	39.5	35.0	36.5	39.5	—
	-7.7	-0.9	-0.9	1.7	7.6	16.2	27.6	31.7	33.7	36.6	—
	-40.5	-21.0	-19.5	-16.0	1.0	13.0	25.0	29.5	32.0	34.0	—
February	41.5	49.0	40.5	29.5	27.0	25.0	26.0	29.5	32.0	35.0	—
	7.2	13.6	12.9	13.5	14.2	17.5	24.3	28.4	30.9	33.1	—
	-37.5	-20.5	-19.5	-11.5	1.0	11.0	23.0	28.0	30.0	32.0	—
March	40.0	58.0	50.0	36.0	30.0	30.0	28.0	29.0	30.5	33.0	—
	12.0	25.4	24.4	25.0	24.5	25.7	27.1	28.5	30.0	31.7	—
	-22.0	-1.0	1.0	12.0	19.0	22.5	22.0	28.0	29.0	31.0	—
April	71.0	93.0	85.0	68.0	50.0	37.0	29.5	29.5	31.0	33.0	—
	41.6	51.2	49.7	46.3	36.0	30.1	28.4	29.0	30.0	31.8	—
	-3.5	14.0	16.0	22.0	23.0	26.0	28.0	29.0	30.0	31.0	—
May	90.0	116.0	103.0	85.5	64.5	77.5	40.5	39.5	33.0	32.5	—
	50.0	62.4	60.9	58.5	51.7	42.8	33.4	30.5	30.6	32.1	—
	18.5	33.0	36.0	42.0	42.0	37.0	29.0	29.0	21.5	31.0	—
June	81.0	109.5	94.5	78.5	81.0	59.0	49.5	45.0	42.5	40.5	—
	52.7	66.1	65.3	63.6	59.0	52.6	45.3	40.9	37.6	35.7	—
	24.0	—	40.0	42.0	50.5	48.5	40.5	35.5	33.0	32.0	—

Table 7 (Cont'd.) St. Anne Test Road Monthly Summary 1969 Temperatures in °F

Month	TR3 4" Pavement			6" Base Course		Sand Subgrade					
	Ambient	Pavement	Level	Pavement	Base	Base	Sand Subgrade	Sand Subgrade	Sand Subgrade	Sand Subgrade	Sand Subgrade
	3'0"	0'0"	0'2"	0'4"	1'7.5"	3'7"	5'6"	7'6"	9'7.5"	11'7.5"	12'0"
July	96.5	122.5	109.5	93.0	75.0	66.0	59.0	54.0	49.0	44.5	—
	64.1	77.0	75.6	73.5	68.0	61.0	54.0	49.2	44.9	41.5	—
	38.0	49.0	50.0	52.5	51.5	55.0	49.5	44.5	41.5	39.0	—
August	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	—	—
September	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	—	—
October	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	—	—
November	56.0	55.0	51.0	45.0	—	—	—	—	—	—	—
	23.6	23.1	26.5	28.9	—	—	—	—	—	—	—
	-8.0	-3.0	4.0	12.0	—	—	—	—	—	—	—
December	45.0	47.0	35.0	32.5	—	—	—	—	—	—	—
	11.3	11.7	15.0	17.8	—	—	—	—	—	—	—
	-20.3	-17.0	-7.0	11.5	—	—	—	—	—	—	—



Figure 1.



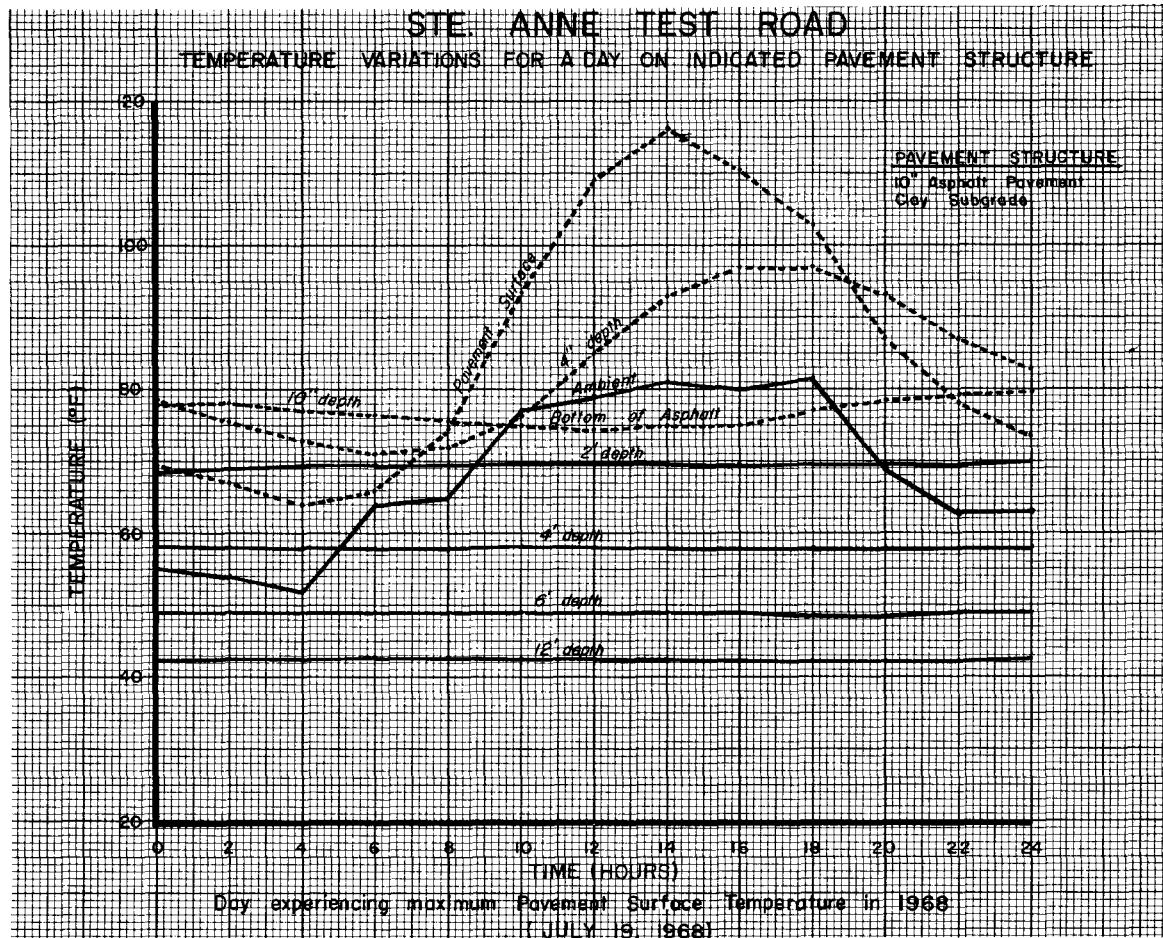


Figure 2.

Figure 3.

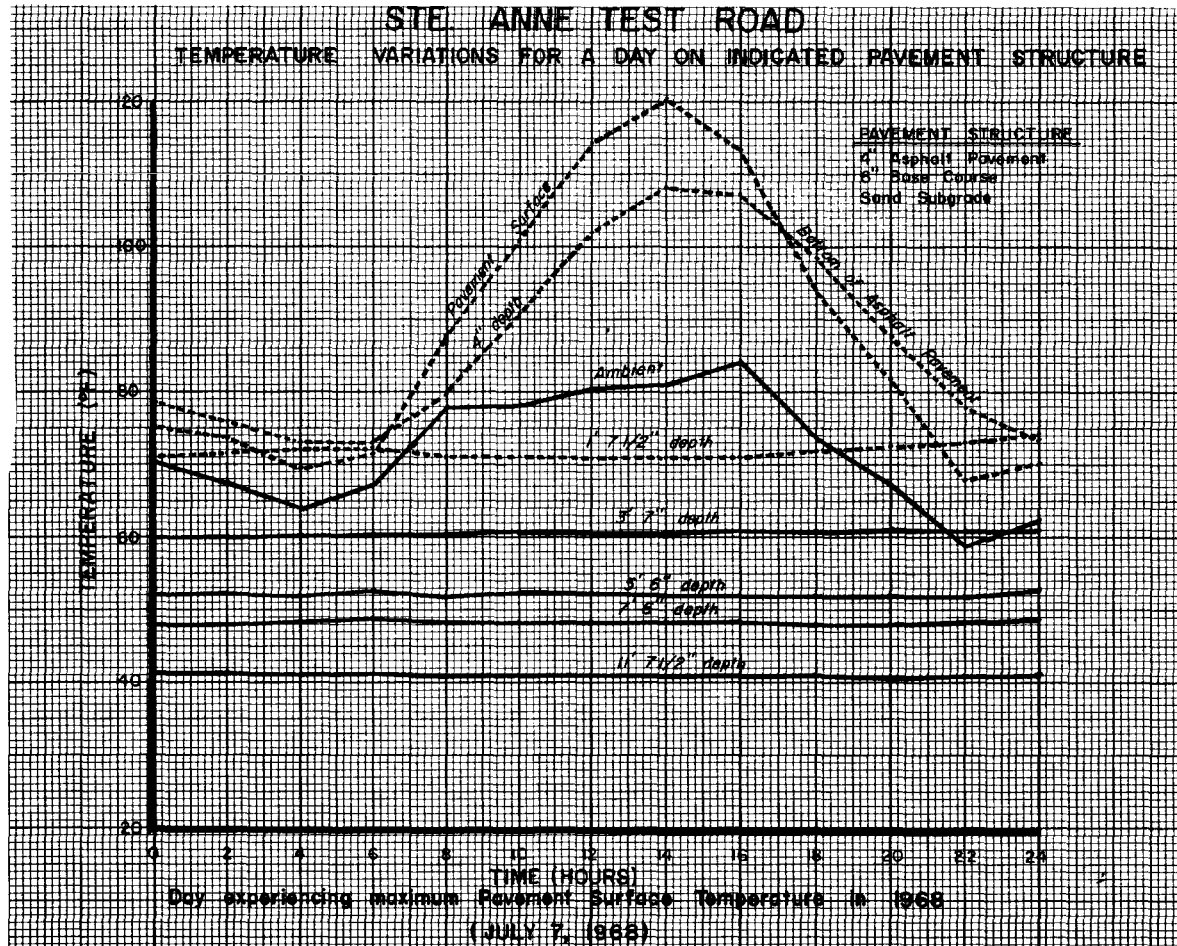


Figure 4.

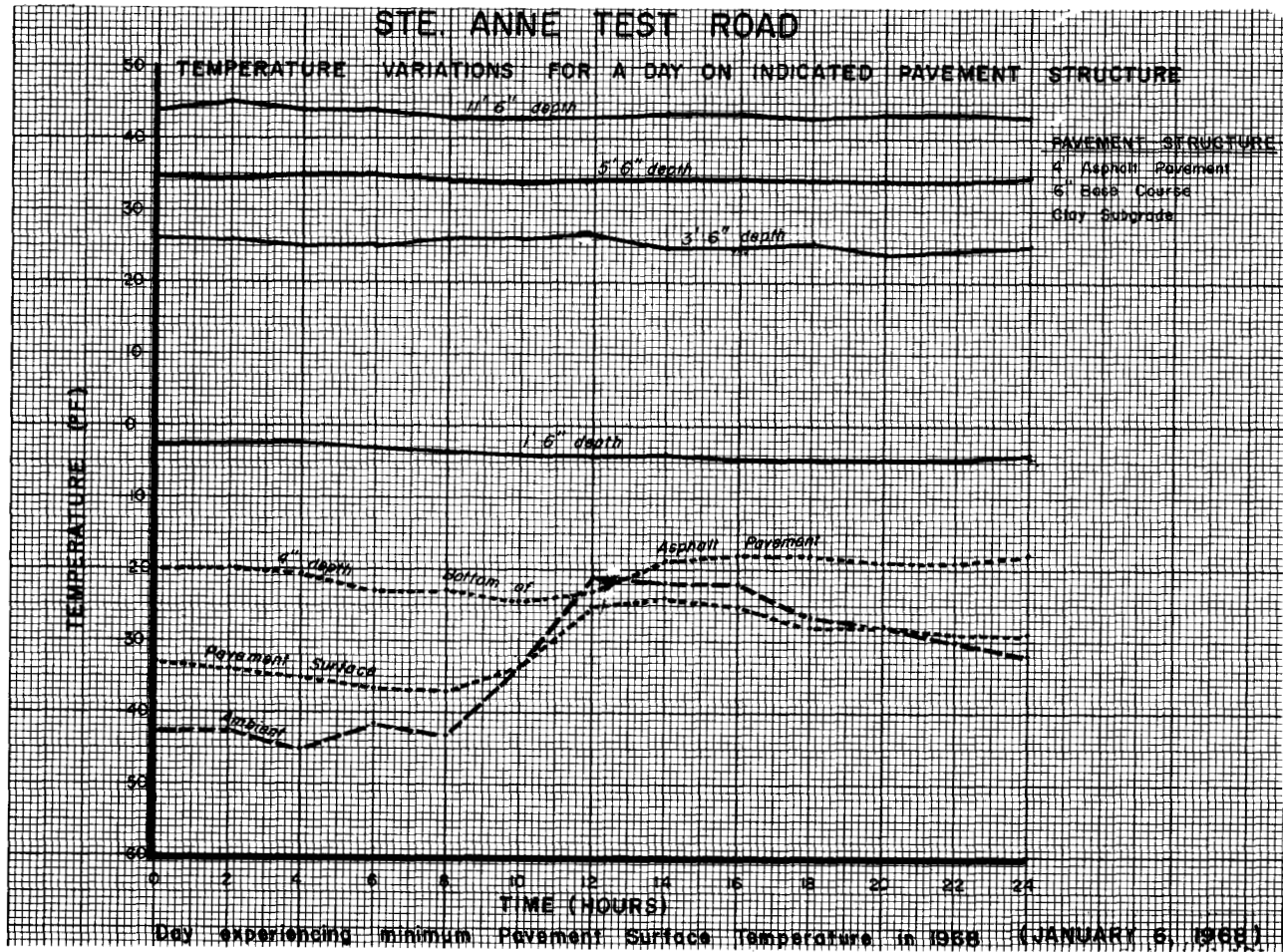
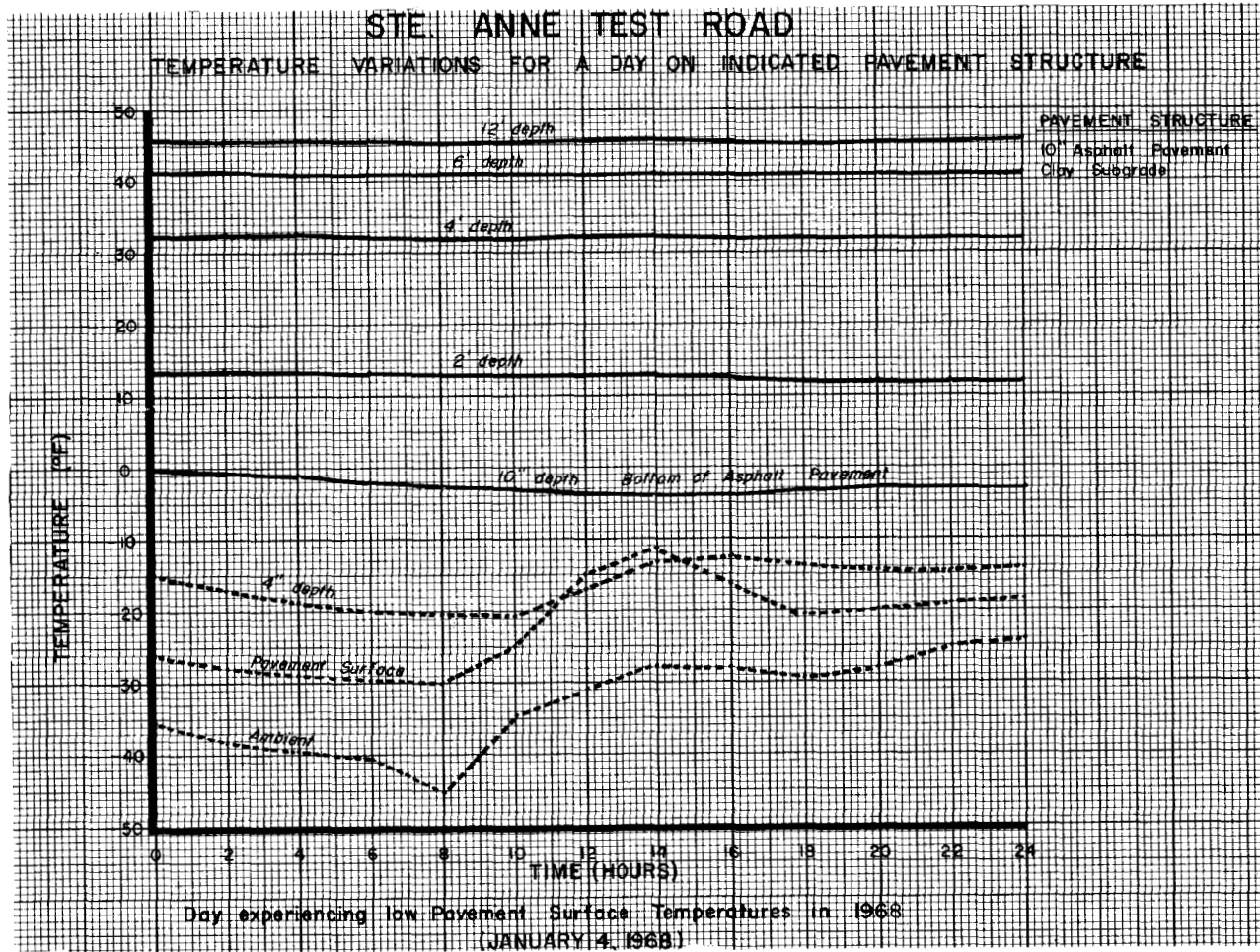


Figure 5.



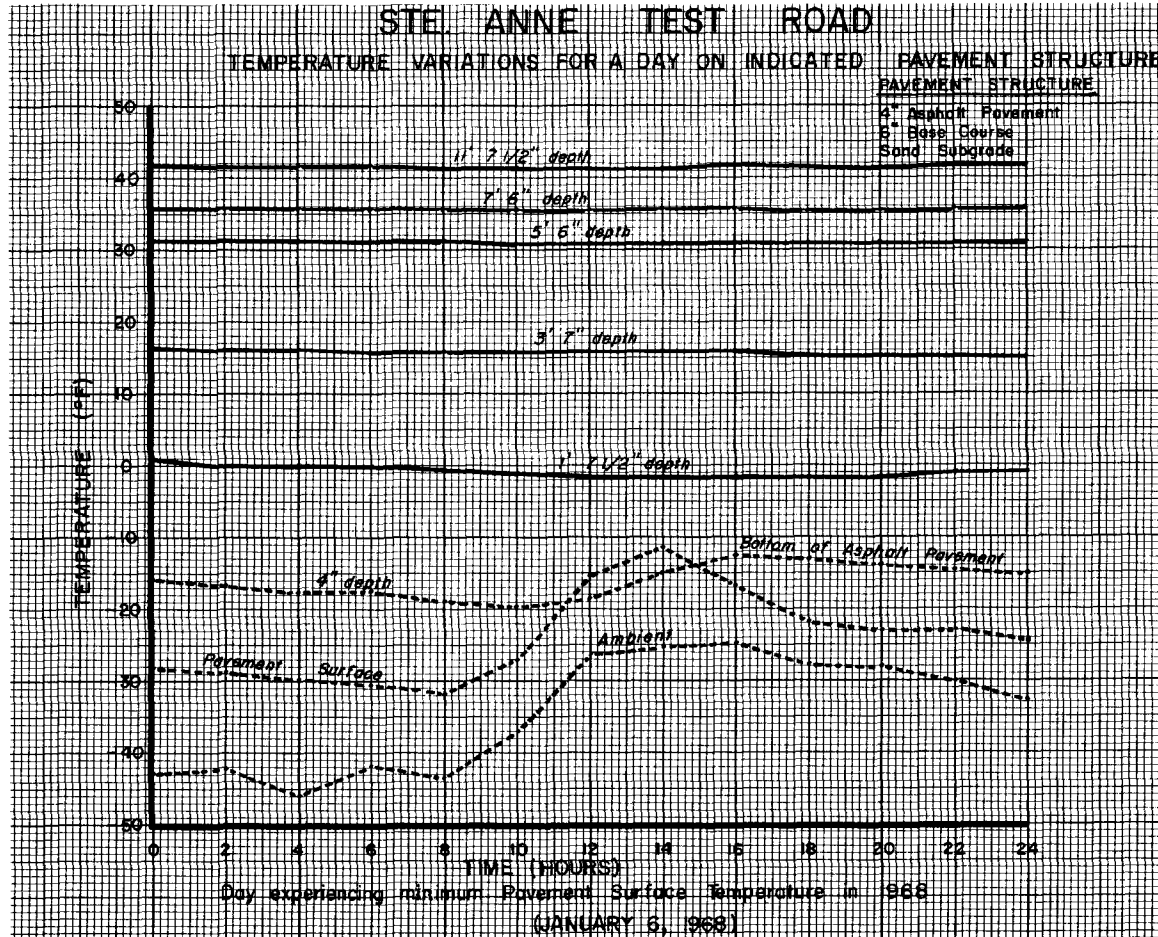


Figure 6.

Monthly and Annual Summary Criteria

1. 4 days (48 readings) missing in any given month deletes it from the monthly summary.
2. 3 or more months missing in the test year deletes the maximum, mean and minimum from the annual summary.
3. 1 and/or 2 months missing in the test year deletes only the mean from the annual summary.
4. Obvious errors in maximum and/or minimum monthly values were deleted.