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WORK SHOP 1 - PAVEMENT DESIGN IN COLD REGIONS

**Joel D. Ulring, P.E.
Golder Associated Inc.
Anchorage, Alaska USA
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ORDER OF PRESENTATION

- **Introduction**
- **Anchorage Facts**
- **Municipality of Anchorage Pavement Design Practice**
- **State of Alaska Pavement Design Practice**
- **Summary**



INTRODUCTION

Joel D. Uring P.E.
Senior Geotechnical Engineer
Golder Associates Inc.
Anchorage Alaska

- 18 Years Public Service in Minnesota Counties
- 10 Years as Geotechnical Engineer Consultant



ANCHORAGE FACTS

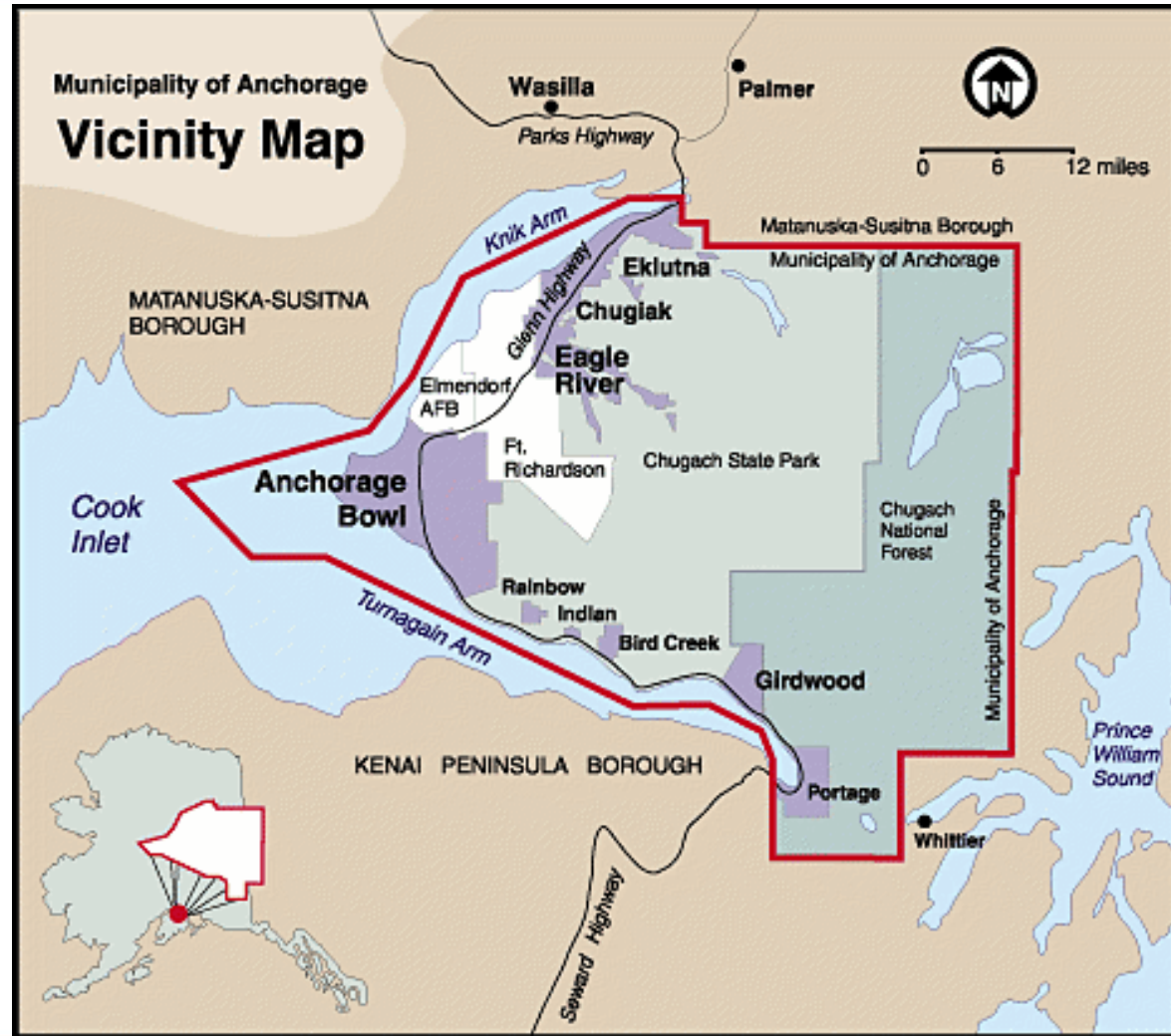




ANCHORAGE FACTS

Anchorage Area Map

- Population
 - Alaska 790,000
 - Anchorage 300,000
- Significant Growth in 1970's

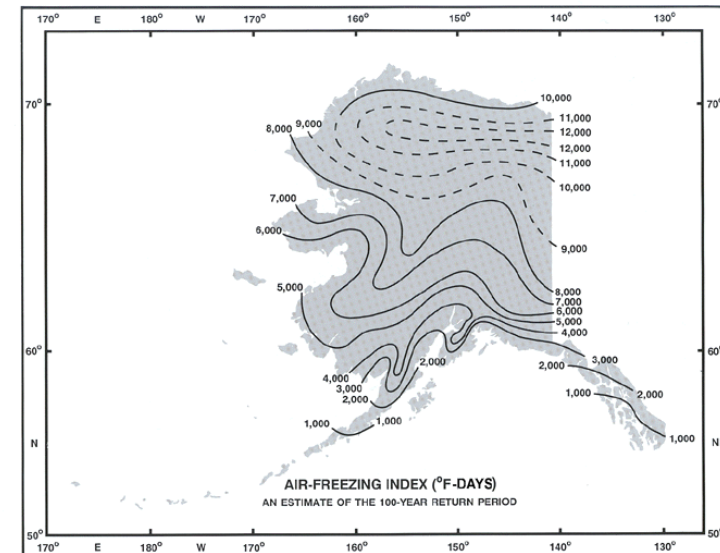




ANCHORAGE FACTS

Anchorage Facts

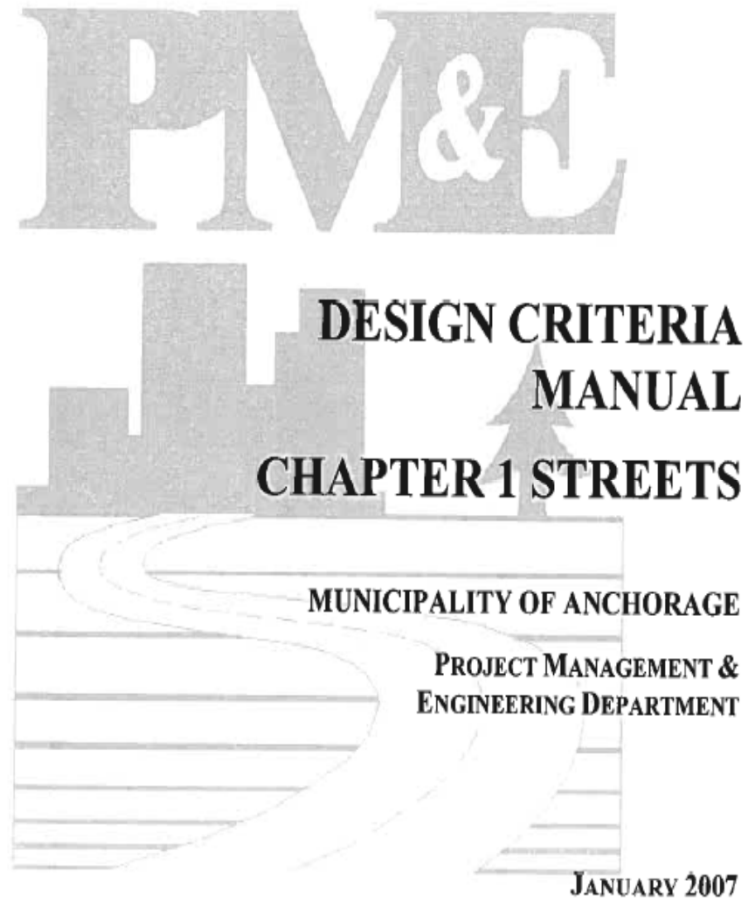
- 61° North Latitude
- Design Thawing Index
Air = 4000 ° Days
Surface = 3200 ° Days
- Design Freezing Index
Air = 3200 ° Days
Surface = 6800 ° Days
- Typical Frost Penetration
Depth 9 feet (2.75 m)





ANCHORAGE PAVEMENT DESIGN

Municipality of Anchorage Pavement Design





MOA Design Criteria Manual – Chapter 1 Streets

- Section 1.10 Road Structural Fill Design
 - Primary Design Objectives
 - Reduce freezing and thawing impacts on road
 - Obtain roadway/Pavement design life



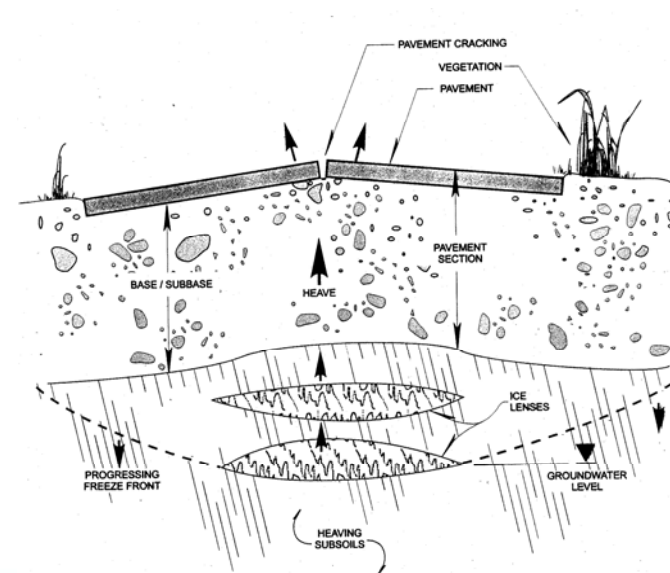
ANCHORAGE PAVEMENT DESIGN

MOA Design Criteria Manual – Chapter 1 Streets

■ Section 1.10 Road Structural Fill Design

■ Mandatory Design Objectives

- Mitigate the formation of ice lenses
- Prevent pumping of subgrade
- Prevent differential frost heave





ANCHORGAE PAVEMENT DESIGN

Differential Frost
Heaving of Insulated
Pavement Section





ANCHORAGE PAVEMENT DESIGN

PAVEMENT DESIGN PROCESS

- Subsurface Soil Investigation (1 borehole \approx 300 ft.)
- Laboratory Testing of Collected Soil Samples
- Soil Frost Group Index Determined
Frost Group: NFS, F1, F2, F3, F4
- Thermal Analysis (Berg2)
- Design Pavement Section



ANCHORAGE PAVEMENT DESIGN

MOA Frost Group Soil Classification

FROST DESIGN SOIL CLASSIFICATION ⁽¹⁾

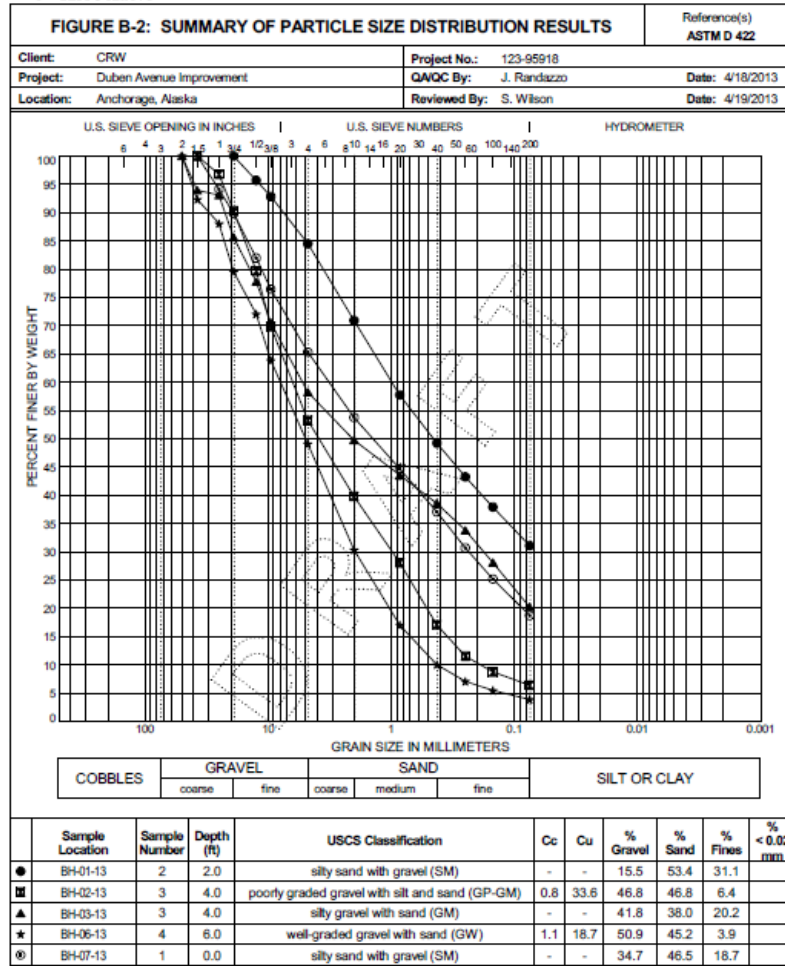
FROST GROUP ⁽²⁾	GENERAL SOIL TYPE	% FINER THAN 0.02 mm BY WEIGHT	TYPICAL USCS SOIL CLASS
NFS ⁽³⁾ [MOA NFS]	(a) Gravels Crushed stone Crushed rock	0 to 1.5	GW, GP
	(b) Sands	0 to 3	SW, SP
PFS ⁽⁴⁾ [MOA NFS] [MOA F2]	(a) Gravels Crushed stone Crushed rock	1.5 to 3	GW, GP
	(b) Sands	3 to 10	SW, SP
S1 [MOA F1]	Gravelly soils	3 to 6	GW, GP GW-GM, GP-GM, GW-GC, GP-GC
S2 [MOA F2]	Sandy soils	3 to 6	SW, SP SW-SM, SP-SM, SW-SC, SP-SC
F1 [MOA F1]	Gravelly soils	6 to 10	GM, GC, GM-GC, GW-GM, GP-GM, GW-GC, GP-GC
F2 [MOA F2]	(a) Gravelly soils	10 to 20	GW, GP GW-GM, GP-GM, GW-GC, GP-GC
	(b) Sands	6 to 15	SM, SW-SM, SP-SM, SC, SW-SC, SP-SC, SM-SC
F3 [MOA F3]	(a) Gravelly soils	Over 20	GM, GC, GM-GC
	(b) Sands, except very fine silty sands	Over 15	SM, SC, SM-SC
	(c) Clays, PI>12	--	CL, CH
F4 [MOA F4]	(a) Silts	--	ML, MH, ML-CL
	(b) Very fine silty sands	Over 15	SM, SC, SM-SC
	(c) Clays, PI<12	--	CL, ML-CL
	(d) Varved clays or other fine-grained banded sediments	--	CL or CH layered with ML, MH, ML-CL, SM, SC, or SM-SC

(1) From U.S. Army Corps of Engineers (USACE), EM 1110-3-138, "Pavement Criteria for Seasonal Frost Conditions," April 1984



ANCHORAGE PAVEMENT DESIGN

Typical Soil Types of Anchorage





MOA Design Criteria Manual – Chapter 1 Streets

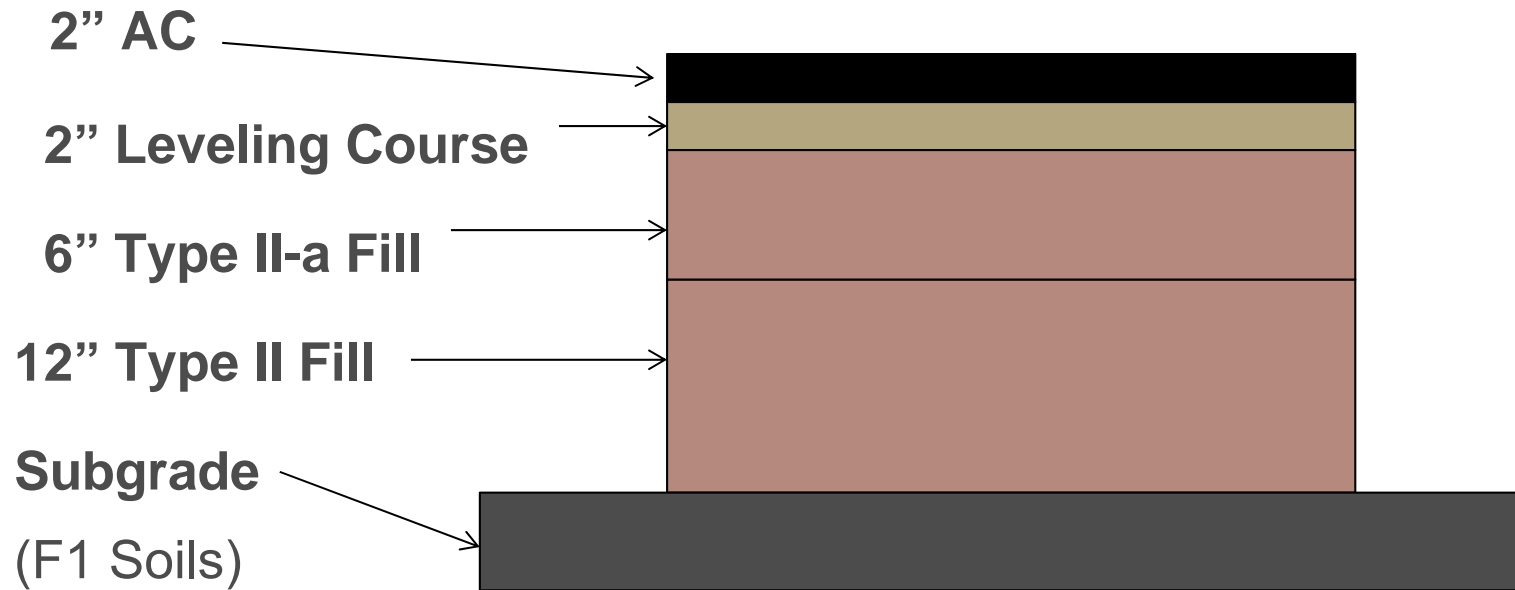
- **Section 1.10 Road Structural Design Methods**
 - **Minimum Section**
 - **Complete Protection Method**
 - Excavate and replace frost susceptible soils with non frost susceptible soil (NFS)
 - **Limited Subgrade Frost Penetration Method**
 - Allows frost penetration of 10% into subgrade based on thickness of structural section

Provision for use of rigid board insulation to reduce structural section thickness.



ANCHORAGE PAVEMENT DESIGN

Minimum Structural Section NFS Soil Subgrade

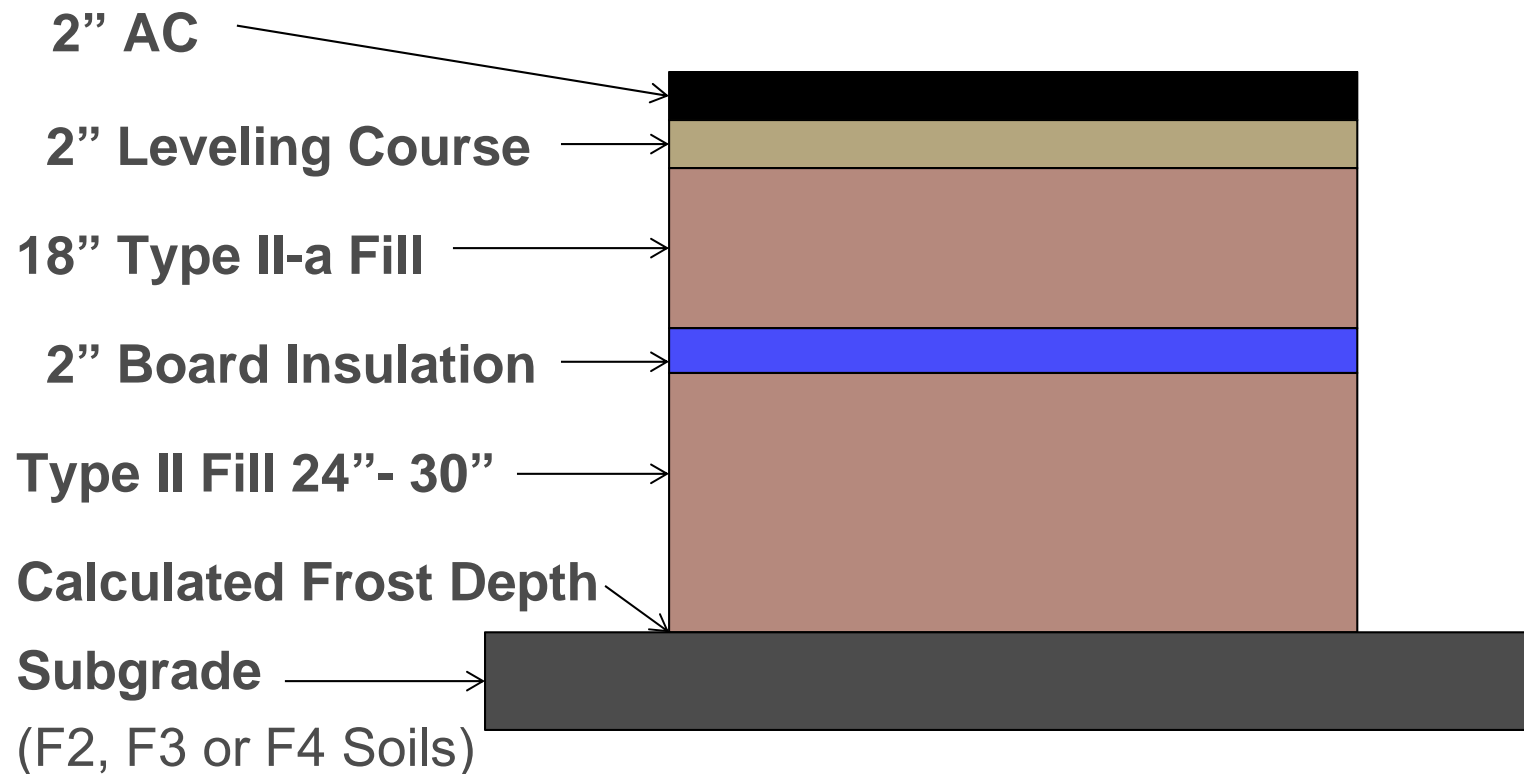




ANCHORAGE PAVEMENT DESIGN

Complete Protection Method

Typical Pavement Structural Section

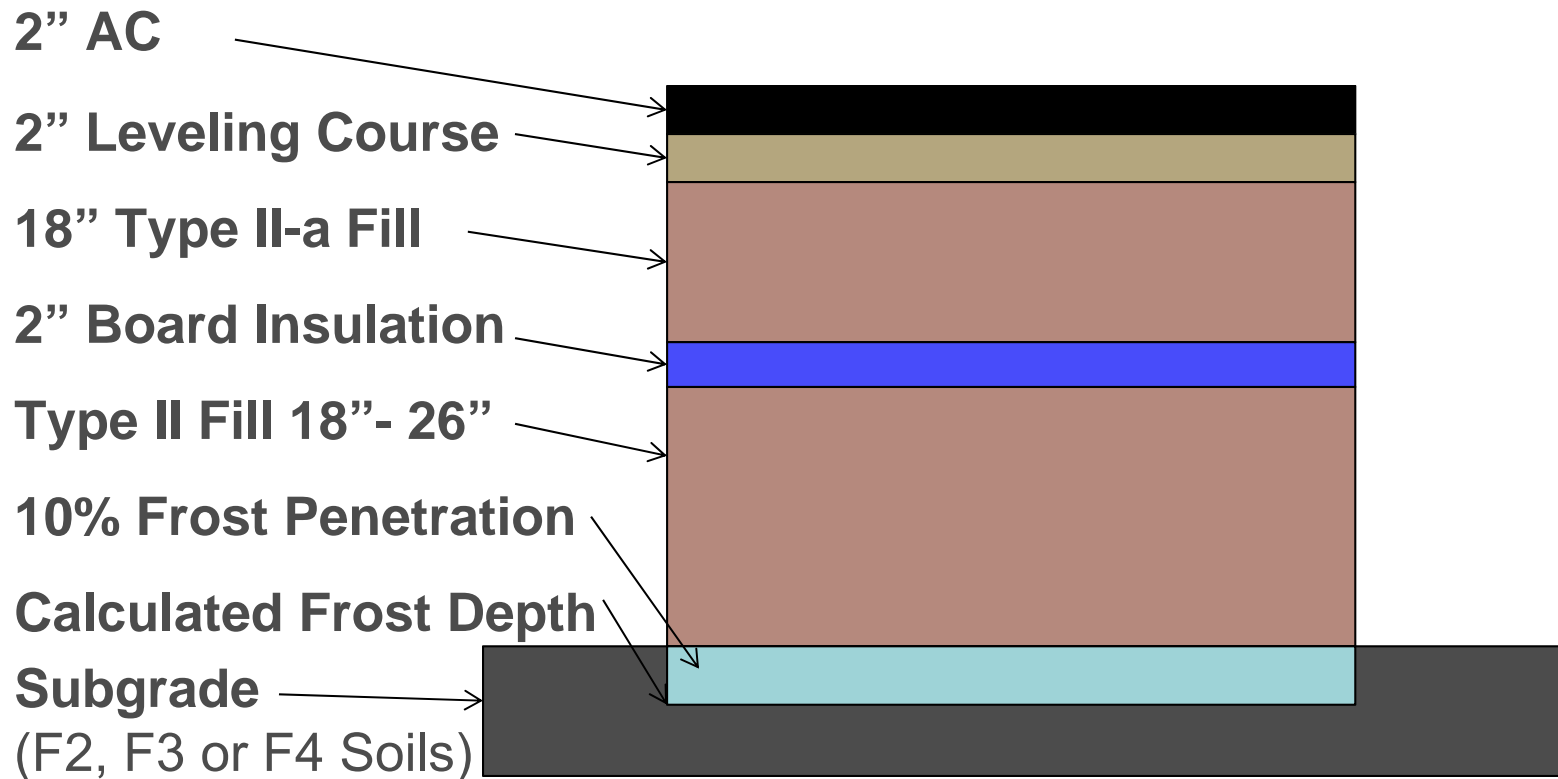




ANCHORAGE PAVEMENT DESIGN

Limited Subgrade Frost Penetration Method

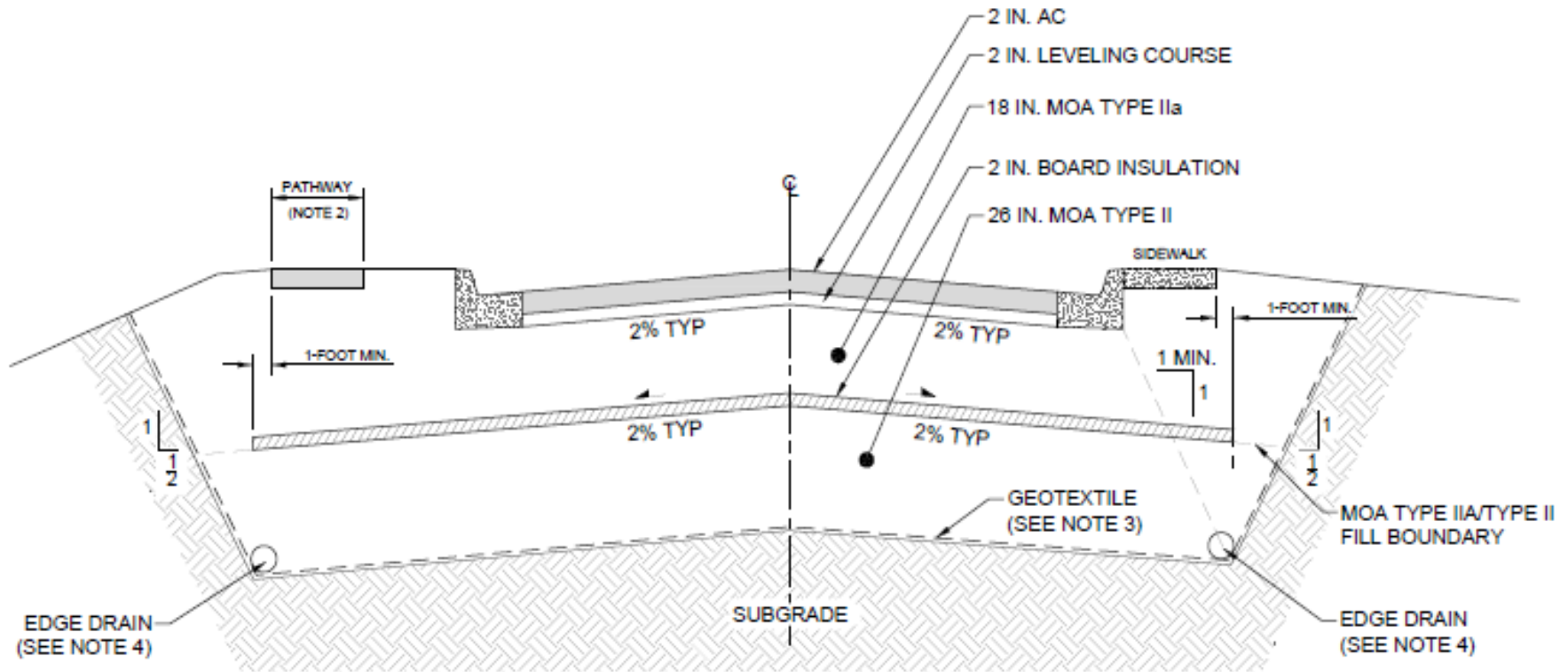
Typical Pavement Structural Section





ANCHORAGE PAVEMENT DESIGN

TYPICAL STREET DESIGN SECTION Limited Subgrade Frost Penetration Method





ANCHORAGE PAVEMENT DESIGN

LEVELING COURSE GRADATION

<u>U.S. Std. Sieve</u>	<u>Cumulative % Passing by Weight</u>
1"	100
3/4"	70-100
3/8"	50-80
#4	35-65
#8	20-50
#50	8-28
#200	*2-6

*In addition to the grading limits stipulated above, fractions passing the #200 sieve shall not be greater than seventy-five percent (75%) of the fractions passing the #50 sieve.



ANCHORAGE PAVEMENT DESIGN

CLASSIFIED FILL GRADATIONS

Type II		Type II-a	
U.S. Std. Sieve		U.S. Std. Sieve	
Cumulative %		Cumulative %	
<u>Passing by Weight</u>		<u>Passing by Weight</u>	
8"	100	3"	100
3"	70-100	3/4"	50-100
1-1/2"	55-100	#4	25-60
3/4"	45-85	#10	15-50
#4	20-60	#40	4-30
#10	12-50	#200	2-6
#40	4-30		
#200	2-6		



ANCHORAGE PAVEMENT DESIGN

COMMENTS

- How should current climate trends be accounted for in design?
- Should design parameters (Freezing & Thawing Indices) within Berg2 analysis be adjusted?
- Should another thermal analysis model be considered?
- MOA is currently reviewing their pavement design manual.

THANK YOU !
QUESTIONS ?

