

# Otta Seal:

## Thin flexible pavement surface treatment

60<sup>th</sup> Annual County Engineers' Workshop  
Delta Hotels Muskegon Convention Center, Muskegon, MI  
04 February 2026

# Agenda

- Introduction
- History
- The Johnson County (Iowa) Otta Seal
- Wrap up
  - Lessons Learned
  - Questions

# THANK YOU!

Michigan County Engineer's Workshop

Pete Torola - Michigan Technological University



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# History



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# Johnson County Iowa (2000's)

1. Road performance issues
  - a) Frost boils
  - b) Vanishing rocks
  - c) Impassible in spring
2. Macadam/Choke rehabilitation
3. Drainage improvements
4. Traditional double chipseals

# What is Otta Seal?

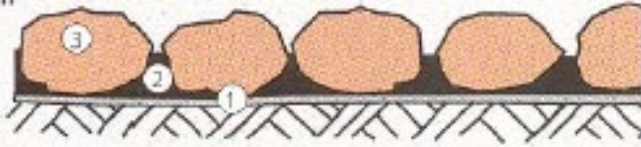
## SAND SEAL

- 1 Prime
- 2 Binder
- 3 Sand



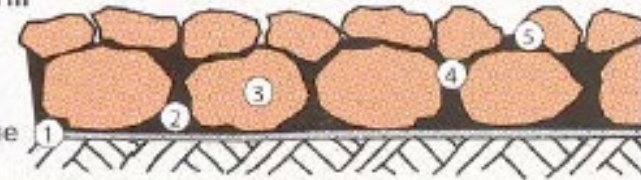
## SINGLE CHIP SEAL

- 1 Prime
- 2 Binder
- 3 Stone



## DOUBLE CHIP SEAL

- 1 Prime
- 2 Binder
- 3 Large stone
- 4 Binder
- 5 Small stone



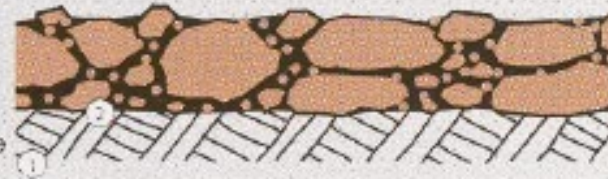
## CAPE SEAL

- 1 Prime
- 2 Binder
- 3 Stone
- 4 Slurry



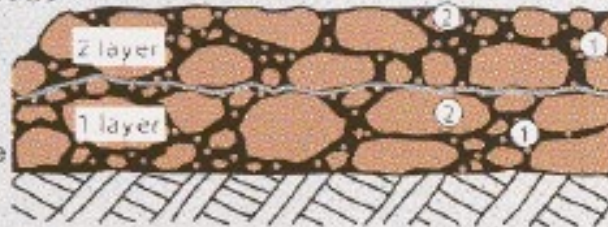
## SINGLE OTTA SEAL

- No Prime
- 1 Binder
- 2 Graded aggregate



## DOUBLE OTTA SEAL

- No Prime
- 1 Binder
- 2 Graded aggregate



## ASPHALT CONCRETE

- 1 Prime
- 2 Asphalt Premix



**Figure 3.1 - Schematic of common types of bituminous surfacings**

# What is Otta Seal (Cont.)

Charles Overby (probably):

“Do you have some cheap, local rocks?”

“Do you have any recycled dinosaur products?”

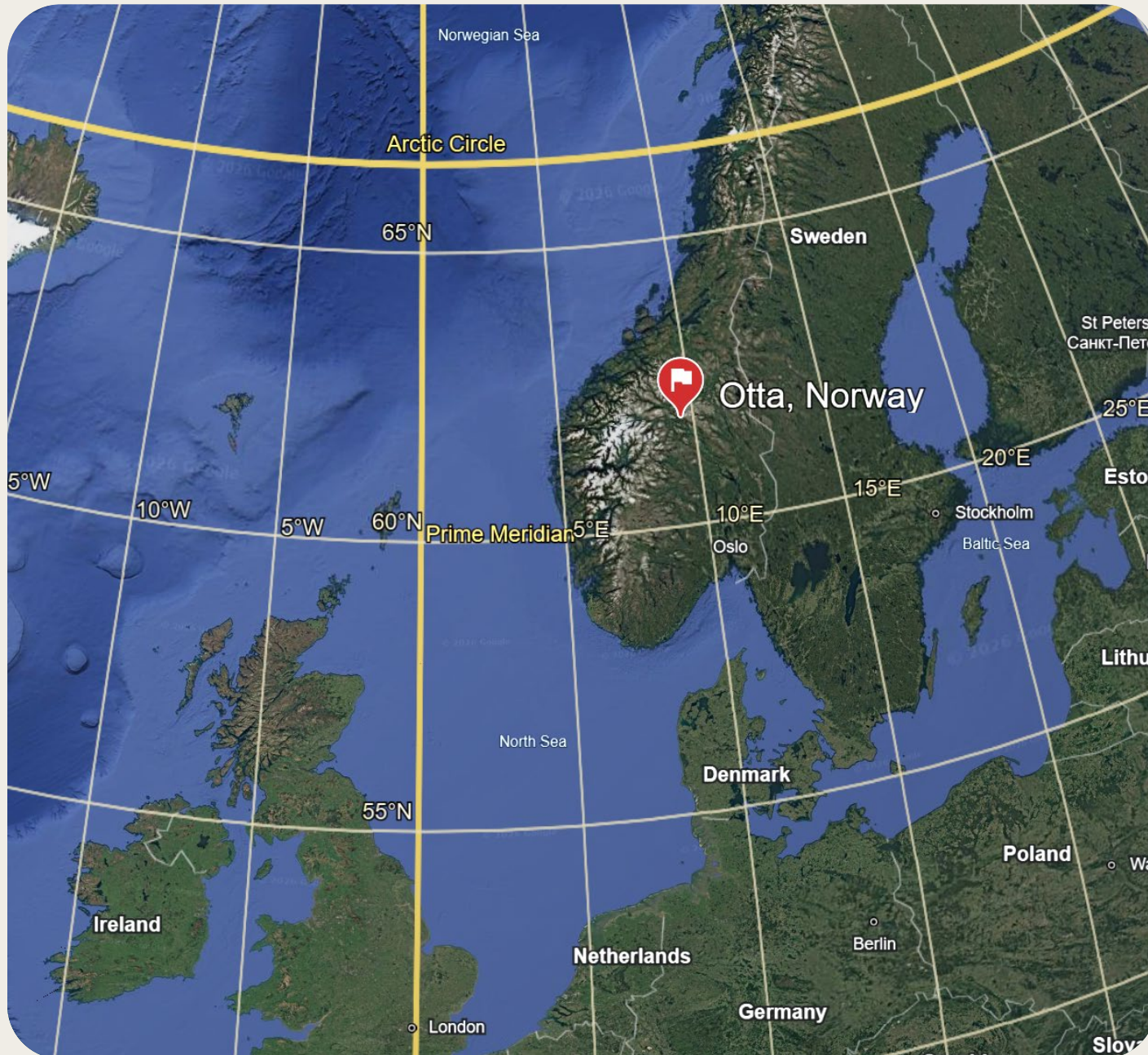
“Do you have any equipment that can bring those two things together?”

“No equipment. Ok, how about inexpensive labor?”

Hold my beer.



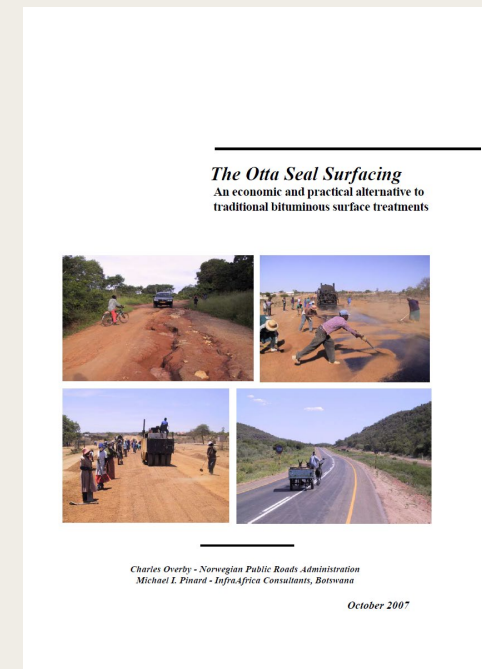
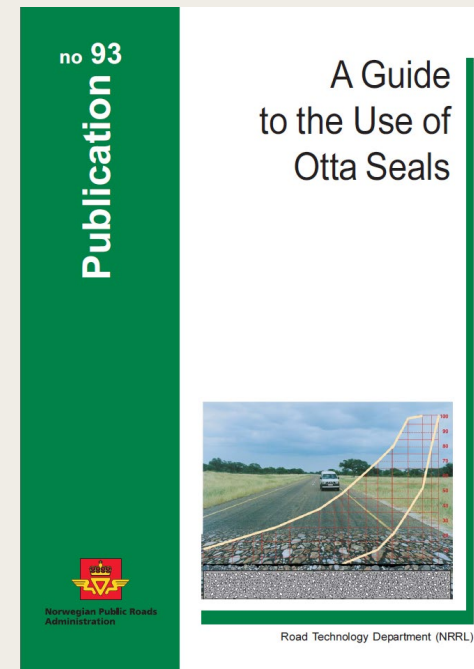
Image credit: Overby/Pinard (2007) *“The Otta Seal Surfacing”* [Botswana]



# Norway

(Charles Øverby)

1. Named for the Otta Valley
2. 60+ years of construction & performance observations
3. Published in 1999 & 2007





# Minnesota

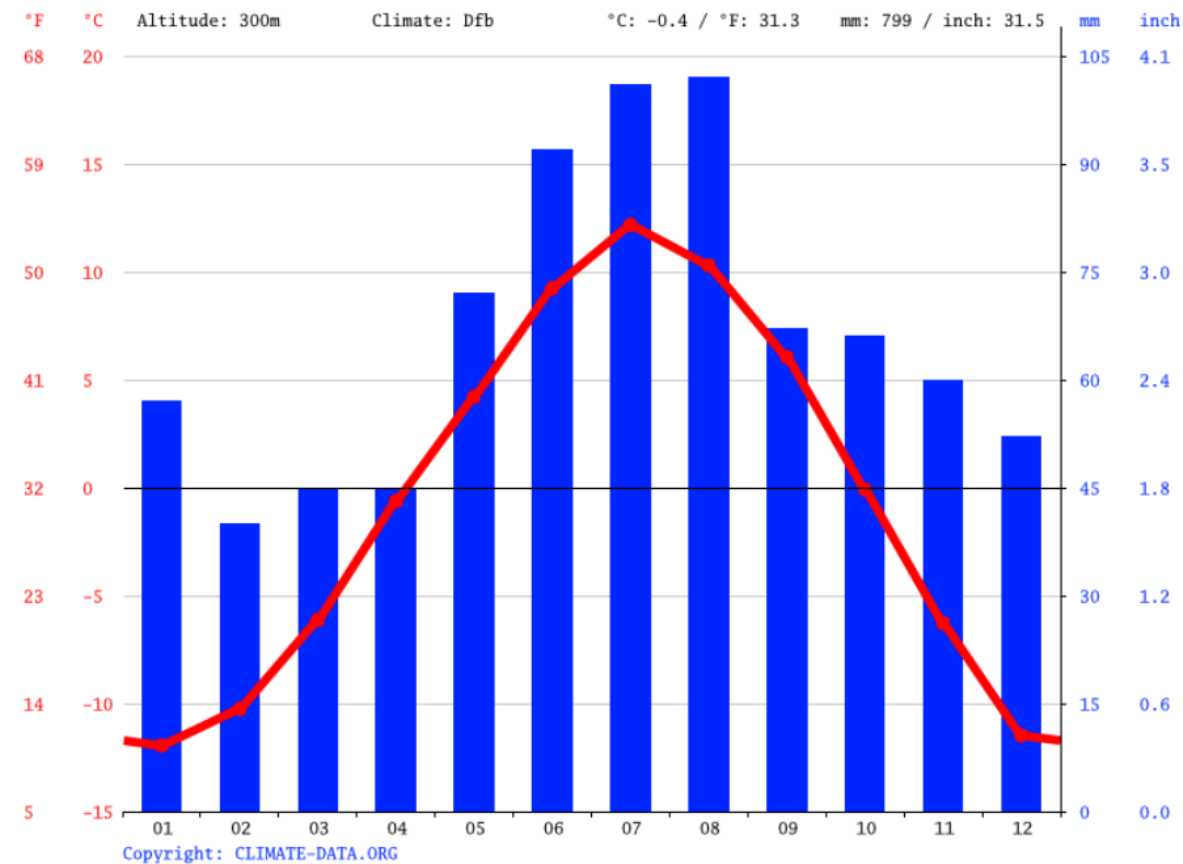
1. Similar climate
2. Same road performance issues
3. Minnesota Road Research, 2003 & 2008

Otta Seal Surfacing of Aggregate Roads	
2008 M&RR	2003, 2008
Author: Greg Johnson, John Pantelis	
<p><b>Description:</b> An Otta seal is an asphalt surface treatment constructed by placing a graded aggregate on top of a thick application of relatively soft bituminous binding agent. Minnesota has used emulsified asphalt exclusively (HFMS-2s); it could be constructed with cutback asphalt if desired. The binder works its way into the aggregate with rolling and traffic. In comparison to other surface treatments, material and construction specifications are not as strict. Local aggregates that would not meet the requirements for high quality paving aggregate are often used in Otta seals.</p> <p><b>Traffic Range:</b> Very Low to High (AADT &lt; 2000) for a double Otta seal.</p> <p><b>Base/Subbase Requirements:</b> Otta seals are constructed over an aggregate base course. Since Otta seals do not add structural capacity to the roadway, the base/subbase must be designed to support the anticipated traffic loading. Subgrade and base materials should be compacted and graded to provide a stable working surface prior to Otta seal placement. A prime coat is usually not used above the aggregate base prior to Otta seal application.</p> <p><b>Materials:</b> An Otta seal is constructed of a graded aggregate on top of a thick application of relatively soft bituminous binding agent. The bituminous binding is typically an emulsified asphalt (e.g. HFMS-2s). Bituminous binder application rates vary from about 1.9 liter/m<sup>2</sup> (0.45 gallyd<sup>2</sup>) to 2.4 liter/m<sup>2</sup> (0.56 gallyd<sup>2</sup>) for emulsified asphalt, depending on aggregate gradation and type. In comparison to other surface treatments, material and construction specifications are not as strict. Local aggregates that would not meet the requirements for high quality paving aggregate are often used in Otta seals. Natural gravels are acceptable. The maximum aggregate size in the graded aggregate is generally 13 to 25 mm (0.50 to 1 in.). The graded aggregate can be crushed or uncrushed and contain up to 10% fines. Quantities of aggregate are usually around 50 lb/yd<sup>2</sup>. Otta seal design is empirical in nature and trial sections are recommended to determine the appropriate material application rates.</p>	 

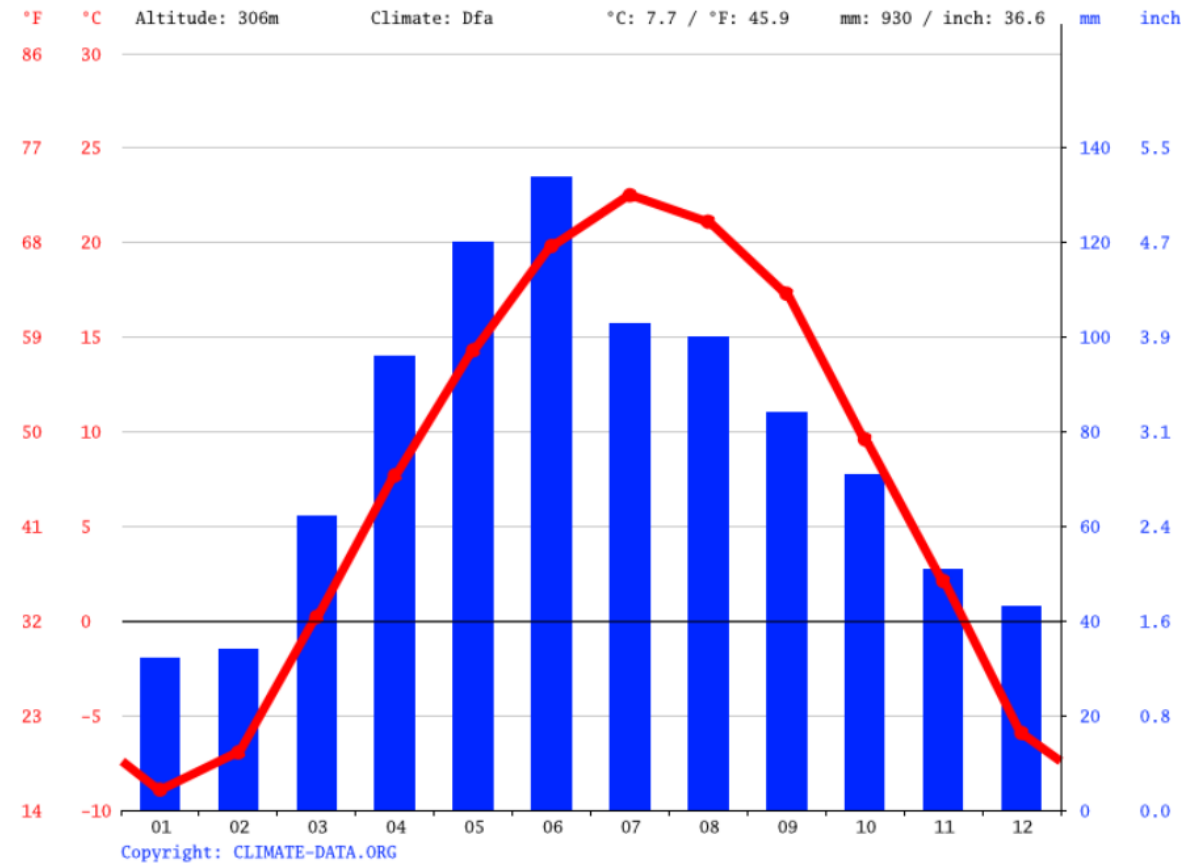
Otta Seal Const. 2007, Olmsted County CR58

# Climate Comparison

CLIMOGRAPH OTTA



CLIMOGRAPH ROCHESTER



# Climate Comparison

## Otta, Norway

	January	February	March	April	May	June	July	August	September	October	November	December
Avg. Temperature °C (°F)	-11.9 °C (10.5) °F	-10.2 °C (13.6) °F	-6.1 °C (21) °F	-0.6 °C (30.9) °F	4.2 °C (39.6) °F	9.2 °C (48.6) °F	12.2 °C (53.9) °F	10.3 °C (50.5) °F	6 °C (42.9) °F	-0.1 °C (31.8) °F	-6.3 °C (20.7) °F	-11.5 °C (11.3) °F
Min. Temperature °C (°F)	-14.6 °C (5.7) °F	-13.2 °C (8.3) °F	-9.6 °C (14.7) °F	-4.3 °C (24.2) °F	0.1 °C (32.2) °F	4.7 °C (40.5) °F	8 °C (46.3) °F	6.6 °C (43.8) °F	2.8 °C (37) °F	-2.7 °C (27.1) °F	-9 °C (15.7) °F	-14.5 °C (5.9) °F
Max. Temperature °C (°F)	-9.5 °C (14.8) °F	-7.6 °C (18.4) °F	-2.9 °C (26.8) °F	2.7 °C (36.9) °F	7.7 °C (45.9) °F	13 °C (55.4) °F	15.8 °C (60.4) °F	13.7 °C (56.7) °F	9.3 °C (48.8) °F	2.5 °C (36.5) °F	-3.9 °C (24.9) °F	-8.7 °C (16.4) °F
Precipitation / Rainfall mm (in)	57 (2)	40 (1)	45 (1)	45 (1)	72 (2)	92 (3)	101 (3)	102 (4)	67 (2)	66 (2)	60 (2)	52 (2)
Humidity(%)	85%	82%	80%	76%	71%	68%	73%	78%	83%	87%	90%	84%
Rainy days (d)	10	8	8	8	10	11	12	11	9	9	9	9

## Rochester, MN

	January	February	March	April	May	June	July	August	September	October	November	December
Avg. Temperature °C (°F)	-8.9 °C (15.9) °F	-7 °C (19.5) °F	0.2 °C (32.4) °F	7.7 °C (45.9) °F	14.3 °C (57.8) °F	19.8 °C (67.7) °F	22.5 °C (72.5) °F	21.1 °C (70) °F	17.3 °C (63.2) °F	9.6 °C (49.3) °F	2.1 °C (35.8) °F	-5.9 °C (21.3) °F
Min. Temperature °C (°F)	-12.5 °C (9.4) °F	-10.8 °C (12.5) °F	-3.9 °C (24.9) °F	3.1 °C (37.6) °F	9.8 °C (49.7) °F	15.5 °C (59.9) °F	18.2 °C (64.8) °F	17 °C (62.6) °F	13.4 °C (56.1) °F	6.1 °C (43) °F	-1 °C (30.2) °F	-9.2 °C (15.5) °F
Max. Temperature °C (°F)	-4.4 °C (24.1) °F	-2 °C (28.5) °F	5.7 °C (42.2) °F	13.6 °C (56.4) °F	19.6 °C (67.4) °F	24.7 °C (76.4) °F	27.1 °C (80.8) °F	25.7 °C (78.2) °F	22.1 °C (71.8) °F	14.1 °C (57.4) °F	6.3 °C (43.3) °F	-2 °C (28.3) °F
Precipitation / Rainfall mm (in)	32 (1)	34 (1)	62 (2)	96 (3)	120 (4)	134 (5)	103 (4)	100 (3)	84 (3)	71 (2)	51 (2)	43 (1)
Humidity(%)	75%	74%	69%	65%	65%	69%	69%	71%	66%	68%	72%	75%
Rainy days (d)	5	5	6	9	10	9	8	8	6	6	5	6
avg. Sun hours (hours)	4.7	5.6	7.0	8.2	9.4	10.5	10.8	9.5	8.4	6.5	5.7	4.2

# 2014 Crash & burn

1. Wrote my own specification since Iowa didn't have one.
2. Followed Overby's guidelines almost to the letter.
3. Couldn't get a contractor to build it for a reasonable price.



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# 2018 Academia to the rescue

## Evaluation of Otta Seal Surfacing for Low-Volume Roads in Iowa

Final Report  
June 2018



IOWA STATE UNIVERSITY  
Institute for Transportation

Sponsored by  
Iowa Highway Research Board  
(IHRB Project TR-674)  
Iowa Department of Transportation  
(InTrans Project 14-497)

28/2018

Otta Seal Surfacing Workshop

IOWA STATE UNIVERSITY

## Iowa LTAP Workshops

### Otta Seal Surfacing Workshop

#### Dates and Location

Ames, IA, Friday, Sept. 14, 2018  
Institute for Transportation (InTrans)  
2711 South Loop Dr. Suite 4700  
Ames, IA 50010

#### Registration Details

This event is free, but registration is required.

[Click here to register](#)



#### Description

- Iowa has over 71,000 miles of unpaved secondary roads carrying very low daily traffic volumes but frequently supporting heavy vehicle (i.e., farm equipment) movements and Iowa's county road

[https://register.extension.iastate.edu/iowalapl/upcoming-workshops/otta-seal-surfacing-workshop?utm\\_medium=email&utm\\_source=govdelivery](https://register.extension.iastate.edu/iowalapl/upcoming-workshops/otta-seal-surfacing-workshop?utm_medium=email&utm_source=govdelivery)

Special thanks:

Dr. Halil Ceylan (ISU, PROSPER)  
Dr. Charles Jahren (ISU)  
Dr. Keith Knapp (Iowa LTAP)  
Brian Moore, PE (ICEASB)  
Mr. Charles Overby

Iowa DOT

All of the counties and  
engineers that participated in  
the research program.



# Shaping and drainage



# Macadam (daylighted to ditch)



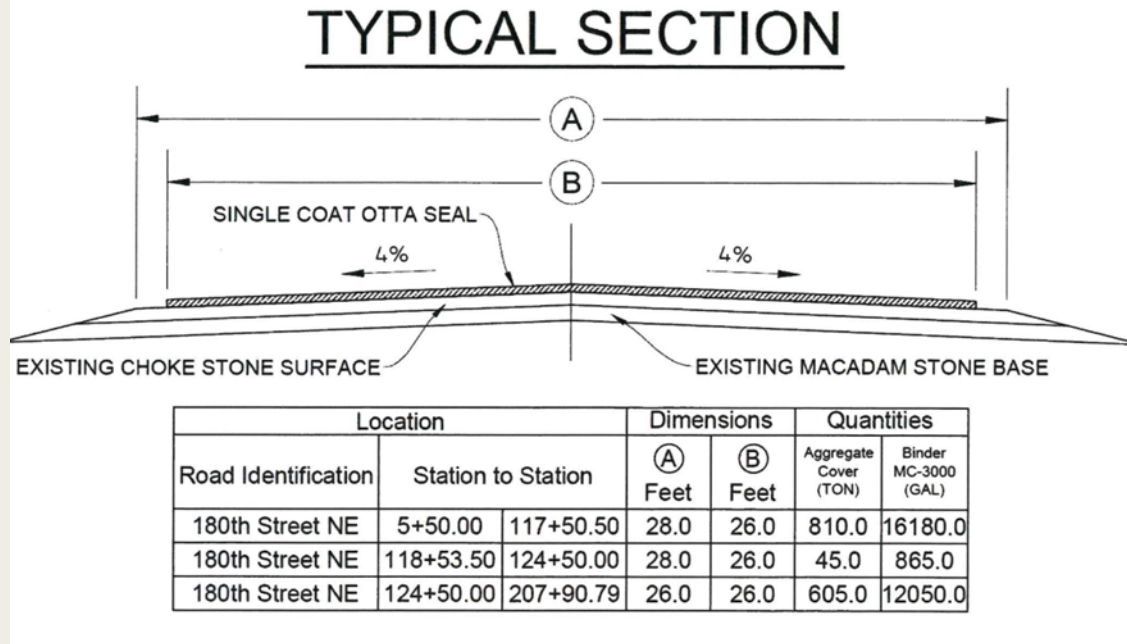
# Choke stone surface shaped



# Putting it all together



# 2021 - Aged to "pretty good"



**JOHNSON COUNTY**  
PROJECT NO: M21-4  
180th Street Otta Seal  
Letting Date 22 July 2021

### IOWA DEPARTMENT OF TRANSPORTATION

Highway Division  
PLANS OF PROPOSED IMPROVEMENT ON THE  
SECONDARY ROAD SYSTEM  
JOHNSON COUNTY

(Refer to the Proposal Form for list of applicable specifications.)

Scale: As Noted  
**M21-4**  
180th Street Otta Seal

(Value Engineering Saves. Refer to Article 1105.15 of the Specifications.)  
A tabulation of Standard Road Plans that apply to work on this project may be found on Sheet A.1.

#### TYPICAL SECTION

Location		Dimensions		Quantities	
Road Identification	Station to Station	Ⓐ Feet	Ⓑ Feet	Aggregate Cover (TON)	Binder MC-3000 (GAL)
180th Street NE	5+50.00 117+50.50	28.0	26.0	810.0	16180.0
180th Street NE	118+53.50 124+50.00	28.0	26.0	45.0	865.0
180th Street NE	124+50.00 207+90.79	26.0	26.0	605.0	12050.0

180th Street Otta Seal  
BOP Sta. 5+50  
EOP Sta. 207+90.79

**JOHNSON COUNTY**  
DESIGN DATA RURAL  
2018 AASHTO 180-280 V.P.D.  
2040 AASHTO 250-400 V.P.D.  
2040 AASHTO 250-400 V.P.D.  
TRUCKS 5%  
TOLER 5%  
Design ESALs

Project No: M21-4

Index of Sheets		1054 10-10-11	
No.	Description	No.	Sheet
A.1	Typ. Design Data, Highway Secondary Roadway Typical Section, and Quantities	1	1

Standard Road Plans

Number	Date	Description	Scale
101	04-18-13	ROAD NOT DESIGNING "Traffic" (Two Lane or Multi Lane)	1"=40'
102	10-10-10	Lane Closure with Flaggers	1"=40'
103	04-21-20	Lane Closure with Flaggers for use with Pilot Car	1"=40'

Estimated Roadway Quantities

Item No.	Item Code	Item	Unit	Quantity
1	2047-000000	ACQUISITION ROADWAY COVER	TON	16180.0
2	2047-000001	ACQUISITION ROADWAY COVER	TON	2000.0
3	2048-000000	PAVING CONTROL	EA	10
4	2048-000001	PAVING CONTROL	EA	10
5	2048-000002	PAVING CONTROL	EA	10
6	2048-000003	PAVING CONTROL	EA	10

Mileage Summary

Dist.	Location	Station	Station	Length	Miles
1	Existing Bridge	117+50.50	118+53.50	102.99	1.914
Total Project Length				207.97	3.914

JOHNSON COUNTY  
Secondary  
Road Department  
Approved: \_\_\_\_\_  
County Engineer Date: \_\_\_\_\_

Approved: \_\_\_\_\_  
Board of Supervisors

IOWA  
ONE CALL  
1-800-292-8989

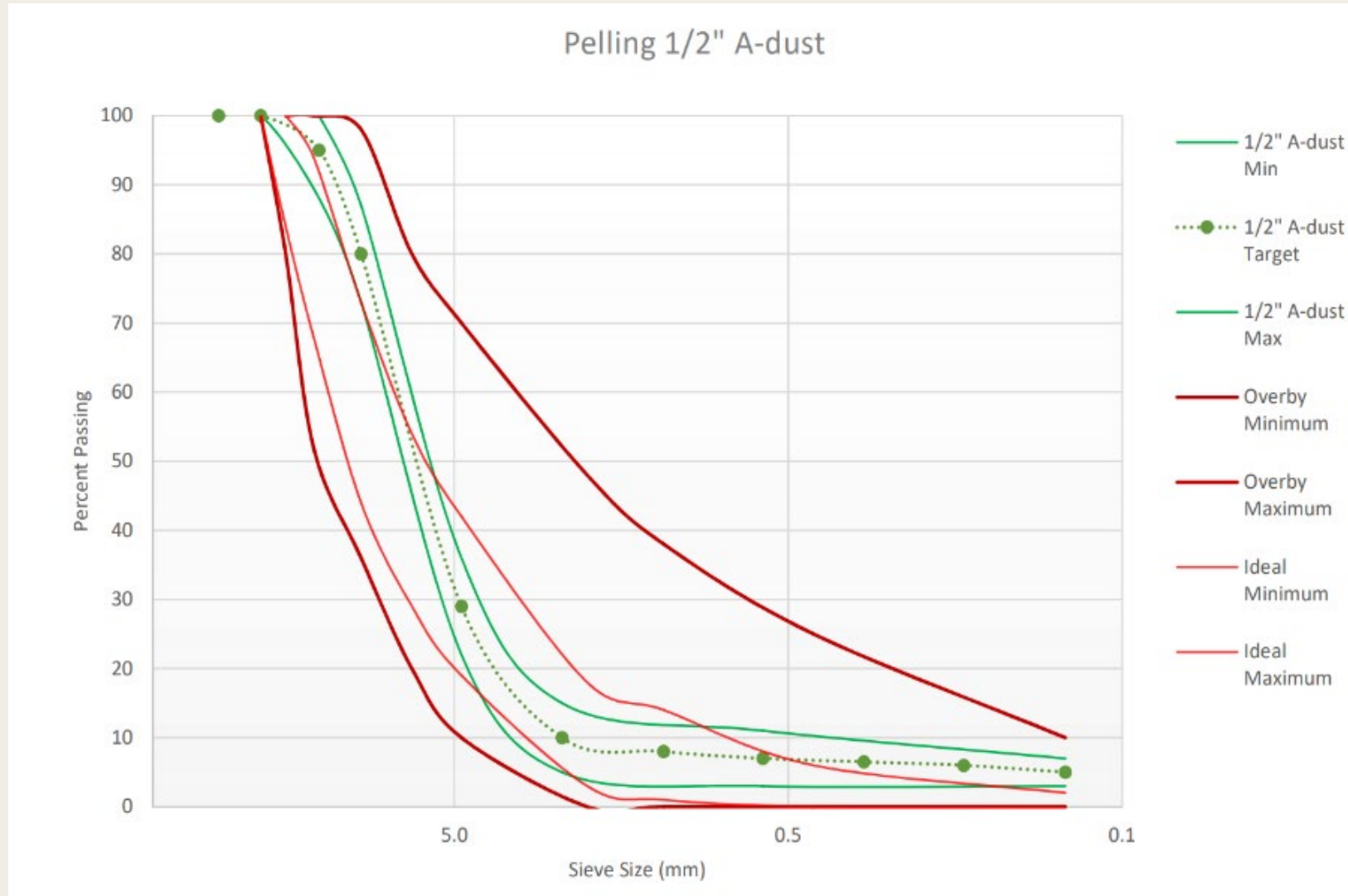
STANDARD & BARTLETT  
1001  
1001  
1001

I hereby certify that the engineering design and plans herein are or under my direct personal supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Iowa.

Edward J. Bartlett, P.E., P.L.L.  
License Number 1001  
My license expires on December 31, 2022  
Plans or sheets created by this seal  
08/01/21

Johnson County      Project Number: M21-4      A.1

# 2021 - Aged to “pretty good”



# 2021 - Aged to “pretty good”

		Overby Publication 93 1999 - Open Grading: AADT<100		Overby Publication 93 1999 - Med. Grading: 100<AADT<1000		Overby Publication 93 1999 - Dense Grading: AADT>1000		Overby Publication 93 1999 - General Grading		IADOT Gradation #11 - Class A		Pelling Gradation 1/2" A-dust		
Sieve Size/No.		%Passing		%Passing		%Passing		%Passing		%Passing		%Passing		
English Standard	Metric (mm)	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Target	Max
1-1/2"	38.1													
1"	25.4									100.0		100.0	100.0	
3/4"	19.0	100.0		100.0		100.0		100.0		95.0	100.0	100.0	100.0	
5/8"	16.0	80.0	100.0	84.0	100.0	93.0	100.0	80.0	100.0					
0.52	13.2	52.0	82.0	68.0	94.0	84.0	100.0	52.0	100.0					
1/2"	12.7									70.0	90.0	88.0	95.0	100.0
3/8"	9.51	36.00	58.00	44.00	73.00	70.00	98.00	36.00	98.00			73.0	80.0	87.0
0.265	6.70	20.00	40.00	29.00	54.00	54.00	80.00	20.00	80.00					
4	4.76	10.00	30.00	19.00	42.00	44.00	70.00	10.00	70.00	30.0	55.0	22.0	29.0	36.0
8	2.38									15.0	40.0	5.0	10.0	15.0
10	2.00	0.00	8.00	3.00	18.00	20.00	48.00	0.00	48.00					
16	1.18	0.00	5.00	1.00	14.00	15.00	38.00	0.00	38.00				8.0	
30	0.595											3.0	7.0	11.0
40	0.420	0.000	2.000	0.000	6.000	7.000	25.000	0.000	25.000					
50	0.297												6.5	
100	0.149												6.0	
200	0.074	0.000	1.000	0.000	2.000	3.000	10.000	0.000	10.000	6.0	16.0	3.0	5.0	7.0

# 2022 Update - Aged to “near perfect”



# 2022 Update - Aged to “near perfect”



# 2022 Update - Aged to “near perfect”



# 2025 Update - are you kidding me?



# 2025 Update - are you kidding me?



# 2025 Update - are you kidding me?



# Wrap-up

# Otta Seal - A Recipe for Success

## STEP 1 - Prepare

- Get the water out
  - Ditches below your base
  - Evaluate and replace pipes
  - Large gaps - no pore space
  - Daylight base/Wicking fabrics?
- Stabilize your base
  - Mechanical
    - Macadam
    - Geogrid/Geosynthetics
  - Chemical (Base 1, etc.)
- Establish Crown (+ drainage)

## STEP 2 - Otta Seal

- Local Rocks
  - *~50 lbs/SY*
  - Well-graded
  - Keep the train tight!
- Match binder to use case
  - MC-3000
  - HFMS-2
  - CRS-2P
  - *~0.50 gal/SY*
- Roll and roll and roll some more
  - 14T Pneumatics
  - Delivery vehicles



# QUESTIONS????

## Contact Info:

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319.356.6046 (o)  
319.310.1714 (m)