Iowa State University
Dept. of Civil, Construction & Envr. Engineering
WISCONSIN
UNIVERSITY OF WISCONSIN–MADISON
Dept. of Civil & Envr. Engineering

Determining Pavement Design Criteria for Recycled Aggregate Base and Large Stone Subbase - DRAFT

Bora Cetin, PI
William Likos, Co-PI
Tuncer Edil, Co-PI
Ashley Buss, Co-PI
Halil Ceylan, Co-PI
Junxing Zheng, Co-PI

MnDOT Project TPF-5(341)
Monthly Meeting
May 3rd, 2018

RESEARCH TEAM

Iowa State University

- Principal Investigator – Bora Cetin

  Assistant Professor – Department of Civil, Construction & Environmental Engineering

- Co-Principal Investigator – Ashley Buss

  Assistant Professor – Department of Civil, Construction & Environmental Engineering

- Co-Principal Investigator – Halil Ceylan

  Professor – Department of Civil, Construction & Environmental Engineering

- Co-Principal Investigator – Junxing Zheng

  Assistant Professor – Department of Civil, Construction & Environmental Engineering

- Research Personnel – Haluk Sinan Coban

  PhD Student – Department of Civil, Construction & Environmental Engineering

University of Wisconsin-Madison

- Co-Principal Investigator – William Likos

  Professor – Department of Civil and Environmental Engineering

- Co-Principal Investigator – Tuncer B. Edil

  Professor Emeritus – Department of Civil and Environmental Engineering

NRRA Members (Agency Partners)

- MnDOT
- Caltrans
- MDOT
- Illinois DOT
- LRRB
- MoDOT
- WisDOT

NRRA Members (Industry Partners)

- Aggregate and Ready Mix (Association of MN)
- APA
- Braun Intertec
- CPAM
- Diamond Surface Inc
- Flint Hills Resources
- IGGA
- MIDSTATE (Reclamation and Trucking)
- MN Asphalt Pavement Association
- Minnesota State University
- NCP Tech Center
- Road Scanners
- University of Minnesota-Duluth
- University of New Hampshire
- MATHY
- 3M
- Paviasystems
- Michigan Tech
- University of Minnesota
- NCAT
- GSE Environmental
- HELIX
- Ingios
- WSB
- Cargill
- PITT Swanson Engineering
- INFRASENSE
- Collaborative Aggregates LLC
- American Engineering Testing, Inc.
- CTIS
- ARRA
- 1st
- O-BASF
- North Dakota State University
- All States Materials Group

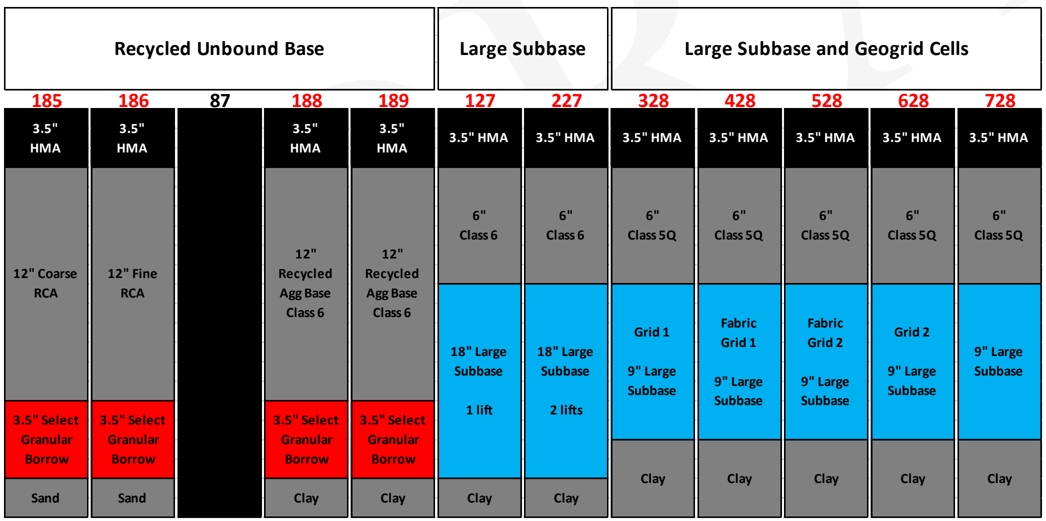
OUTLINE

- Literature Review – Reminder
- Materials
- Tech Transfer Drafts
- Field Testing

MATERIALS

Bucket List - 04.10.2018 - Iowa State University			
Bucket #	**Cell**	**MnROAD ID**	**Description**
1	185	18517SS010	sandy subgrade soil - stations on rover
2	186	18617SS010	sandy subgrade soil - stations on rover
3	188	18817SS010	clayey subgrade soil - stations on rover
4	127	12717SS009	Subgrade soil post-excavation pre-rip top 18"
5		12717SS010	Subgrade soil post-excavation pre-rip top 18"
6		12717GS005	Class 6; green Menard's bucket
7		12717GS006	Class 6; green Menard's bucket
8		12717GS007	Class 6; green Menard's bucket
9		12717GS008	Class 6; green Menard's bucket
10	227	22717SS009	Subgrade soil post-excavation pre-rip top 18"
11		22717SS010	Subgrade soil post-excavation pre-rip top 18"
12	128	12817SS009	Subgrade soil post-excavation pre-rip top 18"
13		12817SS010	Subgrade soil post-excavation pre-rip top 18"
14	228	22817SS010	Subgrade soil post-excavation pre-rip top 18"
15		22817GS005	Class 5Q sampled from original X28 construction; green Menard's bucket
16		22817GS006	Class 5Q sampled from original X28 construction; green Menard's bucket
17		22817GS007	Class 5Q sampled from original X28 construction; green Menard's bucket
18		22817GS008	Class 5Q sampled from original X28 construction; green Menard's bucket

Bucket List - 01.19.2018 - Iowa State University			
Bucket #	**Cell**	**MnROAD ID**	**Description**
1	185	18517GS001	
2		18517GS001	
3	186	18617GS001	
4		18617GS001	
5	188	18817GS001	
6		18817SS001	
7	189	18917GS001	
8		18917SS001	



Gray color ➔ received

Granular Borrow ➔ will be taken from UTEP

LSSB ➔ 1 barrel for ISU & UW-Madison

TECH TRANSFER DRAFTS

- Determining Pavement Design Criteria for **Recycled Aggregate Materials**
- Determining Pavement Design Criteria for **Large Stone Subbase Materials**

NRRA National Road Research Alliance

April 2018

TECH TRANSFER "STATE OF PRACTICE" REPORT

Determining Pavement Design Criteria for Recycled Aggregate Base Materials

Introduction

Figure 1. Recycled asphalt pavement (RAP) (Copeland 2011)

Figure 2. Recycled concrete aggregate (RCA) (Gonzalez and Moo-Young 2004)

Recycled Aggregate Base Materials

Index Properties of RAP and RCA

Develop Collaborate Research Implement 1

NRRA National Road Research Alliance

April 2018

TECH TRANSFER "STATE OF PRACTICE" REPORT

Determining Pavement Design Criteria for Large Stone Subbase Materials

Introduction

Figure 1. The general structure of rigid and flexible pavements

Figure 2. Fine- to coarse-grained aggregates (left to right) (http://engineeringfeed.com/8-factors-affect-workability-fresh-concrete)

Large Stone Subbase Materials

Index and Engineering Properties of LSSB Materials

Grain and Gradation Characteristics

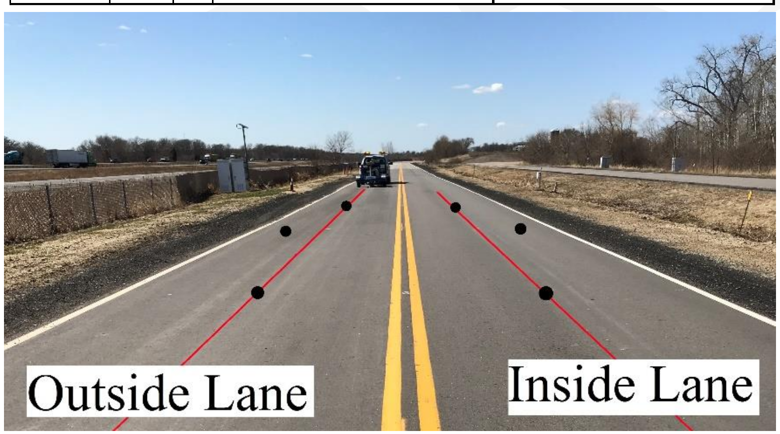
Develop Collaborate Research Implement 1

FIELD TESTING

- Field Trip – 04.26.2018
  - FWD
  - LWD

FIELD TESTING

CELL	STA	TP #	OUTSIDE LANE (+) OWP	OUTSIDE LANE (+) MID	OUTSIDE LANE (+) IWP	INSIDE LANE (-) IWP	INSIDE LANE (-) MID	INSIDE LANE (-) OWP
185 Coarse RCA	16379.00	1	o					o
	16409.00	2		o			o	
	16439.00	3	o					o
	16469.00	4		o			o	
	16499.00	5	o					o
	16529.00	6		o			o	
	16559.00	7	o					o
186 Fine RCA	16630.00	1	o					o
	16660.00	2		o			o	
	16690.00	3	o					o
	16720.00	4		o			o	
	16750.00	5	o					o
	16780.00	6		o			o	
	16810.00	7	o					o
188 Limestone	17057.00	1	o					o
	17087.00	2		o			o	
	17117.00	3	o					o
	17147.00	4		o			o	
	17177.00	5	o					o
	17207.00	6		o			o	
	17237.00	7	o					o
189 RCA+RAP	17308.00	1	o					o
	17338.00	2		o			o	
	17368.00	3	o					o
	17398.00	4		o			o	
	17428.00	5	o					o
	17458.00	6		o			o	
	17488.00	7	o					o



CELL	STA	TP #	OUTSIDE LANE (+) OWP	OUTSIDE LANE (+) MID	OUTSIDE LANE (+) IWP	INSIDE LANE (-) IWP	INSIDE LANE (-) MID	INSIDE LANE (-) OWP
127 18" LSSB	17506.00	1	o					o
	17536.00	2		o			o	
	17566.00	3	o					o
	17596.00	4		o			o	
	17626.00	5	o					o
	17656.00	6		o			o	
	17686.00	7	o					o
	17716.00	8		o			o	
	17746.00	9	o					o
227 18" LSSB	17815.00	1	o					o
	17845.00	2		o			o	
	17875.00	3	o					o
	17905.00	4		o			o	
	17935.00	5	o					o
	17965.00	6		o			o	
	17995.00	7	o					o
	18025.00	8		o			o	
	18055.00	9	o					o
328 9" LSSB Grid1	18079.50	1	o					o
	18099.50	2		o			o	
	18119.50	3	o					o
	18139.50	4		o			o	
	18159.50	5	o					o
428 9" LSSB Grid1+Fabric	18188.50	1	o					o
	18208.50	2		o			o	
	18228.50	3	o					o
	18248.50	4		o			o	
	18268.50	5	o					o
528 9" LSSB Grid2+Fabric	18297.00	1	o					o
	18317.00	2		o			o	
	18337.00	3	o					o
	18357.00	4		o			o	
	18377.00	5	o					o
628 9" LSSB Grid2	18407.50	1	o					o
	18427.50	2		o			o	
	18447.50	3	o					o
	18467.50	4		o			o	
	18487.50	5	o					o
728 9" LSSB original	18519.50	1	o					o
	18539.50	2		o			o	
	18559.50	3	o					o
	18579.50	4		o			o	
	18599.50	5	o					o
	18619.50	6		o			o	

SCHEDULE

TASKS	MONTHS																															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
Task 1	■	■	■	■	■																												
Task 2						■	■	■	■																								
Task 3		■	■	■	■	■	■	■	■																								
Task 4		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■													
Task 5		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■								
Task 6		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■								
Task 7																								■	■	■	■	■					
Task 8																											■	■	■	■	■		
Task 9																															■	■	■

Thank You!

QUESTIONS??