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International Union of Laboratories and Experts in Construction Materials, Systems and Structures Réunion
Internationale des Laboratoires d'Essais et de Recherches sur les Matériaux et les Constructions

RILEM Task Group 2

Mixture Design and Compaction

RILEM TG2 MEETING – WASHINGTON, D.C.

14 JANUARY 2009

12:00 – 2:30 PM

ROOM 8209 MARRIOTT (PARK TOWER)

In attendance:

AARON COENEN, UW-Madison	HYUNWOOK KIM, EMPA
ALLEX ALVAREZ, Texas A&M	JAMES GRENFELL, U. of Nottingham
ANDREW HANZ, UW-Madison	JAMILLA LUTIF, UN-Lincoln
*CARL JOHNSON, UW-Madison	KATHERINE PETROS, FHWA
CHICHUN HU, FHWA	KONRAD MOLLENHAUER, TU-Braunschweig
DAVID HELDT, FHWA	LINBING WANG, Virginia Tech.
EDITH ARAMBULA, FHWA	M. EMIN KUTAY, Michigan State
EMAD KASSEM, Texas A&M	MANFRED PARTL, EMPA
ENAD MAHMOUD, Texas A&M	NELSON GIBSON, FHWA
ERNIE BASTIAN, FHWA	SANJEEV ADHIKARI, Michigan Tech.
EYAD MASAD, Texas A&M	XINJUN LI, FHWA
GORDON AIREY, U. of Nottingham	YONGRAK KIM, UN-Lincoln
HAIZHU LU, Michigan Tech.	YU LIU, Michigan Tech.
HUSSAIN A. KHALID, U. of Liverpool	ZHANPING YOU, Michigan Tech.
HUSSAIN U BAHIA, UW-Madison	

*Via conference call

Purpose: The objective of this meeting was to update the TG2 members on the status of the laboratory compaction study currently underway. Also, there was a focus on image analysis methods in order to standardize the analysis of the compacted samples. Individuals were encouraged to discuss any encountered problems/issues and turn to the group for suggestions for correction.

1. Laboratory Compaction Status & Image Analysis

Carl began the meeting by presenting the updated status of the specimen compaction, imaging and location (shown in the table below). Specimens from UW, Mich Tech, UCPRC, AIT, TU-Braunschweig are being imaged at Turner Fairbank Highway Research Center

using X-Ray CT. Specimens from LCPC, EMPA, TU-B, and Parma are at LCPC for gamma-ray density scanning. Results were shown during the later presentations.

Table 1. Specimen Status (as of 14 Jan 2009)

		Task #1							
		COMPACTION METHODS							
		1	2	3	4	5	7		
LAB No.	LAB name	Gyratory – US	Gyratory - CE	French Roller	German sector	Marshall	Hveem	Sent for X-Ray CT	Sent for GRD
10	AIT					X		X	
14	UC – Davis			X			X	X	
2	EMPA	X		X		X			X
7	LCPC		X	X					X
9	Liverpool				X				
3	Michigan Tech	X						X	
10	Technical Univ. of Braunschweig		X		X	X			X
5	Total			X					X
8	TU-Delft	Shear Box Compaction							
11	University of Parma				X				
1	UW – Madison	X						X	
16	Nottingham		X						
21	University of Palermo				X				

Image Analysis

Aaron has recently become involved in the Task Group, specifically with the 2D imaging taking place at UW-Madison using KCKIM software (MATLAB Script). Aaron presented his approach to understanding the software by analyzing the results rather than the script. After variability in results of asphalt samples, he created black & white images with known orientations to verify the results produced by the software. The results of the B&W images provided more confidence than initial testing, but additional investigation is needed, included solutions to create a more user-friendly/input-driven version of the software.

2. Status of X-ray CT Imaging

Dr. Nelson Gibson – FHWA:

The presentation given by Dr. Gibson described the work performed by the TFHRC participants. The presentation began with an overview of the CT Equipment that is used at TFHRC and typical results of that equipment. Approximately 2/3rd of the specimens have been imaged thus far. Minor set-backs include “ring artifacts” on images and consistency of calibration. To test accuracy and repeatability, “blind” dummy samples have been created since the last meeting. The samples consist of a known number of aggregates, but this number remains unknown to the individual scanning and analyzing. The results can be compared with the known values to determine accuracy for several gradations and aggregate counts.

3. Proposed Framework for Image Analysis Tool

Dr. M. Emin Kutay – Michigan State:

Dr. Kutay’s presentation gave a detailed look at the process of estimating 3D internal structure characteristics from 2D images. He is also currently working on creating a more user-friendly interface for the KCKIM software at UW-Madison. He has begun problem solving for the issues encountered at UW-Madison and is implementing the necessary changes at Michigan State. He is to the point of increasing the accuracy of results via calibration using numerous images from the entire group of a variety of quality, size, gradation, etc.

4. Progress from TU-Braunschweig

Dr. Konrad Mollenhauer – TU-Braunschweig:

Dr. Mollenhauer presented findings of the effects of specimen compaction on performance characteristics as they relate to asphalt concrete. Compaction methods at ISBS include French Roller, German Sector, Gyratory and Marshall. Dr. Mollenhauer presented the variability in cumulative axial strains versus number of cycles between each method. A similar trend was found in the cumulative radial strains and the creep rate of each method as well. This leads to a distinct difference in Poisson’s ratio of samples based on compaction method. Considerable variation in void content was also noted. In summary, compaction method directly affects physical characteristics of asphalt concrete specimens, which may in turn affect performance of the specimens. We need to see if image analysis can identify these variations.

5. Pre-Conference Workshop on Compaction ATCBM09

Dr. Hussain Bahia – UW-Madison

Dr. Bahia used the remaining time for discussion of a possible workshop related to the efforts of the Task Group to be scheduled in conjunction with the RILEM Conference in Greece later this year. All in attendance favored the idea.

6. Discussion

- It is asked that all universities with CT imaging equipment email the specifications of the equipment to Aaron at UW-Madison (arcoenen@wisc.edu). Also, if Michigan State, TU-Delft and any others capable of shear box compaction could send the information for this equipment as well. Aaron will compile the information and send this to the group to inform every one of the availability and capabilities within the group and also to identify any identical equipment within the group. This information should include the power level for CT machines as this was determined to be critical information.
- All those capable of linear kneading compaction are asked to specify the volume of material desired for testing.
- TFHRC has agreed to create additional “blind” dummy samples ranging from angular aggregate to non-angular and from small to large gradation to be circulated throughout the Task Group for consistent calibration of scanning equipment.
- TFHRC has kindly agreed to provide written detail of wedge calibration using a resin/powder spacer for the CT imaging equipment.
- Dr. Kutay has requested that all members of the group begin organization of image databases. Dr. Kutay will create a template of critical information to accompany images. This template will be distributed to the group which can then narrow their individual databases prior to compilation of all images which Dr. Kutay will then use to calibrate KCKIM 2D imaging software.
- Carl & Aaron will follow-up on field specimens to be sent to Dr. Mollenhauer to be tested in conjunction with laboratory compacted specimens.
- University of Nebraska-Lincoln has requested that UW-Madison send the B&W images used for KCKIM verification which will then be used in additional 2D imaging software for a comparison of results.

Please feel free to contact Mr. Aaron Coenen (arcoenen@wisc.edu) regarding this meeting or the project being conducted by TG2.