

Concrete Pavement Vibration and Compaction

Alessandro Fascetti

IRISE ANNUAL MEETING

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The Problem

- ❑ The quality of a paving process is influenced by:
 - ❑ environmental conditions (e.g., temperature and humidity)
 - ❑ the type of concrete mix,
 - ❑ layout of reinforcement, and
 - ❑ the manipulations performed during construction (i.e., vibration and compaction).
- ❑ The effect of each of the influencing factors needs to be accurately defined, to provide guidelines and operational control for the optimization of the process

Project Objectives

- 1) Build novel experimental tools to enable optimized design and construction of concrete pavements
- 2) Experimentally investigate the effect of vibration and compaction in paving processes under different conditions
- 3) Create novel computational tools to perform predictions and identify best practices for optimal paving processes
- 4) Develop guidelines to provide more efficient construction for new pavements

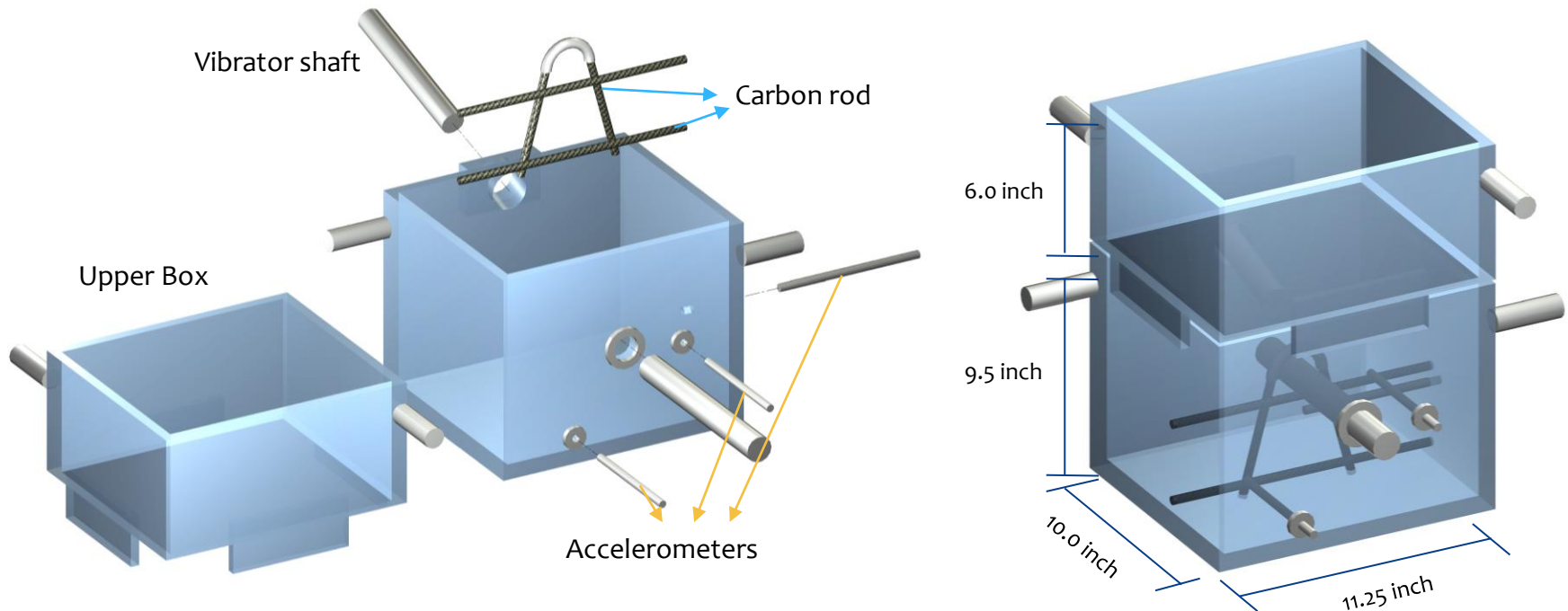
Project Approach

- **Task A:** compile a literature review of existing rules and guidelines from DOTs. (Completed)

	Agency	Vibration frequency	Specification
1	MnDOT	3,600-6,000 vibrations per minute	MnDOT 2301
2	PennDOT	Not less than 100 vibrations per second (6,000 per minute)	PennDOT Pub 408
3	IDOT	Minimum of 3,500 vibrations per minute	IDOT Construction Manual
4	NYSDOT	Vibrators capable of 6,000-10,000 vibrations per minute	NYSDOT Section 500
5	Iowa DOT	4,000-8,000 vibrations per minute	Specification 2301

Project Approach

Task B: design and conduct an experimental campaign on controlled specimens to evaluate micro-mechanical effects of vibration on the 3-dimensional arrangement of aggregate.



Box vibration test device

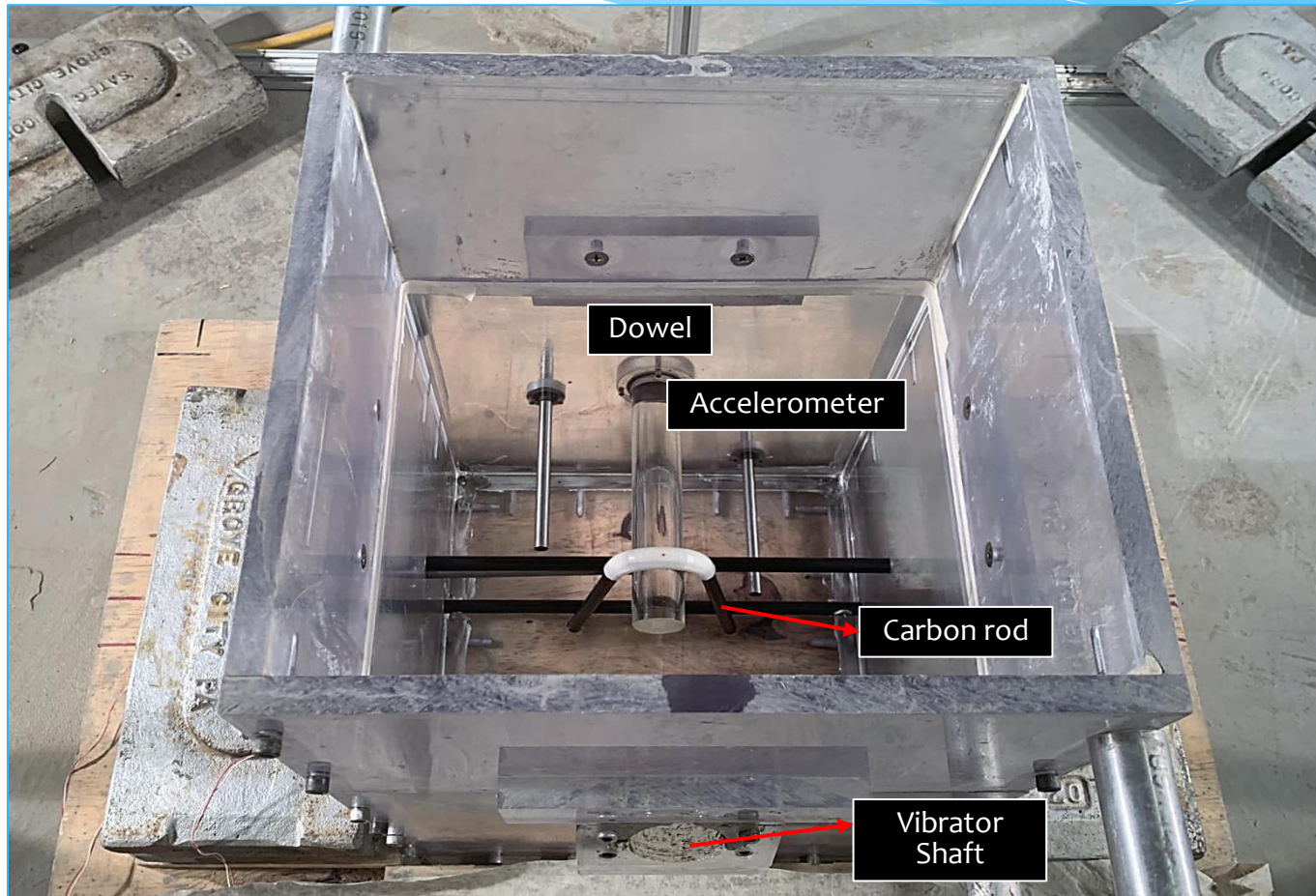
Project Approach

- Task B: design and conduct an experimental campaign on controlled specimens to evaluate micro-mechanical effects of vibration on the 3-dimensional arrangement of aggregate.



Project Approach

- Task B: design and conduct an experimental campaign on controlled specimens to evaluate micro-mechanical effects of vibration on the 3-dimensional arrangement of aggregate.



Project Approach

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Yellow (1")

White (3/4")

Red (1/2")

Limestone (<1/2")

Sand

Weight (lb/cy)

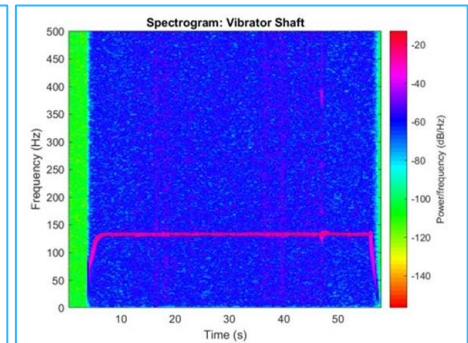
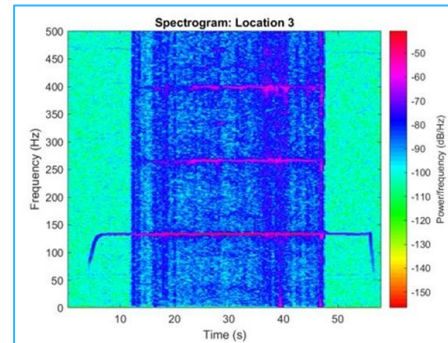
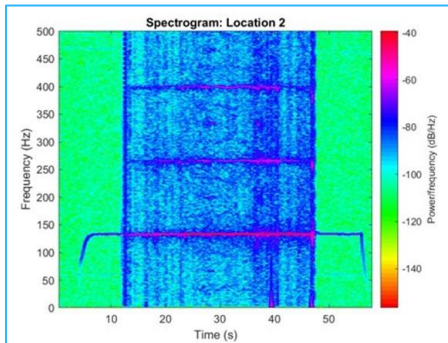
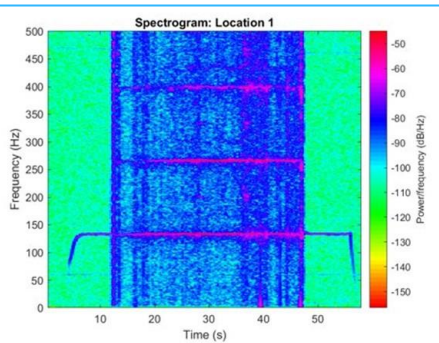
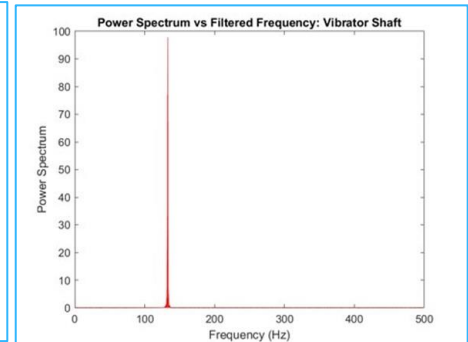
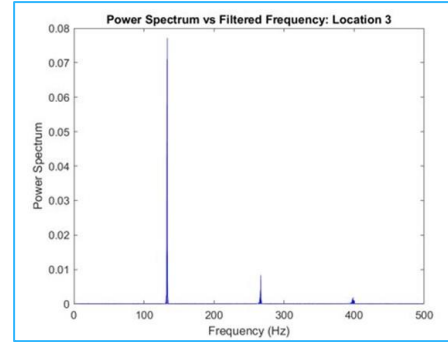
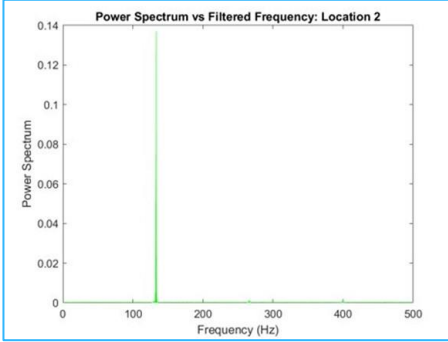
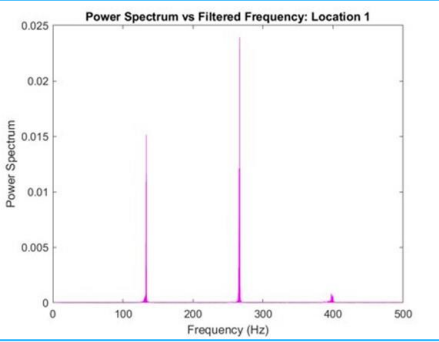
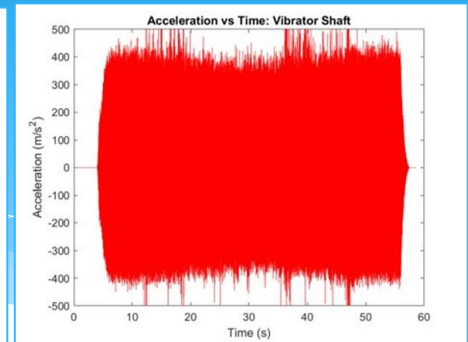
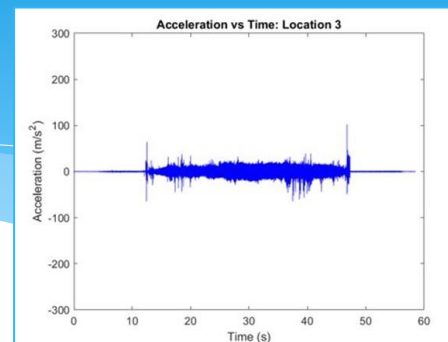
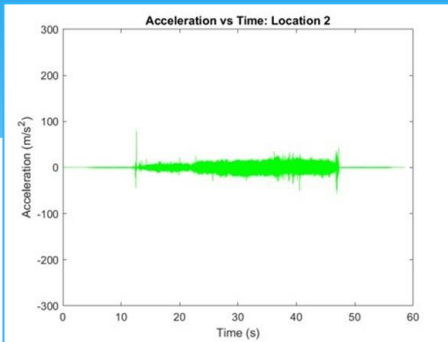
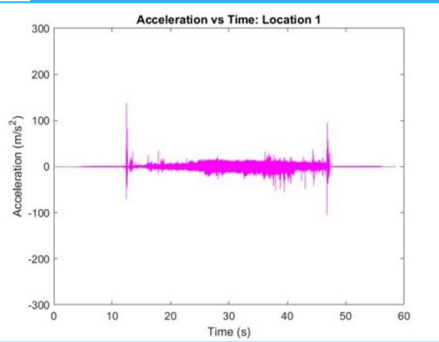
Specific gravity (g/cm³)

Volume (cft/cy)

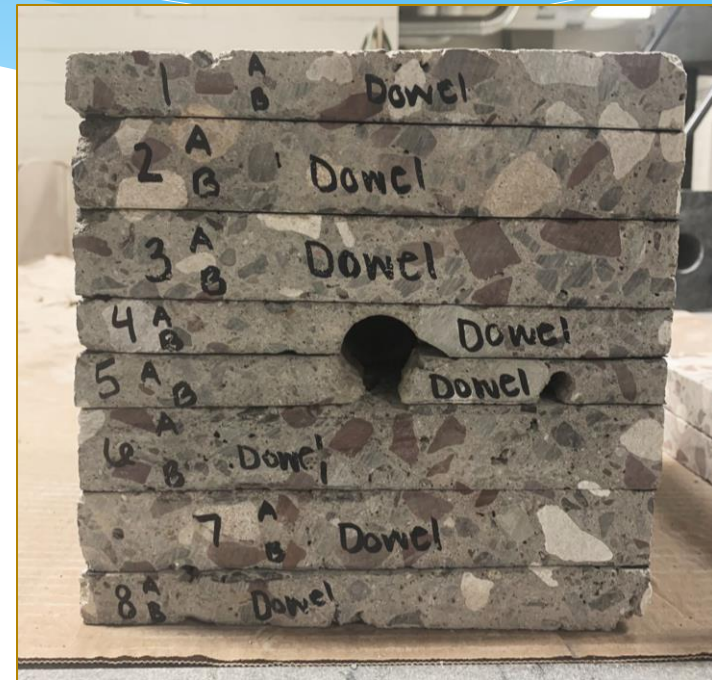
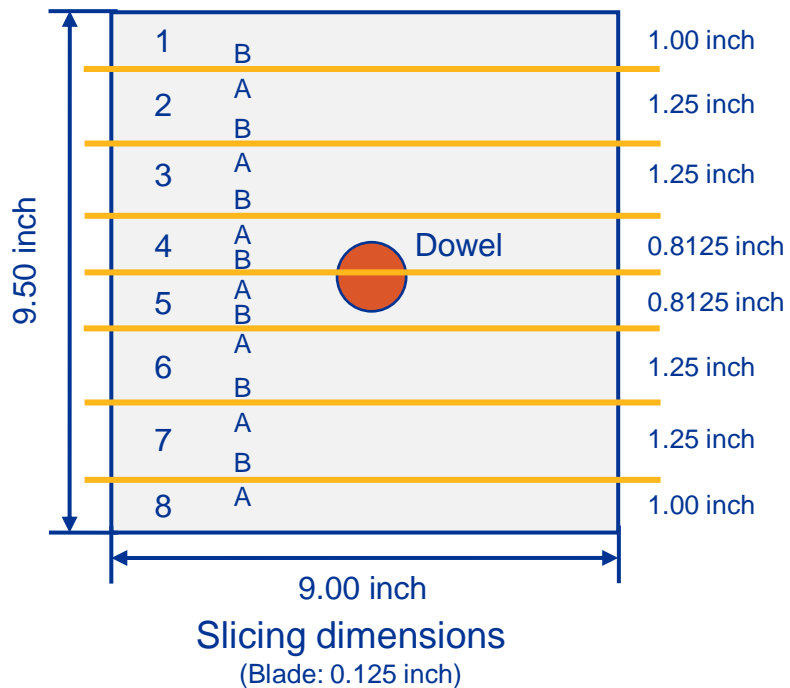
Vol. fraction

Eastern Sea Shore (1")	45	2.61	0.28	0.010
White Marble (0.75")	536	2.82	3.04	0.113
Country Red Stone (0.5")	256	2.70	1.52	0.056
Barn Red Stone (0.5")	257	2.71	1.52	0.056
Limestone (<0.5")	796	2.71	4.70	0.174
Sand	1212	2.62	7.41	0.29
Cement	600	3.15	3.05	0.11
Water	240	1.00	3.85	0.13
Air content	6%	---	1.62	0.06

Data Analysis



Data Analysis

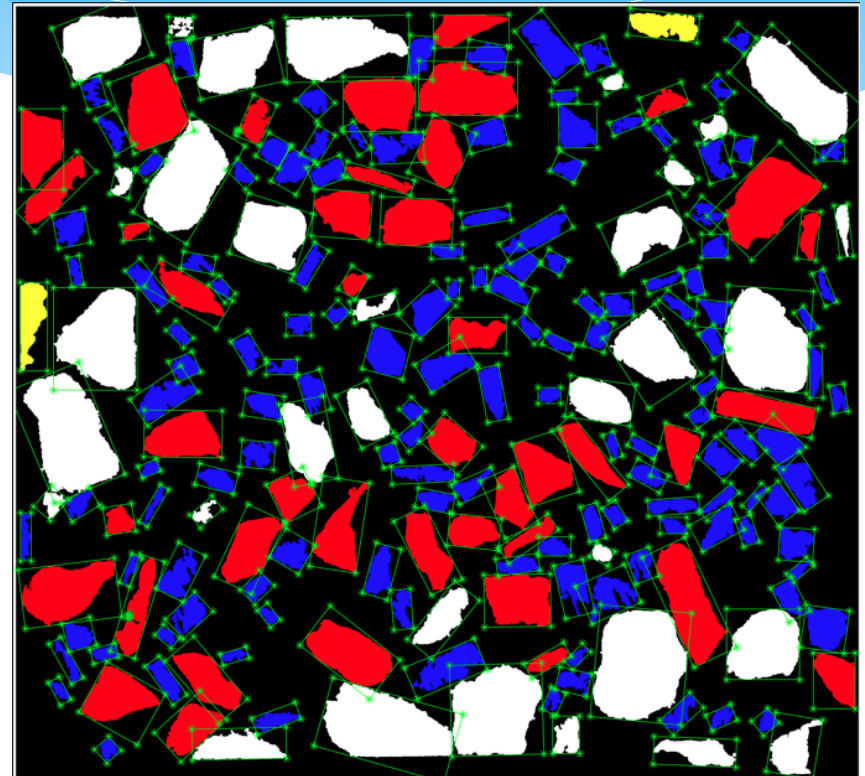


Concrete slices

Data Analysis

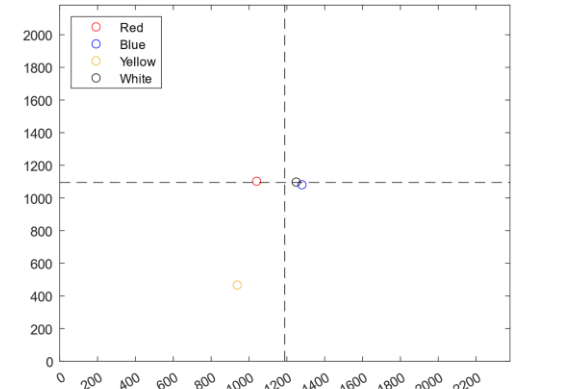
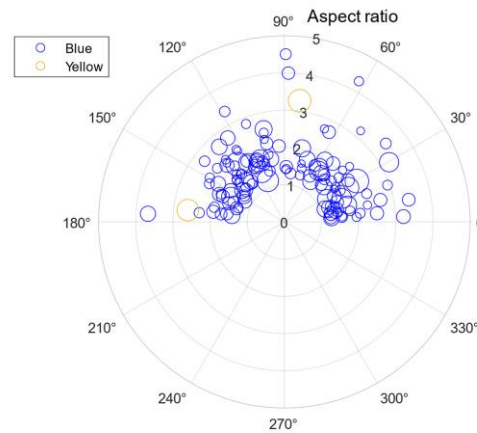
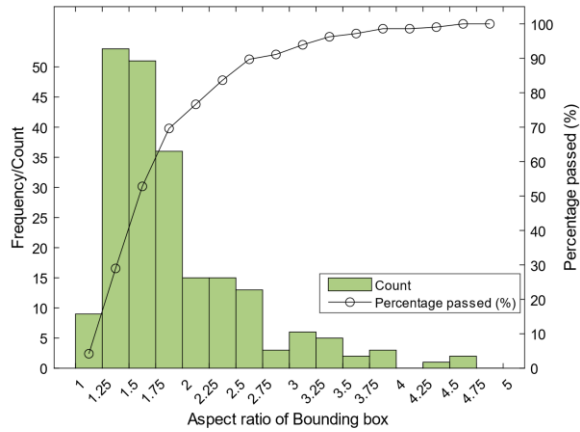
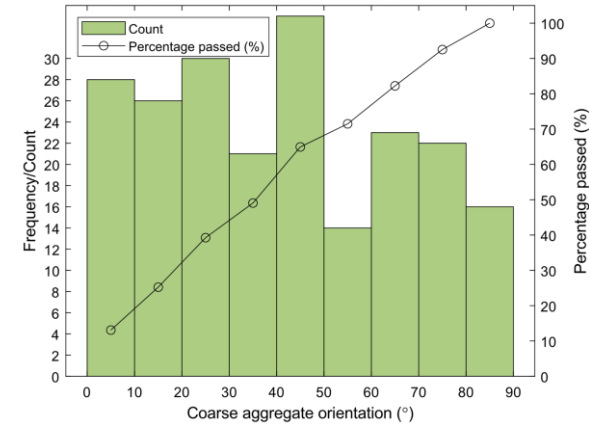
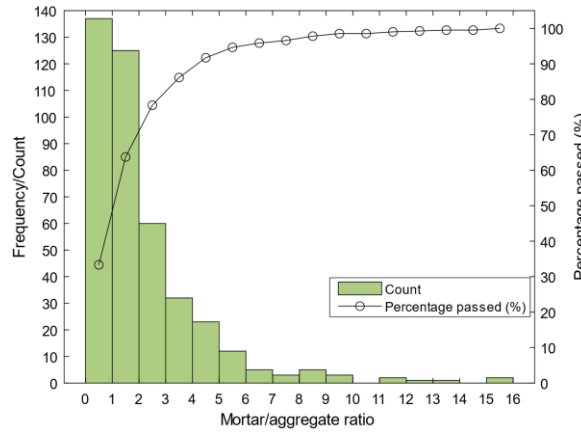
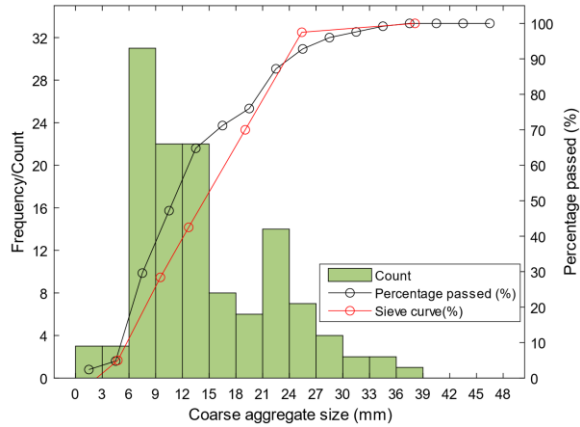


Physical Specimen

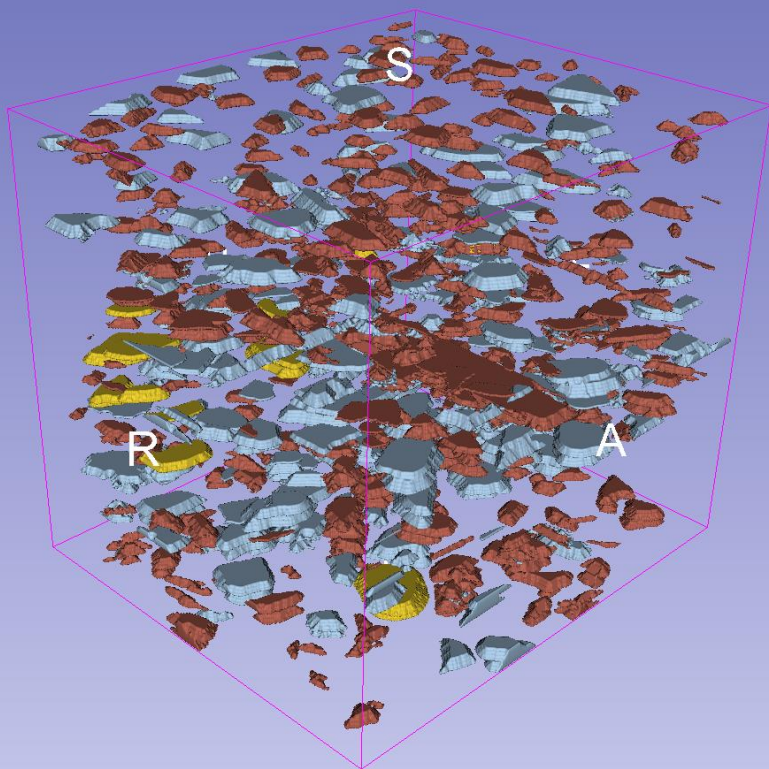


Digitalized Representation

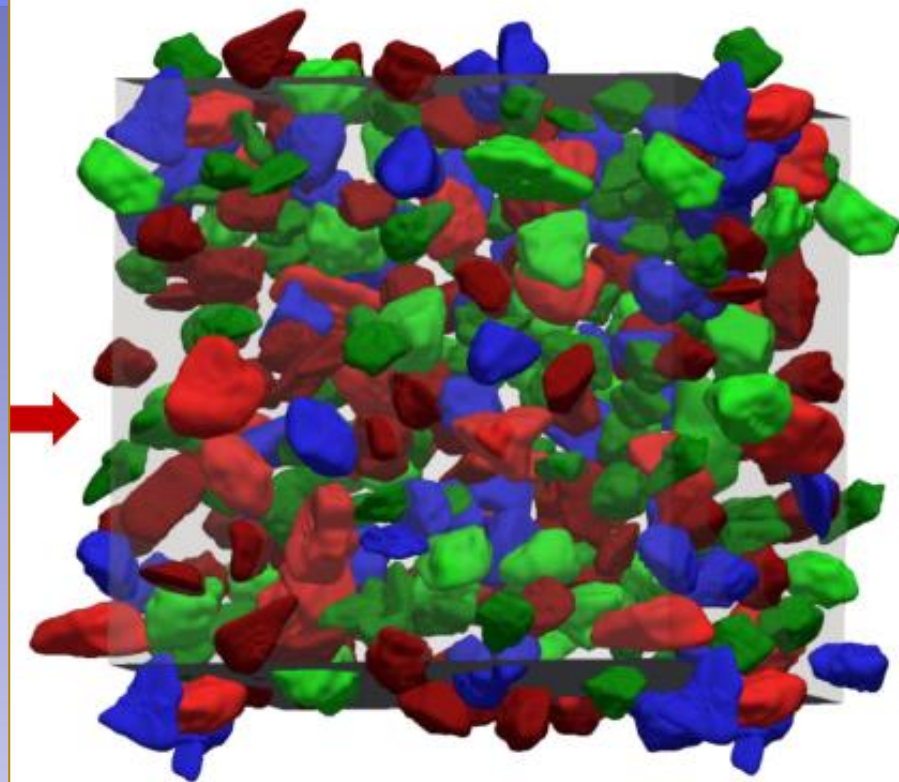
Data Analysis



Ongoing Work



3D reconstruction



Spherical harmonic

Schedule/Status

Task A: Completed

Task B: Underway (80%)

Task C: Underway (65%)

Task D: Planned