

I N T E R N A T I O N A L



CENTER FOR AGGREGATES RESEARCH

## LASS INCORPORATES THE THIRD DIMENSION IN ORDER TO IMPROVE THE ACCURACY OF RAPID-GRADATION TECHNOLOGY

“The researchers have developed a device that the industry has long needed. The LASS evaluates the characteristics important to quality control of aggregates to meet stringent specifications for mixture designs. The industry must support commercialization of this device; the return on its investment will be enormous in terms of accuracy, labor, and cost effectiveness.”

—Randy Weingart, Luck Stone Corporation  
Member, ICAR Technical Advisory Committee

### BACKGROUND

Particle gradation plays a crucial role in the production of quality construction materials such as hot-mix asphalt and portland cement concrete. Recently, there has been increased emphasis on quality control and more rigorous material specifications. Sophisticated asphalt designs, such as the Superpave specification, specify aggregate shape parameters like flatness and elongation ratios as an additional design variable.

Conventional sieve analysis has drawbacks such as: poor efficiency and accuracy; labor intensiveness; time consumption; subjectivity; inability to measure shape parameters; and inability to measure irregularly shaped particles accurately. Although several rapid-gradation devices are currently on the market, their appropriateness and cost effectiveness for various applications in both the laboratory and in the field has yet to be determined.

The research team evaluated five commercially available rapid gradations devices for accuracy and performance using fifteen aggregate test samples of various size, shape, and mineralogy. The project uses several methodologies in characterizing accuracy and studies two technologies in detail: digital-image analysis and laser profiling. The second part of the final project developed a laser scanning device for grading aggregates.

This device, called the LASS, or Laser-based Aggregate Scanning System, provides several advantages over both manual measurements and current commercially available devices. The LASS characterizes aggregates using 3-D laser profiling. This method required the development of particle segmentation algorithms, particle measurement algorithms, and generalized particle descriptors.

## Summary Report ICAR-503-1S

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## LASS ADVANTAGES

When implemented in aggregate plants, HMA plants, concrete plants, or large construction sites, the ability to analyze multiple characteristics of an aggregate sample automatically is expected to have the following potential benefits:

- 1) Improved reliability in the measured aggregate properties as a result of testing larger and more frequent samples of the product stream;
- 2) Reduced labor costs relating to all aspects of aggregate testing;
- 3) Improved worker safety by reducing the need to be exposed to potentially chemically harmful stone material;
- 4) Decreased production of unacceptable material through prompt adjustment of the production process based on real-time measurements;
- 5) Tighter control of aggregate quality based on accurate and complete information.

## CONCLUSIONS

- 1) The shape analysis algorithm developed to measure particle dimensional ratios, such as elongation ratio and flatness ratio, is computationally efficient and accurate.
- 2) The 3D particle indices measured from various properties of aggregate particles correlate well with human visual perceptions.
- 3) The segmentation algorithm that was developed can separate irregular particles in an image acquired from laser profiling in a robust manner.
- 4) The laser-based 3D measurement method can provide fast and accurate automated aggregate characterization, despite the computationally complex procedure required to handle the 3D data.



**LASS (Laser-based Aggregate Scanning System)  
developed by ICAR Researchers**

## RECOMMENDATIONS FOR FURTHER RESEARCH

There are many interesting avenues for continued research:

- 1) Artificial intelligence-based quality control
- 2) Group texture analysis
- 3) Correlation of the 3D particle descriptors with hot mix asphalt and portland cement concrete performance
- 4) Comprehensive economic feasibility study
- 5) Commercialization

*The information in this summary is detailed in ICAR Interim Report 503-1, ICAR Report 503-2 and ICAR Report 503-3F, Rapid Test to Establish Grading of Unbound Aggregate Products, by Alan F. Rauch, Carl T. Haas, Craig Browne, and Hyoungkwan Kim.*

*The contents of this summary do not necessarily reflect the official views of AFTRE or ICAR.*