CS 1-15〔I〕 VISUALIZATION OF SHEARING OF COARSE SANDY MATERIAL THROUGH LASER-AIDED TOMOGRAPHY

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INTRODUCTION

A new technique called "Laser-Aided Tomography" (LAT)[1),2)] is supposed to be a powerful tool to visualize an arbitrary cross-section within a model of granular material. However, the finer the grains of the employed material are, the more difficult it is to observe a cross-section in the model.

This report demonstrates the shearing process in a model made of crushed glass material ($D_{50}\approx$ 1 mm). This means an expansion of the application of LAT for material with a finer grain size.

PERFORMED EXPERIMENTS

Fig.1 shows the setup of the experimental apparatus. According to the method, first crushed glass particles with properties cited in **Table 1** and serving as a model for surface deposit (depth≈90 mm) are submerged in a water tank (W390×D140×H150) containing a mixture of tetralin and turpentine oils. Since the mixture has the same refractive index as the glass (BK7), the model should consequently become transparent. However, in the case of finer particle assemblage, fracture surface microcracks and high temperature sensitivity of the liquid's refractive index cause a reduction in transparency. In order to overcome this problem, six thin strips of very fine glass powder are placed within the model and contribute to better visualization of the failure mechanism[3)]. An intense laser-light-"sheet" is then passed through this model, illuminating the strips of fine powder. A glass cylinder (diameter=50 mm) was attached to a uniaxial loading machine and used to apply loading pressure to the glass material. This caused deformation and shear failure of the glass specimen. **Fig.2** shows photos of the central cross-section of the model during non-stop loading of the specimen. In this case, the cylinder was driven at a speed of 5 mm/min. The observed surface heaving represents a significant increase in volume in the granular assemblage. No clear shear band was observed.

CONCLUSION

In order to expand the application of Laser-Aided Tomography for granular structure models, glass particles with the representative size of 1 mm were used for surface deposit. In the course of this work the following conclusion was achieved:

A thin strip of glass powder placed between the particle layers is brightly illuminated by the diffused laser light and contributes to a better visualization of the deformation process in the LAT test. This is a way to overcome the problem of deteriorating visual quality with decreasing grain size.

REFERENCES

(1) Konagai, K. and Tamura, C.: "Visualization of dynamic behavior of particle assemblage in underwater granular structure models", Bull., Earthquake Resistant Structure Research Center, Univ. of Tokyo, 1989, No.22, pp. 3-12.
(2) Konagai, K. and Tamura, C.: "Visualization of dynamic change in configuration of underwater particle assemblage", Proc., European Conference on Structural Dynamics, EURODYN'90, Germany, 5-7 June 1990, Vol.2, pp. 837-841.
(3) Rangelow, P., Konagai, K., Matsushima, T., Park, C.-S.; "Visualization of Granular Material Deformation through Laser-Aided Tomography, Bull., Earthquake Resistant Structure Research Center, Univ. of Tokyo, No.25, to be published.

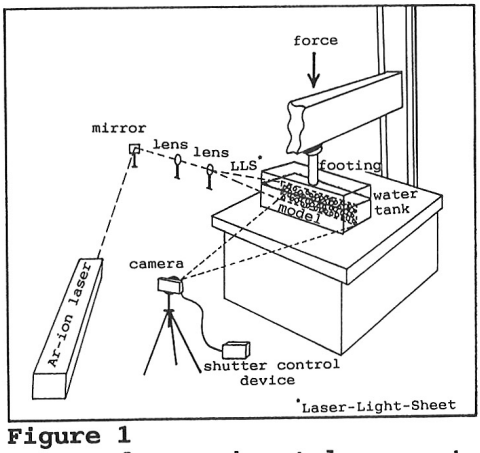

Figure 1
Setup of experimental apparatus.

Grain Shape	very angular
D50 [mm]	1.08
U_c	1.85
G_s	2.52
e_{max}	1.19
e_{min}	0.77

Table 1 Index properties of the crushed glass BK7.

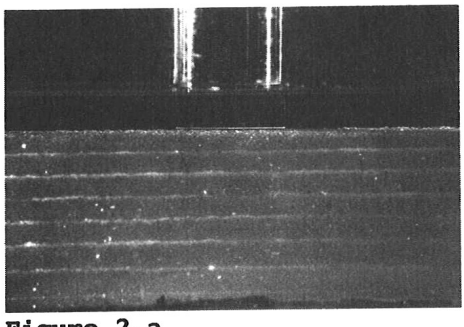

Figure 2,a
Initial condition.

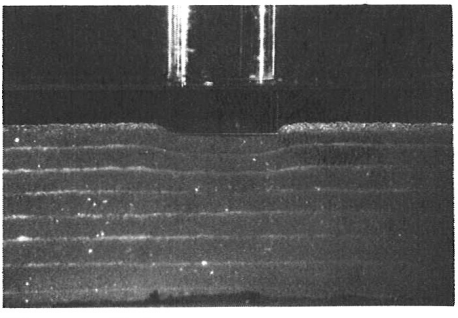

Figure 2,b
Settlement, s = 5 mm.

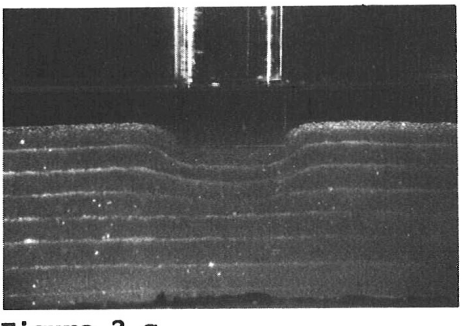

Figure 2,c
Settlement, s = 10 mm.

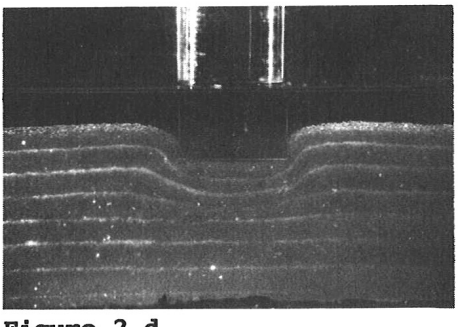

Figure 2,d
Settlement, s = 15 mm.

Figure 2 Visualization of glass material shearing.