

# Basic Study on Stable Levitation for Superconducting Magnetic Bearing Using High T<sub>c</sub> Superconducting Bulks and Coils

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# ABSTRACT

Superconducting magnetic bearings (SMBs) are usually composed of superconducting (SC) bulk and permanent magnet (PM). These SMBs are based on pinning forces between SC bulk and PM. In this paper, SMB-I composed of disk-shaped SC bulk and SMB-II composed of doughnut-shaped SC bulk are studied. To compare SMB-I with SMB-II, impulse responses in the vertical and horizontal directions are performed. Moreover, new types of SMB-III and SMB-IV are proposed. These SMB-I and SMB-II are composed of SC bulks and SC coils. To compare SMB-II with SMB-IV, Impulse responses in the vertical and horizontal directions are studied. Then, natural damped vibration curves for impulse responses are observed. The damping coefficient for SMB-IV is larger than other SMB-I, SMB-II and SMB-III.

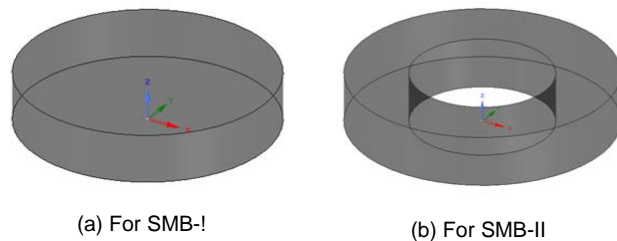


Fig.1. Two types of superconductors for (a) SMB-I and (b) SMB-II

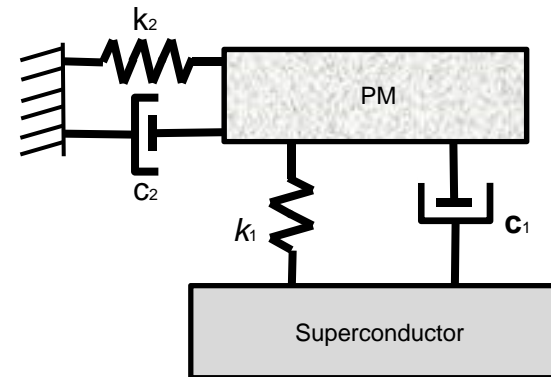


Fig.2. Mechanical model of SMB with spring and damper in the vertical direction and with spring and damper in the horizontal direction.

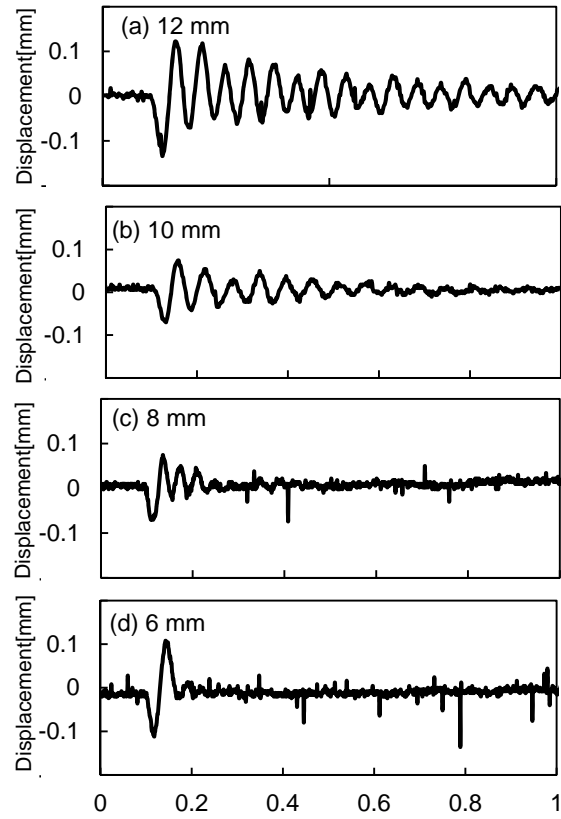


Fig.3. Impulse responses in the vertical direction for SMB-I at various distances of 6, 8, 10 and 12 mm.

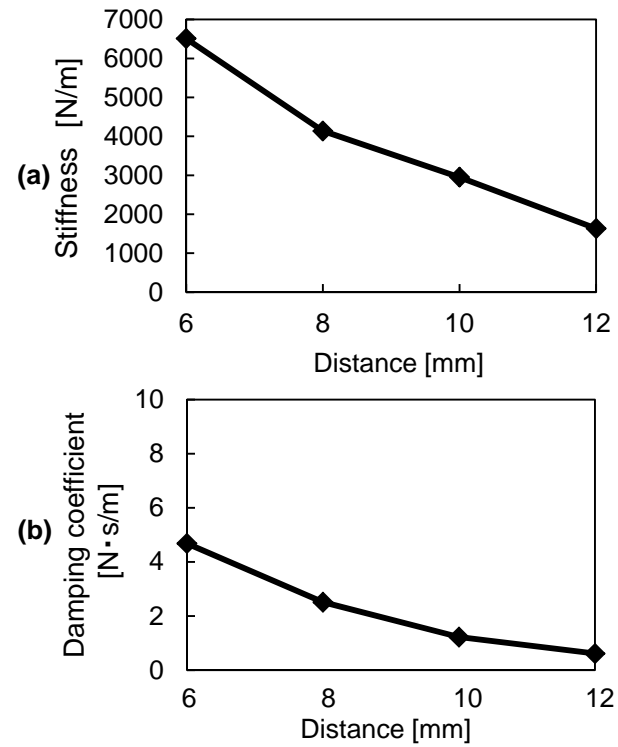


Fig.4. Relationship between (a) stiffness and distance and between (b) damping coefficient and distance in the vertical direction for various distances (SMB-I).

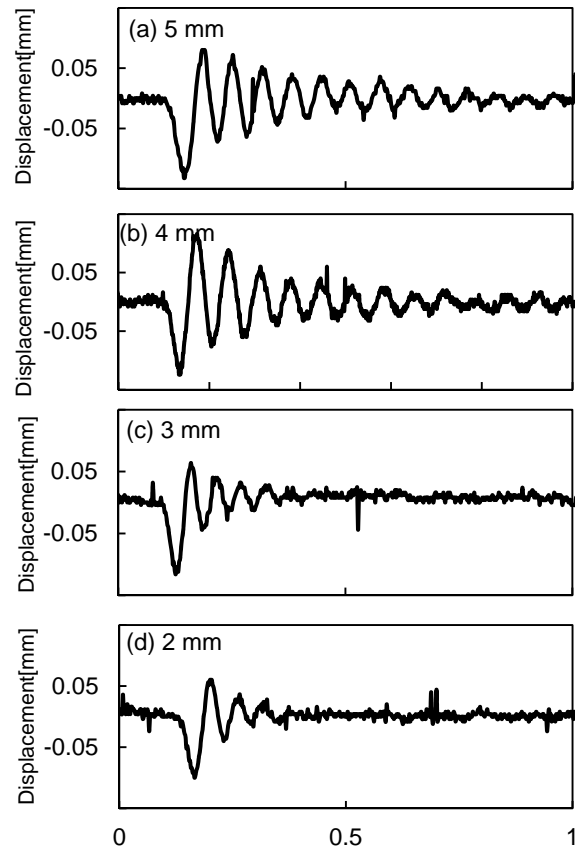


Fig.5. Impulse responses in the horizontal direction for SMB-I superconductor at various distances of 2, 3, 4 and 5 mm.

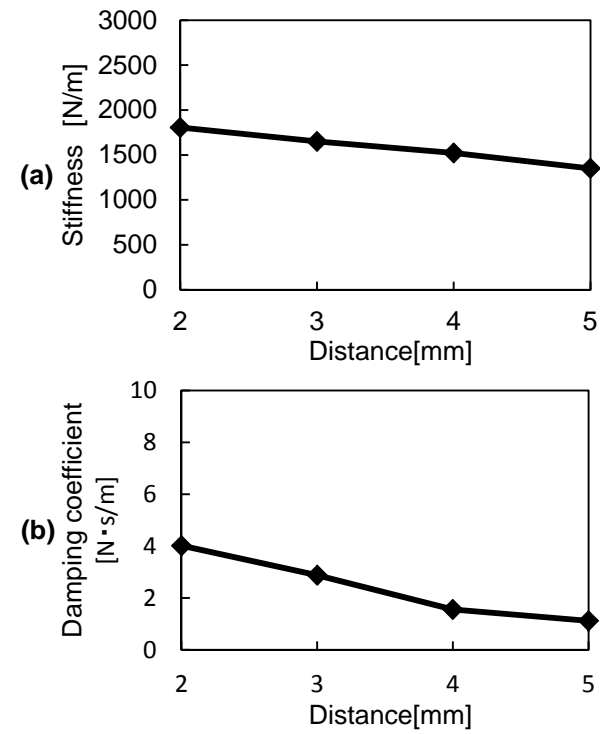


Fig.6. Relationship between (a) stiffness and distance and between (b) damping coefficient and distance in the horizontal direction for various distances (SMB-I).

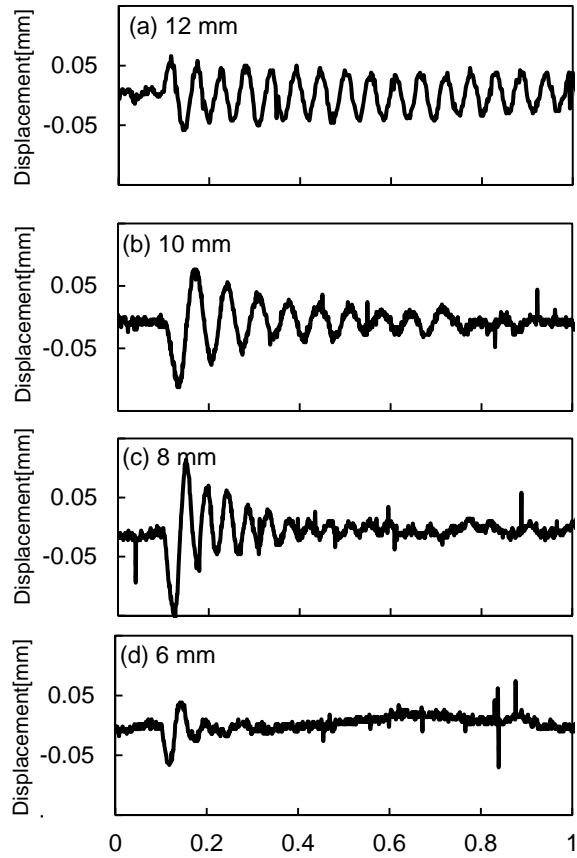


Fig.7. Impulse responses in the vertical direction for SMB-II superconductor at various distances of 6, 8, 10 and 12 mm.

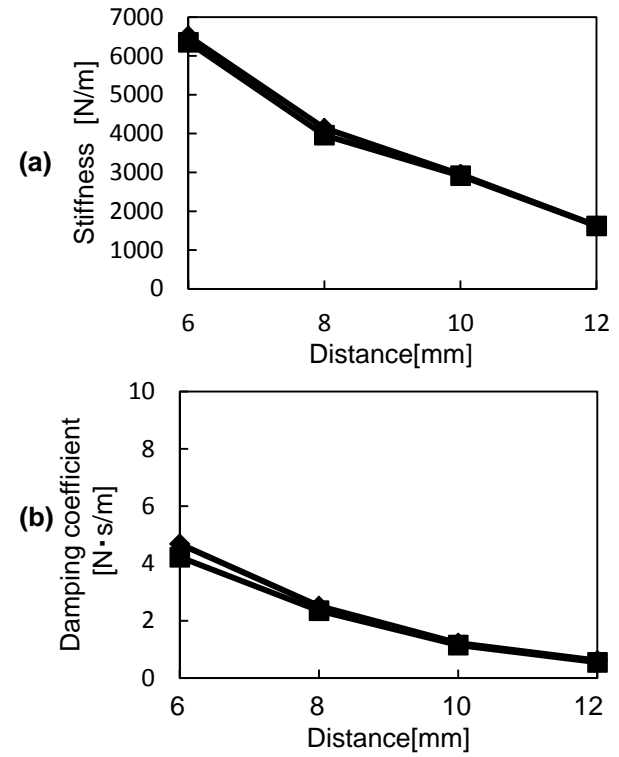


Fig.8. Relationship between (a) stiffness and distance and between (b) damping coefficient and distance in the vertical direction for various distances (SMB-II).

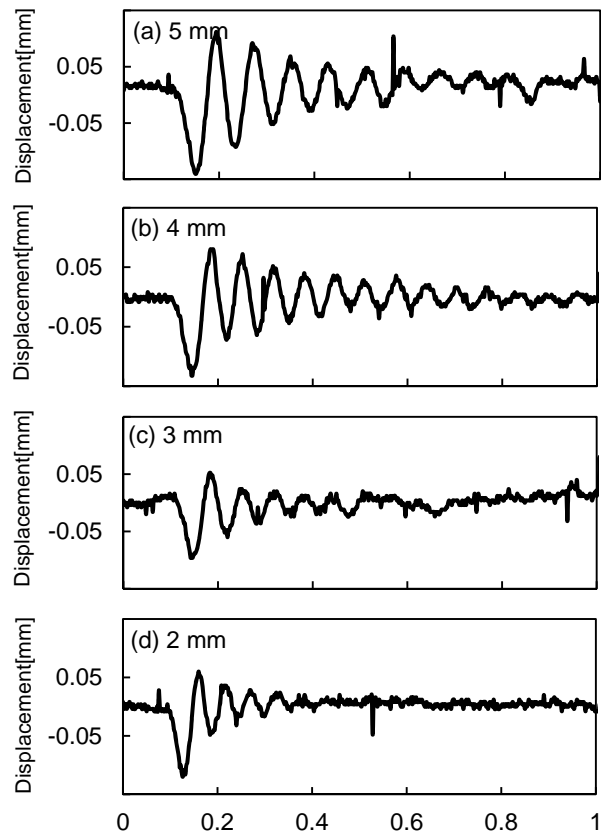


Fig.9. Impulse responses in the horizontal direction for SMB-II superconductor at various distances of 2, 3, 4 and 5 mm.

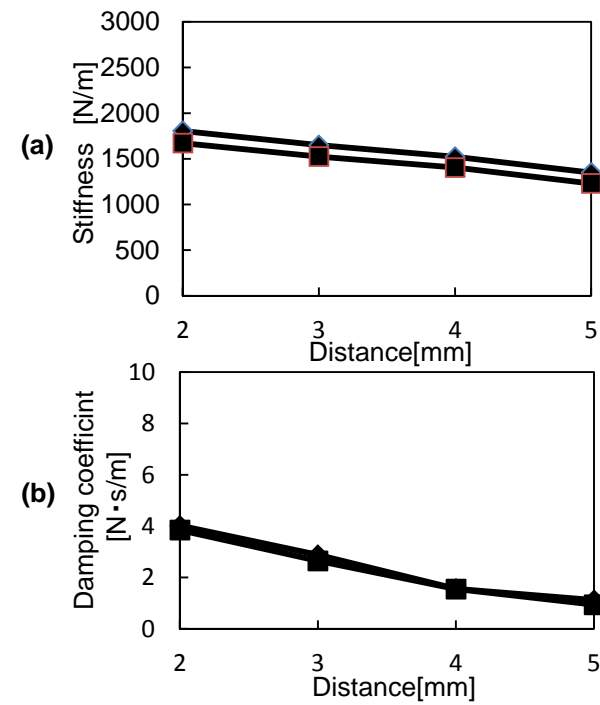
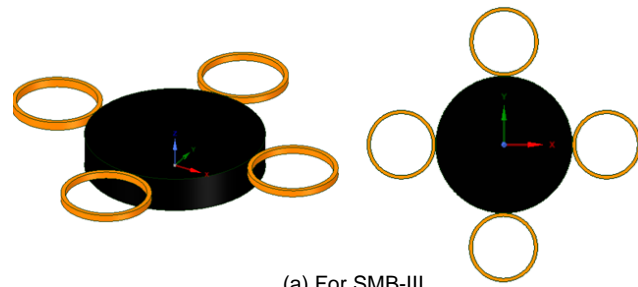
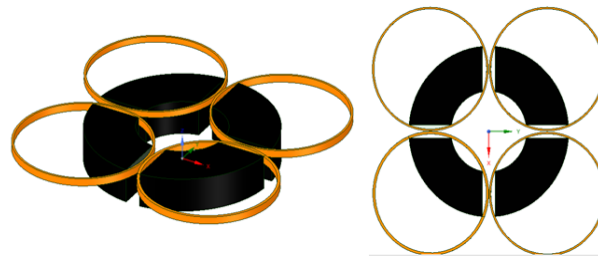


Fig.10. Relationship between (a) stiffness and distance and between (b) damping coefficient and distance in the horizontal direction for various distances (SMB-II).



(a) For SMB-III



(b) For SMB-IV

Fig.11. Two types of arrangements for (a) SMB-III and (b) SMB-IV.

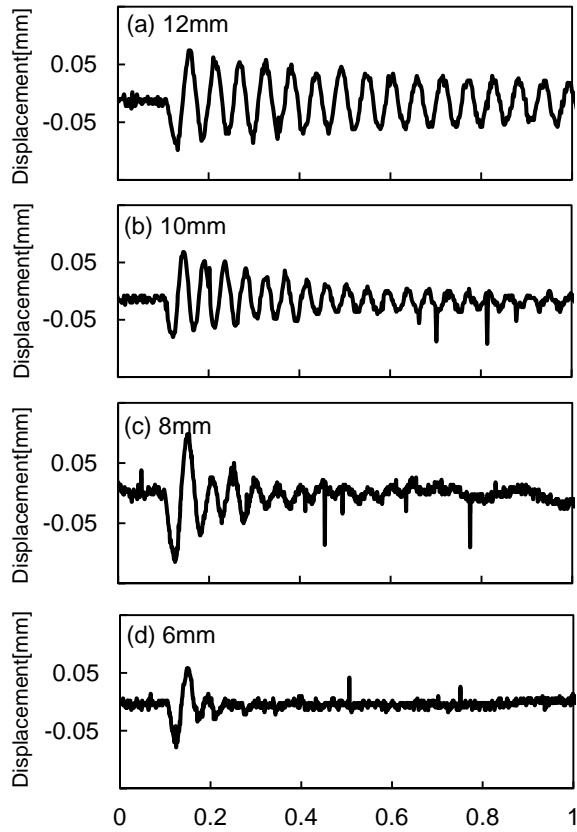


Fig.12. Impulse responses in the vertical direction for SMB-III at various distances of 6, 8, 10 and 12mm

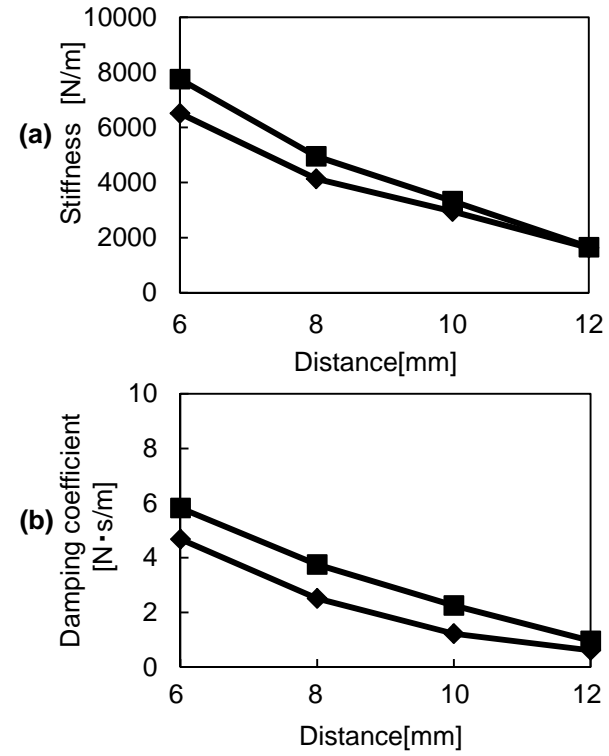


Fig.13. Relationship between (a) stiffness and distance and between (b) damping coefficient and distance in the vertical direction for various distances.



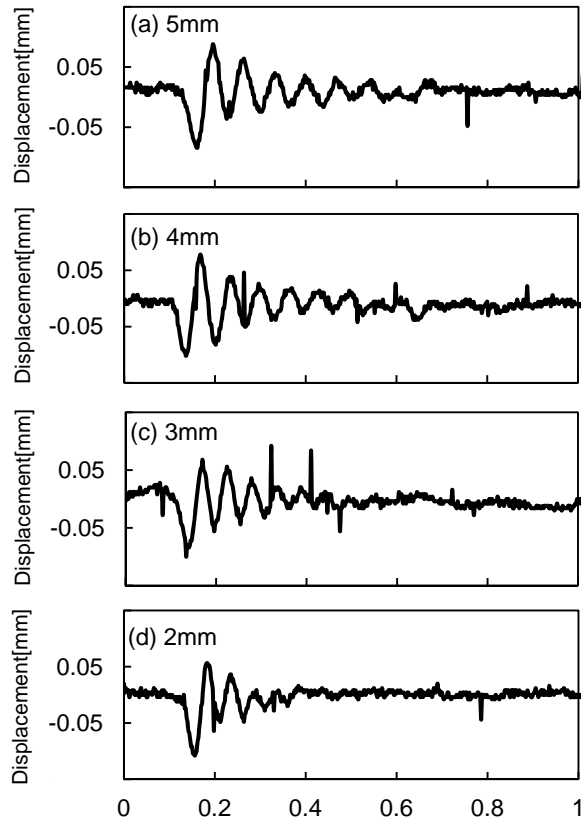


Fig.14. Impulse responses in the horizontal direction for SMB-III at various distances of 2, 3, 4 and 5 mm

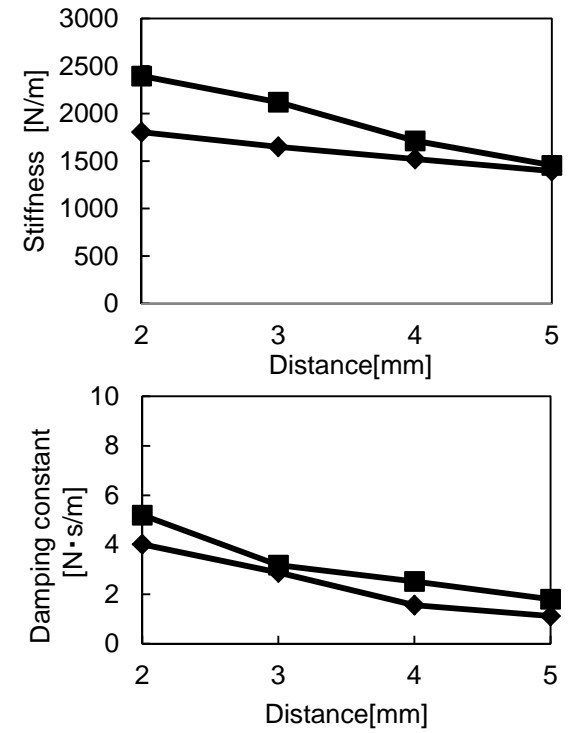


Fig.15. Relationship between (a) stiffness and distance and between (b) damping coefficient and distance in the horizontal direction for various distances.

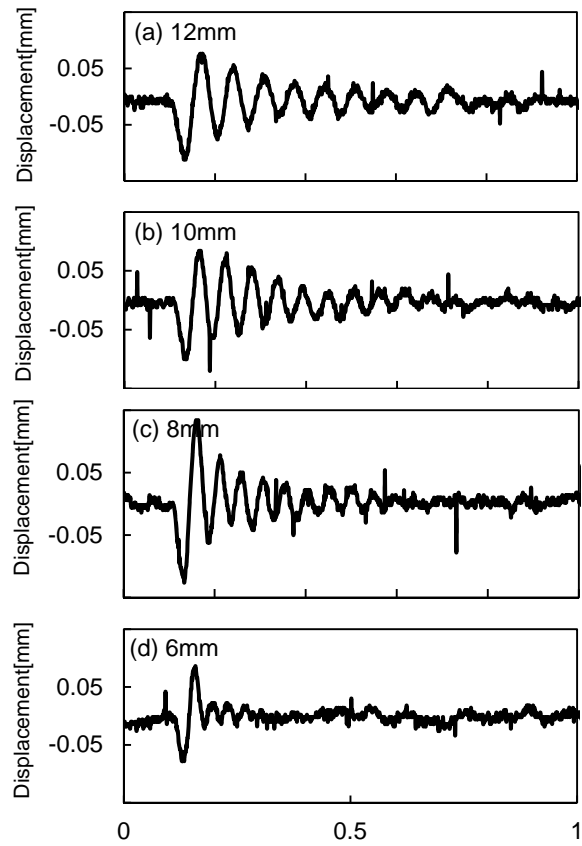


Fig.16. Impulse responses in the vertical direction for SMB-IV at various distances of 6, 8, 10 and 12 mm

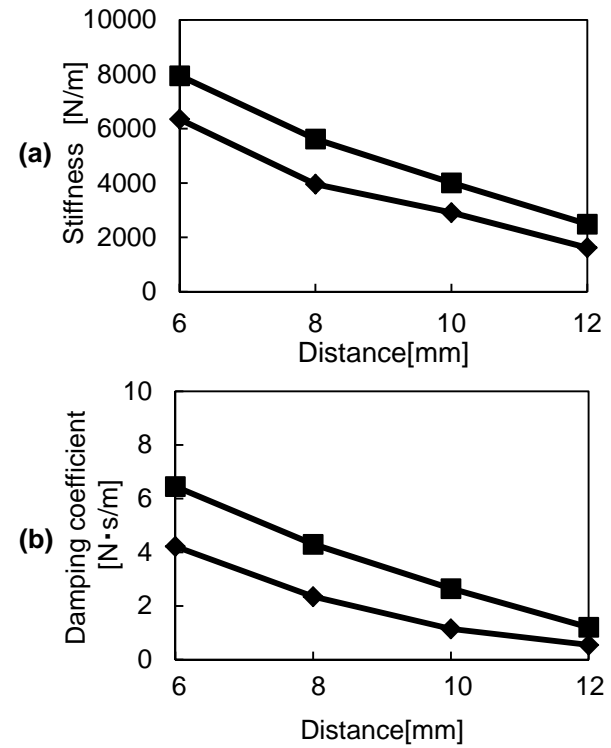


Fig.17. Relationship between (a) stiffness and distance and between (b) damping coefficient and distance in the vertical direction for various distances.

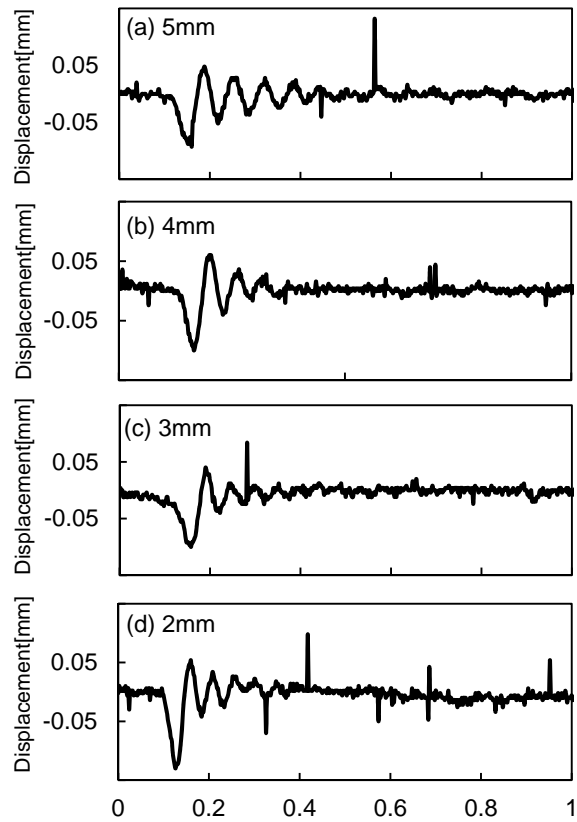


Fig.18. Impulse responses in the horizontal direction for SMB-IV at various distances of 2, 3, 4 and 5 mm

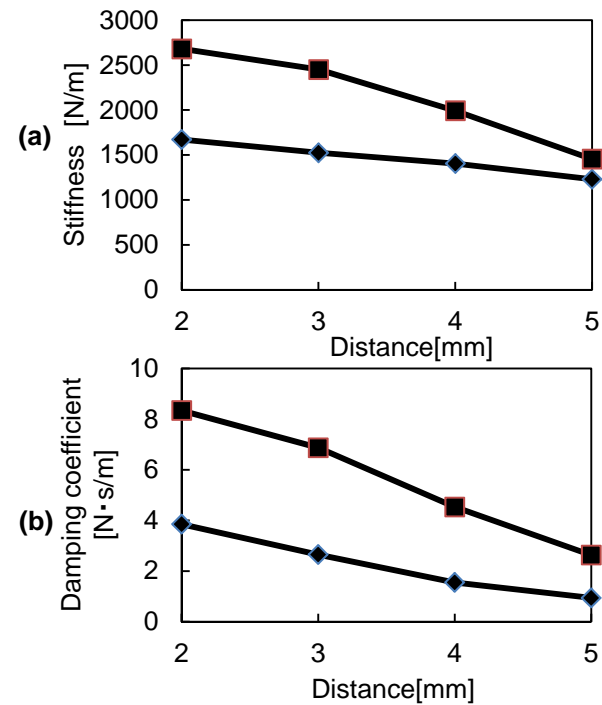


Fig.19. Relationship between (a) stiffness and distance and between (b) damping coefficient and distance in the horizontal direction for various distances.

## CONCLUSION

- ✓ SMB-I composed of disk-shaped SC bulk and SMB-II composed of doughnut-shaped SC bulk are studied. It is found that the stiffness and damping coefficient for SMB-I are almost the same as those of SMB-II.
- ✓ Moreover, new types of SMB-III and SMB-IV are proposed. These SMB-III and SMB-IV are composed of SC bulks and SC coils. To compare SMB-II with SMB-IV, Impulse responses in the vertical and horizontal directions are studied.
- ✓ It is found that the stiffness and damping coefficient of SMB-IV are larger than those of SMB-III.
- ✓ Thus, SMB-IV is more useful for some applications than SMB-III.