船舶技術研究所報告　第32巻　第５・６号合併号　（平成７年）研究報告

外洋ヨットの転覆・起き上がり特性

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Capsizing and Re-righting Characteristics of Sailing Yachts

by

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Abstract

Capsizing and re-righting performance of three types of sailing yachts, IOR racer type, conventional type and intermediate type, was experimentally investigated in beam transient waves with various wave heights. The effect of CG height, existence of mast and flooded water volume on the critical wave height for capsizing and for re-righting was examined.

It was characteristic in the capsizing motion of the models with mast that the rolling motion almost stopped just after the mast plunged into the water because of the hydrodynamic impulsive force on the mast. The stopping heel angle was almost independent of hull forms and model conditions. As a result the static stability vanishing angle, θ_v, was crucial for capsizing even in flooded conditions. As for re-righting motion θ_v was also crucial. It was clarified that the IOR racer type yacht is easier to capsize and harder to re-right because of its small θ_v value even if it has large GM.

The way of improving the capsizing resistance was discussed. Lowering the center of gravity or attaching a small float on top of the mast could be an easy and effective way to prevent capsizing disaster because that leads to a large θ_v value.

The flooded water, in general, enlarged θ_v, that made the models capsize-resistant. But for re-righting motion the relation between the critical wave height for re-righting and θ_v was complicated, because the water prevents the motion of the models at the same time.

The probability of capsizing and re-righting in a sea state with ISSC spectrum was examined. Moreover the capsizing duration time was calculated as a safety index. It was reconfirmed again by the probabilistic approach that θ_v is very important for the safety of sailing yachts. θ_v of 120 degrees was proposed as an safety criteria.

＊運動性能部
原稿受付　平成７年10月30日
審査済　　平成８年２月14日

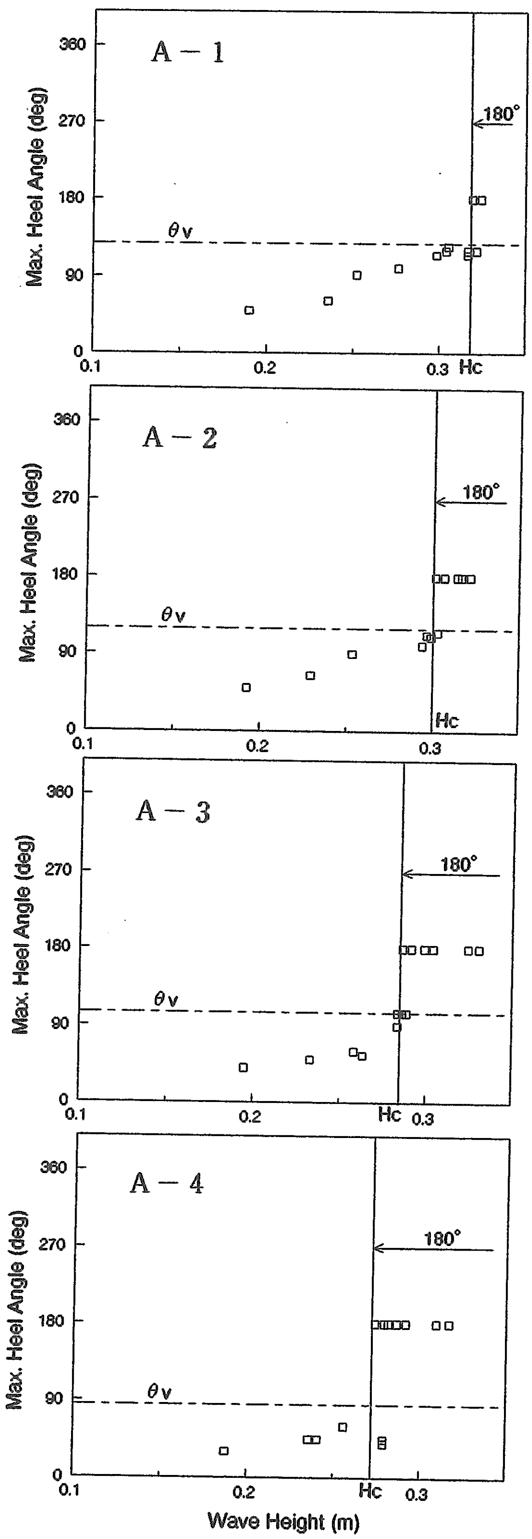

Fig.24 Maximum heel angle versus wave height (Ship-A)

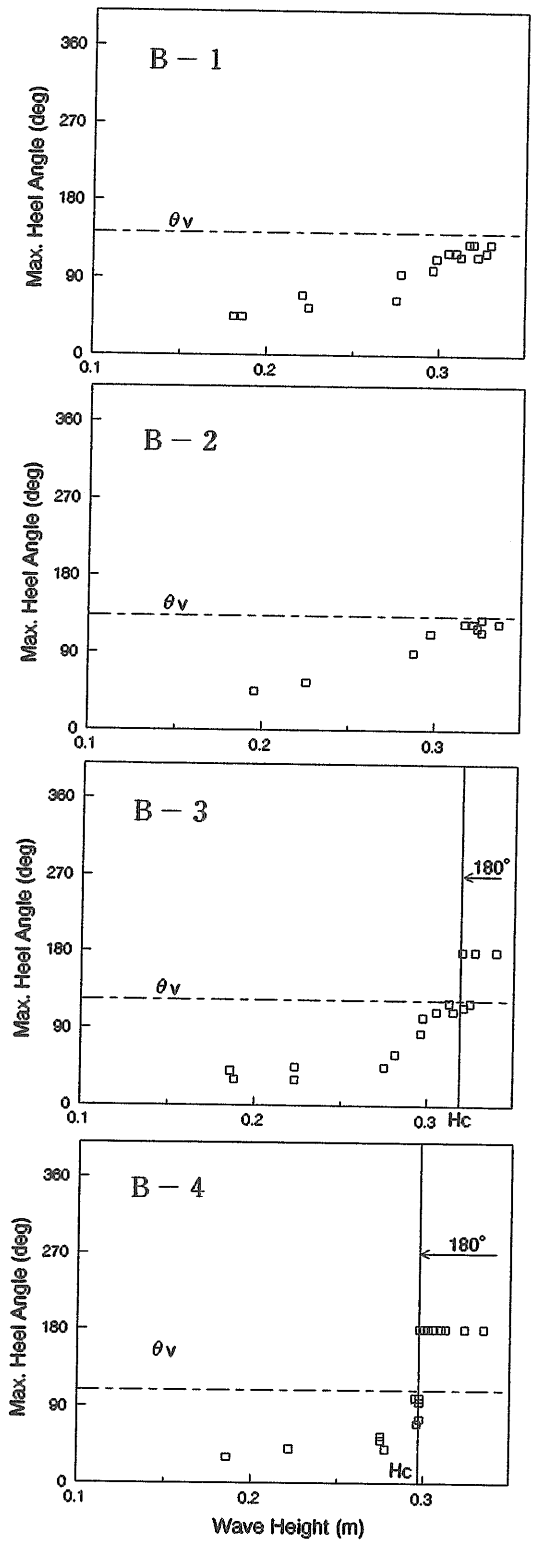

Fig.25 Maximum heel angle versus wave height (Ship-B)

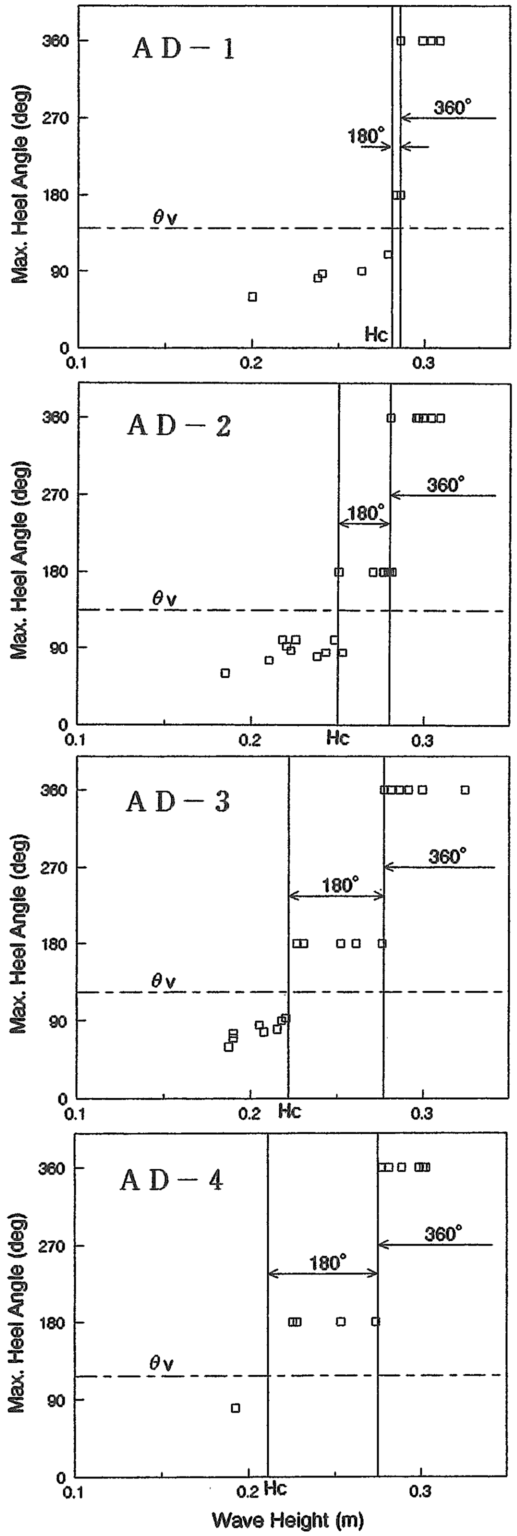

Fig.30　Maximum heel angle versus wave height (Ship-AD (without mast))

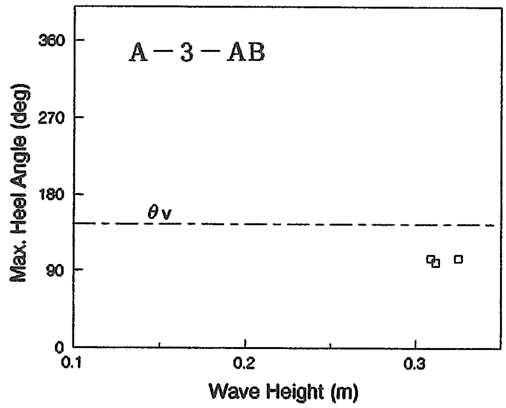

Fig.31　Maximum heel angle versus wave height (Ship-A-3-AB)

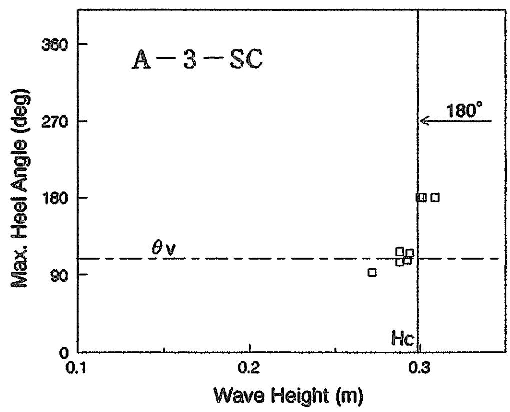

Fig.32　Maximum heel angle versus wave height (Ship-A-3-SC)

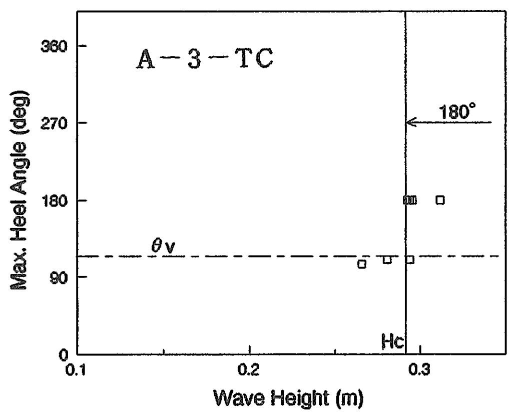

Fig.33　Maximum heel angle versus wave height (Ship-A-3-TC)

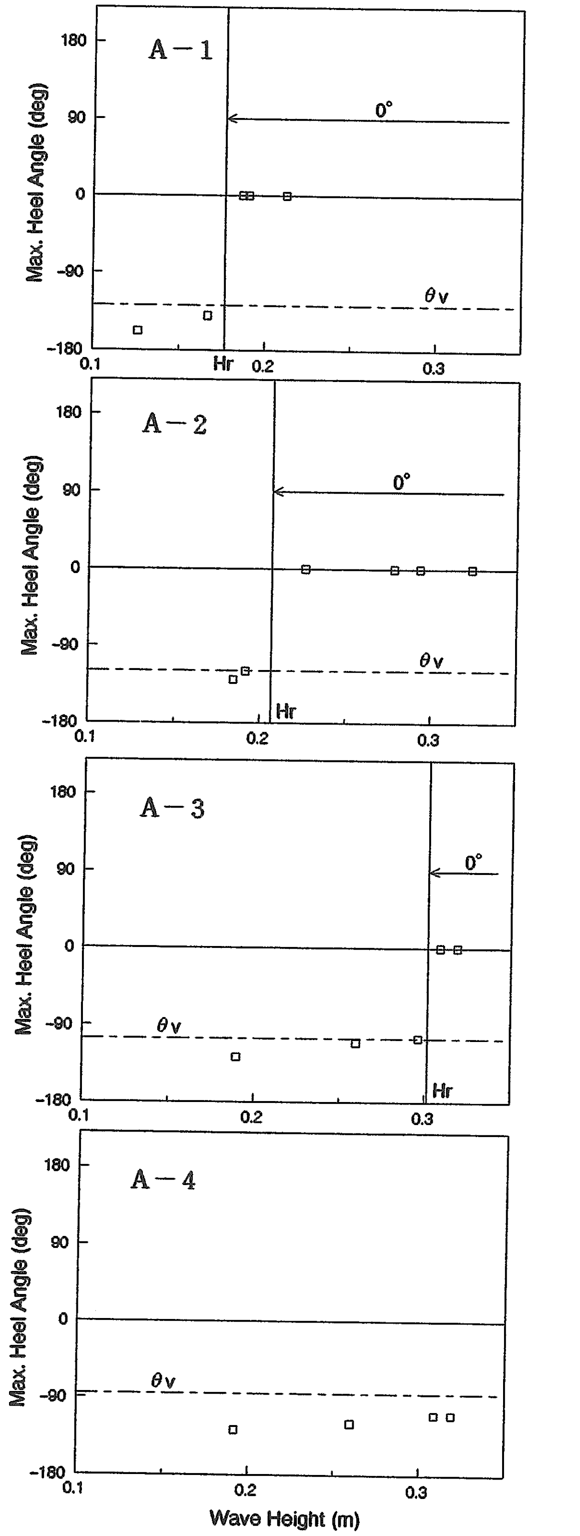

Fig.42 Maximum heel angle versus wave height (Ship-A)

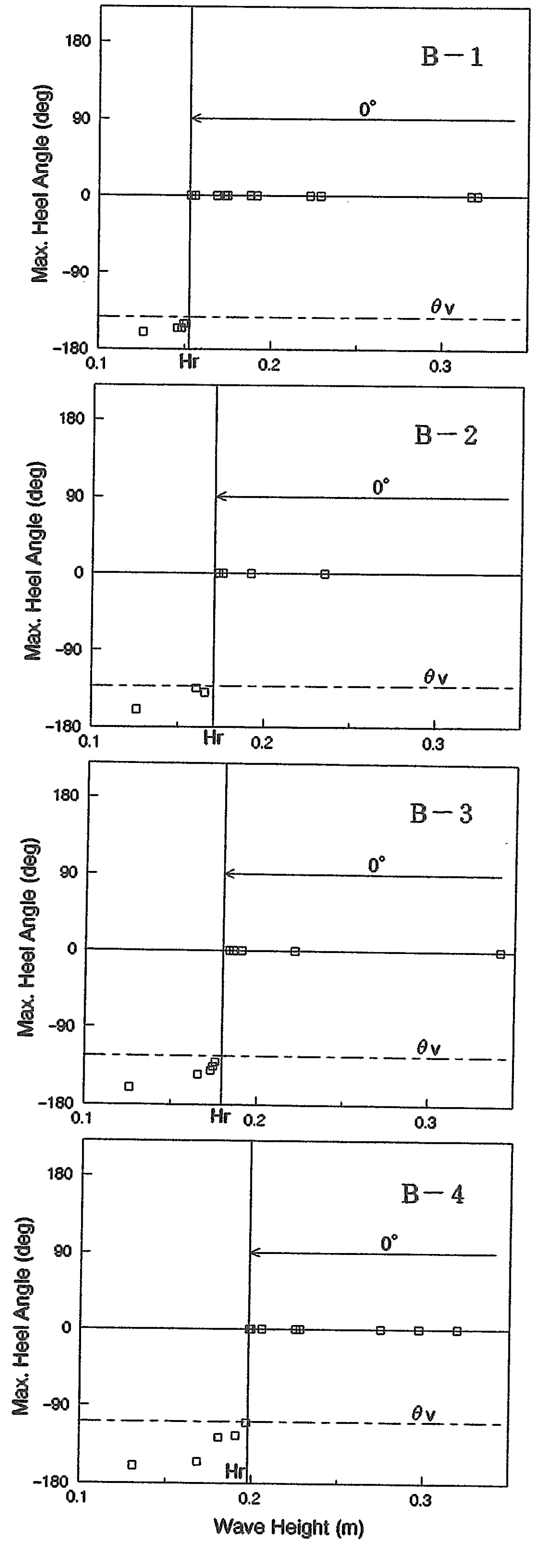

Fig.43 Maximum heel angle versus wave height (Ship-B)

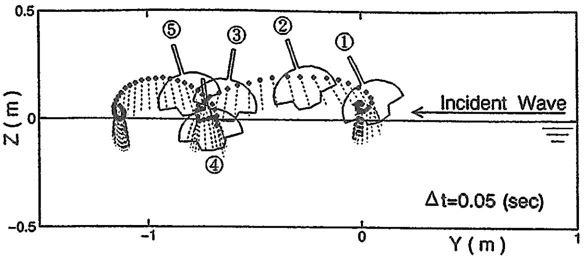

Fig.44　Example of ship motion in upside down condition (Ship-AD-3, Hw=0.19m)

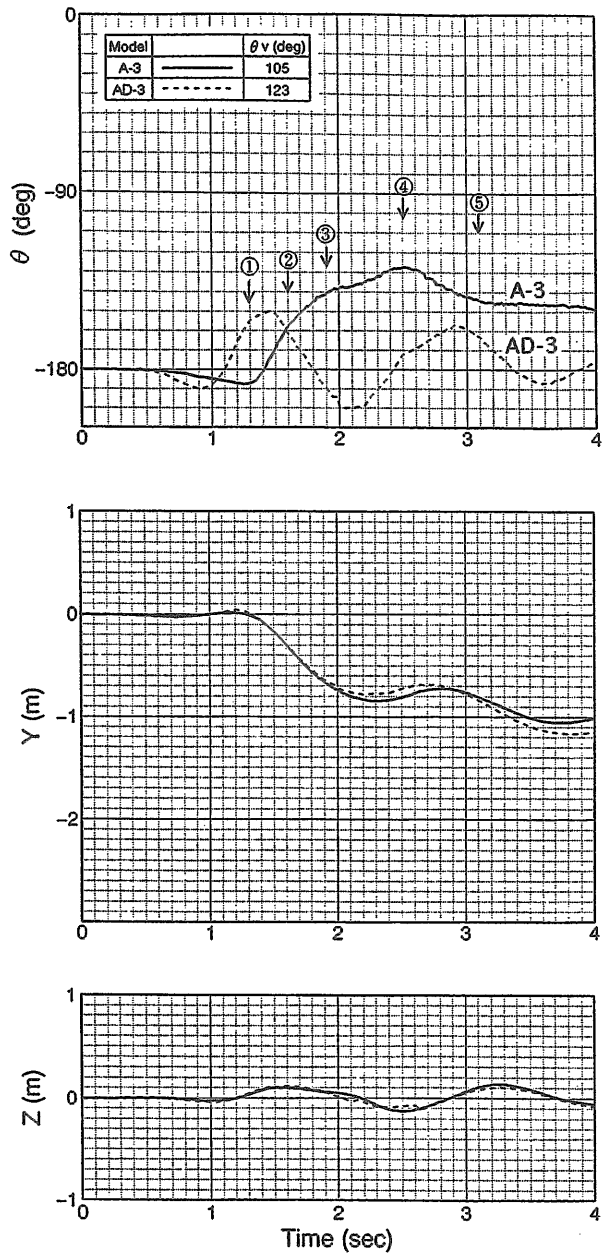

Fig.45　Comparison of rolling, swaying, heaving motion in upside down condition of Ship-A-3 (with mast) and AD-3 (without mast) (Hw=0.19m)

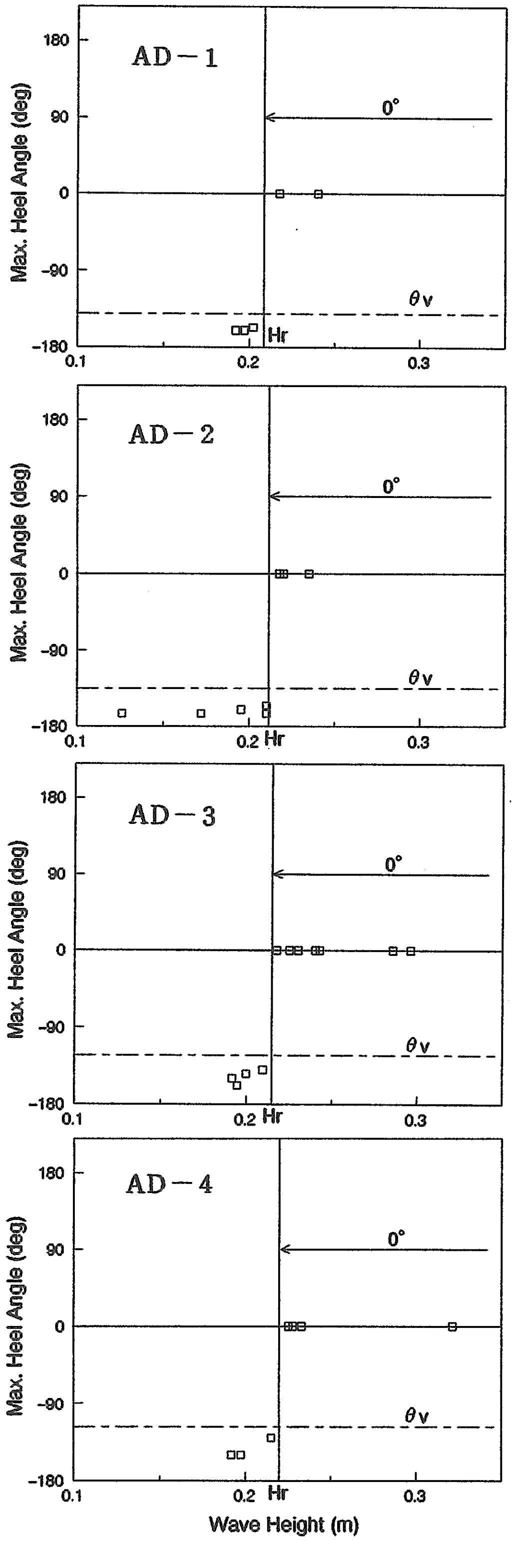

Fig.46　Maximum heel angle versus wave height (Ship-AD)

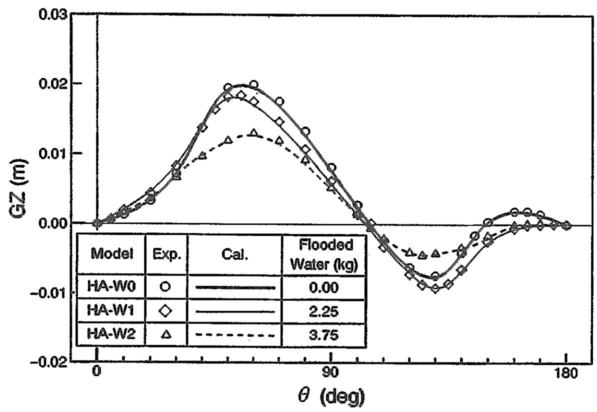

Fig.付2　Variation of GZ curve by the weight of flooded water (HA)

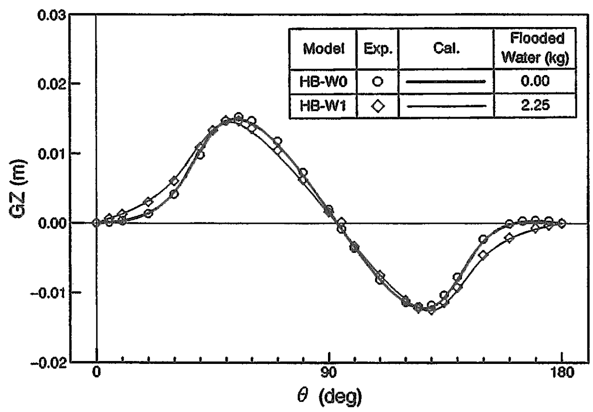

Fig.付3　Variation of GZ curve by the weight of flooded water (HB)

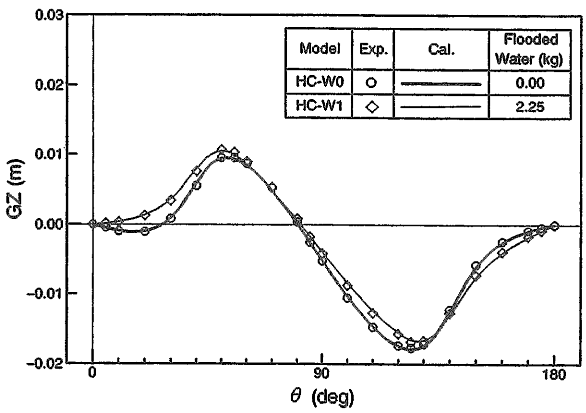

Fig.付4　Variation of GZ curve by the weight of flooded water (HC)