비대칭 고속 쌍동선의 선미터널 출구영역의 경사각 변화에 따른 저항성능 및 항주자세 분석

김상원* · 서광철** · 조대환*** · 김병재***** · † 이경우
*,**,****,† 목포해양대학교 조선해양공학과, ***목포해양대학교 기관시스템공학부

The Comparison on Resistance Performance and Running Attitude of Asymmetric Catamaran Changing Angle of Inclination of Tunnel Stern Exit Region

Sang-Won Kim · Kwang-Cheol Seo** · Dea-Hwan Cho*** · Byung-Jae Kim**** · † Gyeong-Woo Lee*
,,****,† Department of Naval Architecture and Ocean Engineering, Mokpo National Maritime University, Mokpo 58628, Korea*
****Division of Marine Engineering, Mokpo National Maritime University, Mokpo 58628, Korea*

요 약 : 본 연구에서는 선미 터널을 적용한 비대칭 고속 쌍동선을 수치해석 기법을 통해 선체의 유체동역학적 성능을 평가하였다. 선미터널 형상은 터널 출구 형상에 경사각에 따라 구분하였으며, 총 3가지 형상(0°, 3°, 6°)을 사용하였다. 결론적으로, 저항성능의 경우, 전 속도 구간에서 0° 경사각의 선미터널은 기존 대비 4.8-17.9% 감소한 것을 확인하였다. 하지만 3°와 6°경사각을 가진 선미터널은 각각 기존대비 5-14%와 5-29%의 저항이 증가하는 것을 확인하였다. 이와 달리, 트림각의 경우, 0°경사각은 전 속도구간에서 기존선형과 유사한 경향을 보였으나, 3°와 6°경사각의 경우 각각 FnV=1.54이후에서 평형상태 유지 및 계속적인 감소 형태를 보였다. 이와 같은 형상은 터널 출구 영역에 경사각을 증가하는 것이 저항성능 측면에서 다소 악영향을 발생하지만 운항성능 측면에서는 기존대비 개선됨을 보여준다.

핵심용어 : 비대칭 쌍동선, 선미터널의 출구영역, 저항성능, 항주자세, 압력분포

Abstract : *In this research, tunnel stern was applied on the asymmetric high-speed catamaran to evaluate vessel's hydrodynamic performance by numerical method, and the tunnel stern types are distinguished by angle of inclination of tunnel exit region into 3cases (0°, 3° and 6°). Consequently, it is confirmed that the total resistances of tunnel stern which have 0° of inclination are lower about 4.8-17.9% than the bare hull in the wide speed range, but those of 3° and 6° of inclination tunnel stern are higher than bare hull about 5-14% and 5-29%, respectively. On the other hand, trim angles of 0° of inclination tunnel stern show similar trend with those of bare hull in whole ranges of FnV but those of 3° and 6° of inclination tunnel stern are stabilized and declined respectively after FnV=1.54. These phenomena indicated that increasing angle of inclination of tunnel exit region had negative influence on resistance performance, however, it could make vessel's operation performance better than bare hull.*

Key words : *Asymmetric Catamaran, Exit region of Tunnel Stern, Resistance Performance, Running Attitude, Pressure Distribution*

1. Introduction

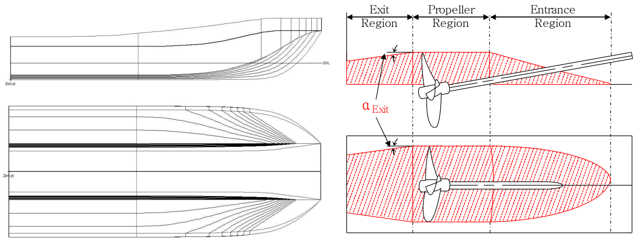
Recently, there has been a significant increase on the use of catamaran vessels for various purposes. The advantages of this vessel compared to mono-hull are that they have better transverse stability, more attractive layout accommodation (Setyawan et al., 2013). these vessels which travel at high speed have shaft angle due to the engine and gearbox in the hull. To overcome this disadvantage, the tunnel stern, which has tunnel shape at the top of propeller on the hull, provides free space which could reduce shaft angle of vessel or increase diameter of propeller. By this shape, it could suppress loss of propeller efficiency and cavitation and has been applied on numerous small and middle vessels which have shaft angle. In this research, we applied tunnel stern on the asymmetric high-speed catamaran and evaluated vessel's performance. The distinction of tunnel stern shape follows Blount D.L (1997). The performance of catamaran was estimated by using commercial CFD software, STAR-CCM+.

2. Numerical method and model

In this study, numerical method and coordinate system

† 교신저자 : 종신회원, kwlee@mmu.ac.kr
*** 종신회원, dhcho@mmu.ac.kr

are applied established numerical method of Kim et al. (2017) for incompressible and viscosity of fluid to calculate performance of planing hull. The commercial CFD code used in this study was STAR-CCM+. Fig. 1(a) illustrates the profiles of model, and length and displacement of the model are 1.803m and 48.7kg, respectively. The bottom and longitudinal views of tunnel stern are illustrated in Fig. 1(b), and where αExit is the degree of inclination of exit region on tunnel stern.



(a) (b)

Fig. 1 (a) model profiles of Asymmetric Catamaran, (b) Conceptual design of tunnel stern

3. Simulation and result

Fig. 2 shows the total resistances which are expressed dimensionless form by weight and compared as cases of tunnel stern. Fig. 3 is trim angle of each tunnel stern, and it is indicated that increasing degree of inclination of exit region cause trim angle to suppress largely.

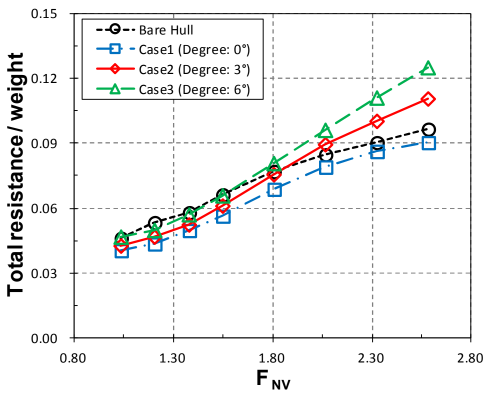


Fig. 2 Comparison of Total resistance

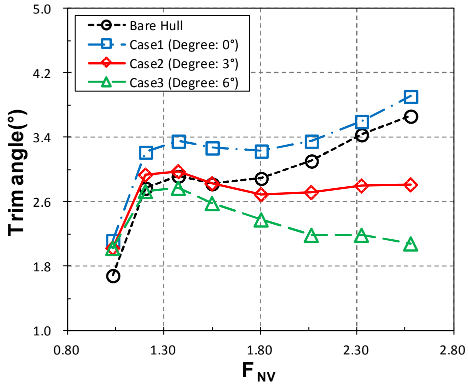


Fig. 3 Comparison of Trim angle

4. Conclusion

The main conclusions drawn from the research presented in this paper can be summarized as follows:

1) 0° inclination at exit region of tunnel stern showed that it produced better resistance performance but there was large trim angle trend.

2) 3° inclination showed that resistance performance was deteriorated after around FNV=1.80 and this phenomena occurred earlier when there is increasing of degree of inclination on the exit region of tunnel stern. On the other hand, trim angle trends are significantly suppressed by increasing those of tunnel stern.

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