Safety and protective design of Go-kart

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ABSTRACT

Go-kart is a very popular recreation and exciting racing around the world, ant it is also the first step for Formula 1 drivers to begin their careers. Usually, one can understand the development of vehicle industry of a country is proportional to the population of participating Go-kart racing. Competition Go-kart must satisfy the philosophy of extreme simplicity, but their design can be even more complex than the one of standard vehicles. Even if experimental test is still the most common and extensively used approach, the numerical simulation has been developed so much in the latest years to become rapid and reliable. Due to the absence of differential gear and suspension system on Go-kart, the frame must be responsible for absorbing the charge generated while the kart is in motion, and transfer the dynamic loads to compensate the defect of no differential gear. Therefore, the torsional stiffness of a kart frame will affect the handling performance obviously. On the other hand, though Go-kart is a very safe recreation, there are still numerous accidents happened every year, especially the kart hit a stationary object, or the kart hit another kart while running. Therefore, the collision performance of Go-kart is also important. In this study, the design and manufacturing process of competition Go-kart was described, comprising the looking of bodyworks, aerodynamic analysis of drag, design of the frame structure, collision performance of Go-kart, design of suitable powertrain system, and kart dynamics. Major works in this study were concentrated on how to improve the torsional stiffness of kart frame, design good kart bumpers which can absorb more energy during impacts, and the analysis of whole Go-kart subject to high speed impacts. The non-linear finite element code LS-DYNA 3D was used to analyze the works mentioned above. In the static analysis of torsional stiffness of kart frame, 10 different model of frame with extra members arranged and 4 different model of frame with increased width between two kingpins were constructed. The results showed that among the 10 different model of frame with extra members arranged, the model with an inclined member arranged in front of the center member was the best one, and in the model of frame with width increased, it was found the torsional stiffness of frame was proportional to the width between two kingpins. In the analysis of crash test, three factors which would affect the collision performance of kart bumpers were investigated, including the angle between the front upper bumper and the horizontal plane, the thickness and diameter of kart bumpers. Deceleration, intrusion, and energy absorption of bumper were investigated. The results showed that whether in frontal or lateral crash tests, the best ones were the model with diameter increased. In the impact analysis of whole Go-kart, three cases of different velocities were studied to observe the dynamic behavior of kart, including the velocity of 10.7km/hr which is the regulated velocity in CIK-FIA homologation crash test, and 60km/hr and 80km/hr are the regulated velocities in FIA impact test for safety barriers. Due to the lack of ability to design legal domestic Go-kart, it was believed the works in this study could provide relative information to people who are willing to design and manufacture new Go-kart in the future.

Keywords : Go-kart, torsional stiffness, energy absorption, collision performance, LS-DYNA 3D

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