Proceedings of the 3rd World Congress on Mechanical, Chemical, and Material Engineering (MCM'17)
Rome, Italy – June 8 – 10, 2017
Paper No. ICMIE 117
ISSN: 2369-8136
DOI: 10.11159/icmie17.117

Development and Evaluation of 6-component Wheel Dynamometer

Sunju Park, Hyunchang Yoo, Jinwon Joo
Chungbuk National University
1 Chungdae-ro, Seowon-gu, Cheongju, Chungbuk, 362-763 Korea
sunju0902@naver.com; hyunandyoo@hanmail.net; jinwon@chungbuk.ac.kr

Extended Abstract

For the durability design of vehicles, it is essential to build database on various performance that can appear while driving. In order to analyze the load characteristics of the vehicle according to the driving conditions, a 6-component (three forces and three moments) wheel dynamometer is attached to vehicle's wheel. For design of a high precision wheel dynamometer, Y. W. Park studied the characteristics of the basic structure of the wheel dynamometer and the characteristics of the flexible fixed end using the Finite Element Method. Also, to design a wheel dynamometer with various flexible output value, H. C. Yoo set various parameters about the shape and studied the influence of the variables on the strain. The wheel dynamometer is a kind of multi-axis load cell. In order to reduce the interference error which is the most important characteristic of the multi-axis load cell, C. H. Shin and H. C. Yoo proposed a new Wheatstone bridge circuit and evaluated the effectiveness. In this paper, The wheel dynamometer with the rated capacity designed by the previous researchers (Fx, Fy is 25 kN, Fz is 15 kN, Mx, My are 5 kN·m and Mz is 8 kN·m) are fabricated by using strain gage and evaluated by static and dynamic characteristic test .

In order to evaluate the characteristics of the wheel dynamometer, a uni-axial load generator of 1.5 ton capacity was used. Through the proper jig fabrication and adjustment of the setting direction of the wheel dynamometer, 3-component force and 3-component moment were generated. A characteristic matrix including the rated output and the interference output was obtained by applying a load of each component and measuring the output of all the components. In the principle of the load generation by this method, when a load of one component is applied, a load of another component that is not desired is generated. Therefore, the interference output is obtained by compensating the load. The design result of the previous researchers and the characteristic test result were compared. The maximum output of the characteristic test results is less than that obtained by the finite element analysis. The interference error showed a maximum error of 40% compared with the rated output, but it was reduced to 0.4% when the compensation method was applied. Also the hysteresis error for Fy and the nonlinearity error for My were higher than the target 0.5%, and the remaining errors were evaluated to be similar or lower.

In order to utilize the wheel dynamometer in the actual rotating state, it is necessary to evaluate the performance through the dynamic characteristic test. Accordingly, a dynamic characteristic testing equipment was developed in which torque is applied while rotating. The system consists of a driving unit that rotates the shaft, a load unit that can break the rotating shaft, and a torque measuring unit. The torque signal and the dynamic load characteristics of the wheel dynamometer were evaluated according to the rotational speed using this test system.

References

[1] Y. W. Park, "Deformation analysis for design of 6-components wheel dynamometer," M.S. Thesis, Chungbuk National University.

[2] H. C. Yoo, Y. W. Park, J. W. Joo, "Performance prediction of wheel dynamometer in accordance with wheatstone bridge's circuit organization," *Transaction of the KSME(A*), vol. 16, no. 2, pp. 219-220, 2016.

[3] C. H. Shin, H. C. Yoo, J. W. Joo, "Design and deformation Analysis of Six-component Wheel Dynamometer," in *Proceedings of the ICMIE World Congress on Mechanical, Chemical, and Material Engineering*, Budapest, HG, pp. 122, 2016.