Study of the Durability on the Supporter of Outdoor Unit at a Ventilation Fan

Jaeung Cho*

*Division of Mechanical & Automotive Engineering, Kongju National University, 1223-24, Cheonan Daero, Seobuk-gu, Cheonan-si, Chungnam of Korea, 331-717

Abstract
This study investigates the durability on the supporter of outdoor unit at a ventilation fan through structural and fatigue analyses. As model 2 has the least value among three kinds of models. In case of the maximum equivalent stress and displacement at structural analysis, model 2 has the highest durability. And there are models 3 and 1 with structural durability in order of this value. In case of fatigue analysis, the maximum fatigue lives of three models are same as 336,930 cycles. But model 1 has the most value among three models as the minimum fatigue life of model 1 becomes 18,719 cycles. And there are models 3 and 1 with fatigue durability in order of this value. As the result of this study is applied by changing the design shape of the supporter of outdoor unit, the safety and its durability at a ventilation fan can be improved.

Keywords
Supporter of Outdoor Unit; Ventilation Fan; Fatigue Life; Safety; Durability

Introduction
A ventilation fan is installed with the supporter of outdoor unit. There were the frequent accidents that its supporter falls to the ground. The study on the noise vibration was initiated by Hu(Hu et al., 2005). Afterwards, the pressure and noise strength of air outlet louver was evaluated but it is not sufficient to evaluate structural and fatigue strength on the supporter of outdoor unit (Hu et al., 2006). The supporter of outdoor unit must endure the pressure and the vibration for a long time. Therefore, it is important to assess the analysis result of structural and fatigue strength on the supporter of outdoor unit. Some people were hurt in the crash of its supporter. So, it is necessary to check and confirm the safety of the supporter of outdoor unit at a ventilation fan. In this study, there are three kinds of supporter models with different configurations. These models are drawn with CAD program of CATIA and analyzed with ANSYS software. This study investigates the durability on the supporter of outdoor unit at a ventilation fan through structural and fatigue analyses (Cho et al., 2010). As the result of this study is applied by changing the design shape of the supporter of outdoor unit, the safety and its durability at a ventilation fan can be improved.

Fatigue Analysis
Fig. 1 shows three models of 1, 2 and 3 with the different configurations and sizes. And the unit is millimeter.

(a) MODEL 1
Fig. 2 shows these meshes.

As shown by Fig. 3, the support stands at one side of installation part and the part settled with the inner wall of building is fixed. At Fig. 4, the load is supposed to be applied at the direction of one side (Kang et al., 2010). By regarding the weight of outdoor unit, it is supposed to support the load corresponding to two outdoor units. So, the load becomes about 500 N as the weight of outdoor unit is 50 Kg and the load is applied as 1000 N.
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FIG. 3 FIXED CONDITIONS OF MODELS OUTDOOR UNIT OF AIRCONDITIONER CRADLE
FIG. 4 FORCE CONDITIONS OF MODELS OUTDOOR UNIT OF AIR CONDITIONER CRADLE
When the outer unit is placed on one side, the force of 1000N is applied on the direction of load. On the same condition, the fatigue analysis is carried on due to the configuration of supporter. In Fig. 5, the changes of the fatigue loads that can be actually received are ‘SAE bracket history’ as the irregular amplitude loads. Fig. 5 shows the history of fatigue load as the stress amplitude and average stress changed during the one elapsed cycle. As this load is imagined as the severest fatigue, the durability of outdoor unit during the fatigue load is investigated whether this unit can be maintained or not.

The relation between stress amplitude and loading repetition number is drawn by an algebraic graph. Fig. 6 is S-N curve obtained by fatigue test. The fatigue simulation in this study is applied with this S-N curve. As shown by this figure, the number of cycle until breakage is increased as the stress is decreased. S-N curve is influenced on the various factors and so the fatigue limit is changed.

Discussion

Figs. 7, 8 and 9 show the contours of equivalent stresses and total deformations at models of 1, 2 and 3 respectively (Cho et al., 2010). As the maximum equivalent stress and total deformation at model 2 become least by comparing with other models, model 2 has the most strength among three models of 1, 2 and 3.
Figs. 10 and 11 show the contours of fatigue lives and fatigue damages at models of 1, 2 and 3 respectively. In case of fatigue life, the maximum fatigue life is $3.3693 \times 10^5$ Cycles at models of 1, 2 and 3. The minimum fatigue lives at models of 1, 2 and 3 are 390.61, 18719 and 739.44 cycles respectively. The design life becomes $10^9$ cycles as the infinite life (Hell et al., 2015). Fatigue damage is defined as the design life divided by the fatigue life. In case of fatigue damage, the minimum fatigue damage is 2958 at models of 1, 2 and 3. The maximum fatigue damages at models of 1, 2 and 3 are $2.5601 \times 10^6$, 53422 and $1.3524 \times 10^6$ respectively (Gigliotti et al., 2015). Model 2 has the most fatigue strength among three models. There are models of 2, 3 and 1 at the order of the fatigue strength.
Conclusion

This study investigates the durability on the supporter of outdoor unit at a ventilation fan through structural and fatigue analyses. It checked which model has the most durability of outdoor unit and it also investigated whether these unit models during the fatigue load can be maintained or not by analyzing the three models and comparing them with each other. As the result of this study, model 2 has the most fatigue strength among the three models. There are models of 2, 3 and 1 at the order of the fatigue strength. As the result of this study is applied by changing the design shape of the supporter of outdoor unit, the safety and its durability at a ventilation fan can be improved.
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