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Fundamental Stress Analysis for a Development of the Safety Block

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Abstract : The falling accidents have increased in the structure and heavy industries. Therefore, a various falling prevention systems with safety block and lanyard have been supplied in order to prevent falling accidents and acquire the long life and cost down for the maintenance. However, there are not the reliable and domestic the falling prevention system until now. Almost systems were imported from U.S.A, Japan, U.K and Germany. The structural safety of the imported safety block is satisfied sufficiently, but it has heavy weight due to the cover with the aluminum and thickness. So, many workers are not feeling themselves. Thus, the aim of this work is to develop a commercial safety block that has a light weight and strength. And the cost efficiency of the system and safety for workers also will be improved remarkably.

Key words : safety block, falling prevention system, FEM, guided rail, comfort

1. Introduction

Many kinds of falling prevention systems with a safety block have been supplied in order to prevent falling accidents and acquire the long life and cost down for the maintenance. The falling prevention systems generally consist of the safety block, lanyard, rail, and the comfort. However, there are not the reliable and domestic the falling prevention system until now. Especially, the falling prevention system as the safety block is very expensive. It brings about flow the enormous money out of country. Furthermore it has a heavy weight. When workers climbed the ladder with a falling prevention system and moved, many workers are not feeling themselves. Thus, the aim of this work is to develop a commercial safety block that has a light weight and an advanced strength. The cost efficiency and convenience of the system and safety for workers also will be improved remarkably even though this system has a light weight. The results show that the maximum stress is obtained in each part by the lower more than yield strength and has sufficient safety in the developed new safety block.

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2. Dynamic Performance Test and Stress Analysis

2.1 Dynamic performance test

Figure 1 shows the dynamic performance test apparatus. The falling impact on the latch of the safety block is supposed to give impact forces which happen by a

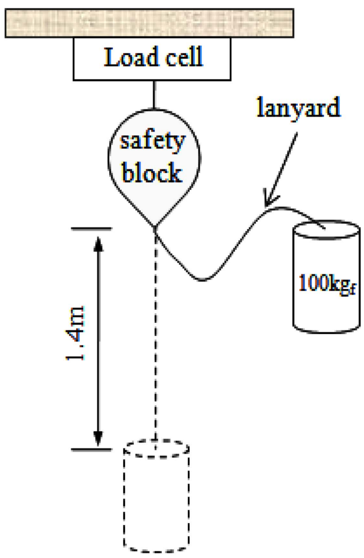


Fig. 1. Dynamic performance test apparatus.

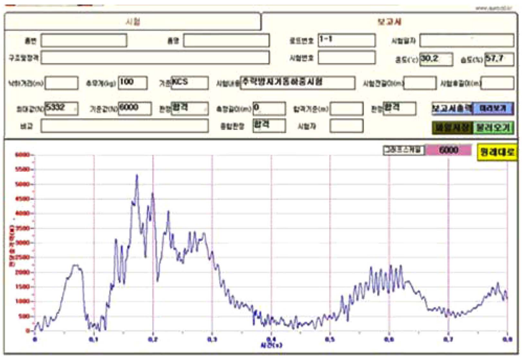


Fig. 2. The result of dynamic performance test.

free drop with 1.4 m height and 100 kgf weight for a model of a human body. The load condition was given when the workers with 100 kgf weight dropped down freely. The analysis was conducted within elastic condition. Dynamic performance test is conformed to CE accreditation criteria.

Figure 2 shows the result of the dynamic performance test. The safety blocks have to relieve the shock when the workers with 100 kgf weight dropped down freely. Its limit value is 6 kN. As the test result, the maximum load is transferred to worker that is shown by lower value than CE accreditation criteria.

2.2 Numerical analysis

Table 1 shows mechanical properties of the material in the safety block parts.

Figure 3 show the principal assembly drawings of the safety block. The newly developed safety block is changed the cover as MC nylon.

Figure 4 shows the FEM model of the safety block. The number of element is about 3,000,000. The modeling and analysis for the safety block was carried out using the auto CAD and FEM software ANSYS.

Table 1. The mechanical properties of the parts in the block

Material	Elastic modulus, GPa	Poisson's ratio
SUS304	195	0.29
AC3A	55	0.28
Al 4000 series	70.3	0.3
ZDC1	56	0.29
ALBC3	70	0.3
AC2A	50	0.29
ADC10	45	0.29
MC nylon	18.9	0.25

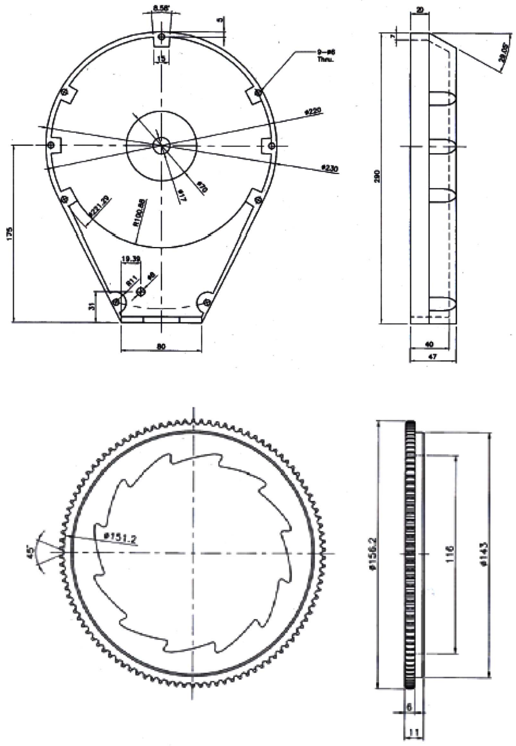


Fig 3. The principal parts of the safety block.

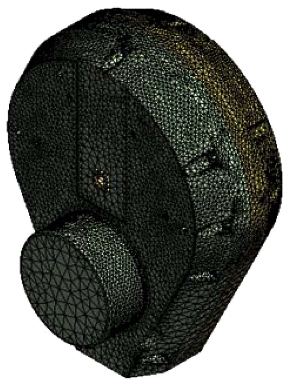


Fig. 4. FEM model of the safety block.

3. Results and Discussions

Figure 5 shows von Mises stress contour for the imported safety block which impacted by the free falling condition with 100 kgf weight. The maximum von Mises stress is obtained by 54.6 MPa in the latch. The maximum von Mises stress in the latch is obtained by the lower value more than the yield strength.

Figure 6 shows von Mises stress contour for the wire drum of the imported safety block. The maximum von Mises stress valve is obtained by 23.3 MPa in the sur-

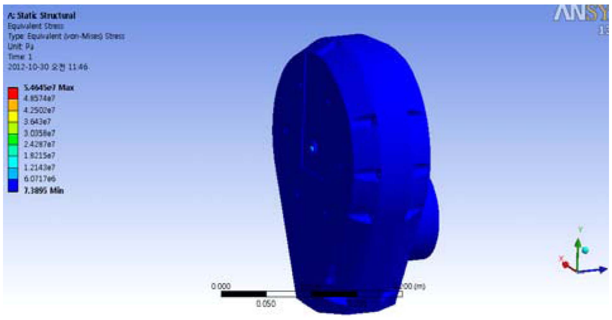


Fig. 5. The von Mises stress contours of the imported safety block.

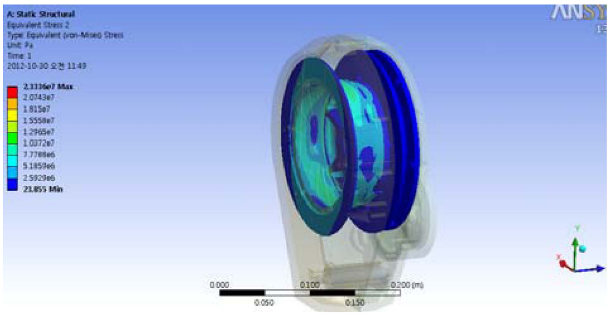
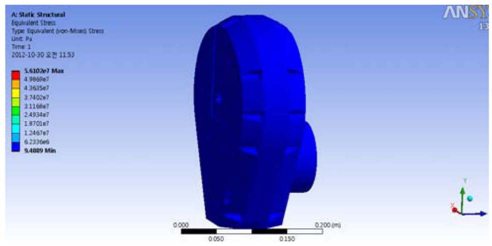


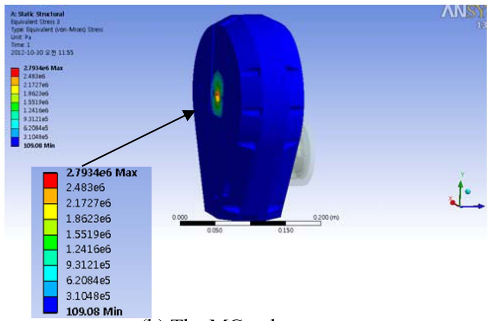
Fig. 6. The von Mises stress contours of the wire drum for the imported safety block.

face of drum. This is very small value in comparison with the yield strength and besides it can be estimated that the structural safety is satisfied sufficiently.

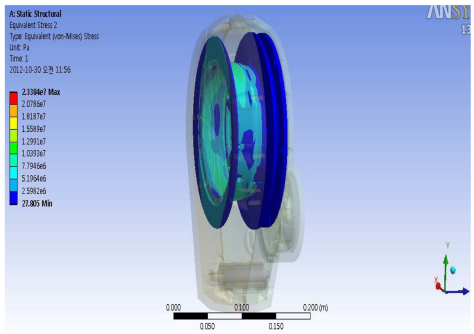
Figure 7(a)~(d) shows von Mises stress contour for a new developed safety block which impacted by the free falling condition with 100 kgf weight. In figure 7(a), the maximum von Mises stress valve is obtained by 56.1 MPa in the latch. This stress value is higher than that of an imported safety block, the maximum von Mises stress value in the latch is obtained by the lower value more than the yield strength. Figure 7(b) shows von Mises stress contour for a newly changed safety block cover. The maximum von Mises stress valve is obtained by 2.79 MPa in the link hole. Also this part the lower value more than the yield strength, 18.9 MPa, of the cover material. Figure 7(c) shows von Mises stress contour for the wire drum of the newd safety block. The maximum von Mises stress valve is obtained by 23.4 MPa in the surface of drum. This is also very small value in comparison with the yield strength and besides it is nearly same that stress was estimated in the wire drum of an imported safety block. And its safety factors are about 5~10. Figure 7(d) shows von Mises stress contour for the friction pad. The maximum von



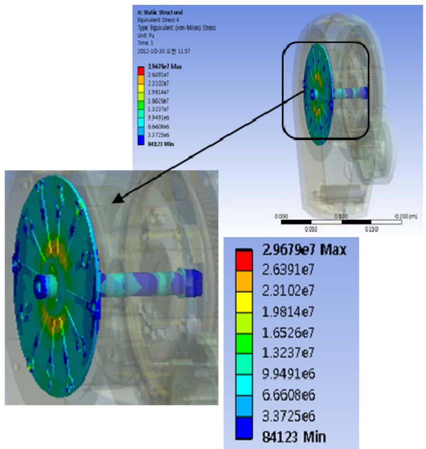
(a) The impacted safety block



(b) The MC nylon cover



(c) The wire drum



(d) The friction pad

Fig. 7. The von Mises stress contours for the new developed safety block.

Mises stress valve is obtained by 29.7 MPa in the linkage of friction pad and drum pipe. This is very lower than the yield strength. Thus, it seems to be safe sufficiently in spite of having a lighter weight cover of the safety block.

4. Conclusion

In this study, the safety block with MC nylon cover was proposed by introducing a light weight and strength.

The conclusions are as follows below.

The maximum von Mises stress valve of the new safety block is obtained by very low value in comparison with the yield strength and its safety coefficient is about 25. So, it can be estimated that the structural safety is satisfied sufficiently. The maximum von Mises stresses in the other parts are obtained by the lower more than the yield strength such as the values of the imported safety block. Its safety factors are about 5~10. Thus, the weak point such as heavy weight and structural performance of the new safety block is improved more than those of the imported block. We considered that it obtained a light weight and a convenience. Therefore the cost efficiency of the system and safety for workers also will be improved remarkably.

Acknowledgements

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