Improvement of performance of impact absorption energy of cylindrical shell model

YOHEI SAKAI
Department of mechanical engineering, Ritsumeikan University, Kusatsu, Shiga, Japan
MASAHITO KAZITA
Department of mechanical engineering, Ritsumeikan University, Kusatsu, Shiga, Japan

1. Introduction

Body of automobiles absorb a kinetic energy at the time of impact and need to cushion the impact. It's one of most important capability considered by designing automobile. Now many shell member are used as member absorbed impact energy. That's what the research to understand the mechanical behavior in a fast deformation have been a focus of constant attention. Additionally, the lightness of the member is very important considering the weight saving of automobiles.

So we give some tests and analyses of cylindrical shell member as member absorbed energy and purpose to consider affect on action of plastic buckling caused by variation of material property.

2. method of impact test

We prepared cylinders of aluminum and vinyl chloride. And we formed them outline and manufactured cylinders of various shell thickness. Additionally, we manufactured a impact test equipment falling weight to conduct impact tests(Fig1). The weight of test equipment can drop flatly along two rails and we designed it who can change its mass. And We prepared a Load-cell as measuring device of load and a measuring device of displacement by laser(KEYENCE LB-02). In impact test we dropped the weight from high of 2 meter. Then impact velocity is about 6.26m/sec and we measured load and displacement after

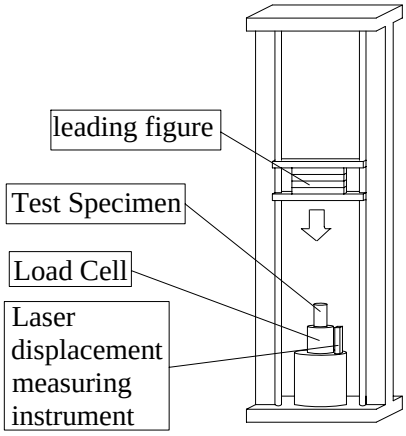

Fig1 Impact test device

impact.

3. model of impact analysis

In impact analysis we used MSC/Dytran as analysis soft. The cylindrical model is configured by shell element of 1000 pieces dividing the axial into 25 and the circumferential into 40. Additionally, we defined a rigid wall to bring into contact with cylindrical shell model and fixed x,y direction of contacting side and x,y,z direction of not contacting side. The velocity of rigid wall is same as impact test and we defined it as 6.26m/sec.

4. results of impact test and analysis

Fig2 is picture after impact test and model after impact analysis of aluminum (Outline 30mm, Thickness 1.0mm). You can confirm buckling of axial symmetry both the test and the analysis.

Fig2 Crushed specimens

Additionally, Fig3 is a graph defined longitudinal axis as load and abscissa axis as displacement and dashed line is absorption energy. Maximum load arise by first wave of load and is about 14kN both test and analysis. And absorption energy, too, almost corresponded and we confirmed the availability of impact analysis.

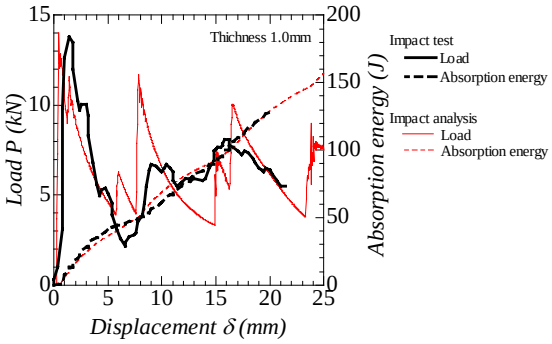

Fig3 Comparing with impact test and impact analysis

Fig4 is a graph defined longitudinal axis as young's modulus and abscissa axis as aspect ratio (ratio of outline and thickness).

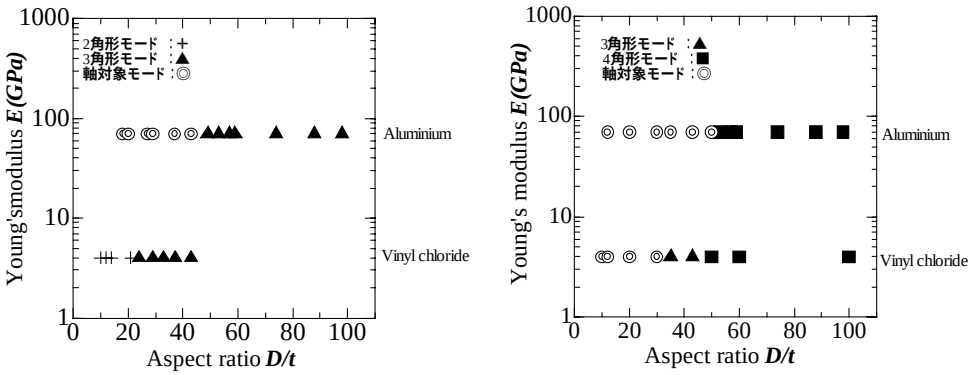

Fig.4　Change of deformation modes
(left: impact test　right: impact analysis)

5. conclusion

In this study, we started to manufacture the impact test equipment falling weight to conduct impact tests and could measure dates of load and displacement. Additionally, in impact analysis we could analyze cylinders of various thickness and organize some behavior of plastic buckling on the change of figure (aspect ratio) and material property (young's modulus). In this time, we used only two materials but in future we need to use other materials