繊維集合体の機能と力学特性の究明
—FRP ポールの衝撃緩和の評価

The study of function and mechanical characteristics for structure which consist of the fiber
—Estimation of FRP Pole under Impact Load

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1. Introduction

In recent years, ski is becoming one of the sports to which growth is anticipated in sport leisure industry.
Also in inside, by enlargement of the spread in game ski, and a consumer age bracket etc., the needs of the consumer to ski are also diversified and the whole ski industry is in the process of evolution.

However, little research about the impact evaluation of a ski pole had been done except the research about grasping force by Tokuyama[1] and the research about swing by Kitajima[2].

In this research, when poking a ski pole, the impact which comes to a shoulder or an arm, is observed, the measurement apparatus which can make objective judgment is proposed, and the mechanism of impact relaxation of a ski pole is clarified.

2. Experiment

2.1 Impact experiment by human

In order to make the measurement apparatus which can make objective judgment on the impact which comes to a shoulder or an arm, when poking a ski pole, it is necessary to prefer to the behavior of the pole.

As shown in Fig.1, the tester holds a ski pole and pokes a plate.
Strain gages are stuck on both sides of the ski pole, and a load sensor is put on the bottom of the plate.

Here, above mentioned test is called to impact experiment by human.

Fig.2 and 3 show two of the results of the experiment by human.

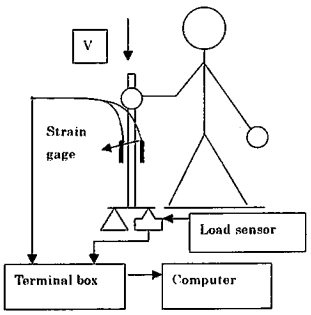

Fig.1 The human impact test.

2.2 The impact experiment by measurement apparatus

An arm is made, and a rail is attached on wall to make the man-made arm fall down free, as shown in Fig.4.

Strain gages are stuck on the upper and lower sides of the arm, and the impact load is measured with FFT analyzer through amplifier when the arm falls down. Moreover, bending strain and compressive strain of the ski pole are measured simultaneously.

Fig.5 and 6 show the result of impact experiment by measurement apparatus.

It is can be seen that the result of experiment by measurement apparatus was almost the same as that by human. From this, the impact experiment by measurement apparatus is considered to be the same as the impact experiment by human.

Fig.7 shows the curve of the impact load measured by measurement apparatus. Impact load of T3 shows bigger than T6.

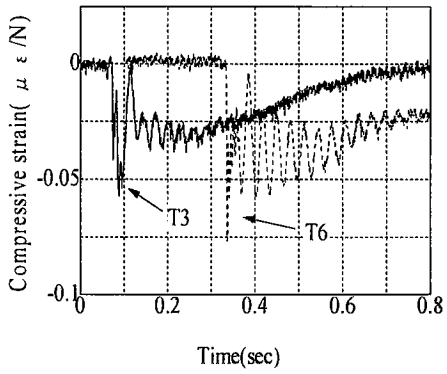

Fig.2 Compressive strain obtained by human.

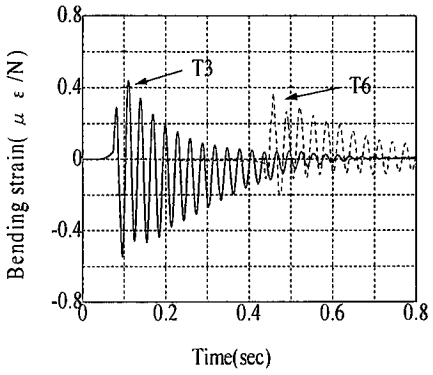

Fig.3 Bending strain obtained by human

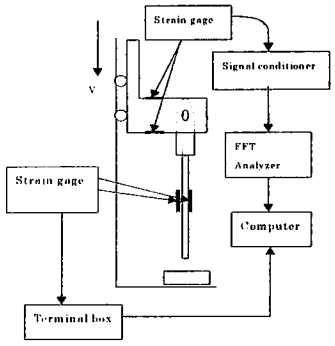

Fig. 4 The experimental apparatus for the impact test

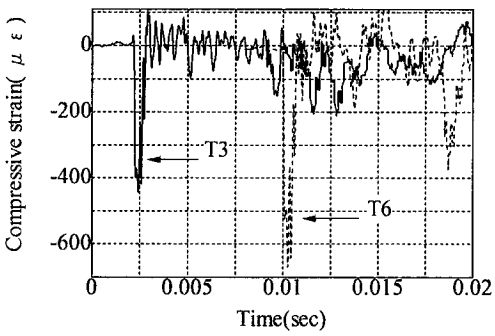

Fig.5 Compressive strain obtained by experimental apparatus.

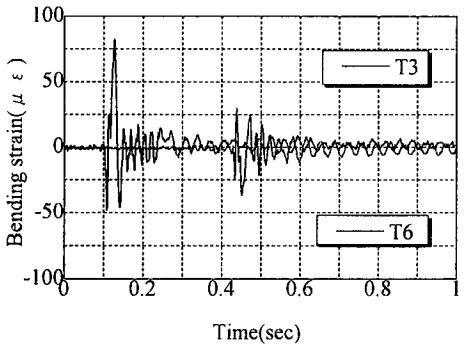

Fig.6 Bending strain obtained by experimental apparatus.

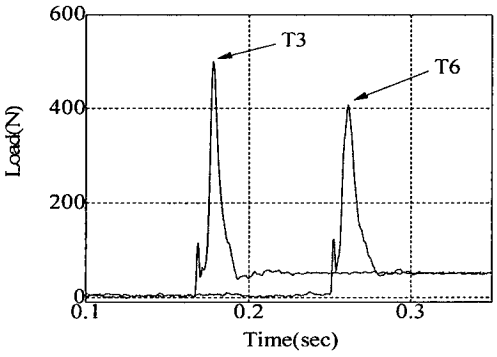

Fig.7 Impact load curve of the pole in the impact test

3. Estimation

In order to compare the estimation by apparatus proposed to the estimation by human, impression estimation is performed as following:

From the experiment result, T3 is selected as standard. Poke T3 and take the impression as normal. Compare T3 to the other 4 poles, and then mark the poles in order of impact strength. An average value is taken and compared by 20 testers' evaluating.

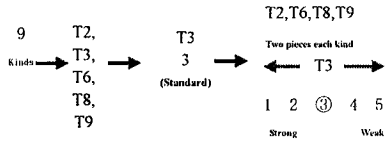

Fig.8 shows a tester how to do the test.

Fig.9 shows the relation between the result by human and result by experiment apparatus. It can be seen that the result by human is almost linear to the result by experiment apparatus.

From Fig.16, three formulas are obtained as followings:

$Y=a\times X+b$ (1)

$a=-19.07$ $b=570.59$

Fig.10 shows impression estimation by human of T1, T4, T5, T7,

As a result, the experiment apparatus can act as human to do the test.

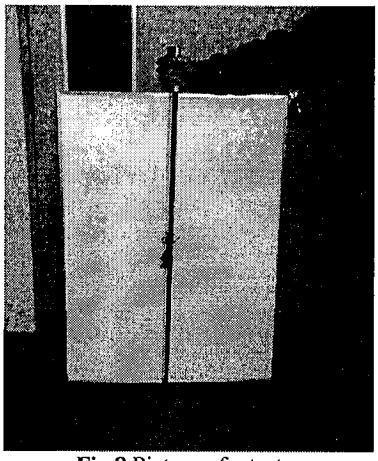

Fig.8 Picture of a tester

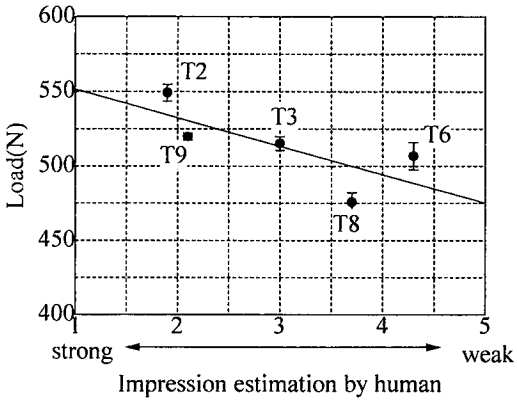

Fig.9 Relation between the result by human and the result by apparatus.

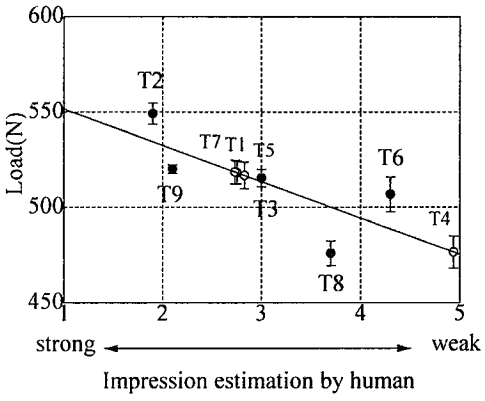

Fig.10 Relation between the result by human and the result by apparatus calculated from formulas.

4. Conclusions

In this research, the measurement apparatus, which can make objective judgment, was proposed. It was known that result from human impact test and result from experiment apparatus are the same. Impression estimation was done by 20 testers. As a result, the experiment apparatus can act as human to do the test.

References

1. M. Kitajima, L.Bao and A.Shinohara, *Symposium on Sports Engineering*(No95-45), 42-46(1995).
2. S. Tokuyama, M. Nakazawa and S. Kitazawa, *Symposium on Sports Engineering*(No99-41), 50-54(1999).