MEASURING DYNAMIC SKI BEHAVIOR WITH STRAIN GAUGES

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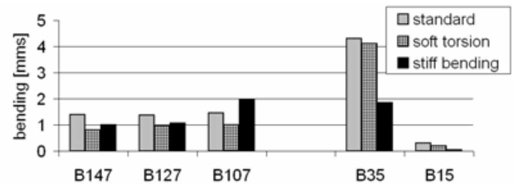
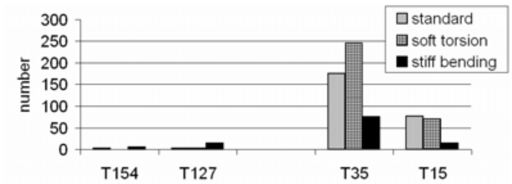
INTRODUCTION: The performance of a ski is influenced not only by geometric properties such as length, width, camber height, side cut and thickness; but also by the deformation behaviour caused by the mechanical properties (Kaps et al. 2001). The purpose of this work was to evaluate the influence of flexural and torsional stiffness on the deformation of a ski during turns.

METHOD: Three highly skilled subjects performed turns through 6 open gates with 3 different skis on the same course. All 3 skis had a side cut radius of 15.4 m and a length of 170 cm. The skis differed only in their stiffness. One ski was a typical slalom ski, Head RC3 (standard), one had 20% greater bending stiffness (stiff bending) and one had 30% less torsional stiffness (soft torsion). The velocity during the turns was approximately 40 km/h. The deformation was measured on the upper surface of the right ski by 5 flexural and 4 torsional strain gauges. The data were amplified and stored by a data logger (Wilke/DL 7000) at a sampling rate of 100 Hz. Additionally the subjects were filmed with a video camera. To describe the deformation of the skis 3 parameters were calculated over the 6 analysed turns: the numeric integral of the rectified data, the number of values above a defined threshold of the rectified data and the numeric integral of Butterworth high-pass (the cut-off frequency is specified) filtered and rectified data.

RESULTS: The numeric integrals of the rectified data are shown for the bending deformation in graph 1. Graph 2 gives the number of values above 1° of torsional deformation. The bars in the graphs display the means of the 3 skiers over the 6 analysed turns. The strain gauges are identified by the distance to the end of the ski (e.g. B35 means bending gauge with a distance of 35 cm to the ski end).



Graph 1 Bending deformation



Graph 2 Torsional deformation

The bending results show a strong deformation on the rear part of the ski. Comparing the bending deformation of the 3 skis, the bending of the stiff bending ski is evenly distributed over the whole ski. In contrast the soft torsion ski seems to have nearly no bending on the front part. Considering the torsional deformation, the soft torsion ski is the one with the highest torsional deformation.

DISCUSSION: By using strain gauges, differences in bending and torsional deformation during turns can be determined. A surprising result is the strong deformation in the rear part of the ski. To investigate if this is an effect caused by the skiing technique of the subjects, the skiers will be replaced by a sledge in further trials.

REFERENCES:

Kaps, P., M. Mössner, W. Nachbauer and R. Stenberg (2001), **Pressure distribution under a ski during carved turns**, Science and Skiing (Hamburg), Verlag Dr. Kovac, pp. 180-202.