MODELING THE MECHANICAL CHARACTERISTICS AND ON-SNOW PERFORMANCE OF SNOWBOARDS

A DISSERTATION

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Signatures

Abstract

Models were developed for calculating the mechanical characteristics and the on-snow performance of snowboards. The snowboards are constructed of layers of materials which may include wood, foam, honeycomb, fiber reinforced composites, and polymeric materials. The models pertaining to the mechanical characteristics provide the bending and torsional stiffnesses, the flex, and the twist. A computer code "Snowboard-MECH" was written which yields numerical values of these characteristics. The model pertaining to the on-snow performance simulates the travel of a snowboarder of given height, weight, and skill level down an S-shaped course. A computer code "Snowboard-TURN" was written in support of this model. This code calculates the time it takes the snowboarder to complete the course. The two computer codes were verified by comparing the outputs of these codes to laboratory data and to data generated by a snowboarder completing a prescribed S-shaped course. The results generated by the models and the data are in agreement, lending confidence to the models and the corresponding computer codes. A procedure is described by which the computer codes developed in this study can be utilized in the design of snowboards.

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Latin Letters

ACP .....aft contact point
A_F .....frontal area
a .....distance used to calculated snow torque
$a-a$ .....line connecting the centers of the two boots
a_p .....acceleration in the direction of the path (p direction)
b .....width of the snowboard
b_s .....width of the snowboard in contact with snow
C .....centroid
C .....centrifugal force
C_D .....drag coefficient
C_p, C_q, C_r .....components of centrifugal force in the path coordinate system
c .....camber height
cg .....center of gravity
c_1, c_2, c_3 .....center of gravity coefficients
D .....total drag
D_{air} .....air drag
dL .....small fraction of the length of the snowboard
dm .....mass of a segment of the snowboard
E .....Young's modulus
e .....direction in the plane of the hill perpendicular to the fall line
$(EI)'$ .....equivalent bending stiffness
f .....spring force
FCP .....forward contact point
F_b^x, F_b^x, F_b^z .....forces applied at the back boot
F_f^x, F_f^y, F_f^z .....forces applied at the front boot
F_p^B, F_q^B, F_r^B .....“midpoint” forces at point B in the path coordinate system
F^y .....axial force applied at each boot
F_Z .....sum of boots forces in the Z direction
f .....direction of the fall line
f^d .....equilibrating forces
f^e .....equilibrium forces