# Analysis of the Load/Penetration Behavior of Skiing Safety A-Nets During Impact Events

N. Petrone[1]*, E. Malandrin[1], G. Zullo[1], F. Ciotti[1] & T. Morandin[2]

[1] *Dept. of Industrial Engineering, University of Padova, Padova, Italy*
[2] *DolomitiCert, Longarone, Italy*

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**INTRODUCTION.** In high speed skiing disciplines, safety of athletes is ultimately entrusted to A-nets when high energy impacts have to be absorbed without contact with the obstacles behind and with minimal decelerations on athletes. Analysis of the behavior of A-nets is a challenging study that has been addressed in the past with experimental and numerical methods [1-3]. The knowledge of A-net tensioning and relaxation after impact is of great importance, as well as the estimation of load/penetration curves of athletes during impacts to prevent injuries.

**METHODS.** Ten load cells 5 kN DMY-103 (CALT) were placed between A-nets and the zig-zag rope connected to the steel cable tensioned between poles as in Figure 1.a, at Val Gardena Saslong race course. A 96 kg dummy, 1.1m height, was suspended with a 5.5m steel cable to the tip of the pole; lifted to the pole height, it impacted as a pendulum against the nets at 0.4 m from the ground. Load cells measured tension loads before, during and after each impact to get the peak loads and the load relaxation after repeated impacts (Figure 1.b). Dummy resultant deceleration was also collected with a 500g triaxial accelerometers in the dummy, penetration was estimated by video analysis and double integration. Static Load-Penetration curves were obtained pulling the dummy with a load cell and a wire potentiometer, compared with the dynamic peak Load/Penetration values (Figure 1.c). Two test sessions G1 and G2 were performed in two different locations of the slope for a total number of 30 impacts.

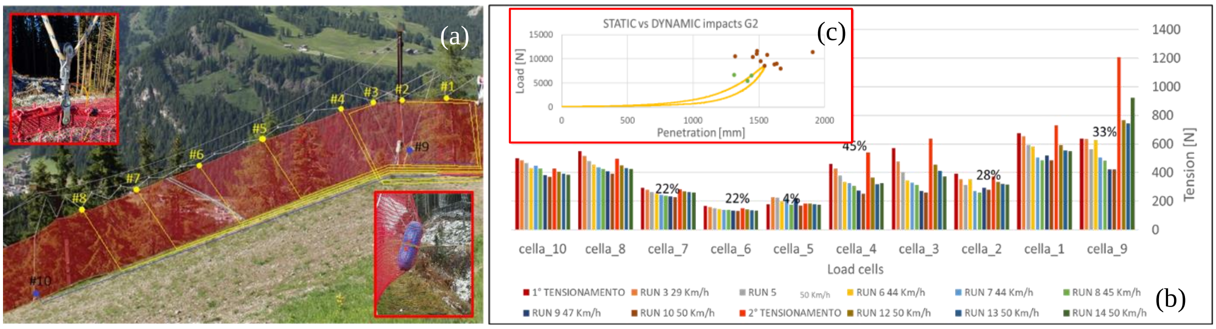


***Figure 1** a) Ten load cells applied to the A-net in G1: in bottom square, A-net penetration static test; b) tension load relaxation after repeated impacts in G1; c) static vs dynamic dummy Load/Penetration curve in G2 tests.*

**RESULTS.** High differences between the pole location (load cells #2,3,4) and the middle portion of the net (#5,6,7) resulted after initial tensioning (Figure 1.b). During impacts, peak values of about 1300 N were reached on load cells close to the pole. Tension load relaxation after 8 repeated impacts reached up to 45% (Load cell #4), with higher loss in proximity of poles. Dummy Load/Penetration non-linear curves showed that with a penetration load of about 8 kN the dummy penetrated of about 1,5 m. Interestingly, the dummy dynamic peak penetration into A-nets, captured with video analysis, associated to inertial load estimated by the resultant acceleration show a fair agreement when compared to the static Load/Penetration curve (Figure 1.c).

**DISCUSSION AND CONCLUSIONS.** Precious information about the tensioning state of the A-nets and their stability after repeated impacts were collected. A static Load/Penetration test can characterize the stiffness of A-net as dynamic impact results matched with fair agreement. The test method can be proposed as an appropriate A-net tensioning test to prevent skiers from impacting obstacles, rocks or even poles supporting the nets.

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