14° September 2023

LIFE RESKIBOOT

MID-TERM SECTORIAL TECHNICAL WORKSHOP

Design for recycling

UNIBO

Co-funded by the European Union

LIFE19 ENV/BG/000059

GRIFONE

DALBELLO

rent and go SPORT YOURSELF

Plastic Sort

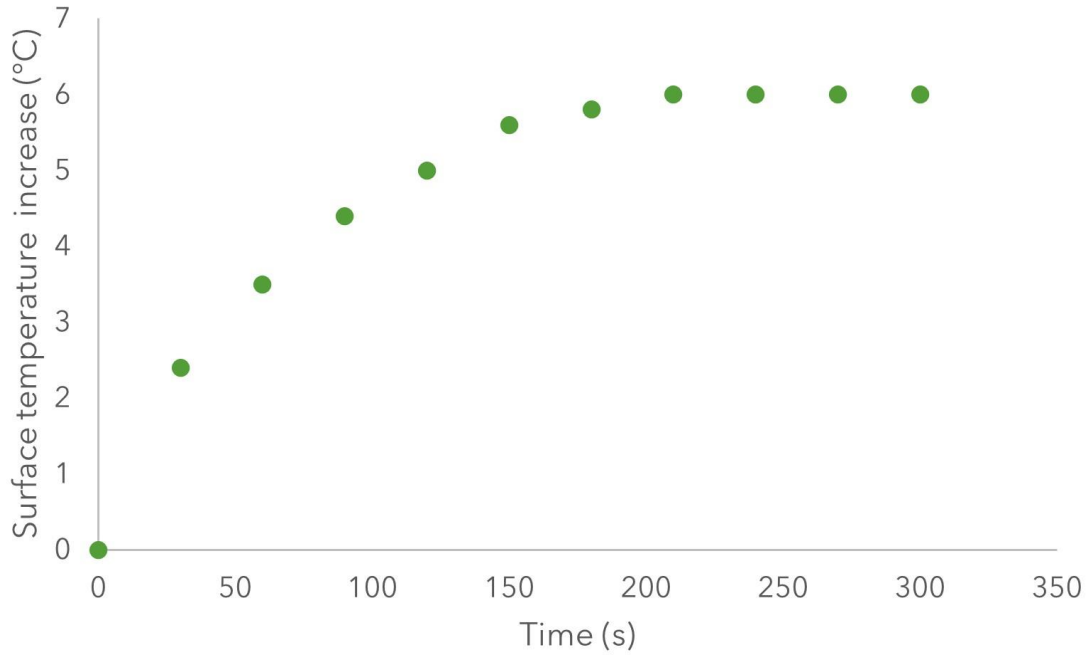
ALMA MATER STUDIORUM UNIVERSITÀ DI BOLOGNA
DEPARTMENT OF CIVIL, CHEMICAL, ENVIRONMENTAL AND MATERIALS ENGINEERING

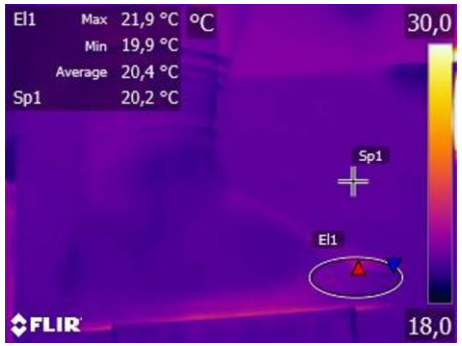
STUDIOFIESCHI & SOCI
sostenibilità su misura

eosi eu

ACTIVITY – WORK DONE

Thermal Insulation Analysis of the Liner



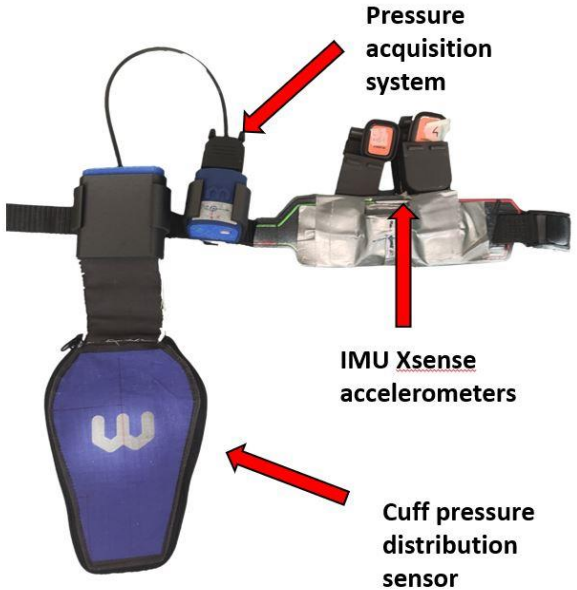


0 seconds

300 seconds

ACTIVITY – WORK DONE

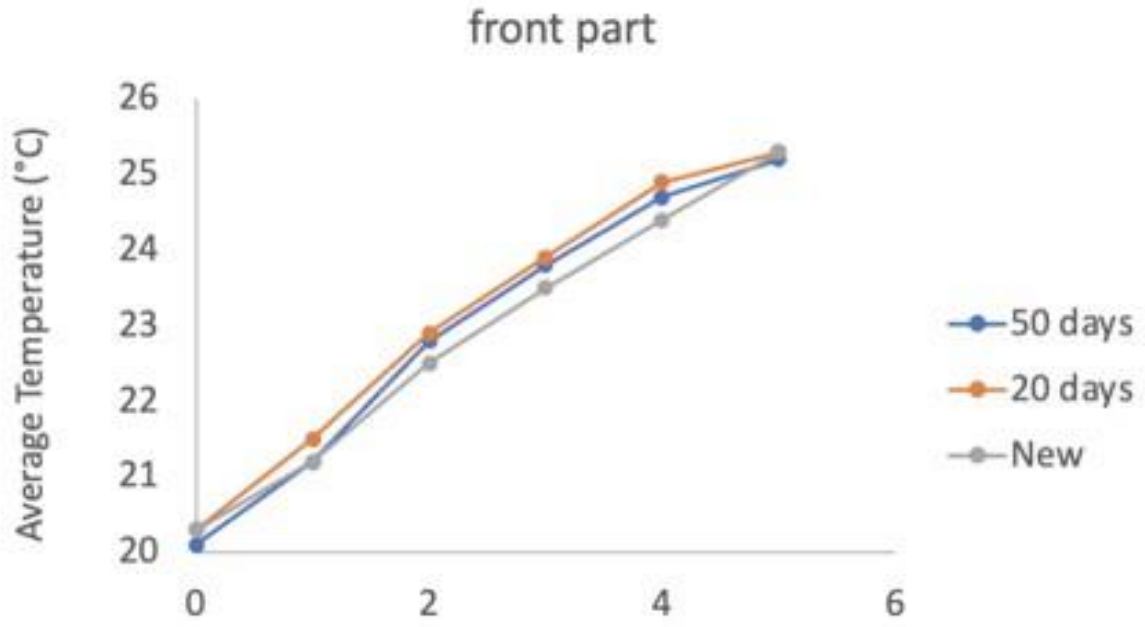
On field tests of the skiboot



We defined a protocol to follow for on field tests using the Xsense IMU system and pressure sensor to evaluate the kinematics of the ski and to be then included in the tests at the walkmeter.

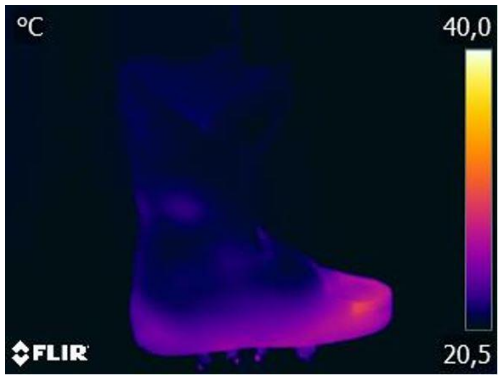
ACTIVITY – WORK DONE

Thermal Insulation Analysis of the Liner



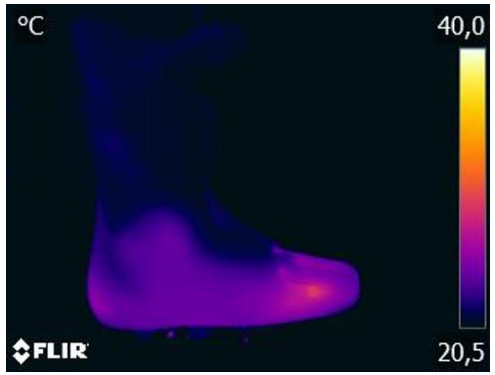
Results:
There is no significant difference between the curves we measured on liners with different days of use, so the time of use has NO EFFECT on the insulation properties of the liner.

Conclusion:
If there will be a loss or increase of the insulating capacity in the recycled liner it will not be due to the past of the materiales.



New

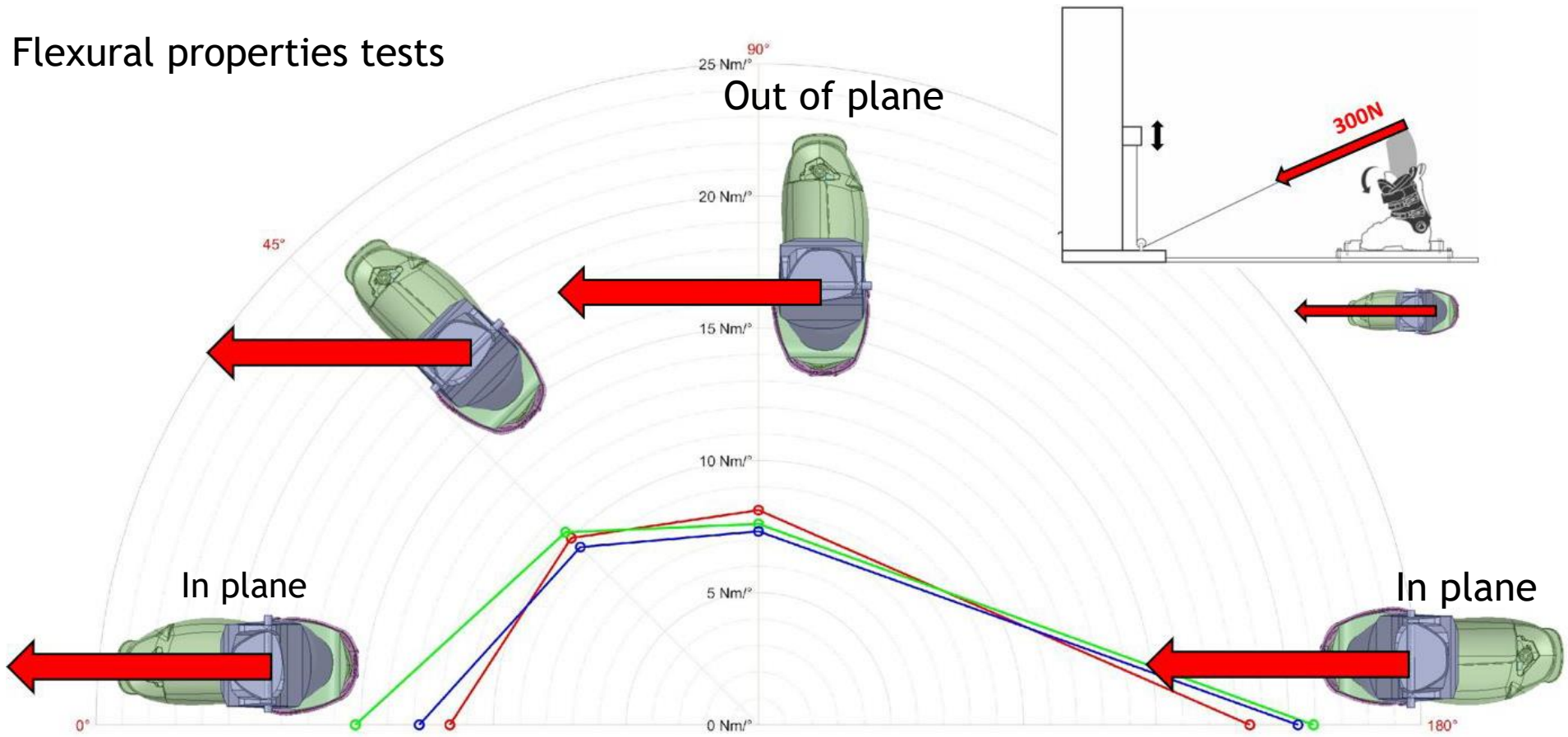
20 days of use



50 days of use

ACTIVITY – WORK DONE

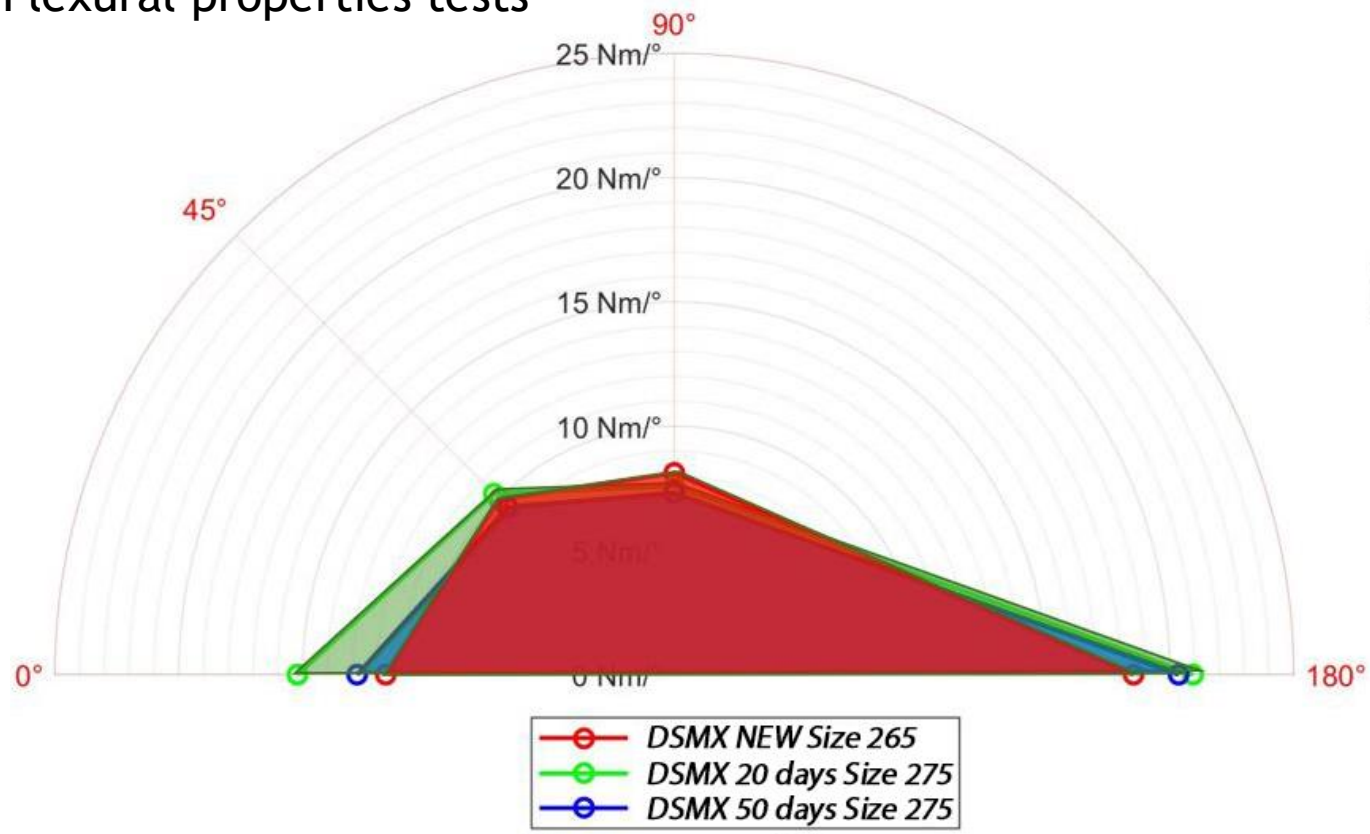
Flexural properties tests

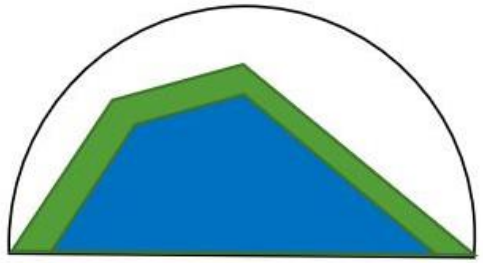


We conceived and realized a novel method to fully characterize the stiffness response of the skiboot «in plane» and «out of plane».

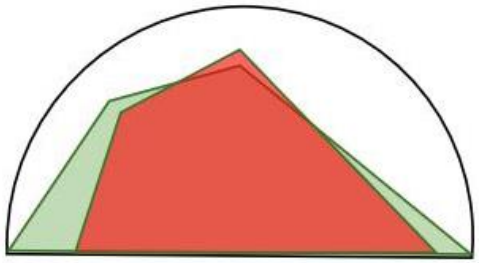
ACTIVITY – WORK DONE

Flexural properties tests





Same shape - same size

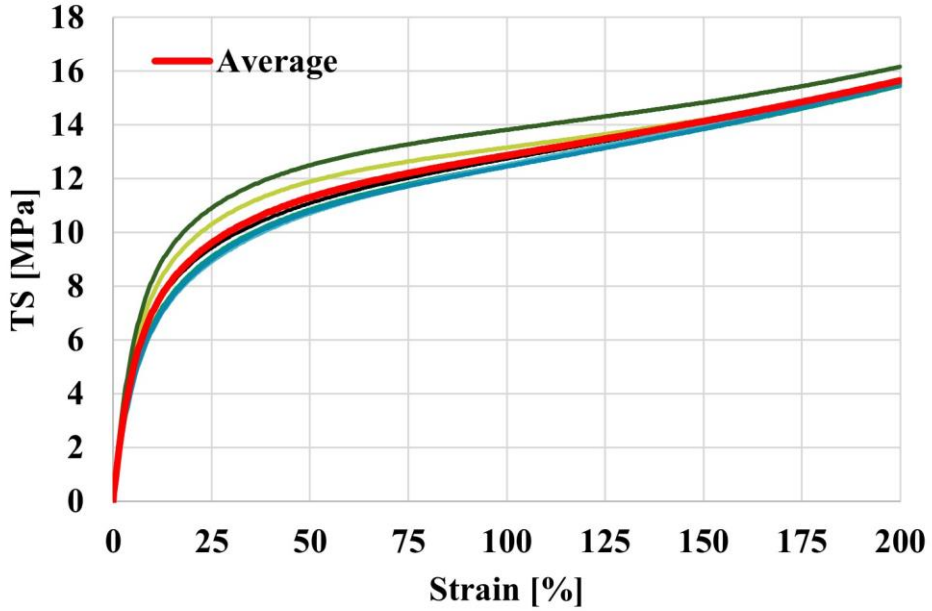


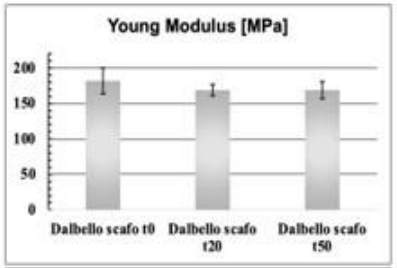
Different shape - Different size

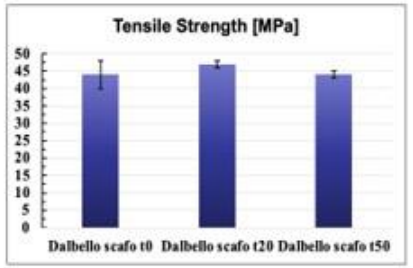
The days of use of the boots have a not negligible effect (-20%) on the flex properties of the boot.

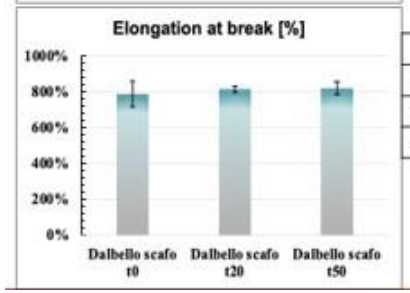
ACTIVITY – WORK DONE

Aged material mechanical characterization









	E [MPa]	TS [MPa]	el,break [%]
Shell 0 days	182 ± 18	44 ± 4	791 ± 72
Scafo 20 days	169 ± 8	47 ± 1	816 ± 17
Scafo 50 days	169 ± 12	44 ± 1	821 ± 36

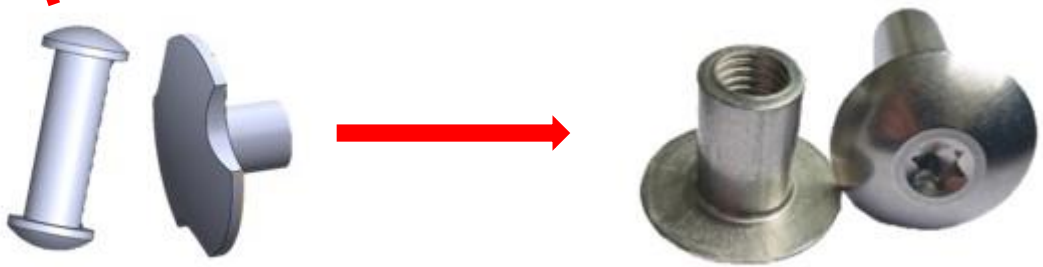
We investigated whether the reason for the flex reduction.
With the tensile test on the materials we can claim that, there are no differences on the Young Modulus, Tensile Strenght and Elongation at break connected with the use of the skiboot.

ACTIVITY – WORK DONE

Rivets replacement

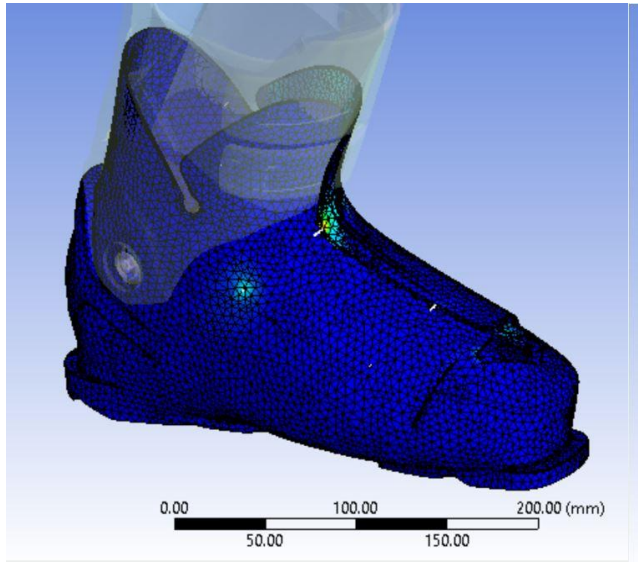
Therefore the 20% reduction on the flex property of the skiboot is not given by a degradation of the materal but by other factors such as the loss of closure of the rivets and the hook system.

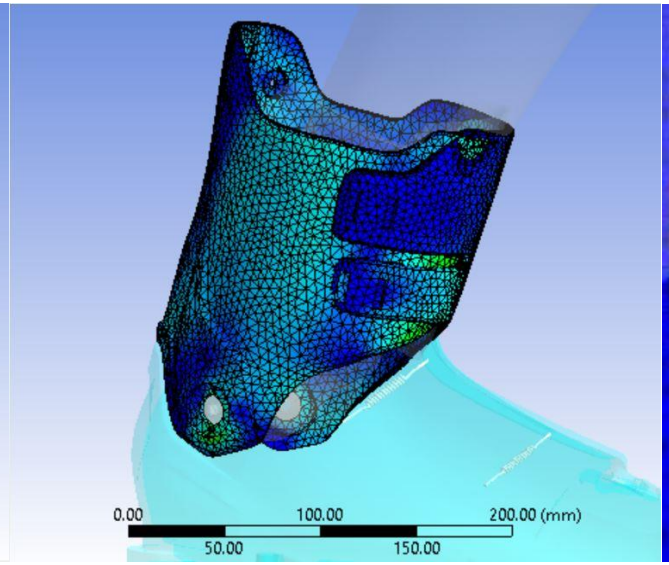
For this reason it was decided to replace the rivets with screws in order to be replaced in case of performance loss.

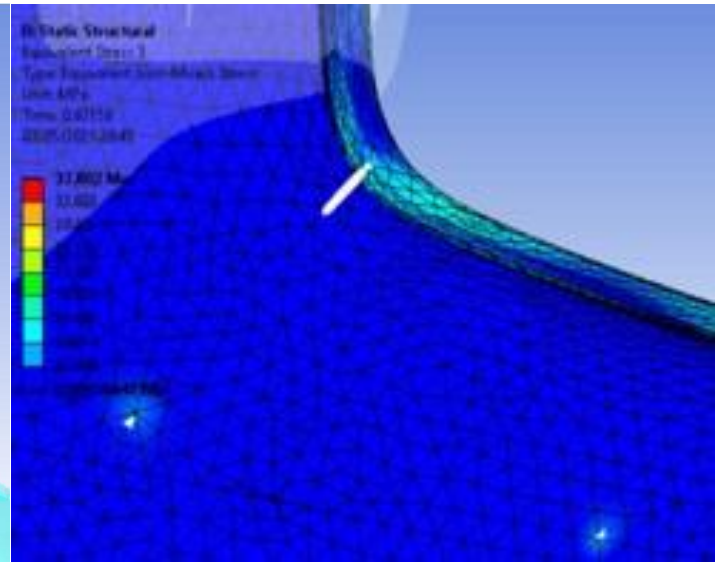


ACTIVITY – WORK DONE

FEM Model Setup



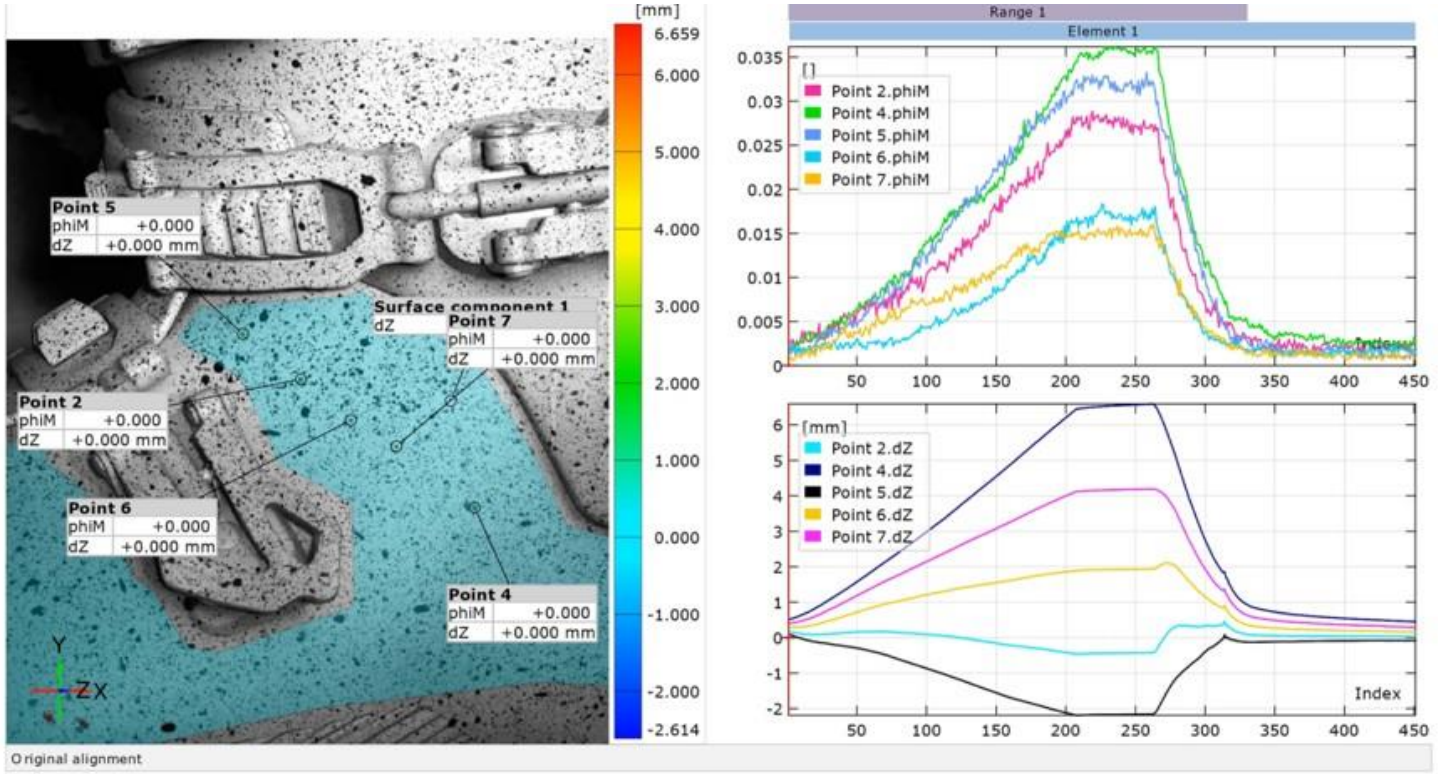


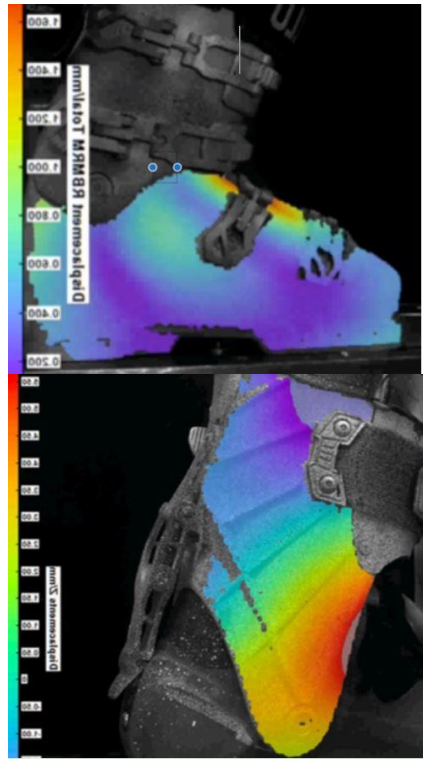


Fem model of the existing skiboot was created and validated thanks to the experimental tests on the walkmeter.

ACTIVITY – WORK DONE

DIC analysis and FEM Model validation

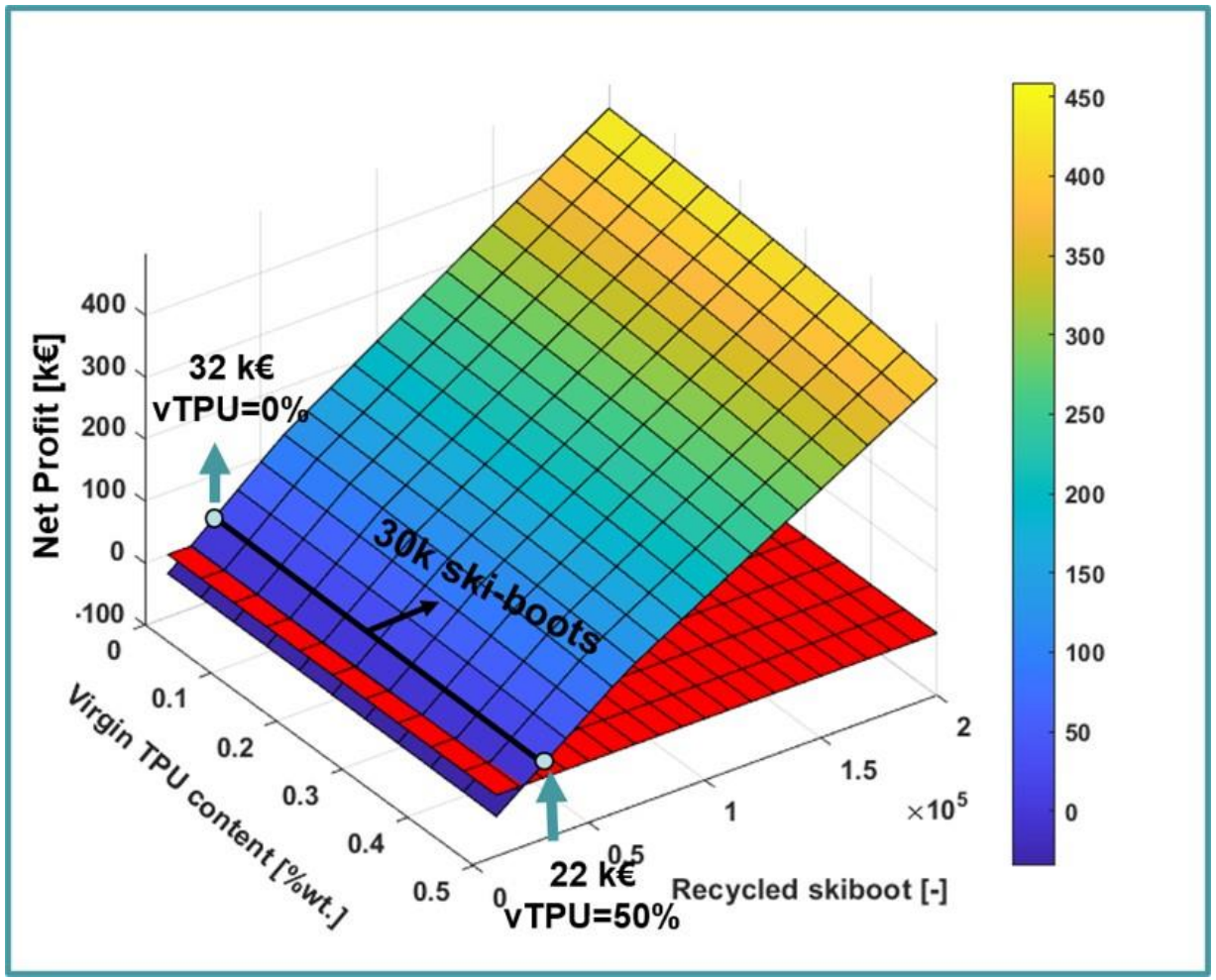




Thanks to the use of the DIC (Digital image correlation) it was possible to validate the results of the FEM analysis and have a starting point for the redesign with topological optimization of the boot.

ACTIVITY – WORK DONE

Techno economic analysis of the process



To perform the recycling processes with third-part existing companies at least 30000 ski-boots are needed (60000-70000 are desirable for good values of profit) while, to build up a dedicated recycling plant from zero, at least 100000-110000 ski-boots have to be available (140000-180000 are desirable for good and fast returns).

ACTIVITY – WORK DONE

Recycled material characterization

From laboratory tests on TPU samples it is clear that the material remains perfectly suitable for the manufacturing of new ski boots.

Sample	R-TPU 1	R-TPU 2	R-TPU 3	R-TPU 4	R-TPU 5	Average	Gap
Modulus (MPa)	311.13	320.22	322.76	342.04	314.43	322.17	+109%
T.S. Max (MPa)	18.41	16.99	15.77	18.42	18.7	17.65	-62%
Elongation at break (mm/mm)	2.46	2.02	1.29	2.24	2.36	2.07	-78%

THANK YOU FOR THE ATTENTION!

Co-funded by the European Union
LIFE19 ENV/BG/000059
GRIFONE
DALBELLO
rent and go
SPORT YOURSELF
Plastic Sort
ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA
DEPARTMENT OF CIVIL, CHEMICAL, ENVIRONMENTAL AND MATERIALS ENGINEERING
STUDIO FIESCHI & SOCI
sostenibilità su misura
epsi EU