



Test Results

Effects of Ultrabase Underlayment Panel on the Impact Attenuation of Artificial Turf.

Prepared for
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Creative Sports Concepts

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Summary of Results:

- An Ultrabase panel base deployed under infilled turf surfaces reduced the peak impact shock (g-max) and Head Injury Criterion (HIC) scores on an ASTM F355-A impact test by 8-15%.
- An underlayment panel is most effective at reducing peak impact shock when the turf surface is stiff. With softer turf surfaces, the effect of underlayments on impact attenuation is reduced. Using material properties determined from impact tests, the use of Ultrabase panel is expected to reduce impact shock (g-max) on typical surfaces by 5-15%. The underlayment would have minimal effect (<2%) on surfaces with g-max scores of 70g or below.
- The underlayment is unlikely to have any effect on the risk of fatal or critical head injuries because the risk of severe injury on typical turf surfaces without additional underlayment is already close to zero. The effects on less severe injuries (AIS level 1 and 2) would also be small (0.6% - 8.3%) for the same reason.
- Additional impact tests simulating the loads produced by a running athlete found no significant effects of Ultrabase panel on impact shock (and hence surface stiffness). A small increase in energy return (less than 5%) was observed.

Comments:

- Under (relatively high energy) loading conditions simulating those produced when an athlete falls to the surface, the addition of an Ultrabase panel underlayment to an infilled turf surface with typical specifications reduces the peak impact shock by 8-15%.
- Under (relatively low energy) loading conditions simulating those produced by an athlete running on the surface, an Ultrabase panel does not affect the impact, stiffness or energy return of the surface to an extent that would influence athletic performance.
- Consequently, the potential benefits of enhanced high energy impact attenuation are provided without affecting the playability of the surface.

Specimens

Client provided samples of Ultrabase panels and turf system materials

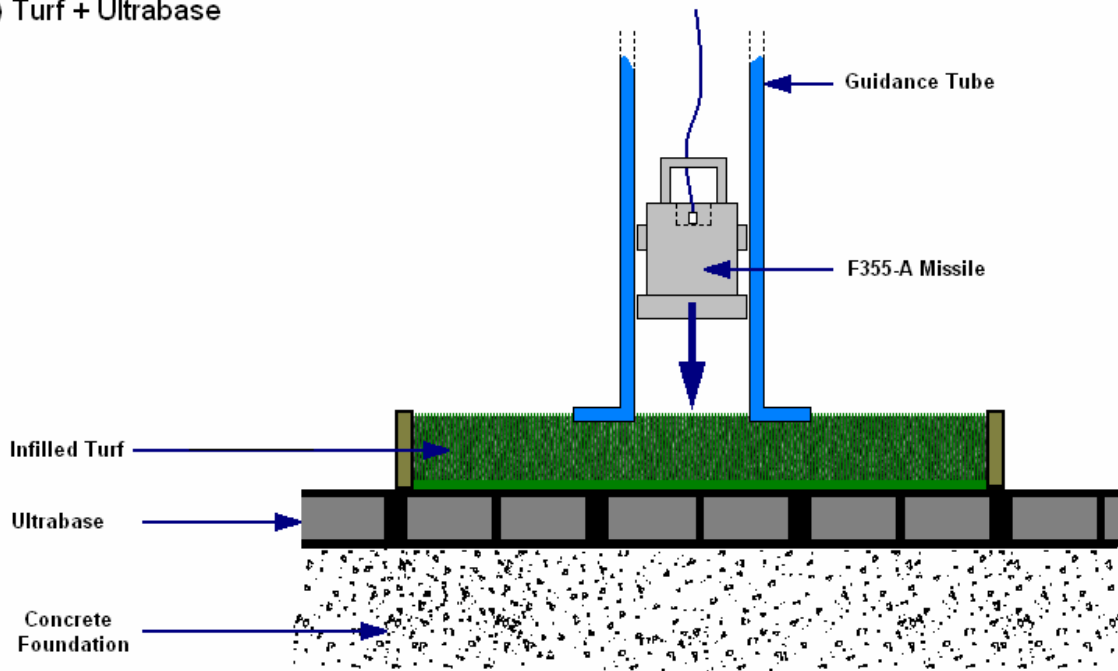
- Turf carpet (a) Generic Turf
(b) AstroTurf
- Infill 1.0 lb sand psf
1.5 lb rubber granules psf

Surface Impact Attenuation

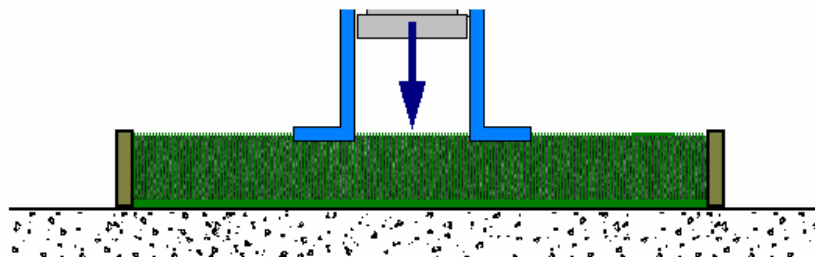
Impact attenuation was determined using a standard test method for artificial turf surfaces (ASTM F-355 A). Impact tests were performed using the Generic and AstroTurf infilled turf systems overlying an Ultrabase panel (Fig 1a). Each turf surface was also tested in isolation (Fig 1b).

Figure 1: Surface Impact Test Configurations (Schematic)

(a) Turf + Ultrabase



(b) Turf

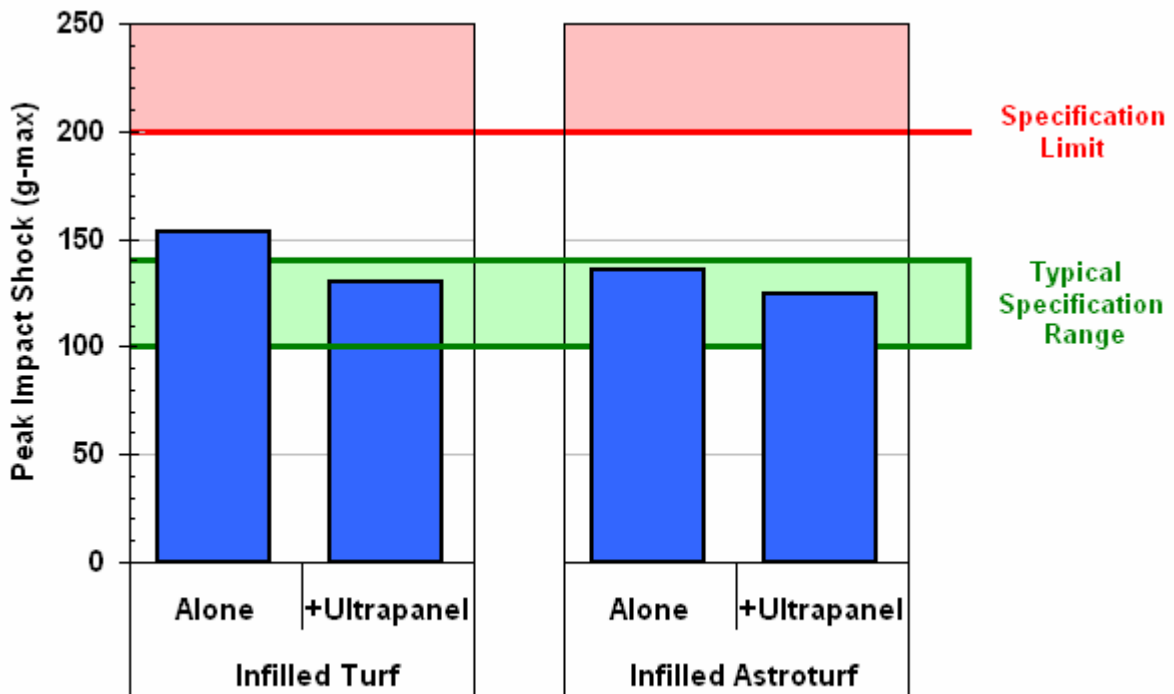


Not to Scale

Surface Impact Test Results

ASTM F355-A peak impact shock (g-max) scores are the average of the second and third of three tests.

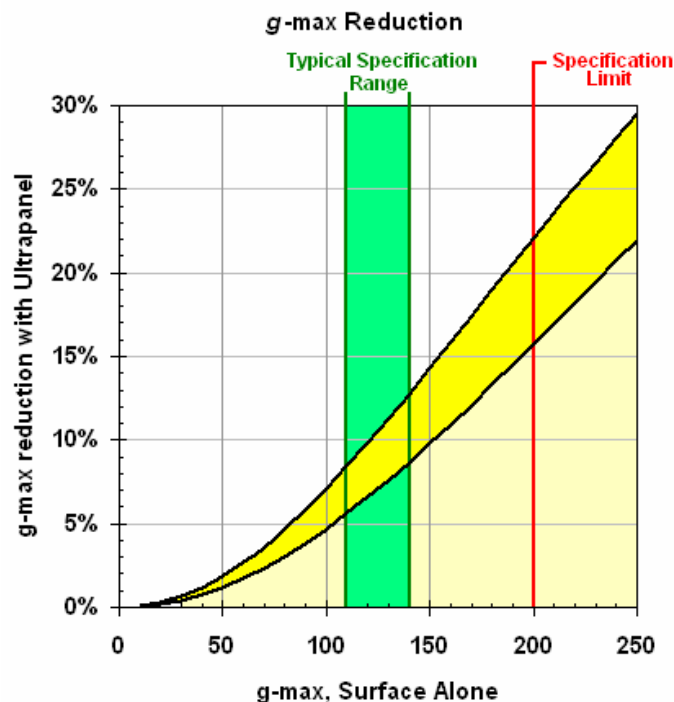
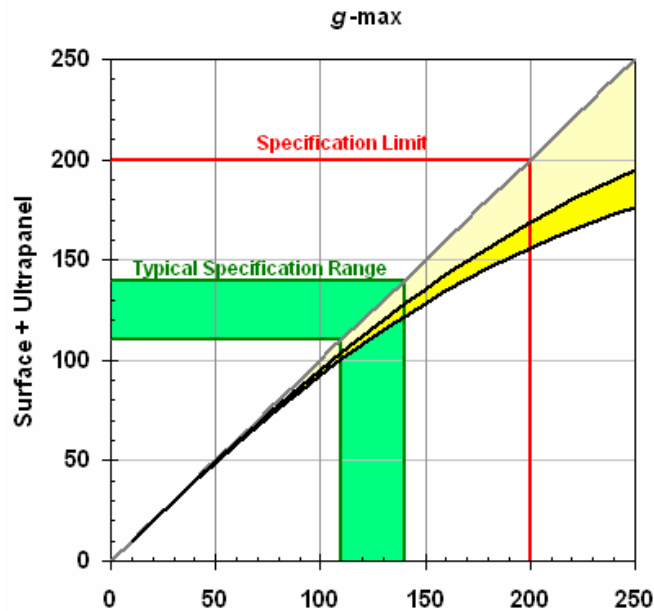
Turf Type	Condition	Infill Depth mm	Vo m/s	h m	gmax g	HIC	g-max difference	
							Δ	Δ%
Infilled Turf	Alone	25	3.46	0.61	153.0	478		
	+ Ultrapanel	25	3.46	0.61	130.4	413	-22.6	-15%
Infilled Astroturf	Alone	30	3.46	0.61	135.5	393		
	+ Ultrapanel	30	3.46	0.61	124.4	363	-11.1	-8%



Estimated Impact Shock Reduction

Using material properties calculated from impact test results, it is possible to estimate the effects of an Ultrapanel underlayment surfaces with different initial properties (charts below). An underlayment panel is most effective at reducing peak impact shock when the turf surface is stiff. With softer turf surfaces, the effect of underlayments on impact attenuation is reduced.

In the specific case of Ultrapanel, the underlayment is expected to reduce impact shock (g-max) by 5-15% in the typical specified range of g-max specifications (110-140g). The underlayment would have minimal effect (<2%) on surfaces with g-max scores of 70g or below.



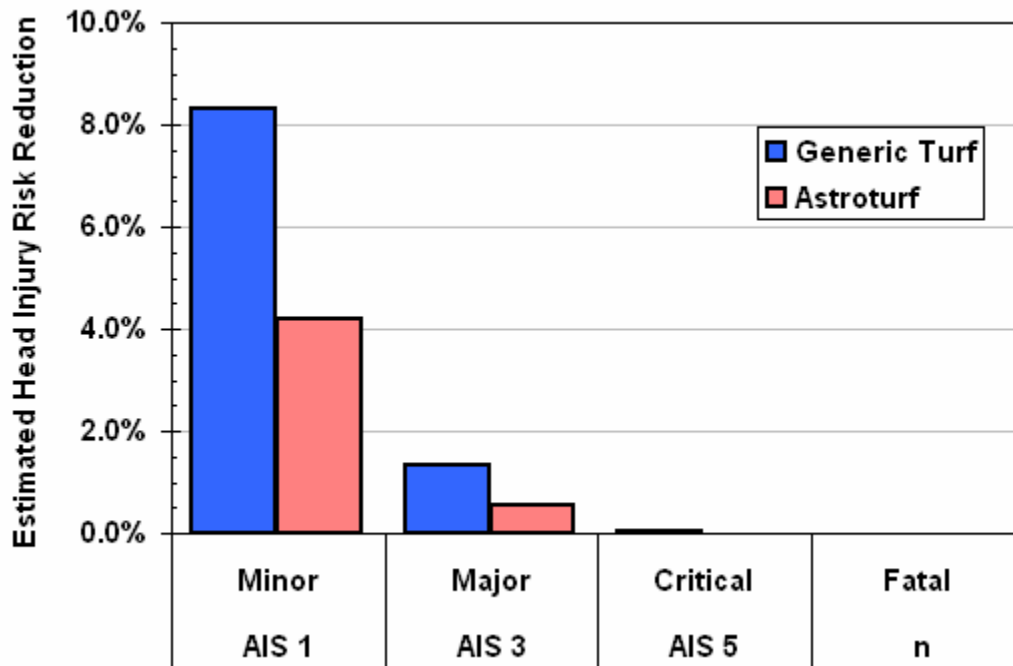
Estimated Head Injury Risk Reduction

Head Injury Criterion (HIC) scores, after correction for missile shape and stiffness¹, can be used to estimate the head injury risk² associated with an impact of given magnitude.

The effects of an Ultrapanel underlayment on the risk of different levels of injury are shown in the chart below.

The underlayment has little or no effect on the risk of fatal or critical head injuries. This is because for typical turf surfaces with g-max scores in the 110-140g range, the risk of these injuries is already indistinguishable from zero. Consequently, there is no meaningful risk to reduce.

The effects on less severe injuries (AIS level 1 and 2) are also small (0.6% - 8.3%) for the same reason. Similarly, since the softer AstroTurf system had a smaller initial risk, the risk reduction potential of an additional underlayment is reduced.



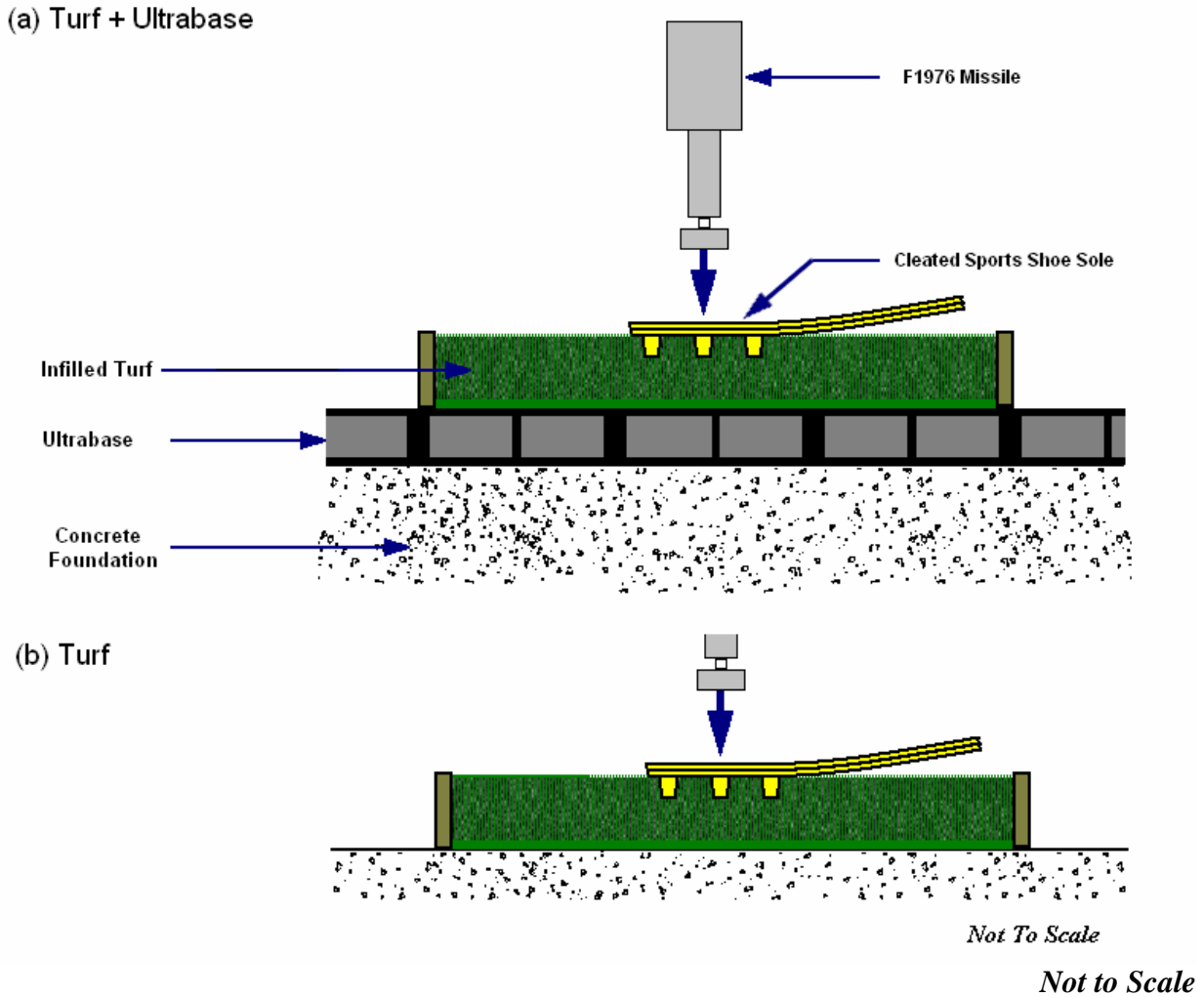
¹ Shorten M.R. & Himmelsbach, J.A. (2003) pp 49-69 in *Sports Surfaces* (Eds. B.M. Nigg, G.K. Cole, D.J. Stefanyshyn) Calgary, University of Calgary

² Prasad P, Mertz HJ, (1985) The position of the United States delegation to the ISO working group on the use of HIC in the automotive environment. SAE Paper# 851246 Society of Automotive Engineers, Warrendale PA, USA.

Athlete Impact Attenuation

A standard test of athletic footwear impact attenuation (ASTM F1976) was used to determine the effects of Ultrabase underlayment under loads simulating those produced by a running athlete. Impact tests were performed using the AstroTurf infilled turf system overlying an Ultrabase panel (Fig 2a). Each turf surface was also tested in isolation (Fig 2b).

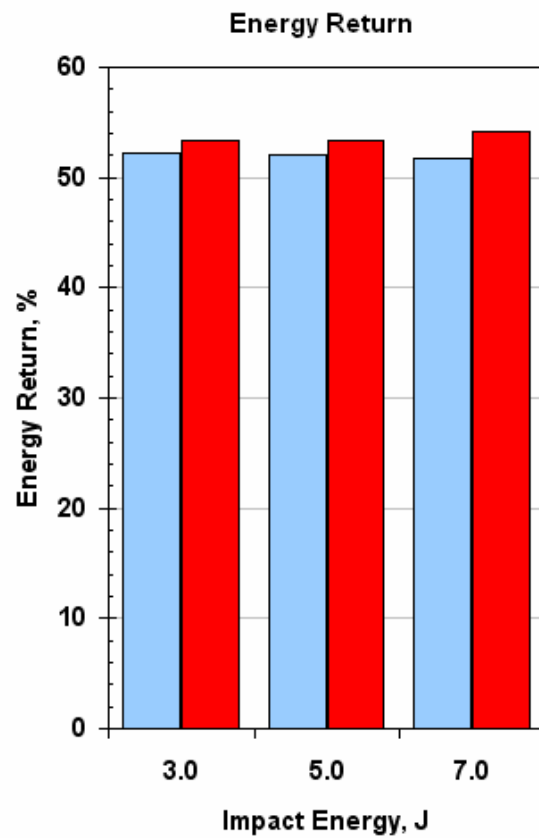
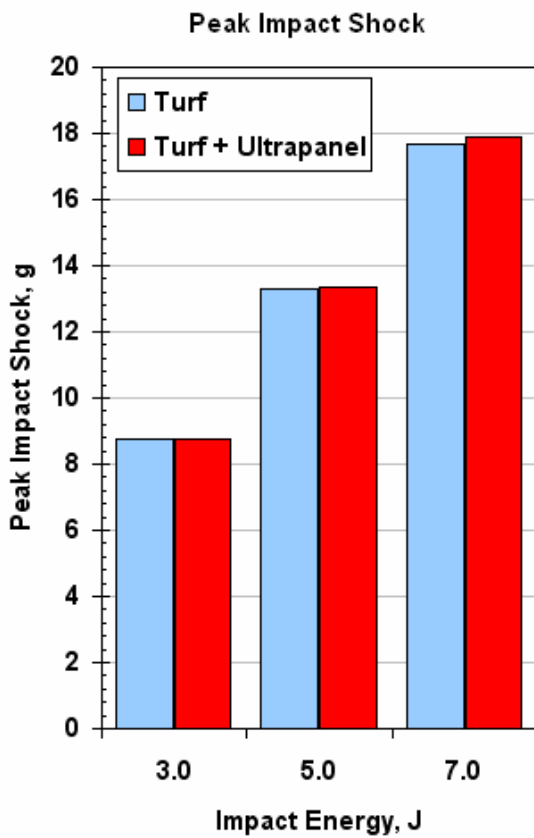
Figure 2: Athlete Impact Test Configurations (Schematic)



Athlete Impact Test Results

ASTM F1976 peak impact shock (g-max) scores at impact energies of 3, 5 and 7 Joules.

Impact Energy, J	g-max, g			Energy Loss, %		
	3.0	5.0	7.0	3.0	5.0	7.0
Astroturf	8.8	13.3	17.7	52.1	52.1	51.8
Astroturf + Ultrapanel	8.7	13.3	17.9	53.4	53.3	54.2
Δ	-0.02	0.04	0.23	1.2	1.2	2.4
$\Delta\%$	-0.2%	0.3%	1.3%	2.4%	2.3%	4.6%



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