Reference model for the development of the artificial grass as surface for golf practice

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Introduction and Objective

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Increase of golf courses demand especially in coastal areas (high sunshine and temperatures)

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Restrictions as water shortage

High maintenance cost of natural grass

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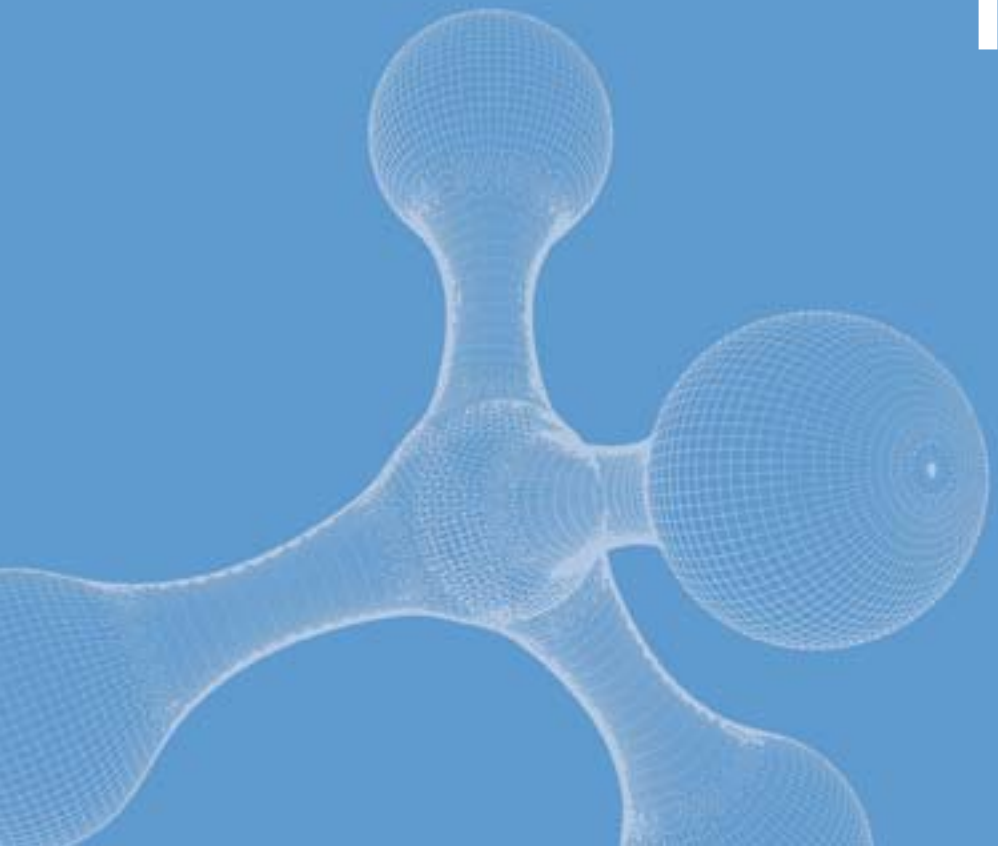
Increasing interest in artificial turf for golf

Artificial turf for golf is a new product and references have not been found.

OBJECTIVE: to obtain an artificial turf with a similar behaviour to natural grass according to golfers' requirements

Materials and Methods



Materials and Methods

This study was carried out in 4 steps:

1- Subjective requirements were determined by means of discussion groups and surveys.

2- Devices and procedures were developed or adapted from other sports standards.

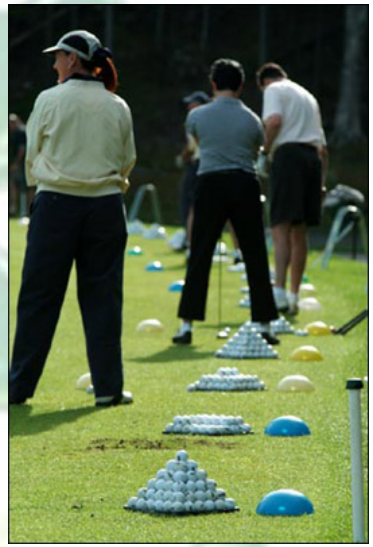
3- Tests were carried out in five golf courses, selected in different Spain areas.

4- As a result of the tests, a reference model of natural turf mechanical behaviour was proposed.

Materials and Methods

1- Determination of users' requirements

The study of requirements was carried out in two stages:



- Two discussion groups were conducted to identify the requirements:
  - •Professional golfers.
  - •Golf course professionals (managers and greenkeepers).

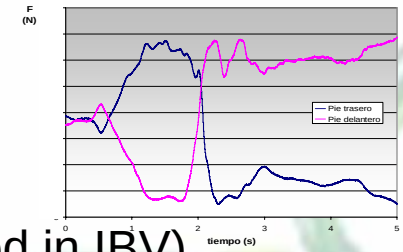
- A 63 items questionnaire was distributed in 5 golf courses to verify and prioritize the requirements identified by means of the discussion groups (200 surveys).

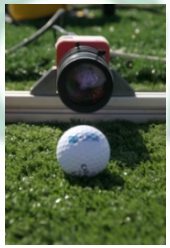
Materials and Methods

2- Development of tests devices

From subjective study results, the developed tests devices were:

- Rotational resistance
- Divot hole strength
- Angled ball rebound
- Distance after bounce
- Green speed (not developed in IBV)



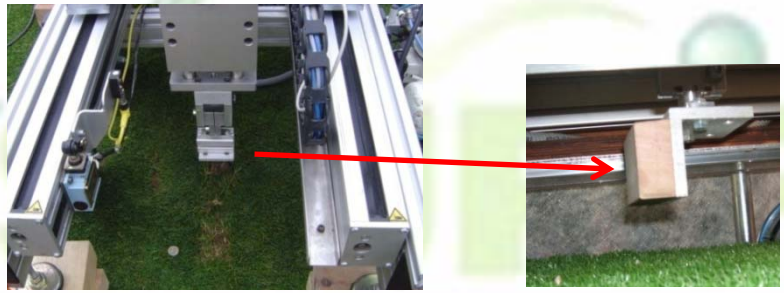


3- Carrying out the tests

All tests were carried out in the morning, with grass in wet conditions:

- Rotational resistance: the torque required to rotate a loaded test foot with four golf studs in contact with the surface is measured.

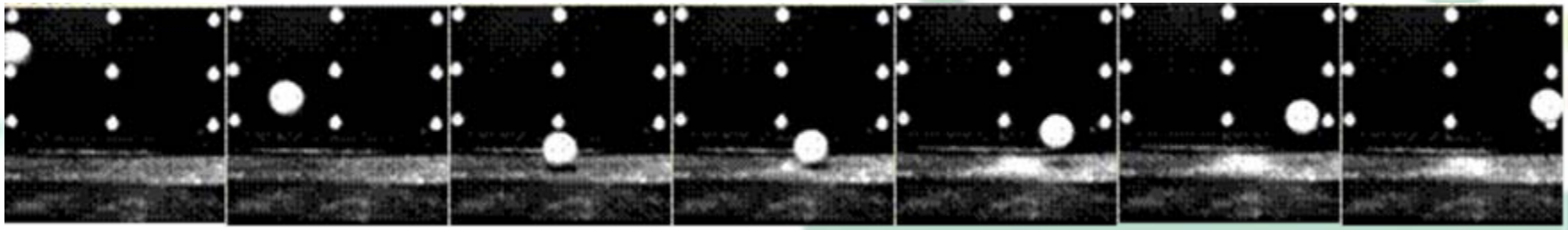
- Divot hole strength: the horizontal force necessary to break the turf cover is studied; vertical force, horizontal displacement and speed of displacement are constant.



Materials and Methods

3- Carrying out the tests

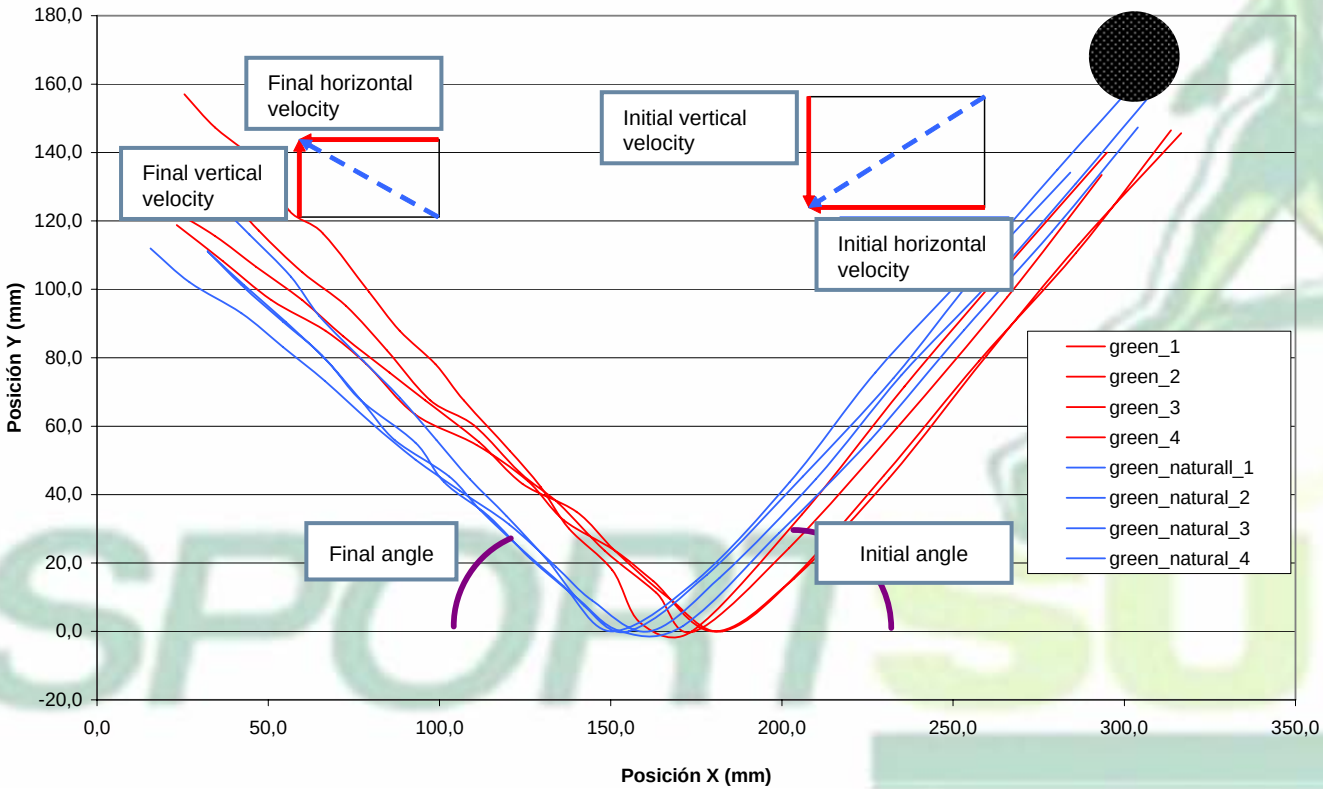
- Angled ball rebound: a ball is projected with a pneumatic cannon at a specified speed and angle onto the surface. Using an high speed camera, the absolute, horizontal and vertical velocities are determined and the energy coefficients of restitution are calculated.



Materials and Methods

3- Carrying out the tests

- Angled ball rebound.



Materials and Methods

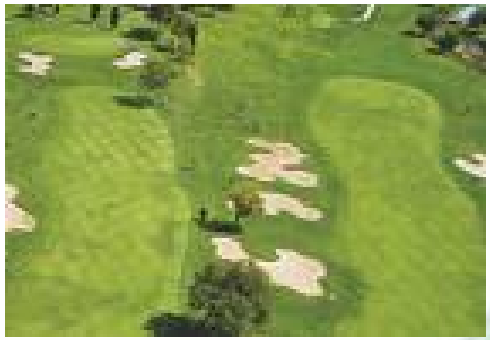
3- Carrying out the tests

- Distance after bounce: the distance covered by a projected ball from the first bounce to the point where it stops is measured.

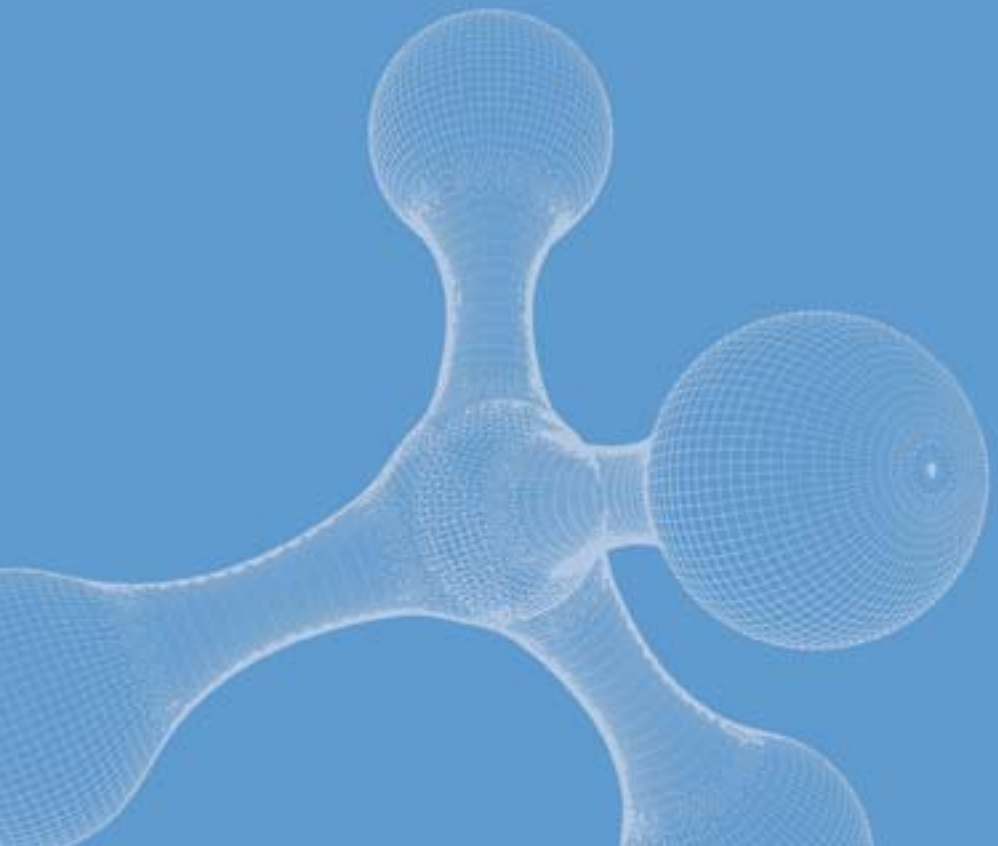
- Green speed: this test measures the ball's capability of rolling on the Green area according to USGA recommendations by means of a stimpmeter.

4- Proposal of the reference model

When the tests were carried out and the results analysed, a reference model was proposed.



Results



Results

From the subjective study:

- The areas to study should be TEE, FAIRWAY and GREEN.
- In the TEE, the most relevant aspect to take into account is the surface grip to avoid sliding during swing.
- In the FAIRWAY, a smooth feel when removing divot holes is the most relevant surface property. About the interaction between the surface and the ball, the participants thought that the rebound and ball roll are very relevant for the game.
- In the GREEN, the rebound, a constant trajectory of the ball and green speed are the most relevant aspects related to the interaction between the surface and the ball.

Results

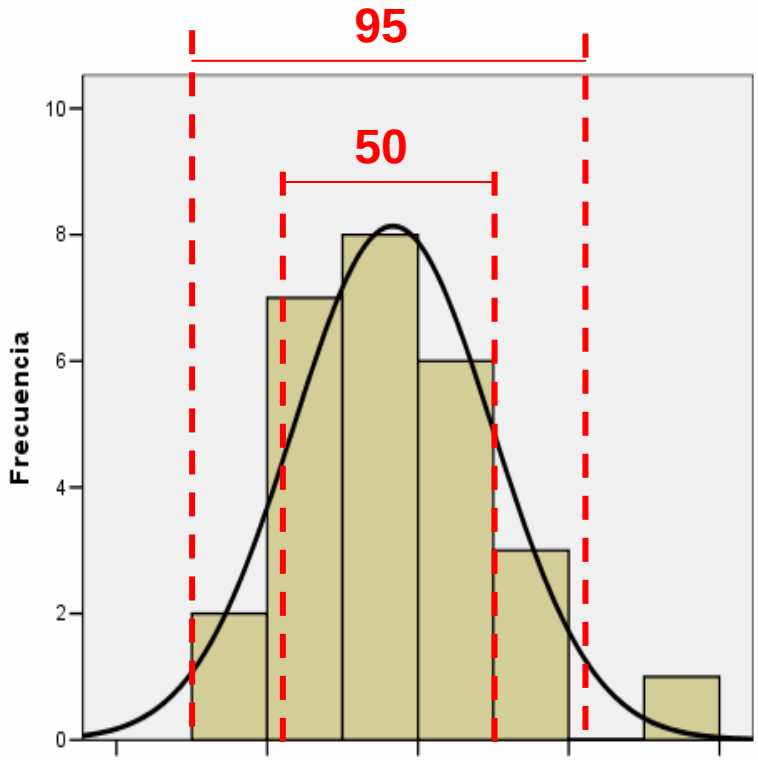
From the subjective study:

GOLF COURSE AREA	TESTS	
TEE	Rotational resistance	Forward foot (N·m)
		Backward foot (N·m)
FAIRWAY	Rotational resistance	Forward foot (N·m)
		Backward foot (N·m)
	Divot hole strength	Peak-CFD
	Angled ball rebound	Coef. X
		Coef. Y
		Coef. ABS
	Distance after bounce	(meters)
GREEN	Green speed	(feet)
	Angled ball rebound	Coef. X
		Coef. Y
		Coef. ABS
	Distance after bounce	(meters)

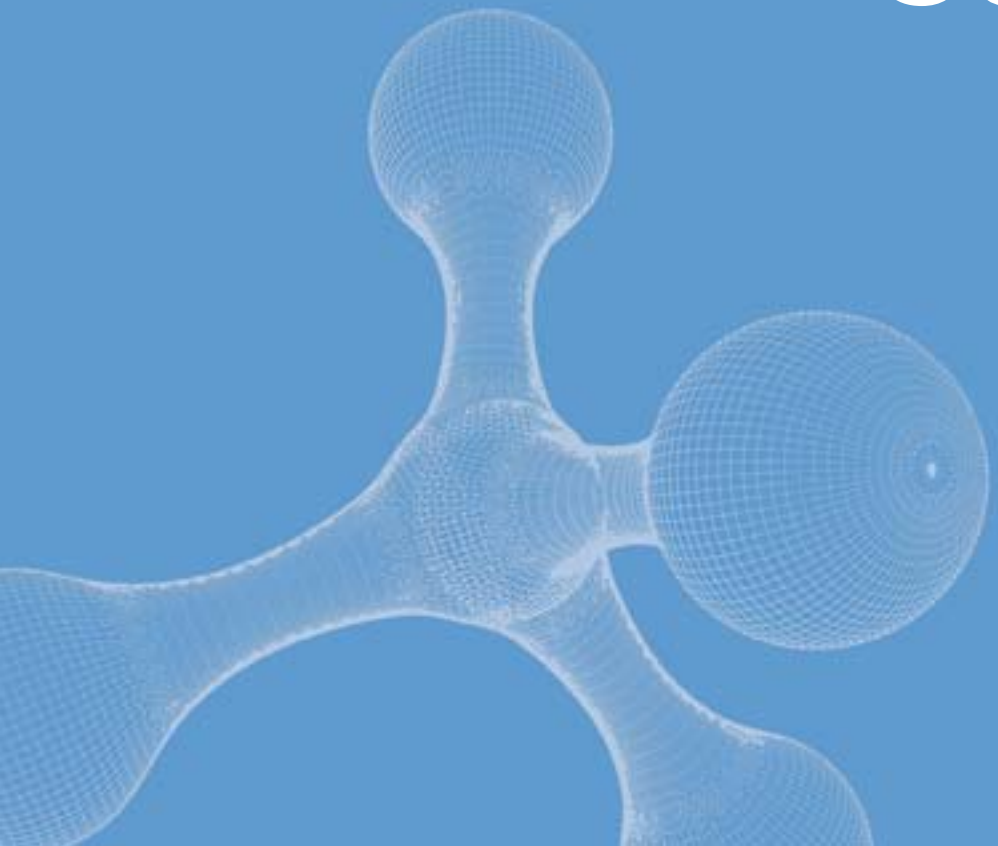
Results

From the mechanical tests:

- From all measured variables, percentile 50 and 95 was used to define two qualities of golf courses.



Conclusions



Conclusions

GOLF COURSE AREA	TESTS		REQUIREMENTS LEVEL	
			☆	☆ ☆
TEE	Rotational resistance	Forward foot (N·m)	18.00 - 28.80	20.00 - 23.00
		Backward foot (N·m)	7.30 - 15.70	10.00 - 12.50
FAIRWAY	Rotational resistance	Forward foot (N·m)	19.30 - 28.40	21.00 - 24.00
		Backward foot (N·m)	8.00 - 13.00	9.00 - 11.00
	Divot hole strength	Peak-CFD	1.603 - 2.786	1.886 - 2.348
	Angled ball rebound	Coef. X	0.241 - 0.556	0.305 - 0.525
		Coef. Y	0.027 - 0.483	0.381 - 0.446
		Coef. ABS	0.223 - 0.496	0.388 - 0.470
	Distance after bounce	(Meters)	4.66 - 9.27	5.79 – 6.97
GREEN	Green speed	(feet)	6.05 - 7.95	6.68 - 7.32
	Angled ball rebound	Coef. X	0.253 - 0.526	0.367 - 0.472
		Coef. Y	0.286 - 0.436	0.308 - 0.357
		Coef. ABS	0.340 - 0.436	0.372 - 0.418
	Distance after bounce	(Meters)	1.2 - 4.74	1.77 - 3.44

Conclusions

- Artificial turf development for golf and its implant in southern europe coastal areas is a process that will occurs.
- Standards related to golf course surface behaviour should be developed.
- This work, could be a first step for standards development.

Conclusions

- Now, we are working in biomechanical test:
  - Vibrations on wrist and elbow
  - The impact of the ball by means of high speed velocity cameras

Thanks for your attention!!

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