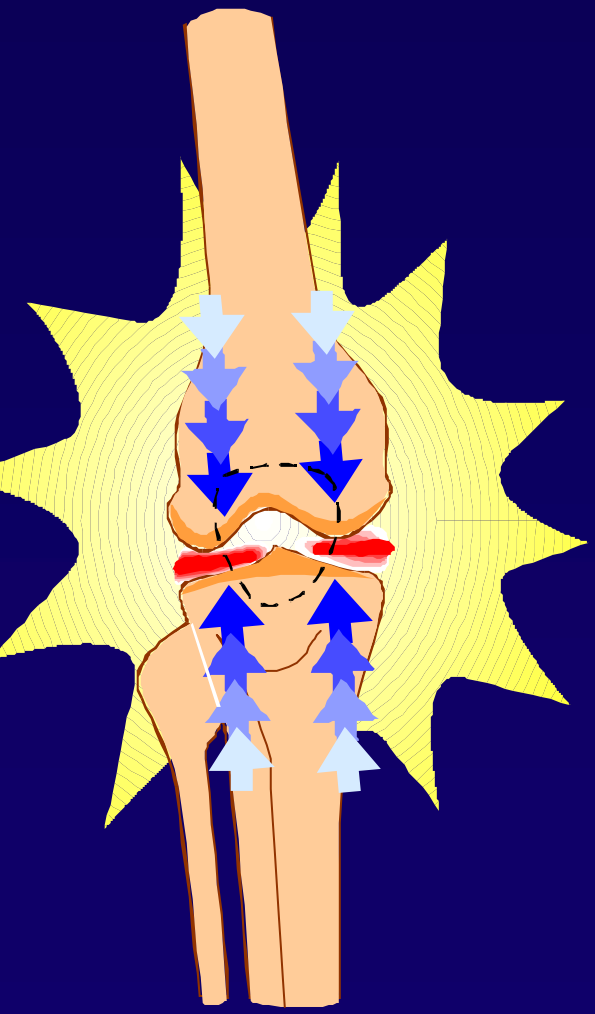
# OPINION STUDY: Application of the IAAF rules in the Valencia region

## ISSS TECHNICAL FORUM 2000

*Juan V. Durá*

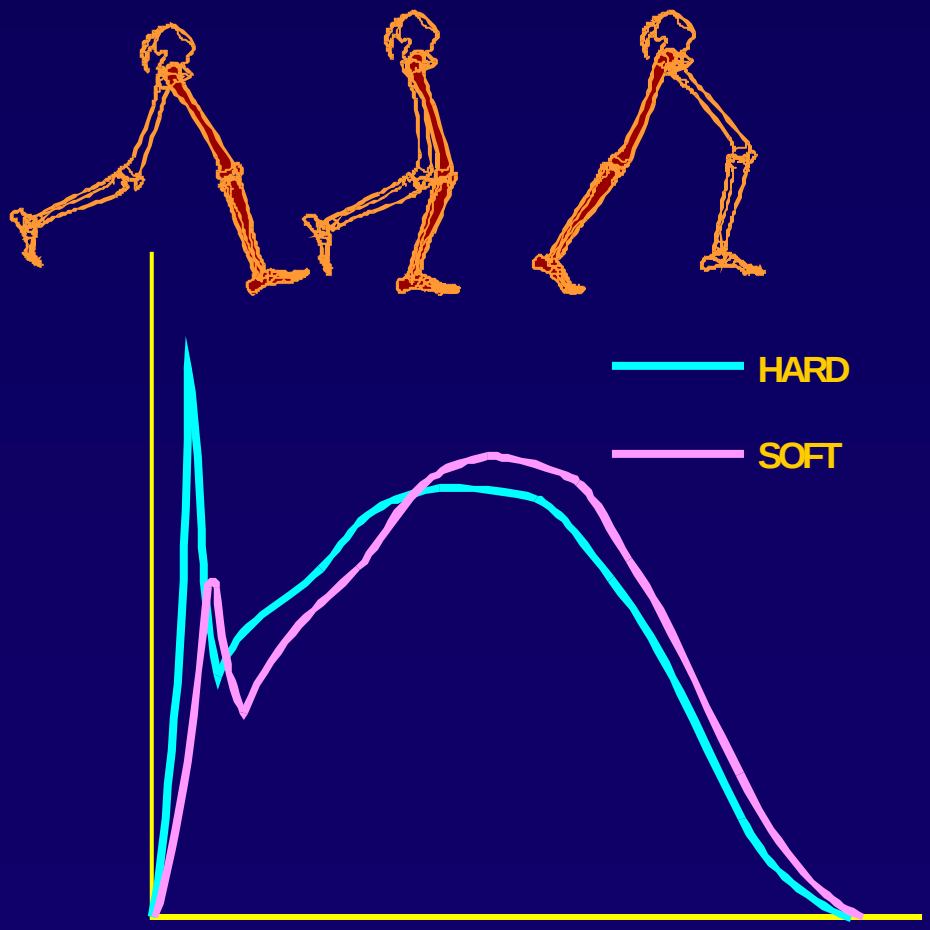
IBV INSTITUTO DE BIOMECÁNICA DE VALENCIA

# Introduction



The shock absorbing property and the compliance of sports surfaces has been related with injuries and performance in sports

# What is shock absorption?

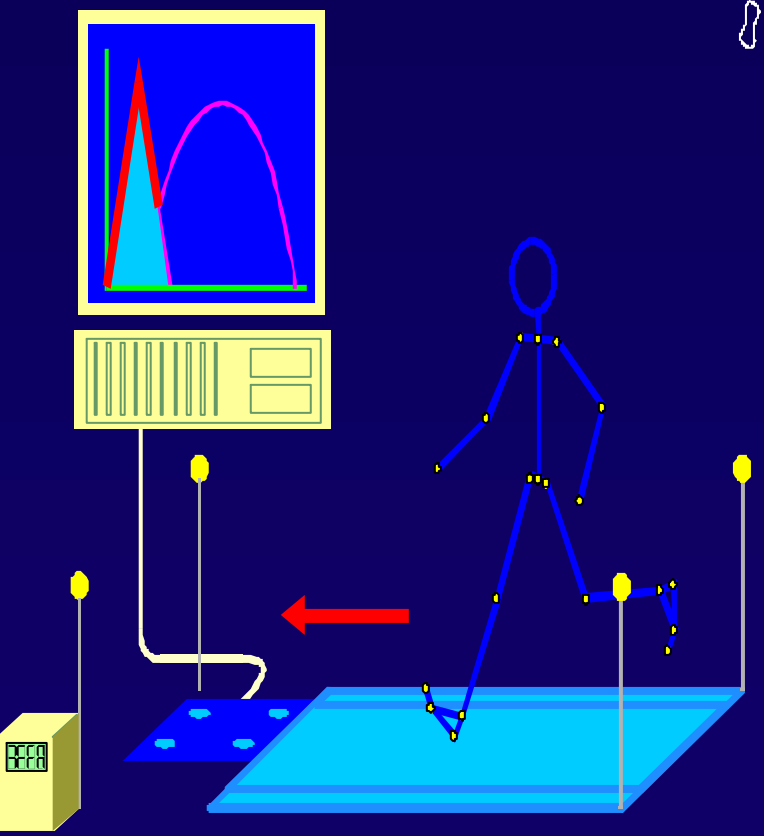



The capacity to reduce impacts

# Protection vs. Performance

- Is there an opposite relation between the necessity to avoid injuries and the performance in sports?
- Is it possible to find an optimal point for compliance in sports surfaces ?

# Protection vs. Performance

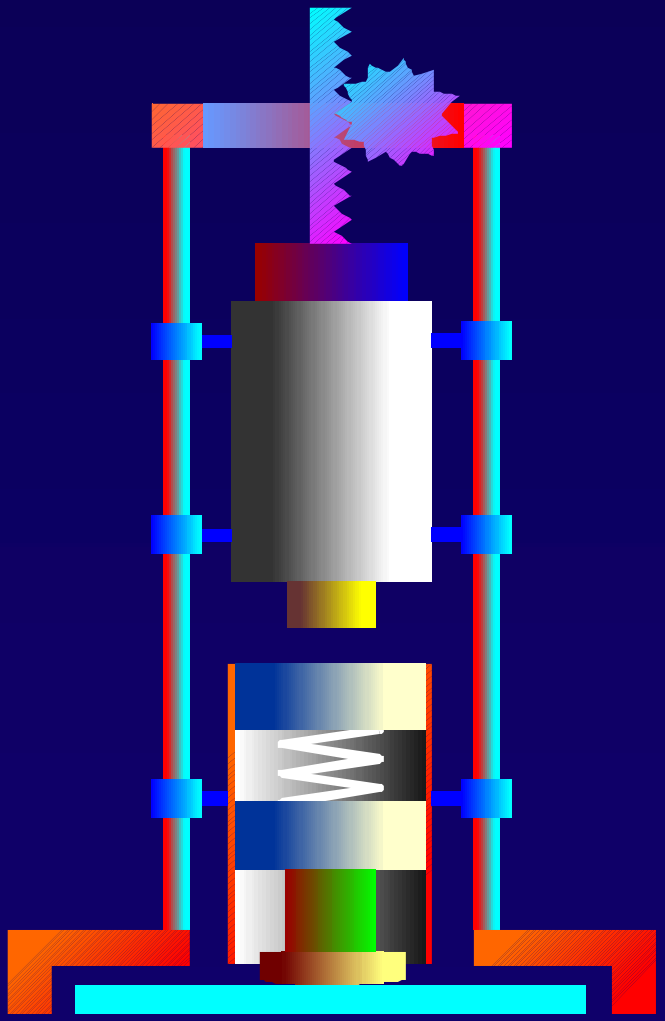


The biomechanical research has shown the possibility of finding an optimal point for compliance in sports surfaces

# Mechanical tests

- Different mechanical testing devices and parameters have been used. But there are doubts about their capability for measuring the effect in athletes.
  - Drop tests.
  - Artificial athletes.

# IAAF



- Artificial athlete
- Parameter:
  Force Reduction 35%

# Research project

- Which is the status of the tracks in Valencia?
- Is the IAAF rule related with the athlete's necessities?

# Objectives

- To measure the mechanical properties of the tracks according to IAAF manual.
- To know the athletes' opinion and preferences.
- To analyse if athletes are able to feel the different track properties.
- To analyse the relation between athletes' opinion and IAAF tests.

# Methods

- Mechanical tests
- Opinion study

# TRACKS

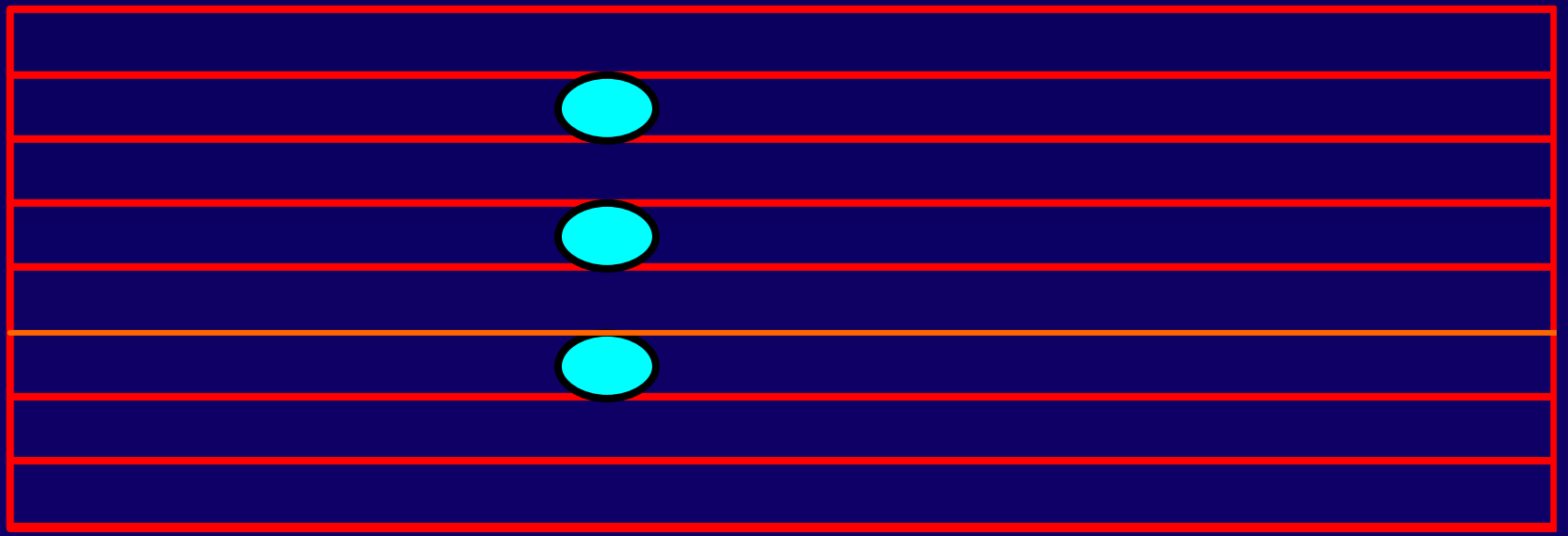
| TRACK | YEAR | TYPE |
|---|---|---|
| Monte Tosal de Alicante | 1993 | Prefabricated |
| Gaeta Huguet de Castellón | 1985 | In-situ Resurfaced in 1998 |
| Jardín del Turia de Valencia | 1993 | Prefabricated |
| Gandía | 1993 | In-situ |

# Mechanical tests

- Friction
- Force Reduction
- Vertical Deformation
- Force Reduction & Vertical Deformation

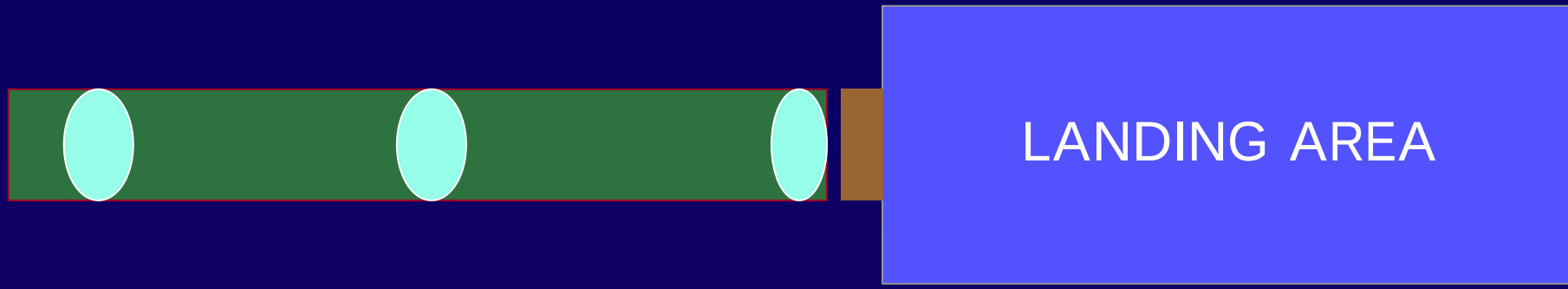
# Tested areas

**Testing points on the main straight: lanes 2, 4 and 6**



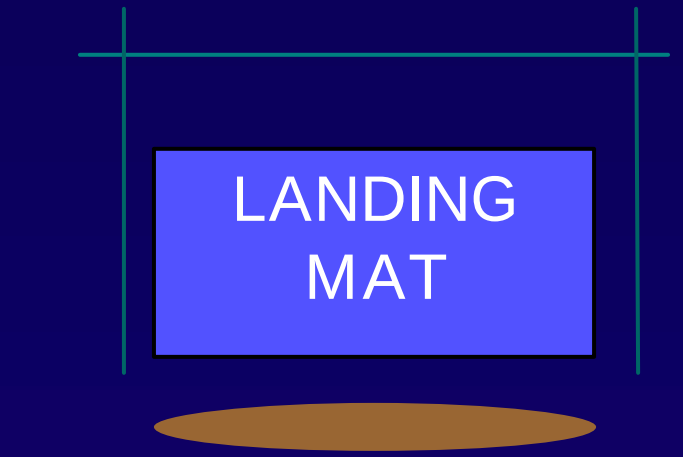
# Tested areas

**Testing points on the Long Jump Runway**

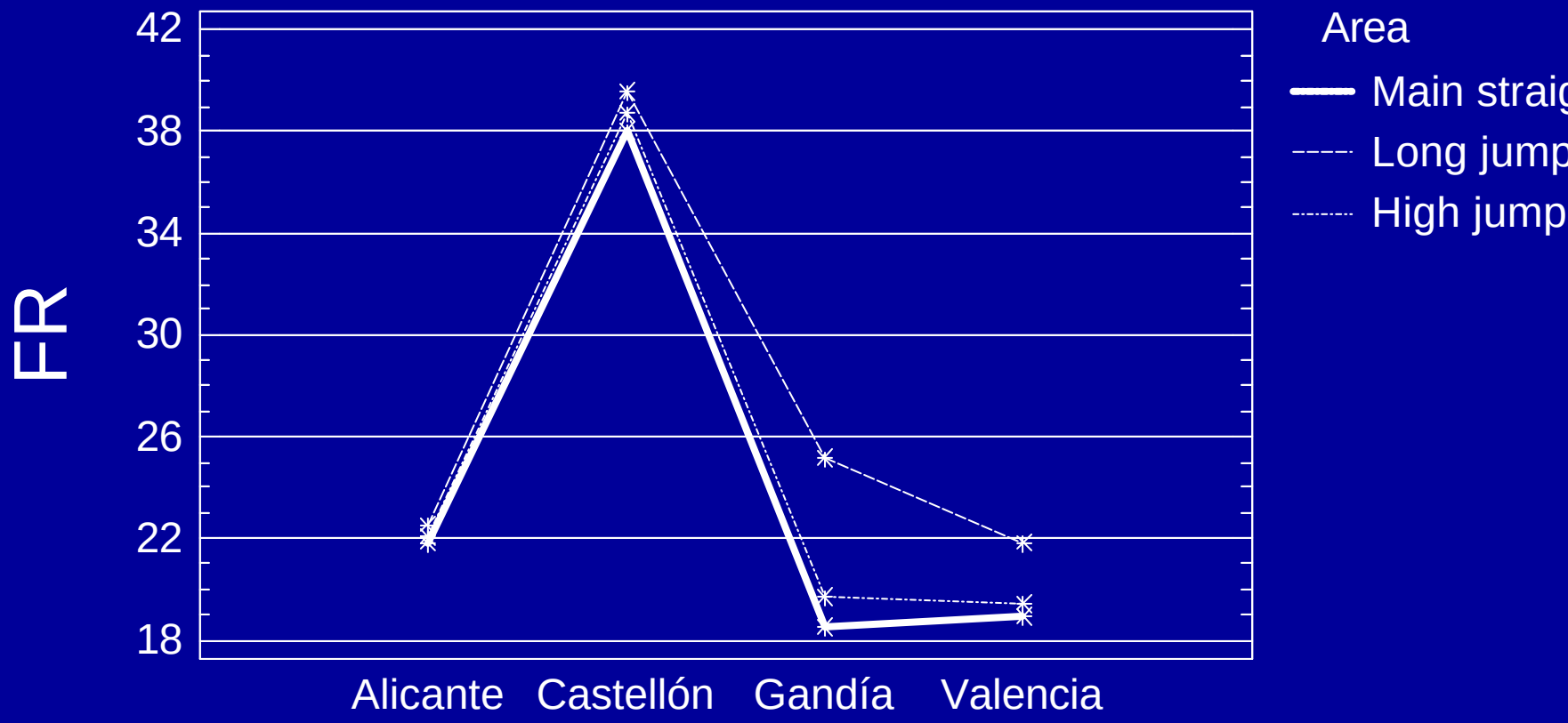


# Tested areas

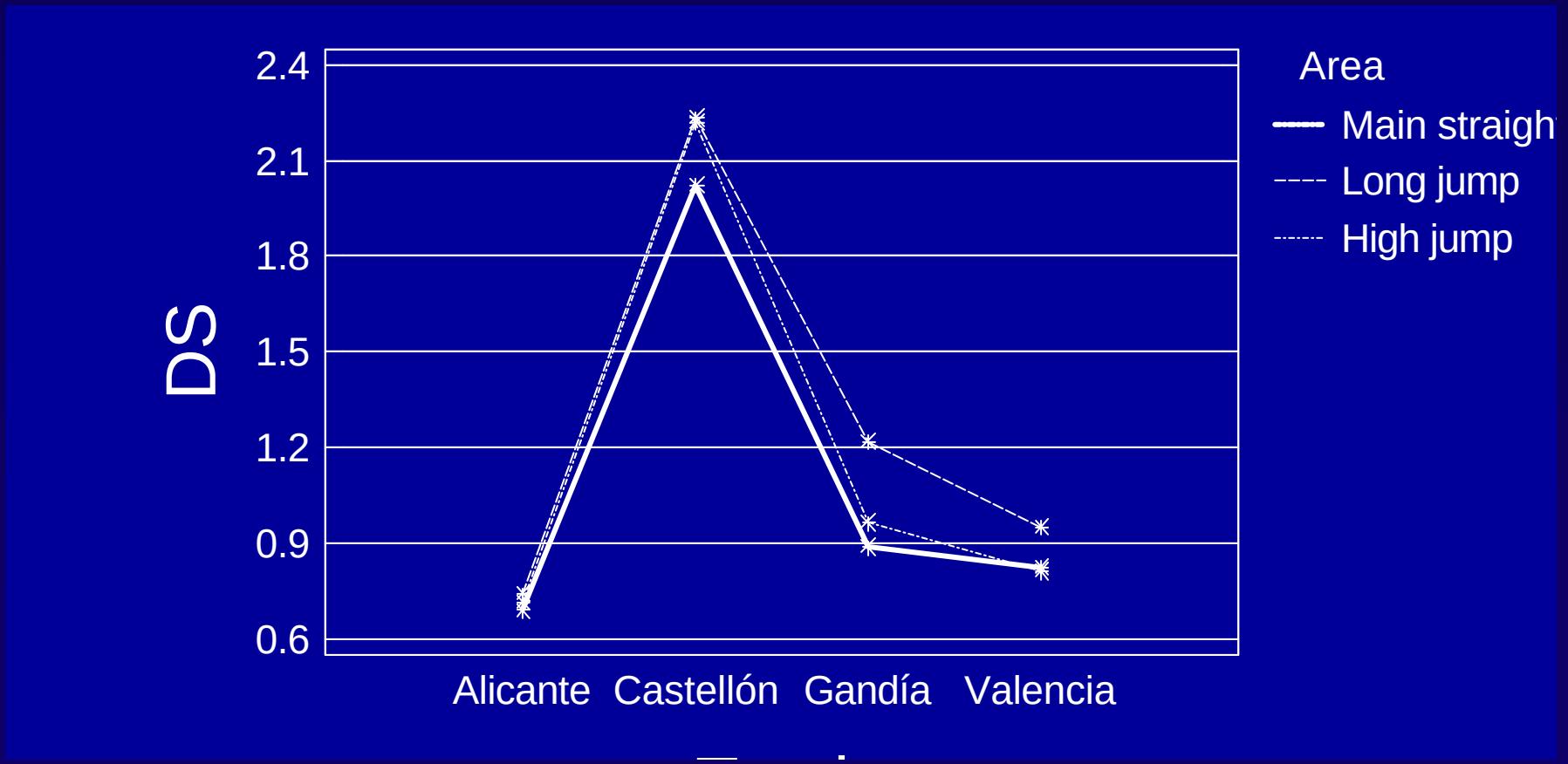
**High Jump Facility**



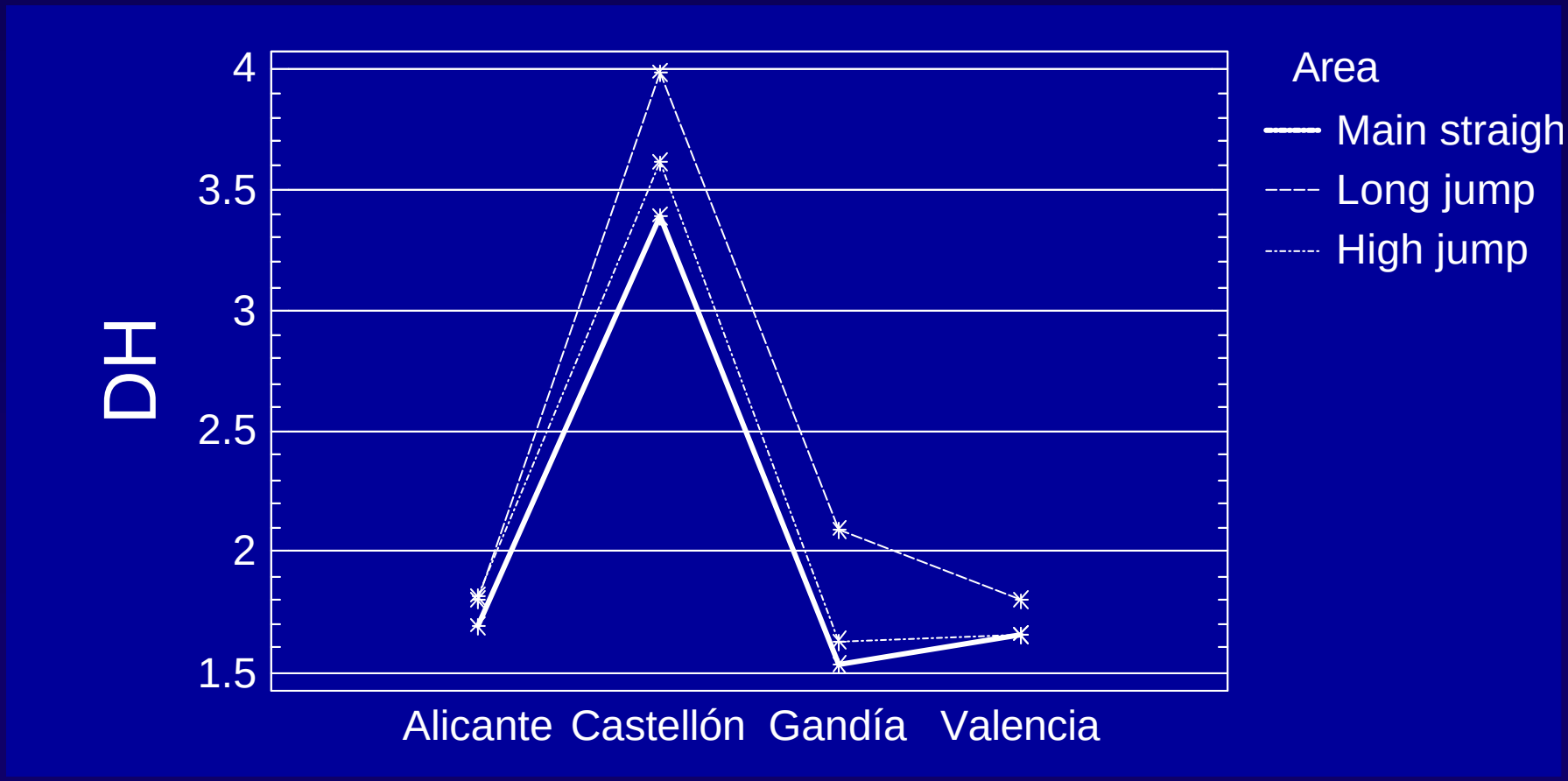
# Force reduction



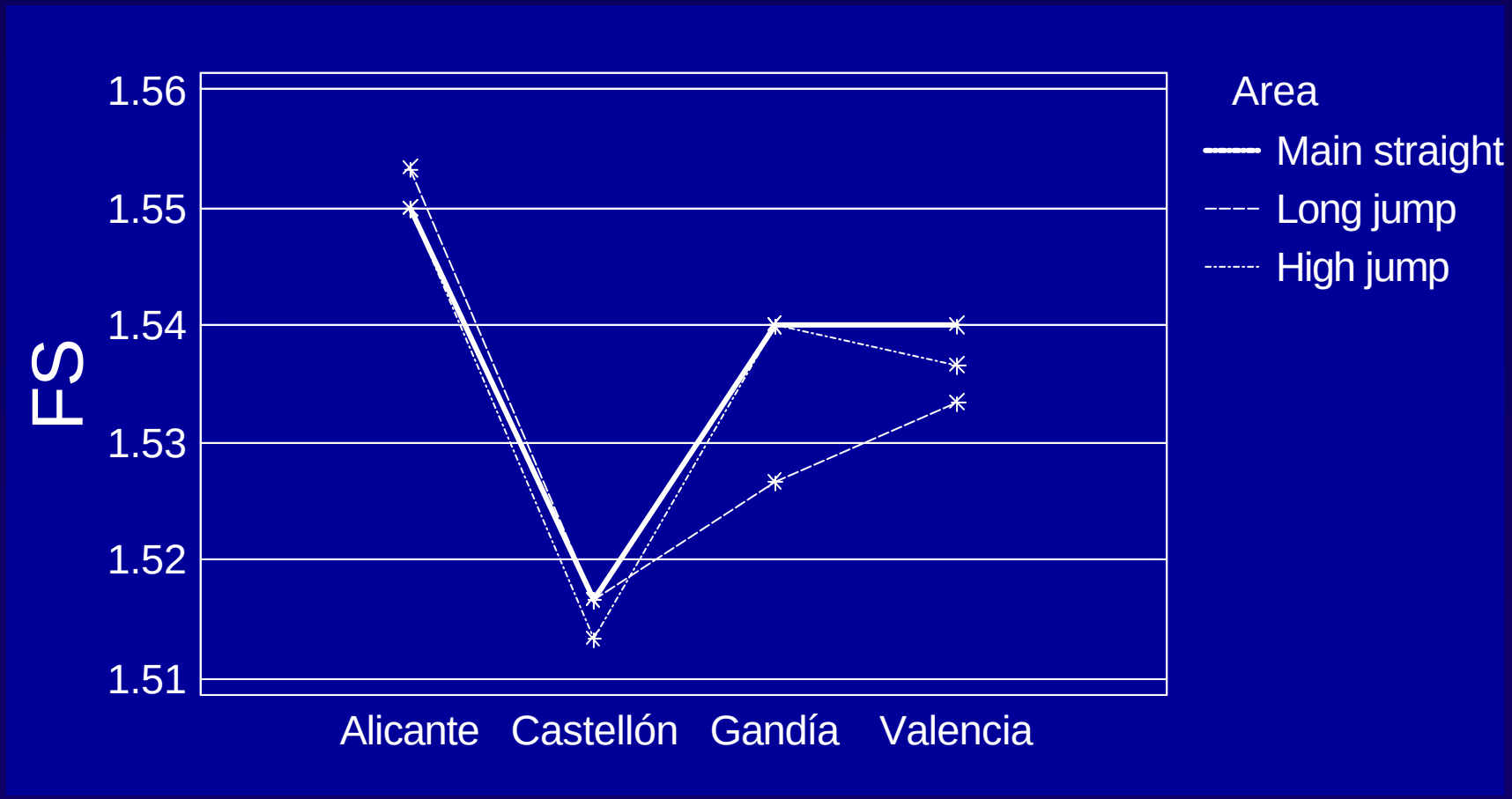
# Maximum deformation with the softer spring (DS)



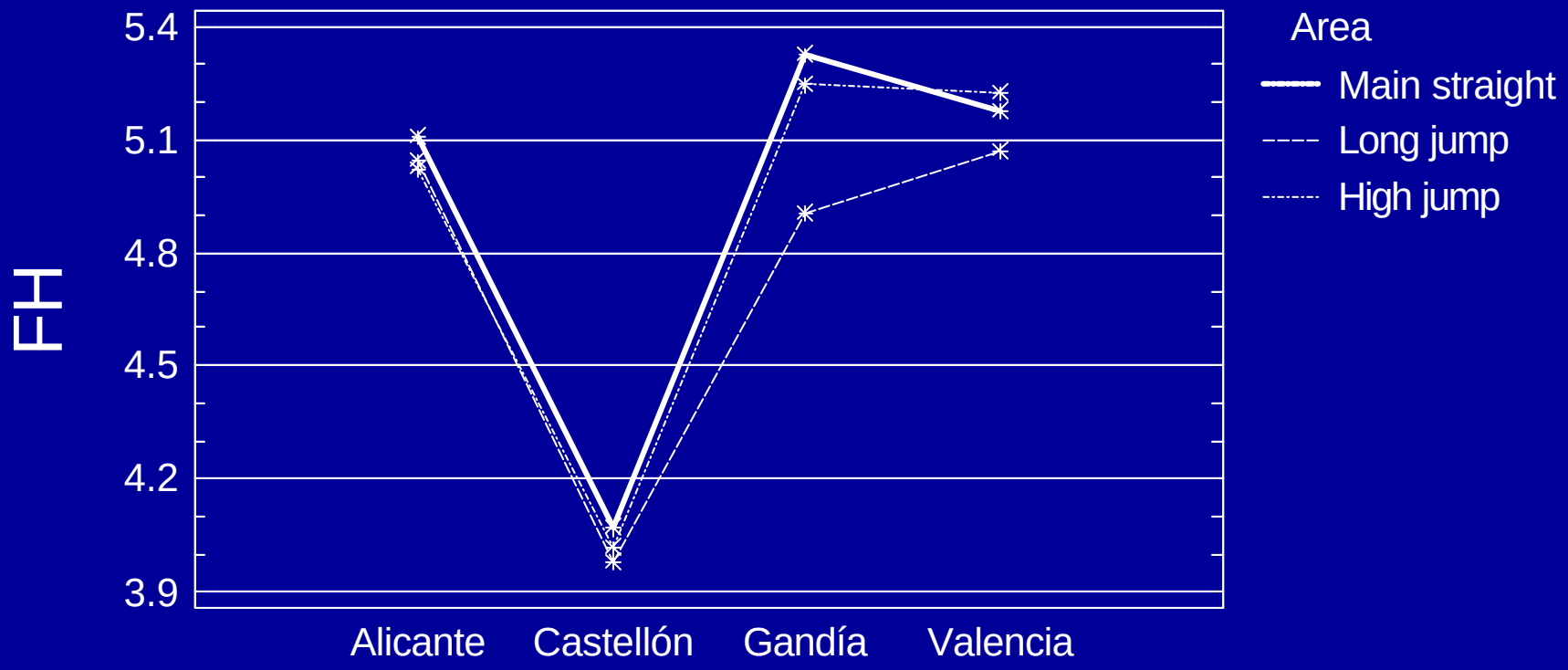
# Maximum deformation with the harder spring (DH)



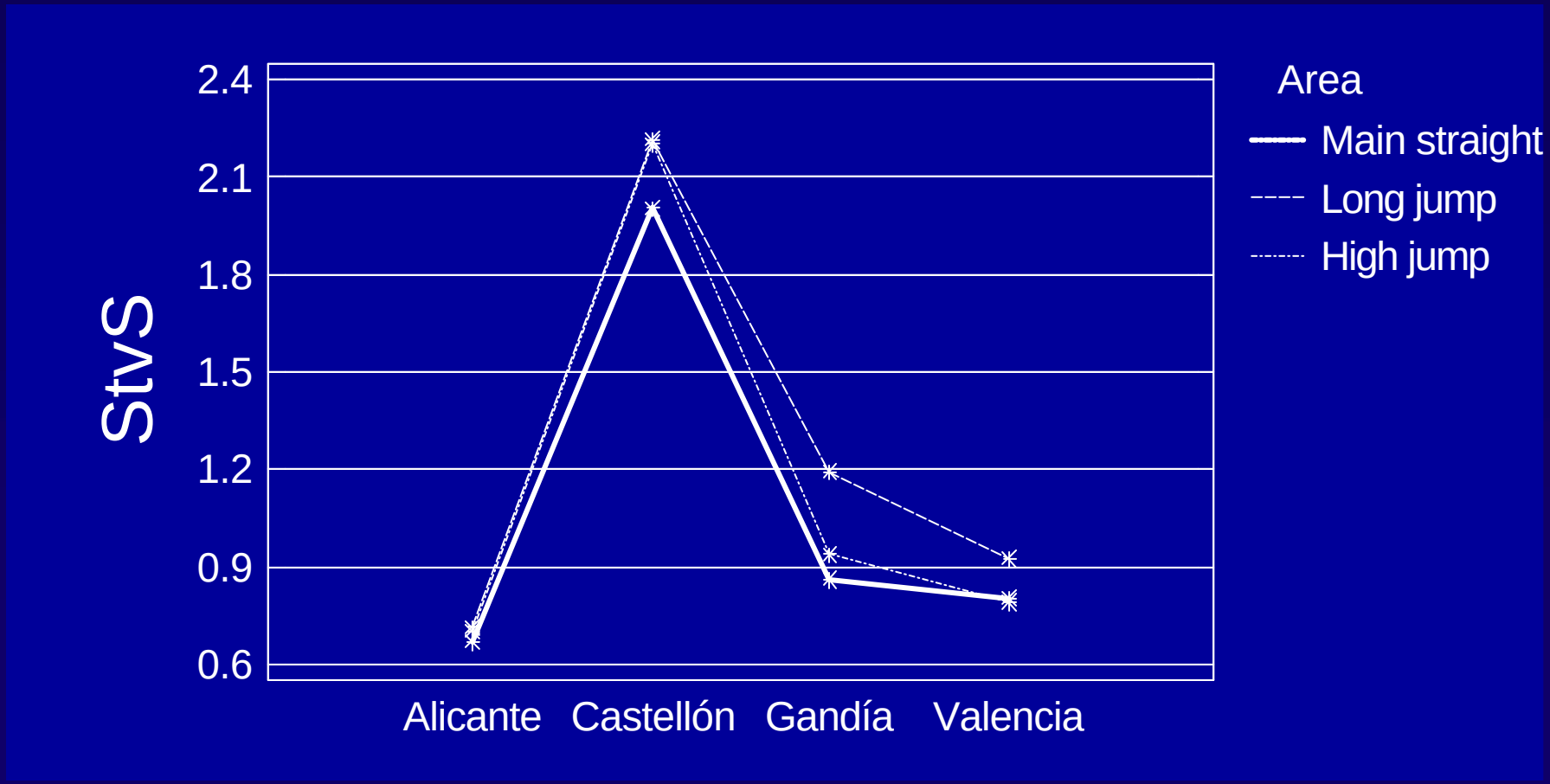
# Maximum force with the softer spring (FS)



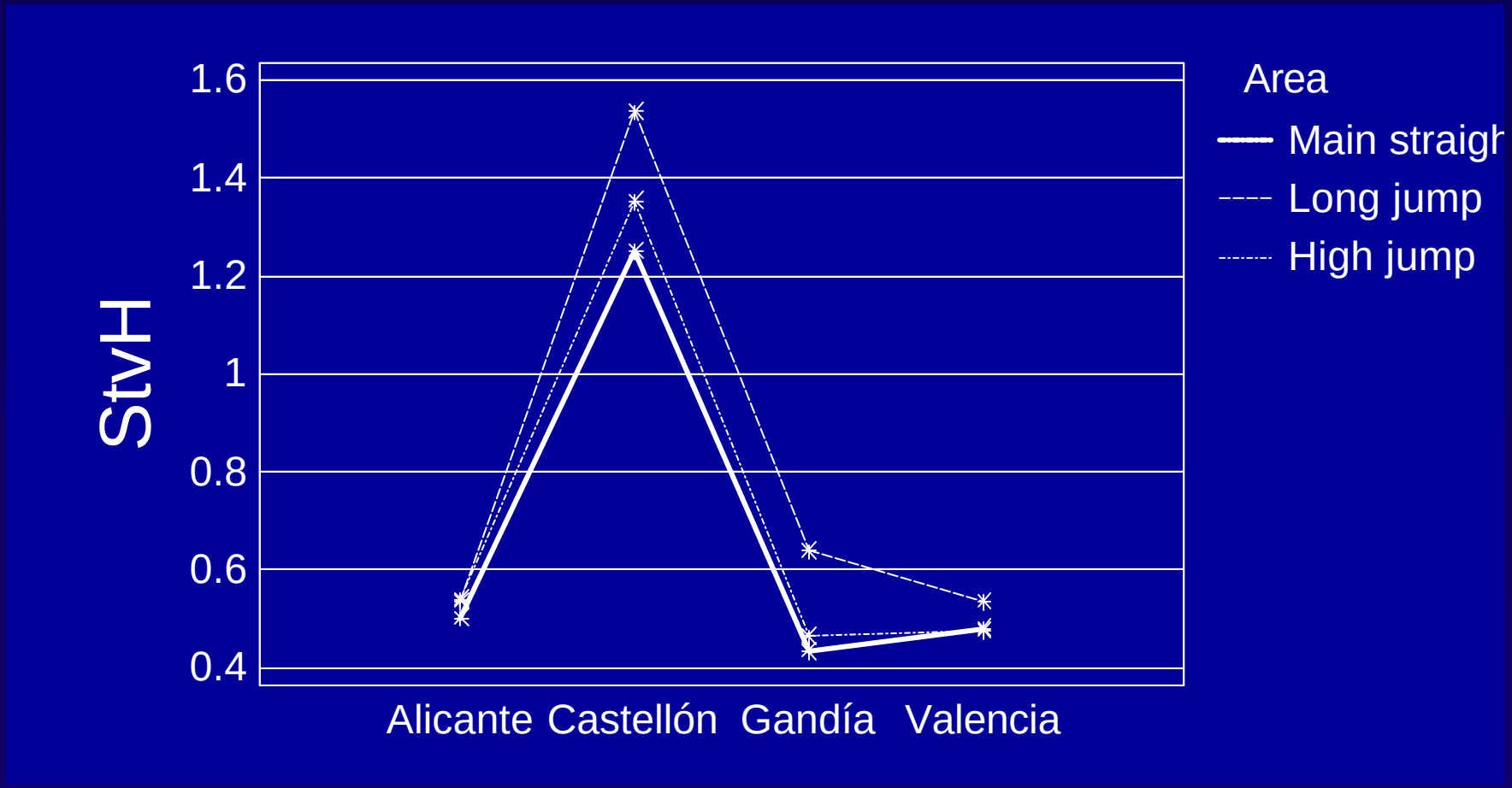
# Maximum force with the harder spring (FH)



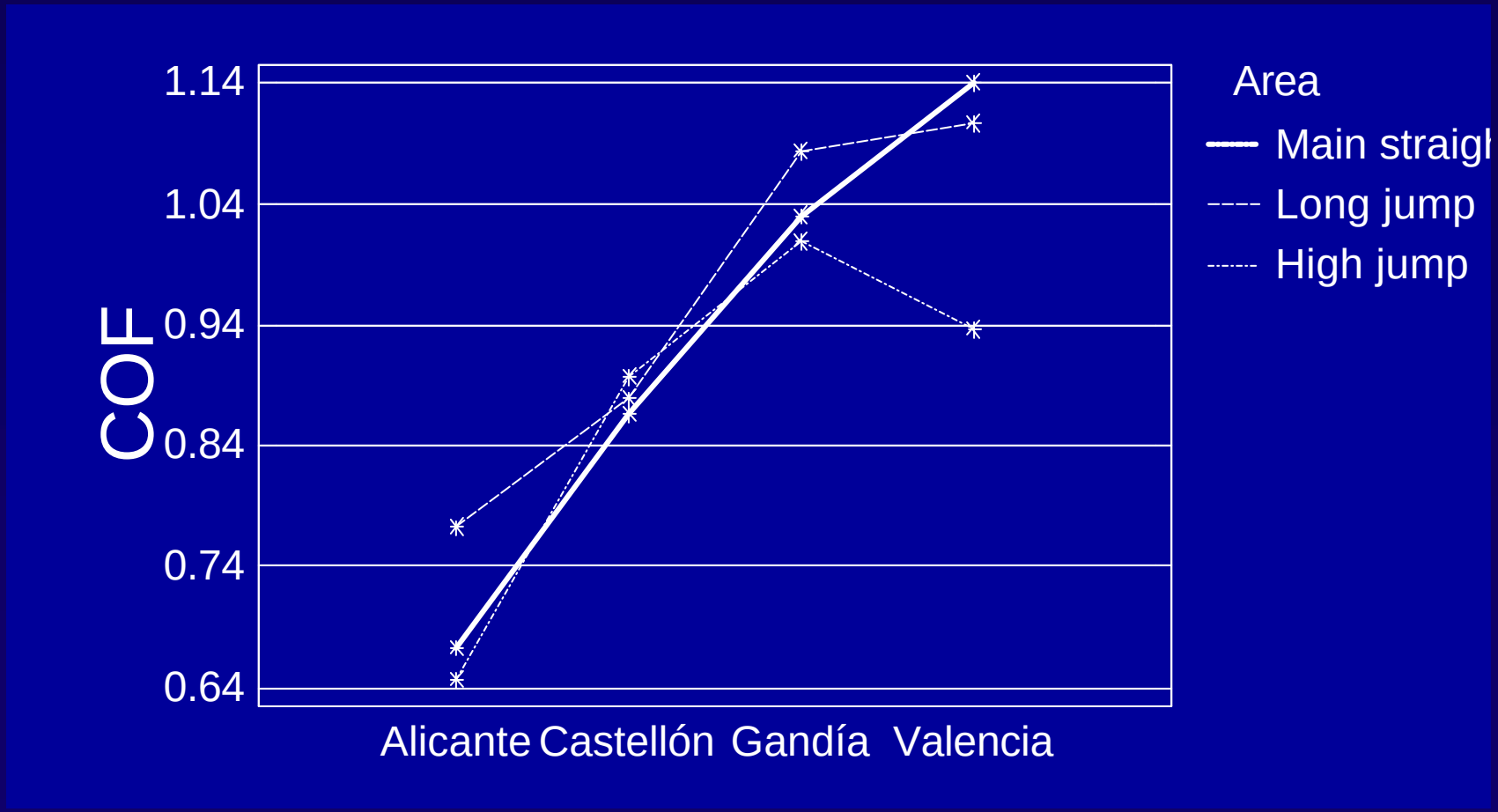
# Standard deformation with the softer spring (StvS)



# Standard deformation with the harder spring (StvH)



# Coefficient of Friction (COF)



# Survey groups

- Sprinters: from 100 to 400m race and hurdle race
- Middle distance: from 800m to 1500m
- Long distance: more than 3000m
- Walking race
- Jumpers: triple jump, long jump and high jump

# Survey restrictions

- To have taken part in competitions at least in the level of regional championships
- To have been training on the track at least for one year

- However, not enough athletes who met the established conditions were found to complete all the groups in the questionnaires. For this reason the number of significant results, from the statistical perspective, is lower when the data are analysed separately for each discipline.

# Survey groups

| TRACK | GROUP | | | | | |
|---|---|---|---|---|---|---|
| | Sprinters | Middle distance | Long distance | Jumps | Walking race | Total |
| Valencia | 6 | 6 | 6 | 6 | 5 | 29 |
| *Gandía* | *7* | *6* | *2* | *0* | *0* | *15* |
| *Alicante* | *6* | *4* | *5* | *2* | *0* | *17* |
| *Castellón* | *6* | *5* | *4* | *6* | *3* | *24* |
| *Total* | *25* | *21* | *17* | *14* | *8* | *85* |

# Shock absorption ranking

| Track | Number of answers | Rank of the tracks |
|---|---|---|
| Castellón | 24 | 62.38 |
| Gandía | 15 | 51.90 |
| Alicante | 17 | 32.09 |
| Valencia | 29 | 28.76 |

*Statistically significant results for the Kruskal-Wallis test*

# Preference for competition

| | | Valencia | Gandía | Alicante | Castellón |
|---|---|---|---|---|---|
| Less | N | 3 | 6 | 1 | 16 |
| | % | 11.5% | 40.0% | 5.9% | 66.7% |
| Equal | N | 15 | 7 | 9 | 7 |
| | % | 57.7% | 46.7% | 52.9% | 29.2% |
| More | N | 8 | 2 | 7 | 1 |
| | % | 30.8% | 13.3% | 41.2% | 4.2% |
| Total | N | 26 | 15 | 17 | 24 |
| | % | 100.0% | 100.0% | 100.0% | 100.0% |

# Preference for training

| | | Valencia | Gandía | Alicante | Castellón |
|---|---|---|---|---|---|
| Less | N | | | | 4 |
| | % | | | | 16.7% |
| Equal | N | 6 | 14 | 8 | 19 |
| | % | 23.1% | 93.3% | 47.1% | 79.2% |
| More | N | 20 | 1 | 9 | 1 |
| | % | 76.9% | 6.7% | 52.9% | 4.2% |
| Total | N | 26 | 15 | 17 | 24 |
| | % | 100.0% | 100.0% | 100.0% | 100.0% |

# Sprinters Preference for competition

| | | Valencia | Gandía | Alicante | Castellón |
|---|---|---|---|---|---|
| Less | N | | | | |
| | % | | | | |
| Equal | N | 1 | | 4 | 3 |
| | % | 16.7% | | 66.7% | 50.0% |
| More | N | 5 | 7 | 2 | 3 |
| | % | 83.3% | 100.0% | 33.3% | 50.0% |
| Total | N | 6 | 7 | 6 | 6 |
| | % | 100.0% | 100.0% | 100.0% | 100.0% |

# Sprinters preference for training

| | | Valencia | Gandía | Alicante | Castellón |
|---|---|---|---|---|---|
| Less | N | | | | 4 |
| | % | | | | 16.7% |
| Equal | N | | 7 | 5 | 6 |
| | % | | 100.0% | 83.3% | 100.0% |
| More | N | 6 | | 1 | |
| | % | 100.0% | | 16.7% | |
| Total | N | 6 | 7 | 6 | 6 |
| | % | 100.0% | 100.0% | 100.0% | 100.0% |

# Middle distance preference for competition

| | | Valencia | Gandía | Alicante | Castellón |
|---|---|---|---|---|---|
| Less | N | | 1 | | 4 |
| | % | | 16.7% | | 80.0% |
| Equal | N | 6 | 4 | 2 | 1 |
| | % | 100.0% | 66.7% | 50.0% | 20.0% |
| More | N | | 1 | 2 | |
| | % | | 16.7% | 50.0% | |
| Total | N | 6 | 6 | 4 | 5 |
| | % | 100.0% | 100.0% | 100.0% | 100.0% |

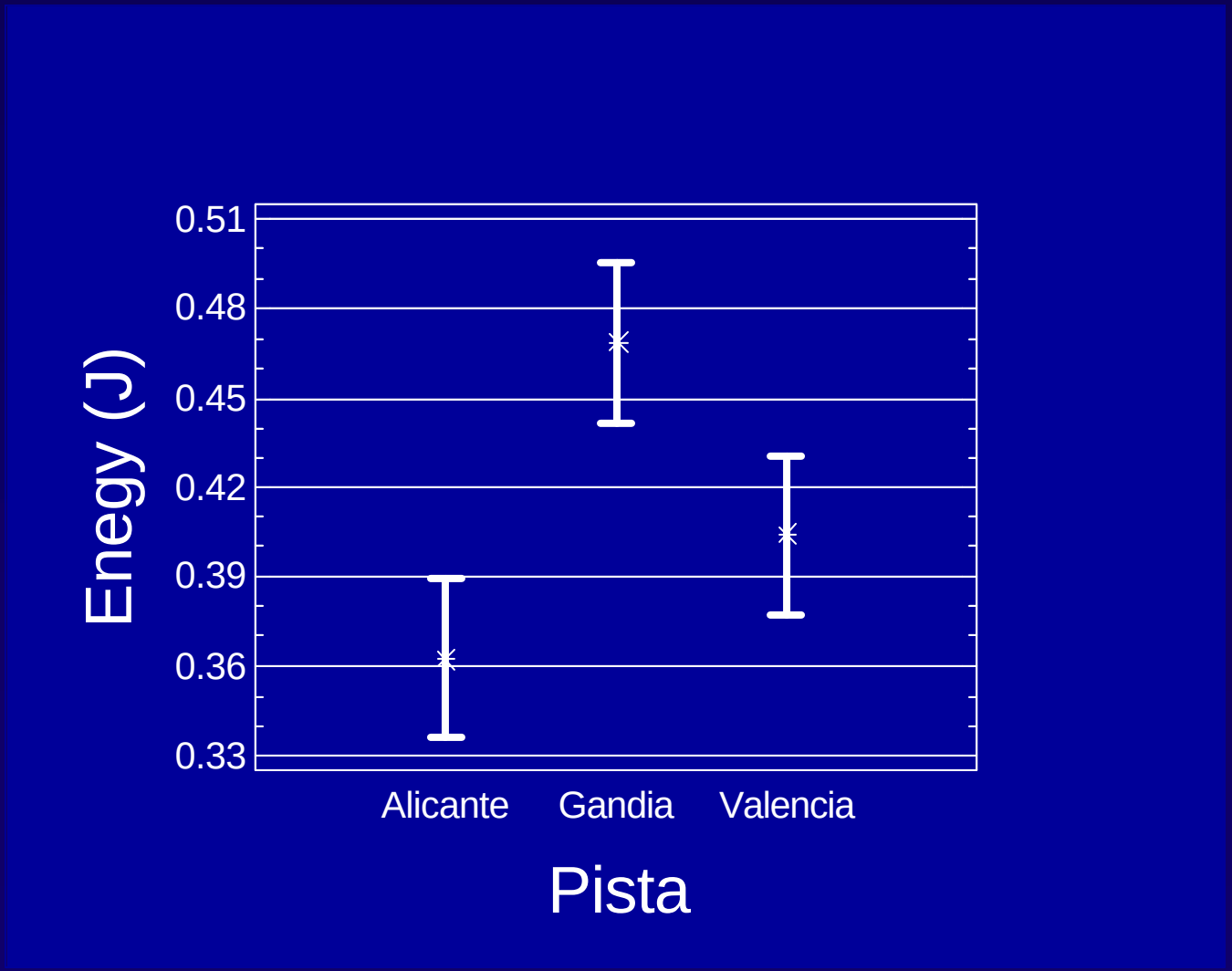
# Long distance preference for training

| | | Valencia | Gandía | Alicante | Castellón |
|---|---|---|---|---|---|
| Less | N | | | | 1 |
| | % | | | | 25.0% |
| Equal | N | | 2 | | 3 |
| | % | | 100.0% | | 75.0% |
| More | N | 6 | | 5 | |
| | % | 100.0% | | 100.0% | |
| Total | N | 6 | 2 | 5 | 4 |
| | % | 100.0% | 100.0% | 100.0% | 100.0% |

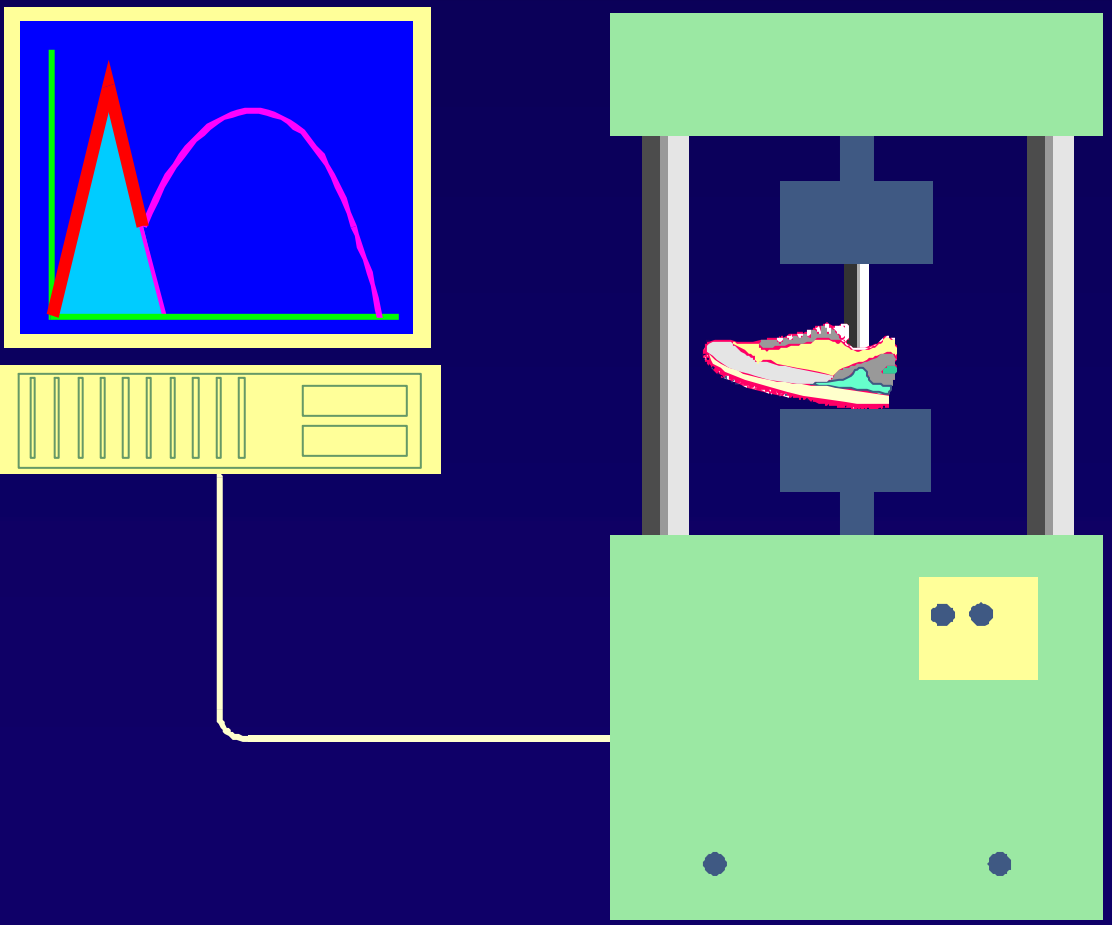
# Conclusion

- These results give us the clues for deducing the next conclusion: If the track is out of IAAF limits, this does not mean that the track will be not shock absorbent in opinion of the athletes. This implies that Force Reduction is not enough for measuring the shock absorption of the tracks, and other parameters must be considered, principally energy and time parameters, for example loss tangent and its behaviour at different frequencies

# Energy analysis



# IBV test for shock absorbing materials



VISCOELASTIC MODEL

$$\sigma = \sigma_0(w)\sin(wt)$$

$$\varepsilon = \varepsilon_0(w)\sin(wt - \partial(w))$$

Rigidity

$$|G| = \frac{\sigma_0(w)}{\varepsilon_0(w)}$$

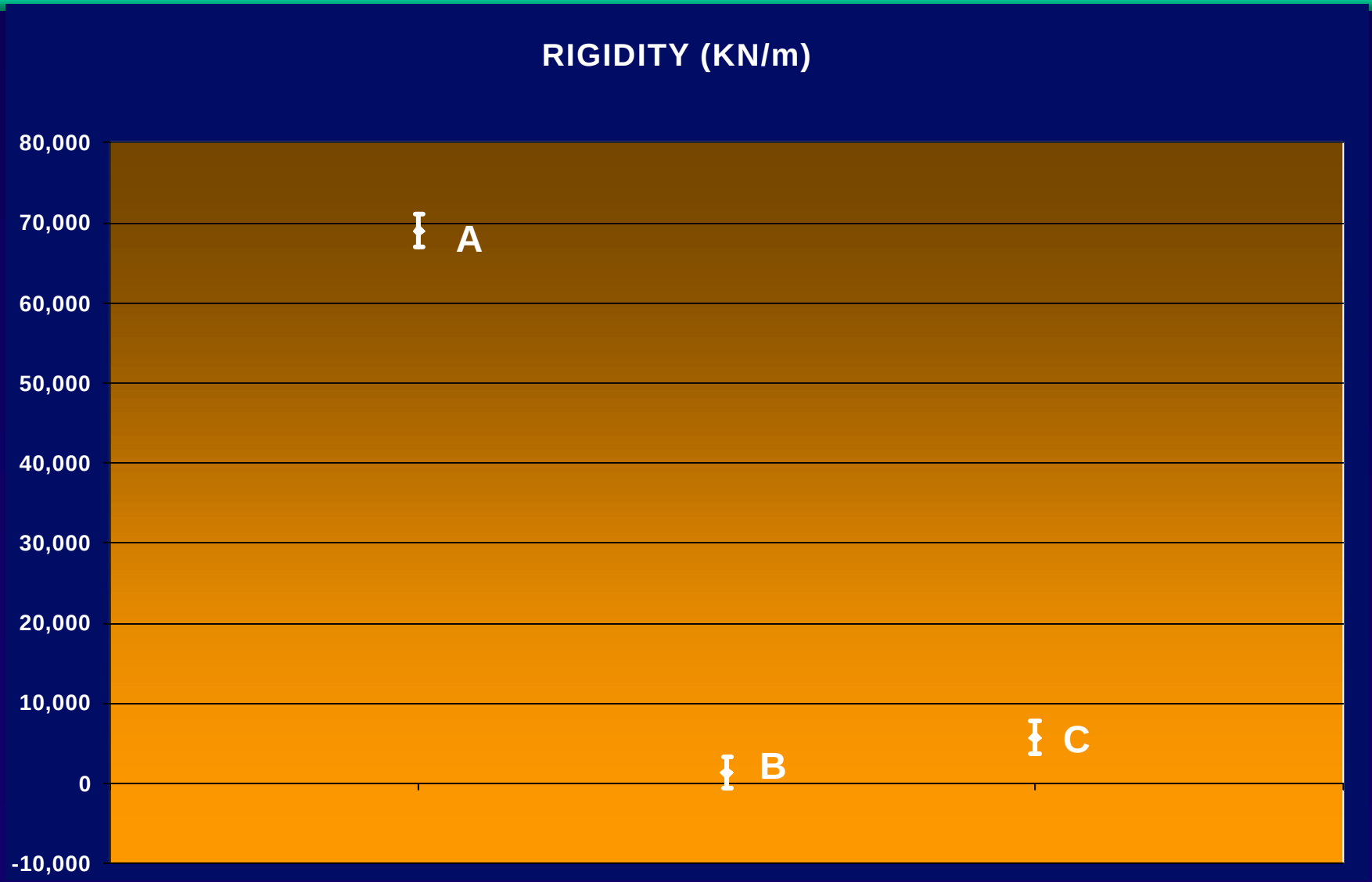
Loss tangent

$$\tan(\partial(w))$$

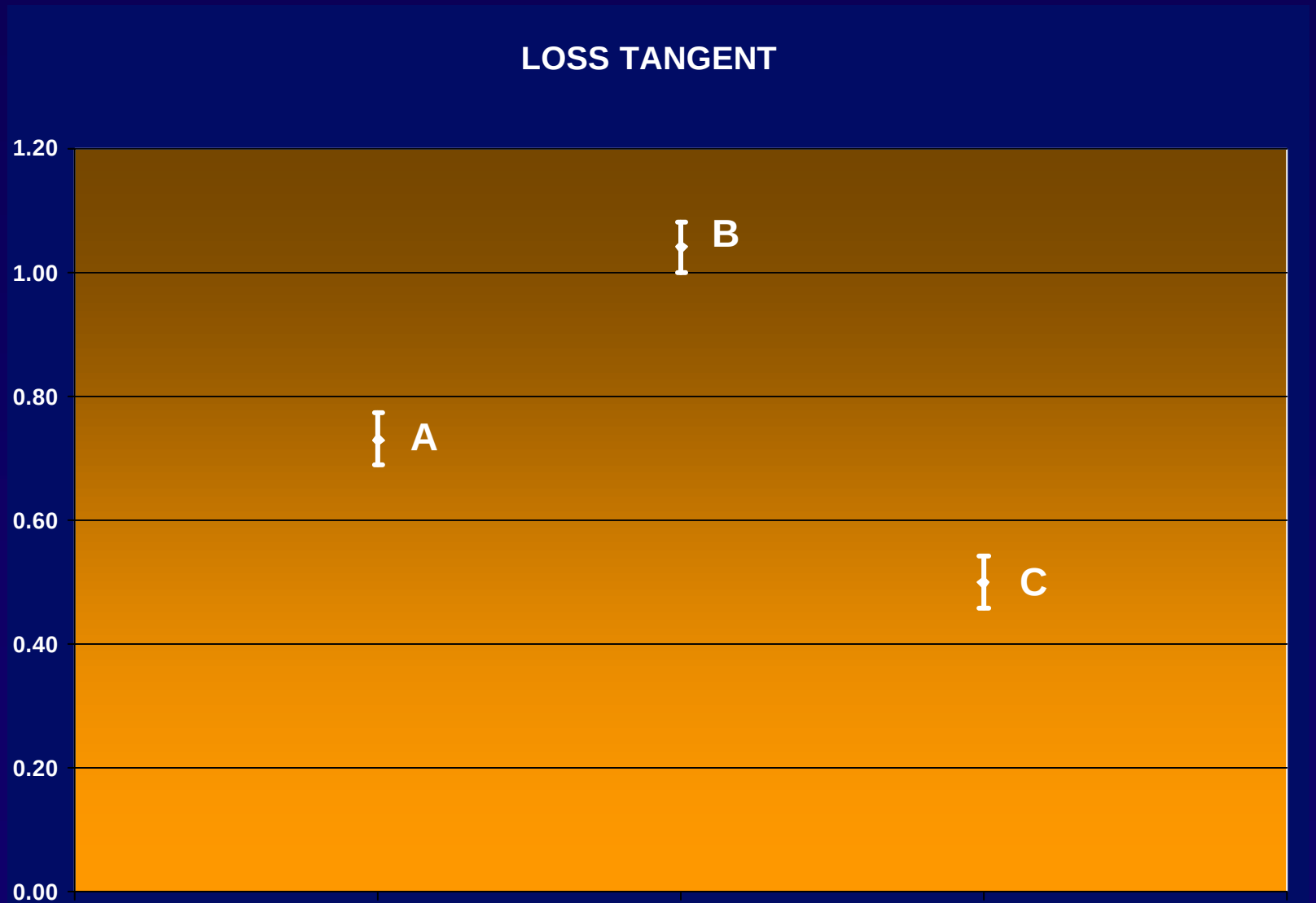
# Example

| MATERIAL | RF % |
|---|---|
| A: PVC 6mm thickness | 19% |
| B: Synthetic rubber 13mm thickness | 37% |
| C: Synthetic rubber 6.5mm thickness | 20% |

# Rigidity


RIGIDITY (KN/m)
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
-10,000
A
B
C

# Loss tangent



# Advantages

- The methodology of frequency analysis permits to obtain additional information to the one obtained with the force reduction parameter. The frequency analysis permits to distinguish between two strategies for shock absorption: high loss tangent and low rigidity.