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EN 14904: Performance Criteria and Requirements

This article is a summary of the performance criteria from the EN 14904. This a new standard that will be replacing existing national standards such as DIN 18032-2 within the European Union in 2008. Because of the nature of the North American market, owners, and architects may start to see EN performance results sooner than 2008. A description of each criteria and the calculations involved are included. General performance requirements are presented in this article. A companion article titled "EN 14904: Introduction to Performance Types" has been developed to introduce the optional performance types listed in EN 14904.

EN 14904 measures a variety of indoor sport surface performance characteristics. Many of which are included in the more familiar DIN 18032-2. EN 14904 has been ratified by the European Union (February 2006) and is scheduled to be implemented and mandatory within the EU by 2008. Once EN 14904 is officially implimented within the EU, DIN 18032-2 will become obsolete throughout Europe, and even within Germany. ASET believes that it is only a matter of time before this standard is introduced in North America, and that it is important for owners, architects and manufacturers to be familiar with it when it arrives.

EN 14904 has grouped the performance criteria into two main categories: Technical Criteria, and Safety Criteria.

Definitions:

- Technical properties describe the mechanical properties of the sports surface such as strength and flexibility.
  - Rolling Load Behavior - Ability of sports surface to withstand general loads common in Europe
  - Ball Rebound - Liveliness of sports surface
- Safety properties describe features that clearly represent interfaces between the athlete and the sports surface.
  - Force Reduction - The ability of the sports surface to reduce forces during impacts
  - Slip Resistance - An estimate of the friction properties of the sports surface.
  - Vertical Deflection - The ability of the floor to deflect during an athletes impact.

1. Technical Properties

The following properties describe the mechanical properties of the sports surface, and are not considered to provide clear biomechanical advantages.

1.1. Rolling Load Behavior

The rolling load characteristic examines the ability of a sport surface system to withstand the loads associated with sports surface use in Europe.

The rolling load testing is conducted with load of 1500 N (335 lbs)[1]. Loading is applied through a single wheel.

Specifiers and managers are encouraged to thoroughly discuss the loads that the system must support with their sports surface provider to ensure compatibility.

1.1.1.Requirements

The surface and the entire system must show no sign of damage after the tests are complete. The residual deformation of the surface along the loaded area must be less than 0.5 mm 15 - 20 minutes after the testing is finished. [2]

1.1.2.Comments

The new EN standard has adopted the same loading requirements for all surfaces. DIN 18032-2 [3] varied the loading based on the type of the system. ASET prefers this single load level because there is no evidence that facilities with synthetic surfaces require lower loading levels than those with wood surfaces.

Sports surfaces are generally used much differently in North America than in most of Europe. As such North America sports surfaces are often subjected to loads that greatly exceed those applied during this test. This test is not an indicator of how the sport surface system will withstand relatively high loads (portable back-stops, greater than 10-15 rows of bleachers, and portable maintenance lifts) common in North America.

1.2. Ball Rebound

Ball rebound is a criterion that evaluates the suitability of the sports surface for basketball. This property provides a numeric estimate for the 'liveliness' of the sports surface system.

The ball rebound property is the rebound height obtained on the sports surface expressed as a percentage of the rebound height obtained on concrete. The following equation is used to calculate ball rebound[4]:

$$BR = \frac{h_{sportsurf}}{h_{concrete}}100$$

Where $h_{sportsurf}$ is the rebound height obtained on the sports surface (measured in meters), $h_{concrete}$ is the rebound height obtained on concrete (measured in meters), and BR is the ball rebound expressed in (%). Rebound height is measured from the top of the floor to the bottom of the ball.

Ball rebound values tend to range from 80%-100%, depending on the inflation pressure, room temperature, and ball construction and system construction. Higher values represent sports surfaces that produce higher rebound heights, and would probably be described as being more 'lively'.

1.2.1.Requirements

The sports surface must have an average ball rebound level greater than or equal to 90%.[2] No individual point may vary by more than +/- 3% from the average[2].

1.2.2.Comments

EN 14904 actually addresses uniformity of performance by stating that ball rebound levels must be within 3% from the average value. While this is a very wide range, it is a start toward improving the uniformity of sports surface performance.

Cultural preferences and the intended uses may result in desires for very high ball rebound characteristics. As an example, a facility designed primarily for competition may choose to specify a very high ball rebound value to promote a fast speed of play.

2. Safety Properties

The following properties are more closely related to athlete/surface interaction than with merely providing mechanical characteristics of the sports surface.

2.1. Shock absorption

Shock absorption is also commonly referred to as force reduction. Shock absorption measures the ability of the sports surface to reduce maximum impact forces compared to impacts on concrete. This property is a strong indicator of the level of comfort that will be provided by the sport surface system to athletes.

This property has the strongest biomechanical foundation of the properties in the EN 14904 standard. The impact duration is developed to be very short and approximately equal to the time when 'passive' impact peaks commonly occur. 'Passive' impact peaks get their name because they are localized maximum forces occurring prior to the bodies ability to actively respond to the landing through the neural-muscular system.

Shock absorption is presented as a percentage of the impact force generated on concrete. The following equation is used to calculate force reduction[2]:

$$SA = 100 - \frac{F_{sportsurf}}{F_{concrete}}100$$

Where $F_{sportsurf}$ is the maximum impact force generated on the sports surface, $F_{concrete}$ is the maximum impact force generated on concrete and SA is the shock absorption of the system expressed in percent.

2.1.1.Requirements

The average shock absorption value will be between 25% and 75%[2]. No individual point may vary by more than +/- 5% from the average value[2].

2.1.2.Comments

EN 14904 allows a much wider shock absorption range than DIN 18032-2. The standard does provide an optional 'Type' system that can be used to group systems with similar performance levels into groups. The type system is explained in a companion article available at the ASET Services' library, Document number EN-002.

2.2. Vertical deformation

Vertical deformation has a biomechanical basis, however its exact importance is somewhat uncertain. It may ensure that the system provides shock absorption without 'bottoming out'. Excessively high levels of vertical deformation may contribute to instability when the foot impacts the surface. Excessively high deformations in synthetic surfaces may contribute to 'foot-blocking' which results in dangerously high internal joint forces and can lead to knee injuries.

The loading rate used during vertical deflection testing is more similar to those produced during running than during landing. Vertical deformation is a measure of how far the floor will deflect under an impact of 1500 N (335 lbs).

Vertical deflection is expressed as millimeters of deflection, and is obtained from the following equation[6]:

$$StVv = \frac{F_{max}}{1500} \bullet f_{max}$$

Where F_{max} is the maximum force generated during the impact (N), f_{max} is the maximum deflection at the point of impact (mm), and StVv is the Standard Vertical Deformation (mm).

2.2.1.Requirements

The vertical deformation shall not exceed 5.0 mm[2].

2.2.2.Comments

As with shock absorption, EN allows for a much wider range of vertical deformation values than DIN 18032-2[3]. The new EN standard provides an optional system by which systems with similar vertical deformation levels may be grouped by type. A companion article introducing the floor performance types is available at the ASET Services' library: Document number EN-002.

2.3. Friction / Slip Resistance

Friction is the resistance to slipping on the sports surface, and has biomechanical implications. Friction that is too low will result in excessive sliding and make directional changes difficult. Friction that is too high or too low may increase the magnitudes of the forces and moments transferred through the joints in the body during directional changes thus increasing the possibility of injury. The DIN standard evaluates the friction using a weighted disk contacting the playing surface at three contact points covered with leather.

The slip resistance in EN offers a relative comparison of friction properties between sports surfaces. It does not represent the absolute slip resistance present when modern athletic footwear is used. Representing the actual friction present in shoe-surface interfaces is not feasible given that the friction coefficient is effected by both tread geometry and tread material.

Slip resistance is measured using a pendulum method[7].

2.3.1.Requirements

The average value shall be between 80 and 110[2]. Individual test points may vary by no more than +/-4 points from the average value.

2.3.2.Comments

The method outlined in the new EN standard is more commercially available than the method included in DIN 18032-2. The test device is also smaller and more portable. It will make field testing for friction more affordable and common.

3. Not Included

One of the more controversial performance characteristics, area indentation, was not included in the new EN standard. This section briefly discusses this characteristic.

3.1. Area Indentation

Area indentation has been a big part of the DIN 18032-2 standard ever since it was developed. However, this parameter was not included within the new European Standard 18032-2.

There were in essence 3 different positions on area indentation within the CEN representatives. Some felt that allowing any level above the previous limits outlined in DIN 18032-2 would be detrimental to the performance of a sport surface. Another position was that while area indentation was important, the limit should be relaxed from15% to 20% or possibly 25%. Finally, there was a group that felt that it was not important at all.

Ultimately, area indentation was not included in the EN standard. This will allow individual member countries to adopt their own area indentation standards if they choose to do so.

4. Conclusion

This article has introduce the performance features of EN 14904 that were based on those from DIN 18032-2. It has also listed the general performance requirements. EN 14904 has taken steps toward addressing uniformity. By allowing a wider range of surfaces to be included in the standard it has also provide a means through which manufacturers can justify developing and improving systems that would not have passed DIN 18032-2 but that might provide sport/activity specific performance.

5. EN 14904 and Safety

At this time no study or publication has been found that links a sports surface's compliance with this standard, or any similar standard, to a reduction in injuries. In fact, no study or publication has been found that links sports surface's compliance to any standard or test method to a reduction in injuries, other than standards designed to prevent head-injuries. There are no guarantees that a system meeting all of the requirements of the DIN standard will reduce injuries.

Specifiers should consider EN 14904 to be an indicator of athlete comfort not an indicator of athlete safety.

6. References

1. (1999) EN 1569: Surfaces for Sports areas - determination of behaviour under a rolling load.
2. (2006) EN 14904: Surfaces for Sports areas - Indoor surfaces for multi-sports use - Specification.
3. (2001) DIN Pre-Standard 18032 Part II: Sports Halls, Halls for gymnastics, games and multipurpose use. Part 2: Sports floors, requirements and testing.
4. (1995) EN 12235: Surfaces for Sports areas - determination of vertical ball behaviour.
5. (2003) EN 14808: Surfaces for Sports areas - shock absorption.
6. (2003) EN 14809: Surfaces for Sports areas - vertical deformation.
7. (2003) EN 13036-4: Road and airfield surface characteristics - Test methods - Part 4: Method for measurement of slip/skid resistance of a surface - The pendulum test

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