

Playground Surfacing, Injury Severity and Liability

Over the past 30 years a significant volume of material has been produced with regard to playground injuries and injury reducing playground surfacing. The publication of various standards in Canada, the United States and other countries has added to the awareness of professionals in all aspects of playground design an heightened awareness of risk by those engaged in the installation and operation of playground facilities. With the issuance, on February 9, 1993 of the Insurance Bureau of Canada ("IBC") Bulletin No. AM 93-02, the insurance industry in Canada has taken the issue of liability in the commercial playground context (municipalities, school boards and day care) very seriously. This will also extend to the play environments that are of the "Pay for Play " type indoor and outdoor playgrounds but will apply with a heightened profile by virtue of the profit factor at operation.

Numerous studies have indicated that 60-70% of all playground injuries requiring medical attention are as a result of a fall to the surface under the playground equipment or an intermediate platform. Nearly half of these injuries are head injuries.

The issue of risk management, liability and the risk exposure of the designer, manufacturer, contractor, owner or operator of any play space has become a significant problem. Understanding the criteria and standards that have been established and the potential for injury will assist in determining what, if any, risk is involved. It is important to understand three important aspects of the problem: liability and negligence, formal tests and test procedures for the evaluation of playground surfacing, and the ability to perform tests of installed surfaces and the availability of experts to provide evidence and testimony.

Negligence and Liability

Since negligence is a common law concept dependent upon legal precedent however modified by legislation, it is important to make assessments of legal liability and business risk in conjunction with an expert within the legal profession. These professionals will be able to provide guidance as to the specific liability for negligence and occupiers liability that could attach to:

- An employee who may be a direct or proximate cause of an injury;
- The contractor(s) and manufacturer(s) involved in the playground;
- The designer and /or specifier of the playground;
- The supervisor, manager, owner and/or operator of the playground;
- Members of the board operating the playground; and
- Any unit of government or agency that has sponsored or funded of the construction of the playground.

A legal profession will be able provide specific information as it relates to the existing law in any jurisdiction, however jurisprudence in the area is recent and developing.

In 1856 Baron Alderson stated what has become the most commonly accepted definition of negligence as:" the omission to do something which a reasonable man, guided upon those considerations that ordinarily regulate the conduct of human affairs, would do, or something which a prudent or reasonable man would not do."¹ The level of care that is to be provided is also based upon the determination as whether the owner/operator of the playground is an invitor

¹ Blyth v. Birmingham Waterworks Company (1856) 11 Ex. 781 at 784

or an occupier. An invitee should be protected from danger about which the owner knows or at least about which the prudent owner should know.² The occupier is liable to a licensee in respect of a concealed trap or danger notwithstanding the negligence of the licensee, who, if he had exercised great care, could have detected the danger in time to avoid it, but whose lack of care was induced, in part at least, by the continuing sense of false security created by the trap.³ In addition the degree of care that must be provided to the user by particular individual parties will be determined by the skill or knowledge of the individuals relative to the involvement of those individuals.

It is obvious that the exposure to liability is very real. The volume of documentation with regard to playground safety and the standards that have been developed have provided the knowledge required to prevent most serious injuries and liability in the playground and to properly manage risk. As indicated above this has the effect of significantly increasing the required standard of care and thereby the exposure of all persons involved in the provision of the playground.

Formal Tests and Procedures for Playground Surfacing

To understand the degree of protection that is being provided through the installation of an appropriate surface, it is important to understand that the test procedures and pass/fail criteria have been time tested and developed through the input of professionals throughout the world. At present the standard quoted in North America is the ASTM F-1292 (Standard Specification for Impact Attenuation for Surface Systems Under and Around Playground Equipment), which states:

"4.1 All surface systems must be tested in accordance with the performance requirements in 4.2. In addition, surface may also be tested in accordance with 4.3. Testing in accordance with the performance requirements in 4.3 is optional.

4.2 When tested in accordance with Test Method 355 or the free fall method in Annex A1, using an average of the last two of three drops, no value shall exceed 200 g-max or 1000 HIC for laboratory tests at temperatures of 30, 72, 120°F ((-1, 23 and 49°C), respectively.

4.3 When tested in the field at ambient temperature in accordance with Test Method F355 or the free fall method in Annex A1, using the average of the last two of three drops, no value shall exceed 200 g-max or 1000 HIC at the height specified by the initial owner/operator prior to purchase of the surface.

4.4 When the surface system, while in use is tested in accordance with the Test Method F355 or the free fall method in Annex A1, using an average of the last two of three drops, at each of three test sites, and exceeds 200 g-max or 1000 HIC at ambient temperature, as determined by Section 13, at the height specified by the initial owner operator prior to the purchase of the surface, the surface system should be made to comply or the playground equipment on the surface should not be used until the surface complies."⁴

2 Wilkinson & Lockhart, Safety in children's formal playgrounds, (1976) p. 75

3 Wilkinson & Lockhart, Safety in children's formal playgrounds, (1976) p. 86

4 American Society of Testing and Materials, ASTM F-1292-99, p.2

Three types of head injury can occur as a result of an impact. The first is the deformation of the skull, when skull fracture and concussion can occur. The second is when the relative motion of the brain and the skull is different causing concussion and the third is rotation of the head with respect to the neck and torso producing stretching and damage to any one or all of the neck ligaments, cervical cord and brain stem.

Tests performed on cadavers and animals have resulted in the Wayne State University Tolerance Curve, which predicts human tolerance to linear fracture and concussion. In the tests performed

By Hodgson, et. al. by dropping adult cadavers, peak accelerations in the range of 190 to 370 g's were observed at the fracture level.⁵ A study by Mohan et. al. reported a conservative estimate of head injury tolerance for head first falls of children are 150-200 g's average acceleration for 3 milliseconds or 200-250 g's peak acceleration.⁶

Whereas the G-max measures peak acceleration, the HIC measures the total force that is applied to the skull during acceleration and is an enhancement of the severity index (SI) developed by Gadd. An HIC greater than or equal to 1,000 represents a danger to life, when assessing internal head injuries resulting from frontal impacts.⁷

The foregoing is very critical in the development of the present and future standards for the safety surfaces for children's playgrounds. It is expected that not only the G-max of 200 or less will continue as maximum peak acceleration, but an additional proviso that the surface when tested according to ASTM F355, Procedure C must also provide a HIC of less than 1,000 will appear in future standards. This will then take into consideration peak force and the total force applied.

It is important to note that the threshold level of 200 G-max and a HIC of less than 1,000 are on the border of being a danger to life and definitely must raise questions of potentially causing concussion and serious brain damage. Installation of a surface that provides test data at, or close to, the threshold should be avoided and a surface with a G-max of a under 160 should be seriously considered. This will allow for changes that occur during the life of the surface and its exposure to the outside environment.

The ASTM F1292 test procedure does not require any ageing of the samples and it must therefore be assumed that the samples being tested by an independent test centre are newly manufactured. Although the samples are tested within a range of temperatures, they are always in a dry condition, which is especially critical in the tests performed at -1 degree C. Obviously the influences of weather, accumulated dust, or sand from the sandbox, snow and ice will have an effect upon the performance of the surface. This is particularly true of surfaces that retain moisture, allow for the accumulation of silt and sand in the surface or are installed in a cold climate.

5 Consumer Product Safety Commission, Bethesda, MD., Impact Attenuation Performance of Surfaces Installed Under Playground Surfaces, Feb 79, p10

6 Consumer Product Safety Commission, Bethesda, MD., Impact Attenuation Performance of Surfaces Installed Under Playground Surfaces, Feb 79, p8

7 Watson & Tipp, Safety Surfaces for Children's Playgrounds, p4

Since an injury will occur while the surface is in service, the potential for a reduction in resilience over time must be taken into consideration at the time of surface selection. Therefore the combination of a maintenance manual and the installation of a surface that will always be more resilient than the threshold is essential.

Independent Testing, Site Testing and Experts

The ASTM F1292 test procedure utilising ASTM F355 was established subsequent to the research by the United States Consumer Product Safety Commission in 1979. This test has subsequently been utilised for the setting of standards for bicycle helmets and the other head protection. As a result there are a number of independent test centres in Canada and the United States that can perform tests on sample surfaces. Although synthetic surfaces are easily transported from the point of manufacture to the test laboratory, surfaces that consist of loose or natural materials

require some very carefully drawn specifications and construction for the sample to simulate the surface that is to be installed. Generally the tests performed on surfaces consisting primarily of loose materials do not take into consideration the potential compaction or shifting of the materials over time.

The free fall test method that has now become a part of the ASTM F1292 standard is the result of many years of development and severe scrutiny of industry professionals. The free fall method now allows for the cost effective and accurate testing of the playground surface in place. This is a significant advantage to the owner/operator and ultimately to the children using the playground.

The Free Fall test method provides the owner/operator with a number of advantages. The first is to determine contractual compliance at the time of the installation. The second is to determine warranty claims and performance issues for systems carrying a warranty for resilience. And the third is that maintenance schedules and budgets can be developed from a knowledgeable base.

Failure of the surface at any time during its life will raise the exposure for liability to all persons involved in the surface selection, installation and operation. The designer, specifier, owner and manufacturer and installer are all exposed. This exposure to liability can be limited on behalf of all parties through the selection of a surface that has met the following;

- test results are provided for the surface according to F-1292 and performed by an independent test laboratory and generating a G-max of less than 200 and the HIC of less than 1,000 for the maximum platform and or fall height for the play structure installed;
- the surface is installed according to the specifications and duplicates the properties and performance of the tested surface; and
- On site testing of the surface using the free fall test method 10 to 55 days of the completion of the installation.

This will ensure the performance of the surface for impact attenuation at the time of installation.

To limit the exposure to liability during subsequent years the following must be performed;

- on site testing of the surface using the free fall test method a minimum of once per year at 3 sites around the play structure;
- provision of a maintenance manual for the surface;
- Performance of the maintenance a required in the manual.

The extent to which negligence and therefore liability exposure can be established will be in part dependent upon the ability of the plaintiff to find experts that are able to provide evidence with regard to the danger that is present within a site. With the passage of time since the field has come to the forefront of the industry and the volume of information that has been generated in the field of playground injuries and related subjects there are a significant number of experts available within industry and academia.

Conclusions

For more than 20 years there has been active discussion and the development of tests and standards within the area of accidents in playgrounds. This volume of information and the ability to test for performance has raised the risk of, and significance of, liability for negligence for designers, specifiers, manufacturers, installers and operators. The availability of information and, in the case of Canada, the CSA Z614 Standard for Playspace, almost all persons involved in the building of a playground will have skills and experience that will not excuse negligence. In addition the invention of on site test apparatus has now allowed for performance testing of actual conditions at any time.

All of the studies of playground injuries indicate that the majority of the injuries are as of a result of an impact with the underlying surface or intermediate platform below play structures. The issuance by the IBC of the above mentioned AM 93-02 indicates that the risk of exposure to liability and the potential for litigation is very real, especially when one considers the costs that can be associated with any head injury.

It is the responsibility of everyone involved in the construction of playgrounds to provide the maximum amount of care, as they are able for today and into the future. Failure to do so will inevitably result in injury and financial loss.

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