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Playground Surfacing, Injury Severity and Liability

BY ROLF HUBER

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Over the past 25 years, a significant volume of material has been produced on playground injuries and injury reducing playground surfacing. The publication of various standards in Canada, the United States and other countries has added significantly to professionals' awareness in all aspects of playground design and 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 daycare) 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 to 70 per cent 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 to the designer, manufacturer, contractor, owner or operator of any playspace 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 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 the construction of the playground.

A legal professional will be able to 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." 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 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. 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. 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 regarding playground safety and the standards which 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 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 standards quoted in North America is the ASTM F-1292, which states:

"6.1 When tested according to the Test Method F355 Procedure C, using the average of the last 2 of 3 drops, no value shall exceed 200 g-max at temperatures of 30, 72 or 120 degrees F (-1, 23 and 49 degrees C, respectively), at the height specified by the purchaser.

6.2 If the surface system, while in use, is tested according to Test Method F255 Procedure C, using an average of the last 2 of 3 drops, at each of three test sites which exceed 200-g's when tested within a temperature range of 30 to 120 degrees F (-1 to 49 degrees C) as determined by section 12, at the height specified by the purchaser, the surface should be replaced."

The other often quoted criteria is that when the same test is utilized, the head injury criteria (HIC) is to be less than or equal to 1,000. The concept of the G-max being under 200 has been commonly quoted since the late 70s while the HIC is relatively new to North America. In any event, there are two

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measures that have become accepted by standard and common usage.

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.

Test performed on cadavers and animals have result 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 acceleration in the range of 190 to 370 g's were observed at the fracture level. A study by Mohan, et. al. reported a conservative estimate of head injury tolerance for head first falls of children are 150 to 200 g's average acceleration for 3 milliseconds or 200 to 250 g's peak acceleration.

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

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 only the G-max of 200 or less will continue as maximum peak acceleration, but as an additional proviso, the standards would include that the surface, when tested according to ASTM F355, Procedure C, must also provide a HIC of less than 1,000. This will then take into consideration peak force and 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 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 F355 test procedure does not require any aging of the samples and must therefore be assumed that the samples being tested by an independent test centre are newly manufactured. Although 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 influence of weather, accumulated dust, or sand from the sand box, snow and ice will have an effect upon the performance of the surface. This is particularly true of surfaces which retain moisture, allow for the accumulation of silt and sand in the surface or are installed in a cold climate.

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 which will always be more resilient than the threshold is essential.

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INDEPENDENT TESTING, SITE TESTING AND EXPERTS

The ASTM F355 test procedure was established subsequent to the research by the United States Consumer Product Safety Commission in 1979. This test has subsequently been utilized for the setting of standards for bicycle helmets and other head protection. As a result, there are a number of independent test centres in Canada and the U.S. which 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 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.

Irrespective of the tests performed according to ASTM F355, the surface must be installed under a play structure and perform to the expectations of the user - that is to provide impact forces below the threshold. In the past, liability for the performance of the surface has been limited to the tests originally performed on the designed system. The only option to testing a surface in service has been the removal of a section of a core sample of the surface and testing in a laboratory. This is difficult and costly.

The invention of the MAX / HIC instrumented head form provides the capability to measure a G-max and HIC for a surface at the ambient temperature at the time of the test wherever the surface is located. Although this is an approximation of the fixed test apparatus utilized in the ASTM F355, a test result of a drop with the MAX / HIC that exceeds the specified criteria will be a failure provided the test is performed with the temperature range stipulated in F355. A failure with MAX / HIC will warrant the expense of the taking of a core sample for testing and confirmation at an independent test laboratory.

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, 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 F1292 and F355 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 by removal of a test core or MAX / HIC within one month of 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:

- test the surface by removal of a core or MAX / HIC a minimum of once per year at three sites around the play structure;
- provision of a maintenance manual for the surface;
- performance of the maintenance 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 with the volume of information generated in the area of playground injuries and related subjects, there is a significant number of experts available within the industry and academia.

CONCLUSIONS

For more than 15 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, a National Standard, almost all persons involved in the building of a playground will have skills and experience which 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 a result of an impact with the underlying surface or intermediate platform below play structures. The issuance by the IBC of the 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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Rolf Huber, author of this article, brings a wealth of experience with him, not only on a personal level but on a professional one as well. With a background in landscaping, thanks to his father, Willy Huber, Rolf gained insight into landscaping and, particularly, playground design, both with playscape surfaces developed by Willy Huber and his own "EverPlay" system. As a member of the CSA Task Force for Playgrounds and the ASTM F-1292 Committee, and as head of Sportbau Canada, Rolf has worked to bring a set of standards to playground surface manufacturing in Canada and the U.S.