UNI EN 1177: Impact attenuating playground surfacing
Determination of critical fall height

Martino Olivo e Arianna Visintin

How is possible to quantify the risk of severe head injuries due to a fall from a given height on a specific surface? The "UNI EN 1177: Impact attenuating playground surfacing – Determination of critical fall height" standard provides a method for determining the critical fall height of the surface by means of the Head Injury Criterion (HIC). As an example: in the medical field an HIC value of 1000 is associated to a likelihood of about 18% of getting head injuries that are classified as "severe".
The test consists in letting a hemispherical metallic tool fall from increasing heights to simulate repetitive head impacts. A triaxial accelerometer that is mounted in the center of gravity of the tool measures the impact curve (deceleration vs. time) of every impact. From such a curve it is then possible to calculate the HIC value by means of a numerical integration procedure.

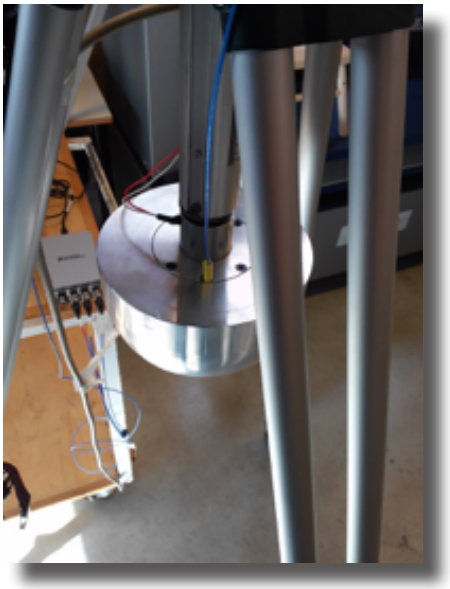

Fig. 1: Equipment for determining the critical fall height.

The test equipment developed by CATAS (Fig. 1) includes:
- a height-adjustable (up to 3 m) tripod,
- a metallic hemisphere, a triaxial accelerometer mounted in the center of gravity of the hemisphere sensitive in the 0-500g range,
- a data acquisition unit for the digitization of the signal at a sampling rate that exceeds 50 kHz.

The hemispherical tool is released by means of a portable electromagnet that is attached to the tripod and ensures a non-rotating vertical fall. Typically, the impact durations range from 3 to 10 ms and are characterized by peak accelerations up to 250 g (g is the unit of measurement corresponding to the acceleration of gravity). The critical fall height is defined as the height corresponding to a HIC value of 1000, rounded down to decimeters. For a specimen tested in our lab, an impact curve relative to a height that produces a HIC larger than 1000 (Fig. 2) and the regression curve (x axis: growing heights; y axis: HIC value) relative to a specific impact point on the surface (Fig. 3) are reported.

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The analysis software allows us to interactively visualize all impact curves and to calculate the HIC and the critical fall height. In addition it makes possible to analyze the data in the frequency domain in order to monitor and remove noise that possibly affects the time-acceleration signal caused by mechanical loosening of the connections within the metallic hemisphere.
The test for the determination of the critical fall height is now accredited.

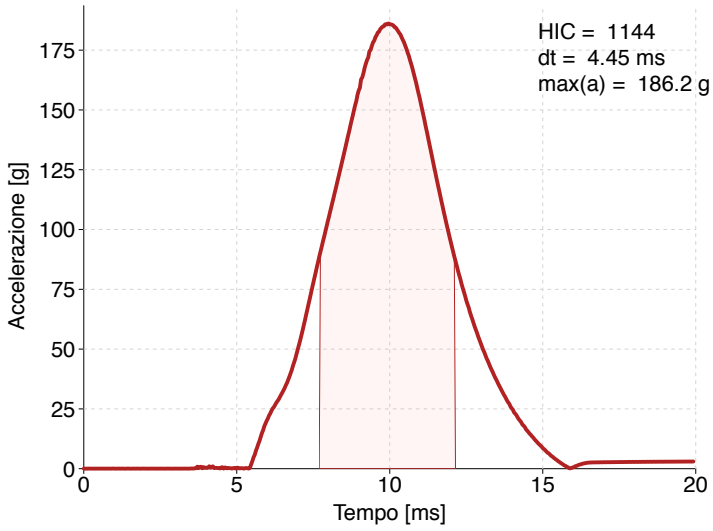

Fig. 2: time-acceleration curve relative to an impact that produces a HIC value larger than 1000.

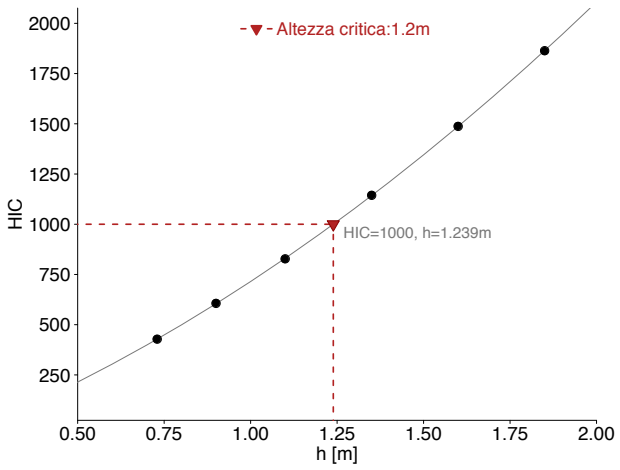

Fig. 3: regression curve for the determination of the critical fall height from experimental data.

Contacts:
Arianna Visintin
Tel: 0432-747233
e-mail: visintin@catas.com