GRASS AND IMPACT ABSORBING SURFACING IN CHILDREN'S PLAYGROUNDS

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INTRODUCTION

This publication aims to assist playground managers to save money on the provision of impact absorbing surfaces (IAS).

The second part explains the background to the introduction of IAS and provides a balance against statements made at national level by many who are not competent to give advice.

Part 1: Grass as an Impact Absorbing Surface (IAS)

In EN 1176 grass has been regarded as a suitable surface for fall heights of up to 1m. With the introduction of the revised EN 1176 came a British Foreword which suggested that grass may well be suitable for fall heights up to 1.5m if it fulfils certain criteria.

Part 1 of this document explains how to carry out the assessment to determine whether or not grass is suitable for a surface and how managers of playgrounds may be able to save significant cost in impact absorbing surfacing.

Part 2: Impact Absorbing Surfacing – Understanding the Background

There has been considerable misunderstanding of the reasons why impact absorbing surfaces were developed. Influential statements have been made at national level by a number of people who neither understand that under even moderate use grass quickly wears out nor that in towns the ground is often "made up" of concrete, bricks, etc just underneath the surface which quickly become hazards after only light wear to the grass above. This section helps to clear up the misunderstandings and enable playground managers to take a balanced approach.

THE CONSULTANT (AUTHOR)

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These inspections have been undertaken on behalf of the Child Accident Prevention Trust, the Institute of Leisure and Amenity Management, National Playing Fields Association and RoSPA and now with Children's Play Advisory Service. He has served as a member of the Play Safety Forum, BSI Committee SW65 (dealing with playgrounds), and was the first inspector to be tested (and was successful) for registration with RPII. He is working with others to bring quality assurance procedures to the role of independent play inspectors.

He has worked in children's play since 1971, starting as an Adventure Playground Leader.

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Part 1: Grass as an Impact Absorbing Surface (IAS)

INTRODUCTION

Grass appears to be a suitable surface for children's playgrounds and both parents and children like to see grass in playgrounds. It does, however, have limitations. It does not wear well in high scuff areas and can hide underlying hard surfaces and projections which are potentially dangerous. Part 2 gives examples of where grass is not suitable.

The new British Foreword to BS EN 1176-7:2008 gives guidance on where grass may be suitable for a fall height of up to 1.5m. This document explains the test.

DEPTH OF SOIL

Grass should have at least 150mm of soil beneath it. It needs this depth both to give sufficient depth for impact absorption but also to give sufficient soil for the grass to continue to grow.

The author demonstrating the test he devised

Grass may have encroached over tarmac or concrete or there may be bedrock very close to the surface. In these circumstances the grass can often look healthy but in reality give very little impact absorption. In city areas particularly playgrounds are often built on "made up" ground. That is land which previously had buildings on it and consequently when it is levelled there may still be lumps of concrete, bricks, iron bars and all manner of other materials which are close to the surface. Grass can sometimes grow and appear to be in good condition yet will be quickly eroded and expose jagged projections which are both trip hazards and hazardous points on which a child might fall.

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Common screwdriver used as a test probe

The Foreword to EN 1176 recommends a test of using a thin probe such as a screwdriver "to a depth of 150mm at regular and frequent locations without it being impeded by a high proportion of solids such as stone, brick or tree roots."

Probe goes in easily where good grass depth

Probe detects hidden underlying hard surface

The probe may be impeded by the occasional large pebble or tree root without it failing the test. If, however, there is a high proportion of solids then there will not be the impact absorption required and it is also likely that the grass will wear (see Part 2) and soil erode quickly exposing the hard surface or the hidden bricks, lumps of concrete etc.

Another criterion is that the grass should remain throughout the year and does not become "mud and bare earth".

The grass sward (the green bits above the surface) does not itself give significant impact absorption. However what it tends to indicate is that there is a good root structure underneath and it is the good roots which keep the soil structure having an open uncompacted texture which in turn gives the good impact absorption.

COST SAVING

The implications are three-fold.

Firstly, in relatively low-use playgrounds with fall heights of less than 1.5m some equipment may not need a manufactured impact absorbing surface (IAS) at all. This is particularly true in low-use playgrounds in rural areas but may also apply to some urban playgrounds.

Secondly, a multi-play or similar item may only need a manufactured IAS at the wear points rather than for the whole area. Typically at the bottom of the steps, the bottom of the fireman's pole and the slide run-out there is grass wear, whereas the rest of the falling space has good grass. In these circumstances it may be possible to install a wear patch only rather than IAS for the whole of the falling space.

NB: The edges of the wear patch should NOT be hard, such as concrete kerb edgings or wooden strips. The edge needs to be soft and extend far enough so that it does not give a trip point. In some surfaces this can be achieved by feathering the surface into the grass so there is a gradual transition rather than abrupt change.

Thirdly, in some circumstances the manufactured IAS may not need to extend the full 1.5m around equipment with a fall height of less than 1.5m. The wear area itself may only extend up to 1m. In these circumstances, so long as there is no hard edge to the IAS, then it may need only to extend approximately 1m. This, when calculated as square metres, may give a greater saving than might initially be expected.

NB: Hard edges and trip points should be avoided as mentioned above.

The problem for the playground manager/installer is at the time of installation they may not be too sure how much the playground will be used and therefore how well the grass will wear. They may not also know the wear characteristics of their particular grass – different varieties of grass do wear in different ways.

With experience they may be able to make a reasonable prediction and therefore put in less manufactured IAS still leaving a reasonable margin for error. They do run the risk that at some time in the future they may need to extend the IAS.

Recommendation

What is needed is for the industry to develop products which are naturally soft-edged or can be installed with soft edges and for these surfaces to be capable of being extended at costs which are not excessive.

LOOSE-FILL AS TOP DRESSING

Where grass is used with low fall heights, ie under 1m, there are sometimes small areas of wear which become a little muddy and there is the risk that the earth will become compacted.

In these circumstances a loose-fill, such as bark or wood chip, can be used as a top dressing to cover the mud and prevent compaction. Such a top dressing is not then acting as an impact absorbing surface and so there is no requirement that it should be installed to any specific depth.

A judgement needs to be made as to whether the top dressing is sufficient or if the wear requires an impact absorbing surface. The probe test detailed above may assist in making that judgement.

In low use areas this can be a reasonably practicable solution to grass wear.

FALL HEIGHTS BELOW 600MM

The revised EN 1176 of 2008 removed the requirement to install impact absorbing surfaces under fall heights of less than 600mm. A risk assessment should, however, be carried out and it is the author's opinion that an impact absorbing surface or grass may still be necessary where the design of the equipment means children are likely to fall awkwardly and where that risk is an essential part of the play value.

TYPES OF IAS

As an independent consultant the author makes no recommendation for the use of any particular system of impact absorbing surfacing or any particular manufacturer. All the different surfaces have benefits and shortcomings.

A couple of the following photos show grass grid systems (where grass grows through). They do, however, not imply support by the author for any particular system of impact absorbing surface nor any particular manufacturer.

Managers should be wary of claims of critical fall height for these grid systems as they may have been tested with grass over very good topsoil which may not be the case in the location for which the surfacing is ordered.

Other IAS types can be used particularly if the suppliers develop "soft edge" systems of installation.

Rubber tile wear patch of slightly insufficient dimensions

Patches only needed at areas of high wear (slide runout, fireman's pole etc)

Grass unable to cope with scuffing even when reinforced with grass grid

GRASS AS EDGING

Wet-pour and tile surfaces often shrink leaving a gap at the edge which may be a trip hazard. It also means the edge is likely to lift or gives opportunities for inquisitive fingers to get under it and lift it.

Where there is grass on the outside of the area this will often naturally encroach into the gap and for a short distance onto the rubber IAS. This then gives a flush surface with no gaps for fingers and does secure the edge.

Groundsmen often feel the need to cut the grass right up to the edge of the IAS which means no encroachment of the grass occurs.

It is better to encourage them not to cut right up to the edge but to allow the grass to grow into the gap. Even better, if they can fill the gap with some topsoil and seed so the process happens more quickly then you have a low cost solution to what is a common problem.

Grass encroaching naturally and filling the gaps as well as anchoring the edge

Part 2: Impact Absorbing Surfacing – Understanding the Background

INTRODUCTION

I write this document because of my increasing concerns that Local Authorities and other managers/providers of unsupervised playgrounds are being incorrectly informed and advised about surfacing in playgrounds. The advice is coming from people who appear to have some national standing in children's play.

There is a widespread belief that the impact absorbing surface is merely a device by manufacturers of playground equipment to increase the costs of playgrounds and thereby their profits. There has also been influential work by Professor David Ball which, though giving some insights into accidents on playgrounds, has in my opinion misunderstood what is happening on playgrounds and therefore encouraged incorrect understanding.

My concerns were confirmed when a Senior Officer from a Metropolitan Council came to the Play Safety Forum (a national play organisation) and announced that he '*had read David Ball's work and concluded that his authority should have a policy of installing tarmac under all playground equipment'*. This approach received some support from within the Play Safety Forum. I do not believe "tarmac under all playground equipment" is advocated in David Ball's research, though comments he has made elsewhere may indicate he is content to have hard uneven surfaces under equipment (see next paragraph).

Further discussions at that Play Safety Forum resulted in some members including Professor David Ball advocating grass as an impact absorbing surface **regardless of its condition, soil depth and composition.**

An article in "first" a weekly magazine sent to most Councillors stated that "health and safety fears and threat of safety surfacing have conspired to create zones that are so risk averse – coated in safety surfacing and with all danger removed – that they run the risk of being boring". Whilst the risk of playgrounds being boring is widely accepted, there is an inference that all safety surfacing could be removed. It also implies that playgrounds need more danger (different from excitement and challenge).

This publication has therefore been written to give the background to the introduction of impact absorbing surfacing into playgrounds and to discuss related issues.

It will discuss the issues of utility and safety.

> **Utility** – issues around surfacing which enables the playground to be played on throughout the year even when it has heavy usage.
>
> **Safety** – issues around what is 'Reasonably Practicable' to provide, to reduce serious injury.

It will also briefly refer to "risk" as statements such as "children need more risk" are being made **regardless of any benefits to their play.**

PLAYGROUNDS NUMBERS AND COSTS

Those without experience of playgrounds tend to think of playgrounds as those that exist in town parks or similar relatively prestigious locations. Inspection, maintenance and supervision issues are therefore seen to be reasonably low relative to the rest of the costs within the park. Additional or improved procedures can be instituted at low percentage increases in costs.

The reality is that a Local Authority may have anywhere between 30 and 150 or more playgrounds. The majority will be small and in residential areas or housing estates.

The equipment will last for at least 10 years and possibly 30 or 40 years with limited expenditure required to replace parts that have become worn (vandalism can cause increase in costs at some sites).

The sites are unsupervised and may be visited for inspection and litter removal once or twice a week, performed by a manual worker.

Where necessary the grass will be cut a few times each year.

In revenue terms therefore, the cost of running playgrounds is relatively low. Any increases in inspection, supervision, maintenance will be high as a percentage of existing costs.

What is seen as high capital costs of installing a playground is in fact relatively low when calculated over the life of the playground.

Recommendations of increased maintenance and/or supervision would require very significant increased revenue costs or would result in many playgrounds being closed. There are therefore good reasons why playgrounds are made of robust materials which require little maintenance and only occasional replacement of parts.

As children's travel distances are short, their regular play place is close to home, closing local play areas and concentrating on a few well supervised sites with high maintenance costs would diminish the number of children who are able to take part in "freely chosen, personally directed, intrinsically motivated" play.

SURFACING PRE-1978

Prior to the British Standard BS 5696 (1978) "Playground Equipment", which introduced the desirability of Impact Absorbing Surfaces (IAS), the best available advice on playgrounds was from the National Playing Fields Association (NPFA). They advocated hard surfaces.

A report was prepared by the NPFA for the Ministry of Housing and Local Government had six imprints between December 1953 and August 1974. This report 'Playgrounds for Blocks of Flats' stated that:

> **….for two to five years age group** 'it is desirable to provide a hard surface for wheeled toys and under equipment'

> **….for five to ten years age group** 'a hard surface should be provided under equipment…'
>
> **Surfacing** 'Asphalt is probably the best material for this purpose. A single line of flag paving under swing or similar equipment helps to prevent tracking or uneven wear'

Photographs within the publication clearly indicate playground equipment on asphalt tarmac or concrete surfaces.

It can therefore, be seen that on the basis of utility, it was recognised that grass was not a suitable surface in places of reasonable wear and that it was particularly unsuitable under high scuff areas. This knowledge has been around for over half a century.

In the NPFA magazine (Oct-Dec 1976) there is the following statement:

> "The manufacturer's safety clearance area for his equipment should always be given at least a hard surface, usually asphalt or coated macadam. This is particularly important where the wearing away of a grass or gravel surface might increase to a dangerous extent the gap between the equipment and ground, eg under swings or a merry-go-round."

They do, however, continue:

> "It is much preferred, however, if the hard surface can be covered by a synthetic material such as (list of proprietary IAS) … helps to reduce the incidence of minor cuts and bruises from falls."

From this it can be seen that the hard surfaces under equipment were regarded as a safety element but there was beginning to be a realisation that "softer surfacing" was preferable – though not essential.

I worked for NPFA from 1975 until 1984 and my understanding at the time was that the hard surfaces were also considered to have some safety element in that it gave children a sure footing rather than a muddy one where there was a danger of slipping and falling.

UTILITY OF GRASS

I have inspected hundreds of playgrounds each year since 1990 and carried out a considerable number of consultations with children and parents. In addition, whilst working for the NPFA, I was joint author of a research report 'Talking About Play' (pub.1982 by Humberside PFA and a second edition pub. NPFA circa. 1986).

There is no doubt that children value grass as a play surface both as a flat surface for ball games and as humpy-bumpy ground for more imaginative play.

The problem is that grass does not have good wear characteristics. I have seen playgrounds that have become unusable for large periods of the year because mud at the entrance is deeper than shoe height. The pool of muddy water under swings means that a child would have to paddle to use the equipment and mud at the end of a slide means that the child cannot get off the slide.

Comments that '*children do not mind a bit of mud'* demonstrate that those making them, have visited insufficient playgrounds to understand the difference between a temporary puddle which does encourage play, and the long lying dirty muddy water which children do not find attractive.

It also shows a severe lack of visiting play areas in our towns or cities, where playgrounds are often built on 'made up' ground. In these situations there only has to be a limited amount of wear and half bricks, lumps of concrete and other hazardous materials are exposed creating both impact and trip hazards.

Both the photos below were taken at a lightly-used but reasonably drained village play area. The wear at the edge of the wet-pour impact absorbing surface gives a trip point. The edging is sometimes concrete kerbs. The wear to the grass exposes the concrete base at the support and stones under the swing.

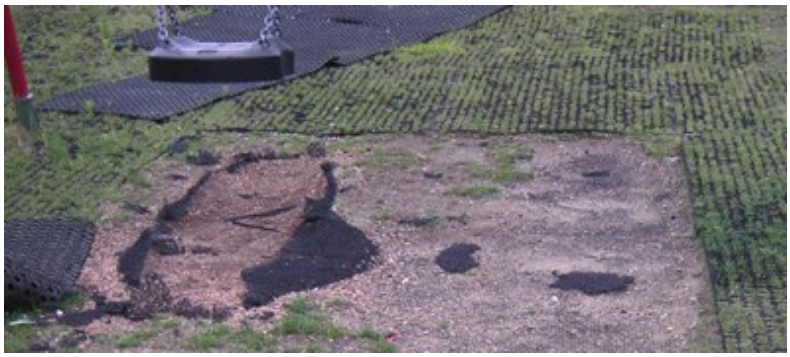
The photo below left is at very lightly-used swings but in ground which does not drain well. The photo on the right is a small kick-about football pitch – it appeared to be grassy but the rocky soil meant that light usage quickly killed off the grass and exposed the rocks.

My conclusion is that on the basis of utility alone, playgrounds or parts of playgrounds which receive anything above moderate use require some surfacing that will cope with the wear.

I further suggest as a rule of thumb that if grass is in reasonable to good condition at a playground then it is proof that the playground is in the wrong location. Children are not using it. The only exception would be at small isolated settlements.

My further knowledge is that at least some of the rubber or plastic grass grid type surfaces which act as a grass reinforcement, quickly deteriorate under high scuff areas such as cantilever swings or roundabouts. In other words, in these areas even with reinforcing the earth and grass, do not have sufficient strength to cope with the wear factor. The impact and scuffing are sufficient to destroy the root system, the earth then compacts and/or erodes and the rubber grid then lifts.

Grass grid systems can support grass growth



Both above photos demonstrate that, even with grass grid reinforcement the grass cannot cope with scuffing

I would stress that some grass grid systems do not rely on the grass and roots to anchor them and give them their impact absorbency.

ACCESSIBILITY OF PLAYGROUNDS

Mud at a gate shows effect of high wear and makes access difficult particularly for push/wheelchairs

An area of utility which has generally been ignored by those analysing playground accidents is the issue of accessibility by those in wheelchairs or with mobility impairments, or for parents bringing a child in a pushchair or buggy. In addition, elderly grandparents or other relatives may wish to take their grandchildren to the playground but may not be quite as agile on their feet as they once were.

In an NPFA publication "Impact-Absorbing Surfaces for Children's Playgrounds", 1987, it states:

> "Hard surface areas are still required in play areas for access by adults, children with wheeled toys and children with physical disabilities. The last group is especially highlighted since many children with movement difficulties can use playground equipment providing they can reach it."

In "Can Play Will Play", pub. NPFA 2004, we recommended the path be "firm". This is different from "hard" as many IAS can be "firm". This was recommended because grass is likely to become "soft or rutted" or even become "mud".

This again emphasises that on the basis of utility grass cannot be relied on as a suitable wearing surface.

POST-1978 – BS 5696

Prior to BS 5696 being issued there appears to have been concerns that avoidable accidents were happening on children's playgrounds. There was a report undertaken by the Consumers' Association (*Which?* magazine) in August 1976 which was felt by the Government important enough to be issued by the Department of the Environment as "HDD Occasional Paper 2/76".

Amongst other interesting issues it found:

> "Whatever the equipment involved, the most common cause of the actual injury was the surface on to which the child fell. The child fell or was thrown on to concrete, gravel or tarmac in nearly half the accidents we were told about by CA members and by the mothers we interviewed."

This and other reports were influential and prior to the publication of BS 5696 the Government wrote to all District and Borough Councils in England on 31 October 1978. It recommended that Local Authorities would pay particular attention to that Standard and in the annex stated:

> "It is strongly recommended that impact absorbing surfaces be provided under and around equipment from which falls are possible, and particularly around agility equipment (climbing frames etc) and free-standing slides."

Research by the London Borough of Lewisham (Marcus Heaster) was delivered to the RoSPA conference in May 1977 and was based on playground accidents 1974-1976. Like the *Which?* report it covered many issues and similarly found:

> "At least 50% of accidents terminate in some form of ground surface impact."

He did however continue:

> "The chances of these surfaces eliminating accidents are remote but many could reduce the severity of injuries."

He pointed out that hard packed earth is "16 times better than concrete and 4 times better than asphalt" (for impact absorption).

He also noted that the proprietary "safety surfaces" are "rarely more than a little over an inch thick" and so "not as good as hard packed earth".

My recollection from this period is one of growing awareness of the unsuitability of tarmac and concrete as surfaces on to which children were likely to fall from a height. Whilst there were beginning to be surfaces available they were in their infancy and were not offered as routine by those building playgrounds.

The pressure for surfacing did not come from an industry wishing to make profits from IAS, in fact I recall and have had it more recently confirmed, that the major equipment suppliers did not immediately have products that were readily available for sale and in fact did not welcome the introduction of IAS. They made their profits from selling equipment and having to sub-contract a large proportion of the contract to a IAS surfacing contractor seriously cut into their profits.

Neither do I recall any 'Esther Rantzen' style campaigning for safety surfacing which preceded this Standard. In fact the Esther Rantzen campaigns were not until the 1980's.

The introduction of IAS was brought about by a rational approach to known instances of injuries rather than any pressure for people to make profits or from any emotive pressure from high profile campaigns.

From my personal experiences in the past ten years, I have twice fallen onto concrete and tarmac. In both instances I fell from approximately 300mm and in both instances the bruising was severe and painful and far more serious than when I have fallen onto grass or IAS on playgrounds.

It is interesting that in BS 5696 concrete or tarmac were still deemed acceptable under fall heights of less than 600mm. This would seem to have been on the basis of "reasonably practicable". My own view is that where fall heights are not significantly more than would be normally experienced eg front step of a house, or low wall (3 or 4 courses) then hard surfaces are not an excessive hazard. The exception would be where a play item is designed to cause the child to topple over.

What is true is that there were unrealistic expectations on the number of injuries the IAS would prevent. Clearly if a child falls awkwardly on to a surface the weight of their body following will tend to cause the break so it is unrealistic to expect a dramatic reduction in long bone injuries. There may still, however, be a reduction in the severity of injuries (see section below – Experimental Falling).

It is, however, generally true that long bone injuries can usually be successfully mended with little or any long term consequences. Head injuries causing brain damage are a different matter altogether.

EPIDEMIOLOGICAL RESEARCH

It is always valuable for organisations to seek assistance from outsiders who can bring 'a second pair of eyes' to issues and have insights which might have otherwise been missed.

Research by Professor David Ball has undoubtedly brought this fresh approach and made people question existing orthodoxies. His research is a welcome contribution which has challenged assumptions about the effectiveness of IAS in reducing injuries.

There are however, I believe, some misunderstandings within his report which have not generally been picked up by those involved in children's play.

One shortcoming is that the research treats 'climbing frames' as a constant and concludes there are increasing injuries associated with 'climbing frames'. This strongly assists the conclusions that the IAS are not having an affect on reducing injuries. It is only relatively recently that Professor Ball has started to acknowledge the possibility of 'modular' equipment having an affect on accident figures.

There has, however, been a change in playground equipment and it is that the standard climbing frame has tended to diminish in number and increasingly complex multi-plays are becoming more numerous.

From many consultation exercises I have carried out, it is apparent that well over 90% of children and parents refer to a multi-play as a 'climbing frame' and it is therefore certain that they would do the same when reporting an accident at a hospital, from where the statistics are taken. "Climbing frames" are therefore not a constant.

The differences are significant. A climbing frame would typically be made of (usually metal) poles. They would cater for a small number of children, say three to five, and the manner of using them would be to hold on tightly to the poles. The research mentioned previously did find, however, that for their use there was a disproportionate number of accidents. Interestingly the experience with challenging space nets is that they do not lead to many accidents as children tend to move slowly and hold on tight.

A multi-play on the other hand, is in effect a collection of three to ten or more individual items of equipment gathered together in one unit which will cater for five to twenty or more children.

In addition, some of the elements will involve 'forced movement' (movement forced by the equipment - EN 1176) where the children will NOT be holding on securely e.g. slide and fireman's pole. They also often include overhead ladder (monkey bars) which are known to provide challenge and have a higher level risk than the average playground item.

A further risk factor in multi-plays, is that children are encouraged to move around on decks which are usually at least 1m above the ground. It is therefore more likely that occasionally bumps between children will occur and that some will result in a fall either to deck or, more seriously, to ground. The incidence of such is likely to be higher than

from a conventional climbing frame. This would also be in line with known accidents in indoor areas where children are encouraged to move around quickly in close proximity.

This is not to say that the multi-plays are unacceptably hazardous but to indicate that in the excitement of using them, there will be inevitably the usual bumps and scrapes that children receive during childhood.

Manufacturers have responded to the market by making these multi-plays more exciting and interesting.

It is therefore, predictable that there should be an increase in injuries related to falls from what people will call "Climbing Frames".

There has been a decrease in injuries attributed to swings and Professor David Ball has attributed this to Local Authorities removing a large number of swings.

I know of no Authority which has had a policy of taking out swings, per se, and the two Authorities I do know that have taken out stressed arched swings have replaced them with other swings. In fact swings remain universally popular and are always highly valued and desired by children and parents when responding to consultations.

There has been a decrease in the height of swings as this gives significant savings in area (and cost) of IAS and it is possible this may have reduced the severity of injuries.

Having said that, it is clear that Local Authorities have been responding to the desire for challenge and excitement and have increasingly installed cantilever or similar swings. These swings usually have a large tyre or hammock which three to five children will use at any one time. I have seen up to five teenagers swinging on one of these, very vigorously indeed. I would therefore anticipate that these do give some increased, though acceptable risk, and this should be reflected in an increased number of injuries.

It is therefore possible that the decrease in injuries at swings is due to the installing of IAS.

I would also disagree with Professor Ball's cost benefit analysis where he assumes that the total cost of impact absorbing surfacing is a wholly additional cost to playgrounds.

It can be seen from what has been previously stated that on the basis of utility that a significant proportion of play equipment needs wear resistant surfacing under and around it. That surface should not be concrete or tarmac and therefore needs to have some impact attenuation.

In other words, even if the concept of IAS had not been invented, playgrounds would have had surfacing installed which would have had many of the characteristics of IAS and would probably have been of similar cost.

If no manufactured or engineered surfacing had been invented, then there would have been seriously increased revenue costs if the grass had to be re-turfed regularly (more than once a year) with fencing to keep children off it until it achieved sufficient root growth. There would have therefore been a serious loss of play opportunity for the children.

An approach based on utility rather than safety would probably have resulted in less surfacing in lightly used areas and more surfacing in heavily used areas where muddy and worn patches and trip points between areas between IAS are still quite common.

A surfacing based on utility may well have had less hard kerbs and edges giving trip points which, in the opinion of the writer, would have been an improvement.

It is difficult to estimate how much cost saving there would have been but as all well used playgrounds would have needed manufacture/engineered surfacing and all those built in heavily populated areas then it is hard to see that the saving would have been more than 50% (still a large amount of money but may have been nearer 25%).

There is some contradictory research from Professor Joe Sibert from the University of Wales. This was a study of 330 children who were hurt when playing in playgrounds in Cardiff. Rather than merely relying on what was reported, parents were interviewed to find out the playground and type of equipment involved. Their study stated that "rubber or bark surfacing is associated with a low rate of injuries and we support their use in public playgrounds". Interestingly, they also stated "our study also suggests that a rubberised IAS is safer than bark".

I would suggest that one of the reasons for this is that because bark feels "soft" children will take greater risks in jumping on to it. Certainly when bark or other wood chip type surfaces are used children have been observed to jump down on to it as if it is a mattress (see following section – Experimental Falling).

Another area where I disagree with Professor Ball is his assumption that some accidents could have been prevented by a greater level of supervision of the children or training children how to use the equipment 'properly'.

This fails to understand the reality of children's play.

Children only go to school half the days in the year and so the remainder days are potentially free for play. Even on school days children will play out in the evenings.

It is therefore unrealistic to expect that parents or paid supervision will be on hand during the whole of this period. The reality is therefore that most play on local playgrounds is unsupervised.

Play is beneficial to children because it is 'freely chosen, personally directed and intrinsically motivated'. This is not to criticise supervised activities but is to maintain that the importance for the children of play is that they make the decisions for themselves, reach the agreements, make the rules, settle the disputes, all as part of the fun at having play. It would therefore be an infringement of children's liberty and damaging to their play to insist all play is supervised or institutionalised.

Economically, the cost of having paid supervision at playgrounds would be out of all proportion to any other measures taken to reduce accidents.

EXPERIMENTAL FALLING

Play Consultants occasionally joke about the undesirability of dropping children from various fall heights on to different IAS to test their effectiveness.

There was however, a long trial and error experiment which has equivalence.

Previous to sand pits being installed in athletic high jump areas, the athletes jumped in an upright position tucking their legs up or with what was called the scissor jump and landed on their feet.

The introduction of the sand pit, ie an IAS, meant that the jumping styles changed. One common style was the straddle jump in which the athlete landed on their side, another was the western roll in which the athlete landed with a three point landing (a knee and two arms).

Club athletes were regularly jumping over and therefore dropping from fall heights of six feet or more (1.8m). They were landing in what if it was a fall, would be called 'landing awkwardly'. They were avoiding broken long bones and cracked ribs.

As far as I am aware, the sand pit, the depth of the sand and the need to rake it regularly were arrived at by trial and error rather than scientific means.

Whilst this does not prove from a cost benefit analysis point of view, the desirability of IAS, it does tend to indicate that the sand pits did reduce the possibility of long bone and rib fractures.

It was only with the development of the deep mattress for the fall areas of high jump pits, that the 'Fosbury Flop' style of jumping was developed in which the jumper lands on their upper back/neck.

This indicates that with softer landing pits people may take higher risks. In other words they may give higher levels of excitement and challenge for the same level of risk.

Conversely it has been argued that IAS should feel hard to the touch so that children do not adopt riskier activities and therefore negate the purpose of the IAS.

Softness and impact absorption are not the same thing. A wrestling ring has a wooden floor with only light padding. The floor is hard and the impact absorption comes from the floor bending. It is therefore possible to have firm surfaces which give impact absorption.

GRASS AS AN IMPACT ABSORBING SURFACE

I have long advocated that for low-use playgrounds with good grass, it would be reasonable to accept a higher fall height so long as a simple method of test is devised. The first part of this publication describes this method of test.

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I am therefore concerned when those without knowledge of playgrounds are advocating grass without qualification.

Considerable research by Peter Drury at Nottinghamshire County Council revealed that the impact absorbency of grass does not just depend on the top surface or the sward but crucially is affected by the top soil for a good few inches underneath. His research was originally for cricket wickets however, the science is the same and he developed a type of Impact Absorbing Surface.

My personal experience, from a slip during an inspection on what I thought to be a grass surface, was that I was considerably winded and bruised to the point of thinking that I may have cracked a rib. On probing the area, I found that the grass was in fact little more than an inch deep and that there was bedrock immediately below.

I am therefore concerned that unless grass is tested, children may be induced to think a grass surface is safe whereas the underlying rock or concrete may mean it is unsafe.

I am further concerned that those advocating grass, have not seen what happens at high wear points when grass becomes eroded. In green field sites stones and rocks may become exposed and the concrete bases of equipment also become exposed. In towns and cities however, the land is often "made up" and therefore may contain half bricks and other items which may be pointed. These often become exposed quite quickly as the depth and quality of the top soil is insufficient to maintain even modest grass growth.

These exposed bricks etc are hard and may provide a raised leverage point which is more likely to give broken bones. They may also give a small pointed projection which greatly increases the potential for a serious head injury.

Grass with a high clay content will wear and then dry out and form hard ridges which can be hazardous trip points (twisting and breaking ankle potential) particularly round items such as roundabouts. These hard ridges can persist for a considerable time.

'THEY'LL LEARN ONCE THEY HAVE BROKEN A BONE'

It is often stated that children learn from their mistakes and that there is therefore no need to worry too much about the surfaces under children's playground equipment.

I support the position statement of the Play Safety Forum 'Managing Risk in Play Provision'. I accept that normal bumps and scrapes and indeed the occasional broken bone are part of childhood and that to try and avoid these completely would be a severe limitation on children's' freedom to play and would be more damaging to their overall health than the accident reduction which might result.

If children have the freedom to play out on the pavement or in the tarmac school playground, they will have sufficient falls to ground to learn that falling on to hard surfaces does hurt and can cause injury.

It is a completely different matter for them to be encouraged to undertake agility play over a surface which we know to be more likely to result in serious injury than a surface with reasonable impact attenuation.

An awkward fall onto tarmac or concrete will very often lead to a broken long bone and if it is a head injury, can lead to permanent disablement or death.

The excitement and challenge for the child is in the fun of the equipment itself. Going on a swing, slide or roundabout give excitement through the movement and the fear that they might fall off. There is no added excitement or enjoyment from hitting the concrete rather than a surface with some impact attenuation if they actually fall off. If there was excitement from providing an additional risk then there would be no point in rounding off sharp edges or leaving projecting points exposed.

We therefore need to be clear that increased risk as a consequence of necessary or desirable activities is often inevitable and acceptable. Increased risk for no beneficial outcome and in the knowledge that it will cause harm is not acceptable – modified of course by the "reasonably practicable test"

LESS RISK MORE ADVENTURE, CHALLENGE AND EXCITEMENT

Whilst not the main theme of this paper I feel it is important to correct some fairly loose thinking around risk which is in danger of promoting "risk" without any beneficial increase in adventure, challenge or excitement.

"Children need more risk" is commonly stated however it is a misunderstanding.

If I give an example: those attending Alton Towers type theme parks are invited to ride on "death-defying" rides. Passengers have adventure and excitement, they have the challenge of facing and overcoming real fear but the risks are low. The risks are probably less than driving a car or crossing a road.

It would be negligent if the risks were increased.

If a parent wants their child to be able to make a cup of tea before they leave home to get married, they run the risk of the child being scalded. Occasionally people are scarred for life. The benefit of being able to make the tea outweighs the risks. It would be unreasonable and damaging to the development of the child to protect them from this risk.

Kettles have been designed so that there is a reduced risk of them toppling over or dribbling boiling water, electric kettles are designed to avoid the risk of electrocution.

It would be negligent to increase these risks so that scalding or electrocution was more likely on the basis that "children need more risk" and that there would be increased learning from the resultant injuries.

There are sufficient opportunities for children to learn that hot water hurts without making it more likely that they will be injured.

Adventure, challenge and excitement are therefore not the same as "more risk" and there is not necessarily any correlation between them.

I believe that we should be ensuring children have opportunities to experience adventure, challenge excitement or simply fun but that we have a duty to reduce unnecessary risk.

What children want from playgrounds is adventure, challenge and excitement NOT an increased risk of injury. The two are not automatically linked. Well designed equipment can give an impression of danger where risks are low.

Some items have a higher risk of being associated with accidents than others e.g. overhead bars. In those cases their popularity, the fun and challenge they present justify the increased risk. They cannot be used without facing that level of risk. The risk is necessary for the enjoyment of the item. The risk can be increased unnecessarily by, for instance, having the child reaching sideways to access the ladder so that they swing sideways which levers open their hands making a rotating fall likely. The risk of injury can also be reduced by having a good impact absorbing surface underneath.

Increased risks with no increased benefits in either adventure or utility should be avoided.

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It is right that conventional wisdom is challenged. If it was not, we would all still believe that the earth was flat.

We should however, recognise the importance of IAS being included as desirable in the European Standard effective from 1 January 1999 (as it had been recommended in BS 5696. since 1978).

This standard was formulated by experts from all over Europe and built on particularly the British and German standards which had been operative from many years before.

It would, however, I believe, be negligent to recklessly ignore that advice and to advise others to wilfully ignore it. I am concerned that some individuals working in influential positions in children's play appear to be taking this position. They appear to be doing this from an ideological position rather than from any significant knowledge of unsupervised children's playgrounds.

TAKING INCREASED RISKS

There is an argument that children will take increased risks if they know that the surface is safer. The increased safety is therefore cancelled out by the increased risk that they take.

I have observed children where they have obtained mattresses launching themselves onto them because they know that they will absorb their impact. They will jump onto them rotating and landing on their backs in a way that otherwise be dangerous. That change in behaviour was also seen in the invention of the mattress for high jump pits meant that the Fosbury Flop, where athletes land on their back.

There is some anecdotal evidence that children do take increased risks when they realise that there is an impact absorbing surface underneath.

The possible additional evidence I have seen for this in the Professor Joe Sibert research which found that the rubberised surfaces were safer than the bark. This appears to be contrary to what might be expected as bark has very good impact attenuating properties. It may be due to local factors such as maintenance. It would also seem likely that, particularly when new, bark and other loose-fill surfaces have a soft appearance and may encourage children to jump into it as they would on to a mattress.

There does not appear to be any definite evidence for this and I do not believe the risk to be sufficient to say that bark or other loose-fill surfaces are not suitable for playgrounds I only state it as an area for possible further enquiry. My own feeling is that there may be some validity in thinking that the softer the feeling of the surface the more likely it is to encourage some increased risk taking. I would also add that it is important to realise that "feeling soft" and "impact absorption" are not the same thing.

CONCLUSIONS

1. Concrete and tarmac are not acceptable surfaces under equipment where children are encouraged to undertake agility play.

2. Children like grass as a surface, however it has poor wear characteristics and in moderate to well-used playgrounds will quickly become worn giving muddy, rutted conditions or exposing underlying bricks, concrete, etc. Other surfacing is therefore needed to maintain utility.

3. Even if the concept of IAS had not been thought of, surfacing would still need to have been invented which would have ensured that the utility of the playground could be maintained. Such surfacing would have had to have significantly greater impact attenuation than concrete or tarmac.

4. As a simple cost-effective method of test has been devised grass is suitable for fall heights of up to 1.5m providing it meets the 2 criteria indicated in Part 1 of this report.

5. Those without competence (and probably without insurance to back up their advice) should be cautious in the advice they give so that Local Authorities and other playground managers are not misled into misunderstanding the status of the advice they are giving.

6. The debate about surfacing playgrounds has been insufficiently about overall utility itself including safety. The concentration on safety at the exclusion of utility has probably meant that money has been wasted though the amounts are not nearly as significant as many have believed.

7. The industry should look to providing impact absorbing surfacing which can be laid in areas of wear and feathered or graduated into the grass so that there is no wooden or concrete edging which gives a trip or impact point. The surfacing should be capable of being installed both at the time of installation of the equipment/ playground or afterwards when areas of wear are evident both at the equipment and in other heavily trafficked areas.

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