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An examination on safety and standards of children playgrounds and playground equipment in parks located in north of Tehran (regions 1,3,5,6 and 21) with some advisable suggestions

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ABSTRACT

Current research was conducted to examine safety and standards of children playgrounds and their equipment in northern half of Tehran (including regions 1, 3, 5, 6 and 21) and provide appropriate solutions. For this purpose, a checklist was prepared for data collection based on information derived from instructions of Consumer Product Safety Commission instructions and standards of American Society for Testing and Materials in addition to regulations of Institute of Standard and Industrial Research of Iran. These regulations were then validated by researchers and all these parks were checked as examples. Average percentage for regions 1, 3, 5, 6 and 21 were 48, 46, 62, 45 and 67% of the standard and safety, respectively. A wide range of safety issues were obtained in different items. Finally, safety and standardization recommendations were made for children playgrounds and equipment therein.

Keywords: safety, standard, park, playground equipment

INTRODUCTION

Taking into account physical limitation and small areas of houses, which are simply expressed by the term "apartment life", it seems necessary to use public areas like parks, sport environments and entertainment areas more than any time before. In this regard, practitioners of the municipal affairs such as municipality should inevitably develop these environments. This issue is more important in Tehran as a strategic metropolis than other cities in Iran or in the world. That is why the municipalities have recently decided to develop these environments. Citizen's rights and safety management by the involved parties are certainly important factors in development of these environments during their design, construction and administration.

It seems necessary to consider proper managerial solutions for providing a suitable environment both theoretically and practically in entertainment and playground environments of parks. Therefore, examination and controlling the physical environments and their safety are of significant importance. Thereby, reinforcement and improvement of these public environments as well as prevention of serious injuries and problems can positively appear in mind for tendency toward healthy entertainments during spare times in the parks. Passing the spare times in these places will undoubtedly incorporate various physical activities especially for children. Incidents for children covers a wide range of consequences including cost-related and economic issues, epidemiologic studies, health improvement programs, production of equipment and relevant standards. However, they are not just limited to local and national levels, and they include international levels, too. Standards of American Society for Testing and Materials (ASTM) and Public Playground Safety Handbook of CPSC are two examples of them. The main reason for checking the standards is occurrence of several incidents all over the world, which is reported to be about 16,000 deaths due to

various injuries as one major causes of death [25]. Some of these incidents happen in the parks which are frequently seen in Iran. One of the recent examples is the one occurred in 2011 in one of the parks of Mashhad, Iran. An electric wire was left exposed in a lighting system and led to death of a curious child. Many of these situations can be found in the parks but they are rarely reported officially. Various reports have been addressed in the literature. For example, Sadeghi Naeini et al.(2010) have investigated children safety in playgrounds of urban parks (case study: local-regional parks of Tehran). They demonstrated that more than 68%of the playground equipment in the parks could be potentially hazardous and cause serious injuries for the children. Inadequate service and maintenance of the park equipment has made running and walking on surfaces of the playgrounds rather dangerous. It was additionally shown that the safety issues have made mothers anxious about playing of their children in the park [10]. Nevertheless, main drawbacks of the research implemented by Naeini et al. was incomplete and inexact identification of the safety factors and also lack of proper access to a complete and comprehensive check list about the safety factors. Moreover, Zamani Sani et al. (2010) by comparing safety and standards of the entertainment and sportive environments of regions 1, 3 and 5 have shown that the standard and safety had been observed 48, 46 and 62%, respectively [8].

It can be initially inferred from the subject of this research that some of the problems are identified or obvious but it is evident that providing proper solutions for facilitation and resolving the obstacles is possible through launching studies and giving research statistics, figures and data.

It can be argued that Sweden was the first country which has respected importance of children health and prevention of incidents associated with their safety. Death toll of children in Sweden was greater than that of U.S. something about six decades before. However, by performing effective actions, this country (Sweden) now has the lowest overall children incidents in the world. In a recent work (2008) it has been reported that approximately 90% of the incidents of the playgrounds that have led to a hospitalreference were due to the playground equipment [27]. Some 102 playgrounds in the Canadian parks were examined during years 1991 to 1995 with some 1286 individuals of the parents being interviewed. It was shown that the fall downs are of significant risk in 35% of the cases. Falling down from equipment of 2 m height was 2.56 times more common than from 1.5 m height. Material of the surfacing was more relevant than height of the playgrounds and equipment to the risk. Moreover, it was mentioned that selection of a material with proper flexibility for the surfacing is of key role in reduction of the injuries. Approach of the present work mainly emphasizes on “playground equipment” [24].

Australian hospital database (*Newsoftools*) showed about injuries of children under 14 years that prevalence of fall down incidents is 106.6 cases in every 100,000. Incidents of upper limbs are more prevalent. Safety auditing and risk assessment such as safety considerations in the related decision makings are among actions needed to control problems of children playgrounds. This paper will mainly concentrate on “playground equipment” [26].

Taking into account the importance of physical activity and mentioned risks in various researches throughout the world, as well as the existing concerns in this field and significance of physical activity and children participation, it seems necessary to conduct proper initiatives. Noteworthy in this regard is that despite greater prevalence of playgrounds in low income and developing countries, most of the published studies and papers belong to developed countries. On the other hand, the ratio of playground users in parks to users of these parks in the developing countries is greater than the developed countries. This can be regarded somehow as a reason for the increased injuries. Therefore, examination and evaluation of safety in the playgrounds and also a correct environmental planning is evidently necessary in these societies. Various incidents associated with the playgrounds in the developing countries will be undoubtedly controllable by performing applicable instructions. Under such conditions, some modifications might be required in some economic and cultural variables and the related programs.

Thus, objective of the current work is to identify potentially dangerous factors in this area by examining standard and safety conditions in addition to suggest correct solutions for improvement of the existing situation.

MATERIALS AND METHODS

This study was a descriptive-evaluative research. The required information was collected based on a self-made checklist.

The statistical population was comprised of all municipal parks in regions 1, 3, 5, 6 and 21 the numbers of which were 120, 87, 158, 61 and 35, respectively.

The aforementioned checklist was prepared by a combinational technique as explained below:

- Researchers' observations from parks and gardens, taking photographs, and extraction of questions by observing the risk factors;
- Studying needed international standards and handbooks [2] (i.e. Public Playground Safety Handbook, CPSC Publication [23] and ASTM standards [12-22], and ISIRI standards [1-7,9];
- Studying theoretical bases about standards and risk factors;
- Existing checklists of other countries including US and Europe; and
- Studying the literature and considering reasons for occurrence of injuries and risks in various activities.

Having accomplished the abovementioned items, 200 questions were designed about safety of the playgrounds and the equipment therein in subscales of: (1) surfacing, (2) playing equipment, (3) stairs, (4) guardrails and handrails, (5) horizontal ladders, (6) slides, (7) swings, (8) seesaws, (9) merry-go-rounds.

These questions were confirmed by studying validity and reliability and also by deleting some of the questions due to: (1) being time consuming, (2) needing to long term follow-ups, (3) needing to specialty, (4) possible problems caused during data collection.

Individuals responsible for data collection were selected, instructed about how to fill the checklists, and officially introduced to the selected destinations. For the purpose of attracting further collaboration of municipal practitioners and guardsmen of parks, they received some letters individually which nominated the responsible individuals for data collection and asked them to cooperate with them in filling the checklists.

Data Analysis

The descriptive methods including average, median and tables were used to determine safety status of different factors in the regions under study.

RESULTS

Table 1 lists the percentage medians of standard and safety in children playgrounds and their equipment generally, while table 2 summarizes the subscales of them.

Table.1. Percentage medians of standard and safety in playgrounds and their equipment

Status Parameter	Percentage median of standard and safety in components of playgrounds and their equipment (%)	Minimum standard (%)	Maximum standard (%)
region 1	48	29	67
region 3	46	8	100
region 5	62	18	82
region 6	45	32	57
region 21	67	50	79

Table.2. Percentage median, minimum and maximum values of standard and safety for subscales under study in playgrounds and their equipment

Examined Safety	region 1			region 3			region 5			region 6			region 21		
	Min	Max	Med	Min	Max	Med									
Surfacing	25	90	59	24	77	57	31	86	67	10	80	45	50	94	69
Play Equipment	28	74	43	11	63	36	13	100	57	9	58	34	21	61	50
Stairs	12	100	58	14	80	41	0	100	75	13	98	64	9	100	85
Horizontal Ladder	0	100	36	-	-	-	-	-	-	32	57	53	-	-	-
Slides	33	85	65	8	100	43	12	100	68	18	85	54	11	92	73
Swings	14	93	53	10	69	36	15	90	40	18	62	36	37	98	76
Merry-Go-Round	14	93	53	-	-	-	-	-	-	0	100	50	14	100	68
Seesaw	14	86	52	-	-	-	-	-	-	34	90	67	50	100	87
Spring Rocker	48	92	73	23	100	53	-	-	-	-	-	-	-	-	-

DISCUSSION

The obtained results revealed that the most standard and safe conditions were seen in the parks of regions 21, 5, 1, 3, 6, respectively. However, the statistics showed that the existing conditions are significantly far from the ideal standards. Thus, a number of essential suggestions are proposed here in order to optimize the current situation for making children playgrounds and equipment standard and safe according to the international standards. These standards are proposed using the checklist designed by researchers from the mentioned sources [11, 23, 9, 1-7, 12-22].

Safety of Children Play Equipment

- The equipment with metallic bars should not be exposed to direct sunlight for a long time. When the metallic parts of the play equipment cannot be coated or sheltered, required cautions must be installed on the equipment to avoid risk of burning.
- Suggested age of children must be written on the equipment. In fact, signs, directions and labels should be used to inform the children and support different age groups. Some of the examples are presented in Table 3.

Table.3.Required equipment based on age groups for children playgrounds in parks

Toddler- Under2	Preschool- Ages 2- 5	Grade School- Ages 5- 12
<ul style="list-style-type: none"> • Climbing equipment under 32" high • Ramps • Single file step ladders • Slides • Spring rockers • Stairways • Swing with full bucket seats 	<ul style="list-style-type: none"> • Certain climbers • Horizontal ladders less than or equal to 60" high for ages 4 and 5 • Merry-go-rounds • Rung ladders • Single file step ladders • Slides • Spiral Slides to 360⁰ • Spring rockers • Stairways • Swing- belt, full bucket seats (2-4 years) & rotating tire 	<ul style="list-style-type: none"> • Arch Climbers • Chain or cable walks • Free standing climbing events with flexible parts • Fulcrum seesaws • Ladders- Horizontal, Rung, & Step • Overhead rings • Merry-go-rounds • Ramps • Ring treks • Slides • Spiral Slides more than one 360⁰ turn • Stairways • Swings- belt & rotating tire • Track rides • Vertical sliding poles

- Those play equipment with uncontrollable risks for the children should not be used in the playground. Some of them are trampoline, swing gates, giant strides, climbing ropes that are not secured at both ends, heavy metal swings (e.g. animal figures), multiple occupancy swing, rope swings, swinging dual exercise rings and trapeze bars.
- Children play equipment should have expiry date and consistency;
- All connectors must be manufactured firmly such that they cannot be easily detached by the children. None of exposed connectors and guards may tear, pierce or stick to clothes;
- Clamp washers, single nuts or other clamping devices must be manufactured such that they can reliably resist against loosening or detachment;
- Hardware of moving connections (hinge) must be safe against loosening;
- All clamps should be made from appropriate materials so that they would be resistant to erosion and corrosion. This is particularly important when the metal is in contact with wood because it may quickly lead to erosion;
- Bearings and cuttings of the moving hinges must be made such that they can be easily lubricated;
- All of the used hooks should have "S" or "L" shapes. In this regard, it should be noted that the closed hook should not have an opening larger than 0.04" (1 mm);
- The metallic surfaces should be completely protected with correct painting for example with a galvanized paint. The painted surfaces should be protected against physical damages and erosion;
- Diameter of the protruding is of critical importance. This diameter should not be larger than its circumference;
- Any rope, dog collar and etc. which may possibly snag to the children should be placed somewhere far from the playground;
- The distance between guards or where a child's head might be entrapped there is 3.5" to 9" (9 to 23 cm). This range is very dangerous and no guard can have such a distance;
- The angle between two parts must be at least 55° since below this value a child's head may be entrapped;
- All end parts of the playground tools and equipment or the underground pipes should be covered with caps so that they cannot be opened without special tools;
- All wooden components must be smooth and free of any frills;
- All corners, from either wood or metal should be round or have round caps (triangle and similar shapes are not allowed);
- There are some hanging parts in the play equipment which must be at least 7 ft (2.13 m) high from the ground surface. Furthermore, they are not recommended to be placed in crowded areas and should be painted with bright or distinctive colors.

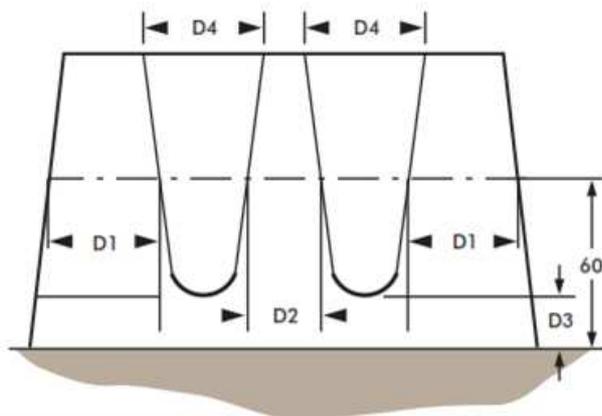
The play equipment must be located in minimum distance of 6 ft (1.82 m) from each other. The moving tools and equipment like swings should have a range of 7 ft (2.13 m) approximately. The operating range of the moving equipment must be exclusive and no other equipment can be used there. The best location for the moving equipment

like merry-go-round is at corners or margins of the playground so that the excessive movements will not endanger the children safety.

Swings

Children of all ages generally enjoy the sensations created while swinging. Mostly they sit on the swings; however, it is common to see children jumping off swings. Younger children also tend to swing on their stomachs, and older children may stand on the seats. To prevent injuries, these behaviors should be discouraged. Swings may be divided into two distinct types:

- Single axis: Sometimes called a to-fro swing. A single-axis swing is intended to swing back and forth in a single plane and generally consists of a seat supported by at least two suspending members, each of which is connected to a separate pivot on an overhead structure.
- Multi-axis: A multi-axis swing consists of a seat (generally a tire) suspended from a single pivot that permits it to swing in any direction.
- General swing recommendations (figure 1):
- Hardware used to secure the suspending elements to the swing seat and to the supporting structure should not be removable without the use of tools.
- S-hooks are often part of a swing’s suspension system, either attaching the suspending elements to the overhead support bar or to the swing seat. Open S-hooks can catch a child’s clothing and present a strangulation hazard. Shooks should be pinched closed. An S-hook is considered closed if there is no gap or space greater than 0.04 inches (about the thickness of a dime).
- Swings should be suspended from support structures that discourage climbing.
- A-frame support structures should not have horizontal cross-bars.



Reason	Dimension	Toddler Full bucket	Preschool-age Belt	School-age Belt
Minimizes collisions between a swing and the supporting structure	D1	20 inches	30 inches	30 inches
Minimizes collisions between swings	D2	20 inches	24 inches	24 inches
Allows access	D3	24 inches	12 inches	12 inches
Reduces side-to-side motion	D4	20 inches	20 inches	20 inches

Figure 1. Minimum Clearances for Single-Axis Swings

Fiber ropes are not recommended as a means of suspending swings since they may degrade over time.

- Swing structures should be located away from other equipment or activities to help prevent young children from inadvertently running into the path of moving swings. Additional protection can be provided by means of a low blockade such as a fence or hedge around the perimeter of the swing area. The blockade should not be an obstacle within the use zone of a swing structure or hamper supervision by blocking visibility.

Single-axis swings

- Belt seats used without adult assistance
- The use zone to the front and rear of single-axis swings should never overlap the use zone of another piece of equipment.
- To minimize the likelihood of children being struck by a moving swing, it is recommended that no more than two single-axis swings be hung in each bay of the supporting structure.
- Swings should not be attached to composite structures. Swing seats should be designed to accommodate no more than one user at any time.
- Lightweight rubber or plastic swing seats are recommended to help reduce the severity of impact injuries. Wood or metal swing seats should be avoided.
- Edges of seats should have smoothly finished or rounded edges
- If loose-fill material is used as a protective surfacing, the height recommendations should be determined after the material has been compressed.

Full bucket swings

Full bucket seat swings are similar to single-axis swings since they move in a to-fro direction (figure 2). However, full bucket seat swings are intended for children under 4 years of age to use with adult assistance.

- The seats and suspension systems of these swings, including the related hardware, should follow all of the criteria for conventional single axis swings.
- Full bucket seats are recommended to provide support on all sides of a child and between the legs of the occupant



Figure 2. Example of full bucket seat swings

The full bucket seat materials should not present a strangulation hazard, such as might be presented with a rope or chain used as part of the seat.

- Openings in swing seats should conform to the entrapment criteria in §3.3.
- Full bucket seat swings should be suspended from structures that are separate from those for other swings, or at least suspended from a separate bay of the same structure.
- Full bucket seat swings should not allow the child to enter and exit alone.
- Pivot points should be more than 47 inches but no more than 95 inches above the protective surfacing.

Seesaw

- Support of the seesaw should not be prone to failure;
- A shock absorber like vehicle tire must be devised under the end chairs and in the ground;
- Maximum angle of the seesaw with the ground should not be greater than 25°;
- The seesaw must never have a footrest;
- Both ends should have handles which do not turn upon keeping. It should be possible to keep them by each of the hands and they should not protrude from sides.

Safety of Surfacing

- The playgrounds should not be constructed beside roads or streets (traffic areas), bluffs or considerable heights;
- When the playground is constructed near a street, a reliable wall or fence must be put between hazardous area like the playgrounds and the street. Meanwhile, a proper design (e.g. shrubs, bushes, benches and platforms) can be used for the purpose of partitioning and separation;

- Construction of pool, lake, stream or river must be avoided adjacent to the playground;
- Sunshade areas should be constructed beside the playgrounds for their resting. If trees are being used as sunshades, their leaves must be regularly cleaned from the playground;
- All the playgrounds should be equipped with appropriate wastewater drainage;
- Different types of the playgrounds should be separated by using proper lines and signs. Moreover, the harsh playgrounds must be separated from the other playgrounds;
- The playgrounds must be built such that they are easily observed by the parents from benches of the park. There should be no obstacle against view of the parents. Of course, the benches should not be placed inside the playgrounds;
- The playgrounds of children and adults must be completely separated. This separation must be easily diagnosed without any hidden paths. In other words, it is not that simple to enter a playground from another one;
- Surfacing of the playground can be one of these types: unitary surfacing, engineered wood fibers, pea gravel, sand, shredded/recycled rubber mulch, wood mulch (not CCA-treated) and wood chips.
- The following types of surfacing cannot be used for the playgrounds: asphalt, carpet not tested to ASTM F1292, concrete, dirt, grass, hazardous CCA treated wood mulch;
- The surfacing materials should be fixed in the place and do not move especially under the playing equipment.

Platforms, Stairs, Guardrails and Handrails

- The platforms should be horizontal and made such that they minimize accumulation of trash;
- The platforms of access to the playing equipment should have an opening as their water drainage;
- The access platforms for the toddlers should not be higher than 32" (81.28 cm);
- The maximum height of stairs cannot be over 7" (17.78 cm) for the toddlers and over 18" (45.72 cm) for preschool-ages and school-ages;
- When the difference height is greater than 12" (30.48 cm) for the preschool-ages, an access device should be devised there;
- The maximum distance between steps in these equipment should be limited to 15" (38.10 cm) for the children of 5-12 years and 12" (30.48 cm) for those 4-5 years old;
- All handrails should have round sections;
- The protecting guardrails should cover the whole platform;
- The maximum unprotected length can be 15" (38.10 cm) except for entrance and exit areas;
- The access techniques should conform to ages of the children. They should be selected from proper solutions as listed below: conventional slope, stairs, ladder, arc ladder, chain climber and tire climber;
- Handling bars for the toddlers and the preschool/school-ages should have diameters of 0.60-1.20" (1.52-3.04 cm) and 0.95-1.55" (2.41-3.94 cm), respectively.
- The best handling bars for the toddlers and the preschool/school-ages have diameters of 0.90" (2.28 cm) and 1.25" (3.17 cm), respectively.
- The protecting bars and guardrails should be made according to basic standards shown in Figure 3 and Table 4.

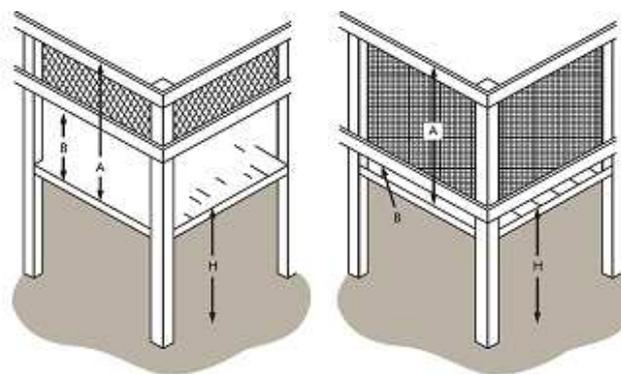


Figure.3. Different dimensions of a standard swing

Table 4. Different dimensions of a standard swing

Protecting Device	Guardrail	Handrail
Toddler		
A: distance of upper side from platform	not recommended	$A \geq 24''$
B: distance of lower side from platform	not recommended	$B < 3.5''$
H: falling from platform of height ...	not recommended	$H \geq 18''$
Preschool-age		
A: distance of upper side from platform	$A \geq 29''$	$A \geq 29''$
B: distance of lower side from platform	$9'' < B \leq 23''$	$B < 3.5''$
H: falling from platform of height ...	$20'' < H \leq 30''$	$H > 30''$
School-age		
A: distance of upper side from platform	$A \geq 38''$	$A \geq 38''$
B: distance of lower side from platform	$9'' < B \leq 28''$	$B < 3.5''$
H: falling from platform of height ...	$30'' < H \leq 48''$	$H > 48''$

Balance Beams

- Balance Beams in the preschool-ages and the school ages are not allowed to be higher than 12" (30.48 cm) and 16" (40.64 cm).

Horizontal Ladder

- The children of years 4-12 should not use the horizontal ladders.
- The first and the last handle should not be devised directly on top of the platform (there must be some distance);
- The highest allowed horizontal ladder for the preschool-ages (4 and 5 years old children) is 60" (152.40 cm), while this value is 84" (213.36 cm) for the school-ages.

Slide

- Diameter of the slide bars should not be greater than 1.9" (4.83 cm);
- The slide platform should be at least 19" (48.226 cm) deep for the toddlers and at least 14" (35.56 cm) deep for the preschool/school ages. The platform part of the slide should be horizontal and properly by appropriate guardrails. The platform of the slide should be free of any crack or opening (where part of the body or clothes may be entrapped). It should have handles to facilitate sitting down from standing position;
- The end part of the slide should have a slope of 0-4° and the exit area with horizontal curvature must be at least 18" (45.72 cm) long;
- The stairs should not have circular or curvy shapes;
- The end part of the slide should have 7 to 10" (17.78 to 25.40 cm) length for the toddlers;
- The slide should have a distance of at least 6" (15.24 cm) with the ground;
- The end part of the slide should have minimum length of 11" (27.94 cm) for the preschool/school-ages;
- If the slide is lower than 4 ft (1.22 m), its distance from the ground should be less than 11" (27.94 cm);
- If the slide is higher than 4 ft (1.22 m), then its distance from the ground should be something between 7 to 15" (17.78 to 38.10 cm);
- For the slides which are higher than 6 ft (1.82 m), range of the area used must be limited to 8 ft (2.44 m);
- The areas of limited access should have 3 ft (0.91 m) distance from each side;
- It is recommended to assign a minimum distance of 6 ft (1.82 m) from each side with the other equipment outdoor;
- The slide should have 3 ft (0.91 m) distance in the combinational structures of the area under use;
- When several slides are located in a playground, they should be located in parallel direction rather than an opposite direction;
- The slides should be installed in areas which are not crowded;
- No metal device should be used in the slides.

Spring Rockers

- Height of the spring rocker should be in the range of 14 to 28" (35.56 to 71.123 cm);
- The spring rocker should have a footrest of at least 3.5" (8.89 cm) width. The spring rocker should have no additional fluctuation;
- The spring rocker can be as high as 12 to 16" (30.48 to 40.64 cm) and as high as 14 to 28" (35.56 to 71.12 cm) for the toddlers and the preschool/school-ages, respectively.
- The spring rocker with more than one sitting area should be 37" (98.93 cm) apart from each other at least;

Horizontal Merry-Go-Round

- The merry-go-round should have no additional fluctuation. The horizontal merry-go-round should be free of sharp and cutting edges;
- Platform of it should not move faster than 13 ft/s (3.96 m/s);
- The horizontal merry-go-round must meet the following height requirements: preschool children 14" beyond protecting level, school children 18" beyond protecting level;
- The maximum difference between various radii of a horizontal merry-go-round should not be greater than 2".

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