# CHAPTER 11

# PLAY AREA SURFACING

## 11-1. Introduction.

A variety of surfaces should be provided in play areas. Both soft and hard play surfaces are needed to support different types of play activity. Hard surfaces and safety surfaces are discussed in this chapter. Safety surfacing is mandatory throughout the use zones of all manufactured play equipment. Safety surfacing includes synthetic surfacing and loose-fill surfacing.

## 11-2. Hard Surfaces.

Hard surfaces include soil, concrete, asphalt, artificial grass, and decomposed granite. These surfaces support a variety of activities for all age groups, including: circulation, wheeled toy play, chase games, site exploration, and ball play. Hard surfaces are accessible to individuals with disabilities.

*a. Design Considerations.*

(1) *Concrete.* Concrete should be poured on a prepared base that is clean and free of debris. Color admixtures or surface paint may be added for interest and to provide opportunities for organized games and dramatic play.

(2) *Asphalt.* Asphalt should be contained with a concrete or timber edge to eliminate chipping and cracking around edges.

(3) *Pavers on Concrete.* The accessibility of this surface depends upon the surface texture of the pavers and the profile of the mortared joints. This material can provide a stable and easily maintained surface for both foot and vehicular traffic.

(4) *Crushed Stone and Decomposed Granite.* When compacted, this material is a good all-weather, accessible surface for picnic areas or pathways. Designers should be aware that maintenance is essential to continued accessibility.

(5) *Wood Decking.* This surfacing material is susceptible to deterioration and wear. It requires moderately high amounts of maintenance. Adequate drainage and ventilation of wood decking is necessary to avoid rot and to prevent the growth of moss. Wood decking can be easily painted to provide interest and to delineate areas.

(6) *Pavers on Sand.* This hard surface material is less expensive than pavers on concrete, and is permeable to allow for drainage. Similar to pavers on concrete, the accessibility of this surface depends on the surface texture of the pavers. This surfacing material is subject to erosion, and to heaving during freeze/thaw cycles. Displaced sand can present a slip hazard.

(7) *Artificial Grass.* Artificial grass *is* an expensive material that is suitable for general play and game areas. It should be laid on a hard surface.

(8) *Soil.* Untreated soil is variable. Soil maybe acceptable for some situations if maintained to prevent erosion and eliminate poor drainage conditions. Soil condition changes significantly with precipitation, temperature, erosion, and wear.

(9) *Drainage.* Positive drainage should be provided. Flat grades or negative drainage should be avoided.

*b. Recommended Ages.* Hard surfaces are used by all ages.

*c. Safety Guidelines.*

(1) *Prohibited Use.* Hard surfaces will not be used in play equipment use zones or crawl areas for infants.

(2) *Slip Hazards.* Concrete finishes with a light texture, such as a broom finish, should be provided to reduce slipping when wet. Loose material, such as sand, gravel, and wood products, create slip hazards on hard surfaces. Where loose-fill materials are adjacent to hard surfaces, the level of loose-fill material should be installed 75 mm (3 inches) below the level of the hard surface. Loose-fill materials should be contained with barriers. Designers should consider that moss and mold on concrete and asphalt are a slip hazard and a maintenance issue.

(3) *Trip Hazards and Dropoffs.* Changes greater than 6 mm (l/4-inch) between levels on pathways should be avoided.

(4) *Drainage Grates and Utility Boxes.* Drainage grates and utility boxes will be locked and located outside of the play area where possible.

*d. Accessibility.*

(1) *Hard Surfacing Options. All* hard surfaces and primary pathways will be firm, stable, and slip-resistant. In the order of decreasing accessibility, the following hard surfacing choices include: concrete; asphalt; pavers on concrete; crushed stone or decomposed granite; wood decking; pavers on sand; artificial grass; and untreated soil,

(2) *Asphalt.* Asphalt will not be used in very hot, sunny locations because it may become soft and cause difficulty for people using wheelchairs. Asphalt used in these locations may also be a safety hazard when hot.

*e. Maintenance.* The maintenance level is low for most types of hard surfaces.

*f. Cost.* The initial cost is moderate. The cost of maintenance is low.

## 11-3. Safety Surfaces.

Adequate safety surfacing throughout play equipment use zones is an essential safety requirement. Falls from play equipment represent over 70% of all playground equipment-related injuries treated in hospital emergency rooms. Without appropriate safety surfacing, these falls may result in permanent head injury or death.

*a. Types of Safety Surfacing.* A number of safety surfacing materials are available. Each type of safety surfacing has unique advantages and disadvantages. The two major types of safety surfaces are synthetic surfacing and loose-fill surfacing. Synthetic surfacing includes tiles that are formed in the factory, or surfacing that is poured in place onsite. Loose-fill surfacing includes organic and inorganic materials, such as sand, gravel, chopped tire, and wood products.

*b. Impact Attenuation Criteria.* Standards for impact attenuation have been developed with the goal of reducing severe head injury or death from falls from manufactured play equipment. Safety surfaces that meet the requirements of ASTM F 1292 will be provided throughout the play equipment use zone. ASTM F 1292 states that the surface must yield both a peak deceleration of no more than 200 g's and a Head Injury Criteria (HIC) value of no more than 1,000 for a headfirst fall from the highest accessible height of the play equipment. G-force measures the peak deceleration of the head during impact. HIC measures the duration of the impact during its most sever phase.

*c. Critical Height of Safety Surfacing Materials.* The performance of safety surfacing is measured from potential fall heights. The critical height of a surfacing material is the maximum height at which a headfirst fall from equipment onto the safety surface meets the ASTM F 1292 standard. For instance, a particular surfacing material may not meet test criteria for a fall from 2400 mm (96 inches), but will meet criteria for a 1800 mm (72-inch) fall. It can then be said that this surfacing material has a 1800 mm (72-inch) critical height. The critical height of safety surfacing material used in children's play areas will equal or exceed the highest accessible height of the equipment provided. The highest accessible height of various types of play equipment is measured from different points. Table 11–1 describes how the highest accessible height is determined for manufactured play equipment.

*d. Manufactured Safety Surfacing.* Testing data should be obtained from manufacturers of synthetic surfaces, chopped tire surfaces, or wood products manufactured as safety surfacing to verify that the surface meets the requirements of ASTM F 1292 for a headfirst fall from the highest accessible equipment height to be provided.

*e. Loose-Fill Surfacing.* Loose-fill materials are often not manufactured specifically as safety surfacing. Therefore, test data is often not available from suppliers. In 1993, the U.S. Army Corps of Engineers commissioned a testing program to develop recommended material depths for loose-fill surfaces. Materials tested include sand, pea gravel, and bark mulch. To reproduce required impact-attenuating performance, the materials must meet the requirements in this chapter; the maximum accessible height of play equipment must not exceed 2400 mm (96 inches); and the surface must receive regular maintenance to maintain material depth. A 25 mm (l-inch) difference in material depth may dramatically increase injury potential. Table 11–2 describes the recommended installed material depth for loose-fill surfacing.

*Table 11-1. Highest Accessible Equipment Height,*

| Play Equipment | Highest Accessible Height |
|---|---|
| Composite equipment | Measure from the top edge of the protective barrier. |
| Infant crawl area | Measure from maximum height of 600 mm (24 inches). |
| Playhouse, nonclimbable | Measure from the maximum height of the highest surface which is a minimum 50 mm (2 inches) wide and has a slope of 30° or less. |
| Spring rocker | Measure from the seat. |
| Stationary equipment, climbable | Measure from the maximum height of the structure. |
| Stationary equipment, nonclimbable | Measure from maximum height of highest surface which is a minimum 50 mm (2 inches) wide and has a slope of 30° or less. |
| Swing | Measure from the height of the pivot point. |

*Table 11–2. Recommended Installed Depths for Loose-Fill Safety Surfacing.*

| Material | Recommended Installed Depth |
|---|---|
| Sand | 450 mm (18 inches) |
| Gravel | 300 mm (12 inches) |
| Wood products | 300 mm (12 inches) |
| Chopped tire | 150 mm (6 inches) |

## 11-4. Synthetic Surfacing.

Synthetic surfacing, such as synthetic tile and poured-in-place surfacing, is available in a variety of thicknesses to provide protection from falls from varying heights. Its major disadvantage is high initial cost. Its major advantages are low maintenance and consistent impact-attenuating performance.

*a. Design Considerations.*

(1) *Poured-In-Place Surfacing.* Poured-in-place surfacing is a relatively new product. It is made from a combination of chopped or shredded rubber and a flexible plastic binder that is mixed and poured on-site. The installation process is similar to the process used to install asphalt. Poured-in-place surfacing consists of a poured-in-place substrate layer, covered by a durable wear surface. The wear surface may be a poured-in-place, manufactured turf, or rubber sheet goods material.

*(a) Advantages.* Poured-in-place surfacing is suitable for any application or climate zone. The surfacing can be installed in any thickness. The material thickness can be varied where necessary to accommodate changing impact attenuation requirements under equipment of different heights. The material's edges can be shaped in freeform or straight lines, making it adaptable to many situations. Color patterns can be created with the surface material. Since the surface is composed of new rather than recycled rubber, the surface may be more resistant to fading. Poured-in-place surfacing is less expensive than synthetic tiles for application in large areas.

*(b) Disadvantages.* Poured-in-place surfaces are more difficult to repair than synthetic tiles. In addition, a qualified, experienced installer is essential to ensure durability and impact attenuation.

*(c) Installation Requirements.* Poured-in-place surfacing may be installed over asphalt, concrete, or compacted gravel subsurfaces. A geotextile fabric should be installed over the compacted gravel subsurface before installing the surfacing. The poured-in-place substrate is mechanically mixed on site in accordance with the manufacturer's recommendations. The substrate should be installed in one continuous pour. A wear surface should be bonded to the substrate.

(2) *Synthetic Tiles.* Synthetic tiles are factory-molded geometric shapes. The tiles may combine an impact-attenuating substrate and a wear surface or consist of a uniform material that varies in density.

*(a) Advantages.* Synthetic tiles are recommended for small projects, for projects where a checkerboard pattern is desired, or for remote locations where experienced safety surfacing installers are not available. Individual damaged tiles may be replaced without replacing the entire safety surface.

*(b) Disadvantages.* For large areas, synthetic tiles may be more expensive than poured-in-place surfaces. When composed of recycled rubber, the surface may be more likely to fade. In addition, tiles may be vulnerable to vandalism.

*(c) Installation Requirements.* Depending on the manufacturer's recommendations, synthetic tiles may be installed over asphalt, concrete, or compacted gravel. When installed over a compacted gravel subsurface, a geotextile fabric should be installed over the subsurface before installing the tiles. The tiles may be secured by an adhesive or hardware in accordance with the manufacturer's recommendations. Cutouts should be filled with sealant to eliminate voids at play equipment.

(3) *Combination System.* The combination system includes modular substrate units overlaid with a bonded, manufactured turf-type or rubber sheet goods wear surface.

*(a) Advantages.* Combination systems provide many wear surface options. These wear surfaces may be especially desirable in areas where a nonabrasive surface is needed.

*(b) Disadvantages.* Combination systems may be less durable than other synthetic surfaces. These surfaces should be selected for areas with low activity levels, or where low use is expected.

*(c) Installation Requirements.* Depending on the manufacturer's recommendations, combination systems may be installed over asphalt, concrete, or compacted gravel. When installed over a compacted gravel subsurface, a geotextile fabric should be in-

stalled over the subsurface before installing the modular substrate. The substrate may be secured by an adhesive or by hardware in accordance with the manufacturer's recommendations. The wear surface should be bonded to the substrate with adhesive. Cutouts should be filled with sealant to eliminate voids at equipment.

(4) *Additional Selection Considerations.*

*(a) Appearance.* The synthetic surfacing should look attractive and should complement the appearance of playground equipment.

*(b) Rubbery Odor.* The material may have an unattractive rubbery odor. It should be determined whether the odor is acceptable.

*(c) Slip-Resistance.* The surface should be slip-resistant.

*(d) Installation.* The manufacturer should be contacted to determine the installation requirements of the proposed surface. Temperature and weather conditions may be important factors.

*(e) Drainage.* Positive drainage should be provided. Some surfaces allow water percolation. The designer should determine drainage requirements for the selected surface.

*(f) Maintenance.* Maintenance requirements for the safety surface should be determined. Techniques used to repair the surface should be established. It should be determined whether play equipment can be replaced or repaired without replacing the entire surfacing.

(g) *Durability.* The manufacturer's warranty and information about the expected durability of the product should be obtained.

*(h) Pests.* It should be determined whether pests, such as moles, may be likely to increase maintenance needs and to affect the surface's life span.

*b. Recommended Ages.* Synthetic safety surfacing may be used by all age groups.

*c. Safety Guidelines.*

(1) *Impact Attenuation.* Manufacturers will be required to produce testing data verifying that the product meets the requirements of ASTM F 1292 from the height specified by the purchaser. In addition, manufacturers should provide written verification that the installed safety surfacing meets this criteria.

(2) *Hard Spots. Be* aware that the ASTM standards do not require testing for potential hard spots, such as seams and hardware. Some manufacturers may perform additional tests for potential hard spots. Manufacturers should provide product performance information for hard spots.

(3) *Flammability.* Some synthetic safety surfaces may be flammable. The surface's potential for burning should be determined.

(4) *Heat Retention.* Heat retention in darker materials may be a safety concern in hot climates. Light colored surfaces should be used in hot climates.

*d. Accessibility.* Synthetic surfacing is a fully accessible safety surface. It may be used to create circulation areas or accessible paths of travel within play equipment use zones.

*e. Maintenance.* The maintenance level is low.

*f. Cost.* Synthetic safety surfacing has the highest initial cost of any safety surface, but the cost of maintenance is low.

## 11-5. Organic Loose-Fill Surfacing.

Organic loose-fill surfacing includes wood mulch, bark mulch, and manufactured wood chips. The impact-attenuating ability of these materials depends on the air trapped within and between individual particles. Compared to the performance of other loose-fill materials, the impact-attenuating performance of wood products is less affected by hot, cold, and wet conditions. Although initially inexpensive, the cost of maintenance is high. The material is easy to obtain and install, less abrasive than sand when tracked into buildings, and easier to police for broken glass than sand. These materials are less likely than sand to attract cats and dogs, but are more likely to attract insects and snakes. Local pests and their habitats should be considered prior to selecting this surfacing. Material specifications for wood products are provided in table 11–3.

*Table 11-3. Wood Product Material Specifications*

| Play Equipment | Highest Accessible Height |
|---|---|
| Bark mulch | Untreated chipped bark with a maximum size of 40 mm (1-1/2 inches) and no twigs, leaves, branches, thorns, dirt, or poisonous plants. |
| Wood mulch | Untreated chipped tree prunings with a maximum size of 40 mm (1-1/2 inches) and no thorns, dirt, or poisonous plants. |
| Manufactured wood chips | Particle sizes may vary from 3 mm (1/8-inch) to 12 mm (1/2-inch) thick by 25 mm (1-inch) to 75 mm (3 inches) long. |

*a. Design Considerations.*

(1) *Wood Mulch.* Wood mulch is relatively inexpensive and easy to obtain. Mulch maybe used as a surface covering in natural areas or as safety surfacing in play equipment use zones. It may be produced by "chippers" used in tree pruning operations. It is possible to acquire wood mulch from maintenance staff or tree trimming companies, but it must be free from harmful plants, pesticides, or other contaminants. Wood mulch may be produced from hardwoods or softwoods.

(2) *Bark Mulch.* Bark mulch is bark that has been stripped from trees and shredded. It is readily available from many nurseries or landscape supply companies.

(3) *Manufactured Wood Chips.* Some manufacturers produce uniform wood chips specifically for use as play area safety surfacing. For these products, ASTM F 1292 testing results may be available from the supplier. This material may be more consistent in type and quality than wood mulch or bark mulch.

(4) *Additional Selection Considerations.*

*(a) Appearance.* Determine whether the surface will look attractive and will complement the appearance of play equipment.

*(b) Drainage.* Positive drainage should be provided. For many play areas, subsurface drainage should be provided. A compacted gravel subsurface may also be considered.

*(c) Installation Requirements.* Wood products should be installed over a compacted subgrade covered with geotextile fabric. Wood products manufactured for the purpose of playground safety surfacing should be installed according to the manufacturer's instructions at the minimum depth specified in this manual. Surfacing should be contained with a barrier.

*(d) Play Activities.* Wood products surfacing materials can provide opportunities for manipulative play. Children can explore the surfacing materials for living organisms and other "finds," such a coins, bottle tops, and small plastic toys. The materials harbor and conceal various insects that are usually harmless and provide learning opportunities for children.

*(e) Maintenance.* It should be determined whether adequate maintenance can be provided to maintain the surface. Regular maintenance is necessary to maintain surfacing depth and to prevent the geotextile fabric from becoming a trip hazard.

*(f) Pests.* It should be determined if pests will increase the maintenance requirements and reduce the material's life span.

*(g) Manufactured Wood Chips.* When specifying manufactured uniform wood chips, test results should be obtained from the manufacturer to verify that a fall onto this surface from the height specified by the purchaser results in a g-force rating of no more than 200 g's and a HIC value of no more than 1,000. In addition, photos of tested samples should be obtained from the manufacturer to compare with the purchased material. A copy of the product warranty and an estimate of the anticipated durability of the material should also be obtained.

*b. Recommended Ages.* Wood products may be used as a safety surface in play areas designed for children ages 2 and older.

*c. Safety Guidelines.*

(1) *Variable Impact Attenuation.* The impact attenuation of different wood products varies, and specific test results for materials may not be available. Weather such as rain, high humidity, cold temperatures, or freezing conditions may affect impact attenuation. With the passage of time, the materials may decompose and become pulverized, reducing their impact-attenuating performance.

(2) *Installation.* Loose-fill surfacing materials will not be installed over concrete or asphalt surfaces.

(3) *Maintenance.* The material requires continuous maintenance, such as leveling, grading, and replenishing, to maintain its impact-attenuating ability. The materials are gradually displaced by wind or the playing action of children, reducing the thickness required for impact attenuation.'

(4) *Contaminants.* Unless a manufactured material is purchased, a consistent product that is free from contaminants may be difficult to obtain.

(5) *Splinters.* Chips may be splintery when first spread.

(6) *Microbial Growth.* When wet, organic loose-fill materials are subject to microbial growth.

(7) *Waste and Litter.* The material conceals animal excrement and other trash, such as broken glass, nails, pencils, and other sharp objects that puncture and cut. Daily removal of waste and litter is required.

(8) *Flammability.* Wood products are flammable.

*d. Accessibility.* The acceptability of wood products as an accessible surface for people with disabilities is still controversial. Some wood products may be accessible to wheelchair users when matted down. Wood products may not be accessible to children who walk with difficulty or use canes or crutches.

*e. Maintenance.* The required maintenance level is high. Continuous maintenance will be provided to preserve impact attenuation.

*f. Cost.* Wood products have a low initial cost and a high maintenance cost.

## 11-6. Inorganic Loose-Fill Surfacing.

Sand, gravel, and chopped tire are popular inorganic loose-fill surfaces. These materials absorb impacts by changing shape upon impact. Chopped tire also traps air between the particles to provide a cushioning effect. The primary advantage of sand, gravel, and chopped tire surfacing is that the materials are easy to install, and readily available. The materials are not ideal for microbial growth. Sand and gravel are nonflammable and initially inexpensive. The primary disadvantage of these materials is that continuous maintenance is required to preserve impact attenuation.

*a. Design Considerations.*

(1) *Sand.* The natural appearance of sand and its importance as a play material makes it a popular safety surface. Sand is an excellent manipulative play material, especially if provided in conjunction with water. However, separate sand play areas should be provided away from play equipment use zones. The impact-attenuating ability of sand is greatly reduced when wet. Therefore, it is not recommended for use as a safety surface in regions with wet climates, such as the Pacific Northwest. Sand is abrasive to floors when tracked indoors. Sand used as a safety surface will meet the following specification: Sand will be rounded naturally or by mechanical means; washed; free of dust, clay, soil, hazardous substances, or foreign objects; and sieved as shown in table 11–4.

(2) *Gravel.* Gravel drains well and does not easily freeze or compact. It is popular in cold and wet climates. It should not be used as a safety surface in play areas designed for children under 3 years because of the potential for choking. Gravel used as safety surfacing will meet the following specification: Gravel particles will be rounded naturally or by mechanical means; washed; free of dust, clay, soil, hazardous substances, or foreign objects; and sieved as shown in table 11–4.

(3) *Chopped Tire.* Chopped tire safety surfacing is highly effective, trapping air between particles to provide an impact-attenuating effect. Chopped tire is nonabrasive. It does not absorb moisture or attract cats, dogs, rodents, or insects. Select chopped tire manufactured specifically for safety surfacing. The results of impact attenuation tests should be obtained from the manufacturer. Chopped tire safety surfacing that is manufactured from steel belted tires will not be used. Chopped tire used as safety surfacing will meet the following specification: Chopped tire will be asymmetrical rubber particles a maximum of 12 mm (1/2-inch) in size; and free of metal, harmful chemical, and foreign material.

*Table 11-4. Sieve Analysis of Sand and Gravel.*

| SAND | |
|---|---|
| **Sieve Size** | **Percent Passing** |
| 10 mm (3/8-inch) | 100% |
| #4 | 99-100% |
| #8 | 81-95% |
| #16 | 53-75% |
| #30 | 35-56% |
| #50 | 20-25% |
| #100 | 5-9% |
| #200 | less than 2% |
| **GRAVEL** | |
| **Sieve Size** | **Percent Passing** |
| 12 mm (1/2-inch) | 100% |
| 10 mm (3/8-inch) | 75-85% |

(4) *Selection Considerations.*

*(a) Appearance.* It should be determined whether the material will look attractive and will complement the appearance of playground equipment.

*(b) Maintenance.* It should be determined whether a high level of maintenance can be provided to maintain impact attenuation.

*(c) Installation Requirements.* Sand or gravel should be installed over a compacted subgrade. Chopped tire should be installed over a subgrade of compacted gravel covered with geotextile fabric. Barriers should be provided to contain these loose-fill materials.

*(d) Drainage.* Positive drainage should be provided. Many play areas may require subsurface drainage under inorganic loose-fill surfaces.

*(e) Chopped Tire.* Test results should be obtained from the manufacturer verifying that a fall onto this surface from the height specified by the purchaser results in a g-force rating of no more than 200 g's and a HIC value of no more than 1,000. Photos of tested samples should be obtained from the manufacturer to compare with the purchased material. A copy of the warranty for the material and an estimate of the anticipated durability of the material should be obtained.

*(f) Pests and Vandalism.* It should be determined whether pests, such as fleas, or high vandalism will increase maintenance requirements,