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An American National Standard

Standard Guide for Construction and Maintenance of Grass Tennis Courts[1]

This standard is issued under the fixed designation F 1953; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This guide covers techniques that are appropriate for the construction and maintenance of grass tennis courts. This guide provides guidance for selection of soil systems and turfgrass species in court construction and for selection of management practices that will maintain an acceptable playing surface.

1.2 Decisions in selecting construction and maintenance techniques are influenced by existing soil types, climatic factors, adaptation of grass species, level of play anticipated, intensity of use, budget, equipment, and training and ability of the turf management personnel.

1.3 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:* [2]

C 33 Specification for Concrete Aggregates

D 422 Test Method for Particle-Size Analysis of Soils

D 653 Terminology Relating to Soil, Rock, and Contained Fluids

D 1140 Test Method for Amount of Material in Soils Finer Than the No. 200 (75-μm) Sieve

D 5268 Specification for Topsoil Used for Landscaping Purposes

E 11 Specification for Wire Cloth and Sieves for Testing Purposes

F 405 Specification for Corrugated Polyethylene (PE) Tubing and Fittings

3. Terminology

3.1 *Definitions*—Except as noted, soil related definitions are in accordance with Terminology D 653.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *cool-season turfgrass*—species best adapted to growth during cool, moist periods of the year, commonly having temperature optimums of 15 to 25°C. Examples: bentgrass, bluegrass, fescue, and ryegrass.

3.2.2 *coring*—small cores are removed from the turf soil by hollow tines or spoons.

3.2.3 *cultivation, turf*—the working of a turf soil without destruction of the turf **(1)**.[3]

3.2.4 *drilling*—vertical holes are created in the turf soil by removal of soil by rotating drill bits or augers.

3.2.5 *gravel*—rounded or sub-rounded rock or mineral particles >2.0 mm and <7.6 mm **(2)**.

3.2.6 *grooving*—vertical rotating blades cut continuous slits through the turf and into the soil, with soil, thatch, and plant material being displaced.

3.2.7 *overseeding*—seeding into an existing turf **(1)**.

3.2.8 *punching, with solid tines*—holes in the soil are created by punching action of solid tines, often mounted on equipment that may also utilize hollow tines.

3.2.9 *renovation*—improvement of turf, usually involving weed control and replanting into existing live or dead vegetation, or both **(1)**.

3.2.10 *soil*—sediments or other unconsolidated accumulations of solid particles produced by the physical and chemical disintegration of rocks, and which may or may not contain organic matter.

3.2.11 *soil profile*—vertical section of a soil, showing the nature and sequence of the various layers, as developed by deposition or weathering, or both.

3.2.12 *soil textural class*—texture designation based on relative proportions of sand (2.0 to 0.05 mm in diameter), silt (0.05 to 0.002 mm), and clay (<0.002 mm) **(2)**.

3.2.12.1 *Discussion*—Particle size ranges for sand, silt, and clay vary somewhat from ranges in Test Method D 422, Terminology D 653, Test Method D 1140, and Specification D 5268.

[1] This test method is under the jurisdiction of ASTM Committee F08 on Sports Equipment and Facilities and is the direct responsibility of Subcommittee F08.23 on Tennis Courts and Track Surfaces.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] The boldface numbers in parentheses refer to the list of references at the end of this standard.

3.2.13 *soil texture, (gradation) (grain-size distribution)*—the proportions by mass of a soil or fragmented rock distributed in specified particle size ranges.

3.2.14 *spiking*—solid tines or flat, pointed blades penetrate the turf and soil surface.

3.2.15 *thatch*—an intermingled layer of dead and living shoots, stems, and roots that develops between the zone of green vegetation and the soil surface **(1)**.

3.2.16 *topdressing*—a prepared soil mix added to the turf surface and worked in by brooming, matting, raking, or irrigation, or a combination thereof, (1) to smooth a green surface, (2) to firm a turf by working soil in among stolons and thatch forming materials, (3) to enhance thatch decomposition, and (4) to cover stolons or springs during vegetative planting; also, the act of applying topdressing materials to turf **(3)**.

3.2.17 *topsoil*—surface soil, usually containing organic matter. Also see Specification D 5268.

3.2.18 *turfgrass*—a species or cultivar of grass, usually of spreading habit, that is maintained as a mowed turf **(1)**.

3.2.19 *warm-season turfgrass*—species best adapted to growth during the warmer part of the year; usually dormant during cold weather or injured by it; commonly having temperature optimums of 27 to 35°C. Examples: bermudagrass, carpetgrass, centipedegrass, St. Augustinegrass, and zoysiagrass.

3.2.20 *winter overseeding*—seeding cool-season turfgrasses over warm-season turfgrasses at or near their start of winter dormancy; used in mild climates to provide green, growing turf during the winter period when the warm-season species are brown and dormant.

4. Significance and Use

4.1 A grass tennis court should provide a relatively uniform, high quality playing surface as it relates to footing and ball bounce. Undulations, rough surface, bare spots, weeds, and wet spots detract from good play. Playing surface quality is largely affected by construction and maintenance procedures, and this guide addresses those procedures.

4.1.1 During construction, consideration should be given to factors such as soil physical and chemical properties, freedom of large stones and debris in the soil, surface and internal drainage, grass species selection, orientation of the court, and provisions for distributing wear on the playing surface.

4.1.2 Maintenance practices that influence the playability of the surface include mowing height, mowing frequency, rolling, irrigation, fertilization, weed control, disease and insect control, cultivation, thatch control, topdressing, and overseeding.

4.2 Those responsible for the design, construction, or maintenance, or a combination thereof, of tennis courts will benefit from this guide.

4.3 This guide provides flexibility in choices of procedures and can be used to cover a variety of use and budget levels.

5. Construction

5.1 *Soil*—Soil may be the existing topsoil or a sandy top mix prepared by mixing sand with soil.

5.1.1 Existing or native soils used for tennis courts should be well drained. Well drained soils are often medium textured. Avoid poorly drained soils, which remain wet for significant periods during the growing season. Poorly drained soils may possess a layer of soil with slow permeability, a high water table, additional water from seepage, or a combination of these properties. The presence of soil mottling (spots of different colors: for example, yellowish, reddish, grayish, brownish) indicates poor drainage and limited aeration in a soil. Coarse textured, excessively drained soils can be used, but irrigation must be provided because these soils have limited capacity to hold plant available water. County soil survey reports, available for inspection at local offices of the United States Department of Agriculture or at county cooperative extension offices, can be used to obtain information on the properties of natural soils at a given location. Relationships between general textural terms, textural classes, and permeability are shown in Appendix X1. In some cases, consideration may be given to modifying fine- or medium-textured soils by adding and incorporating sand into the surface to obtain 8 to 12 cm of modified soil. The amount of sand required to effectively modify a soil (to increase permeability) will vary depending on the soil and sand properties; however, a minimum of 60 % sand on a volume basis will probably be needed to ensure good internal drainage when the soil is compacted **(4)**. Prior to turf establishment, apply lime and fertilizer as required, based on soil test results. During final surface preparation, all debris and any stones greater than 1 cm in diameter should be raked from the surface 1.5 cm of soil.

5.1.2 Artificial (man-made) profiles are often used on highly trafficked turf areas. In general, a coarse-textured topsoil or a top mix, prepared by mixing soil and sand to obtain a well-drained growing medium, is placed on a drainage blanket of gravel, which provides subsurface drainage. A false water table is formed at the interface of the topsoil and the drainage layer. Water will not move readily from the finer top mix into the gravel layer until the water content is at or near saturation at the interface. If fine- or medium-textured soils are used for the topsoil in such profiles, they will remain too wet; however, in the case of coarse-textured topsoils, the increased water retention is a benefit. Such profiles are commonly used for golf putting greens **(5)**. If the particle size differential between the topsoil and gravel layer is great, an intermediate layer is placed on the gravel to prevent in-washing of the topsoil. Some soil laboratories test soils for use on greens. Their services could also be used to evaluate soils for tennis courts, especially when artificial profiles will be used. Steps in constructing a tennis court with an artificial profile follow:

5.1.2.1 Excavate to a depth equal to the depth of settled layers within the profile (approximately 40 cm). Compact the subgrade. The subgrade should be parallel to the finished grade, which should have a slope of 0.8 to 1.0 % to provide surface drainage. The slope may be either widthwise or lengthwise, depending on site.

5.1.2.2 Excavate trenches (approximately 20-cm wide and 20-cm deep) in compacted subgrade for drainage pipe (lateral and main lines), with no more than 10 m between laterals. Remove excavated material or spread it evenly over the subgrade between trenches. Drainage pipe should have a diameter of approximately 10 cm. Corrugated, perforated, plastic drainage pipe (tubing) conforming to Specification

F 405 is recommended. Non-perforated pipe can be used outside the drainage area to carry water to a suitable surface drainage area or storm drain.

5.1.2.3 Place drainage pipe on a 5 to 10-cm bed of gravel in trenches. Minimum grade for drainage pipe is 1.0 %. Use laser or other appropriate equipment to maintain accurate grades.

5.1.2.4 Cover the drainage pipe and subgrade with a 7 to 10-cm layer of washed gravel or crushed rock. Do not use soft or easily weathered materials in this layer. Gravel should consist of hard durable particles of natural gravel or crushed stone or rock that will not degrade when alternately wetted and dried or frozen and thawed. The particle size of the gravel should meet the following specifications.

(a) Ninety to 100 % (weight basis) passing 12.5-mm (0.5-in.) sieve.

(b) Minimum of 50 % passing 9.5 mm (0.375 inch) and retained on 6.3-mm (0.25-in.) sieve.

(c) Maximum of 10 % passing 2.36-mm (No. 8) sieve.

(d) Uniformity coefficient: $^{d}90/^{d}10 \leq 3$ ($^{d}90$ and $^{d}10$ refer to the diameter below which 90 % and 10 % of the particles fall, as determined from a particle size accumulation curve.

(e) Coarse aggregate size Nos. 7 and 8 (see Specification C 33) should receive consideration.

(f) Grading requirements for size Nos. 7 and 8 are as follows:

Sieve Designation	Size	
	7	8
	% passing	
19.0 mm (0.75 in.)	100	. . .
12.5 mm (0.50 in.)	90 to 100	100
9.5 mm (0.375 in.)	40 to 70	85 to 100
4.75 mm (No. 4)	0 to 15	10 to 30
2.36 mm (No. 8)	0 to 5	0 to 10
1.18 mm (No. 16)	. . .	0 to 5

5.1.2.5 Place intermediate layer of 5 to 7-cm thickness on the gravel layer. Material in this layer should have a minimum of 90 % of the particles between 1 and 4 mm. This intermediate layer is placed in the profile to ensure no in-washing of top mix into gravel.

5.1.2.6 Place 25 cm of coarse-textured soil or top mix on intermediate layer. By placing layers of 5 to 6 cm and firming by light rolling or heeling (walking over area on heels of shoes) after each layer is placed, settling of the area after establishment will be minimized. The top mix should have a sand content 70 to 85 %. Growing media with higher sand contents can support turfgrass growth and provide even greater internal drainage, which could provide for quicker use of the court following rainfall; however, excessively sandy top mixes can be unstable underfoot and abrasive to the turfgrass and can cause difficulty in reestablishing grass in worn areas due to low water retention and movement during play. When sand and soil are mixed to create the top mix, the added sand should be uniform in size with 85 % of the particles between 0.5 and 2.0 mm or between 0.25 and 1.0 mm. Well-graded sands are not as effective as uniform sands for modifying soils to create better internal drainage. Organic amendments, such as peat, may be added (generally in amounts equal to 10 to 20 % by volume). Organic amendments will increase water and nutrient retention, an important consideration in very sandy top mixes. The top mix should be screened to remove material greater than 6.3 mm (0.25 in.); or if not screened, raked thoroughly after placement to remove material greater than 1 cm from the surface 1.5 cm of mix. Screening is a usual practice in the preparation of top mixes by commercial companies. As with native soils, use soil test results as a guide for liming and fertilization.

5.2 *Slope*—Final grade should provide for an 0.8 to 1.0 % slope (1-cm fall in 100 to 120 cm) across the width or length of the court. Use laser or other suitable equipment to ensure accurate grade. The surface slope is important for removing excess water during periods of intense rainfall. This slope is essential on all courts regardless of soil type.

5.3 *Orientation*—The long dimension of the court should be close to a north to south direction. Such an orientation minimizes the times when the low early morning or evening sun will be directly in players' eyes.

5.4 *Species Selection*—Species that adapt to the close mowing on golf greens will also do well on tennis courts. Select a creeping bentgrass, *Agrostis stolonifera* L. var. *palustris* (Huds.) Farw., as a cool-season turfgrass or hybrid bermudagrass, *Cynodon dactylon*× *C. transvaalensis* (L.) Pers., as a warm-season grass. Where bermudagrass is overseeded with cool-season grasses in the winter, select species that have done well in winter overseeding of golf greens (for example, perennial ryegrass). Check with other court owners, county or state extension personnel, golf course superintendents, or seed/spring/sod suppliers for cultivars (varieties) best adapted to your area. Grasses other than creeping bentgrass and bermudagrass are used on tennis courts **(6)**. Colonial bentgrass is used with creeping bentgrass in some cases. Annual bluegrass has invaded some courts and has become a major component. Fine fescues and perennial ryegrasses have been used alone and in combination, but should not be as closely mowed as the bentgrasses and annual bluegrass.

5.5 Turfgrasses may be propagated vegetatively or by seed. Creeping bentgrass is usually seeded or sodded. Turf-type bermudagrasses are vegetatively propagated by planting sprigs (stolons, rhizomes, and tillers), by broadcasting sprigs and then topdressing with a soil, or by sodding. If the area is sodded, care must be taken to make sure that the soil on the sod closely matches the texture of the topsoil or top mix. Contrasts in texture of these soil sources can impede water movement and rooting of the grass. To avoid even minor soil differences, use washed sod (soil removed by washing after sod is harvested). Also, any soil used to topdress seed or sprigs should match that already in place.

5.6 *Wear Distribution*—Creating a larger area than needed for one court and installing an extra set(s) of net post sleeves enables the turf manager to distribute wear by periodically changing the net location. The same technique applies to larger expanses where multiple courts are located (see Appendix X3).

6. Maintenance

6.1 *Mowing*—Reel type mowers that collect clippings are preferred.

6.1.1 *Cutting Height*—Grasses differ in their tolerance to close mowing. Suggested cutting heights for tennis courts follow:

Species	Cutting Height	
	mm	(in.)
Annual bluegrass	6 to 12	(¼ to ½)
Bermudagrass	5 to 6	(3⁄16 to ¼)
Creeping and colonial bentgrass	6 to 12	(¼ to ½)
Fine fescues	12 to 19	(½ to ¾)
Kentucky bluegrass	12 to 16	(½ to ⅝)
Perennial ryegrass	10 to 12	(⅜ to ½)
Cool-season grasses overseeded on bermudagrass	5 to 6	(3⁄16 to ¼)

6.1.2 *Cutting Frequency Guideline*—Mow often enough so that no more than one third of the height is removed in a mowing (for example, if mowing height is 6 mm, mow before height exceeds 9 mm). More frequent mowing helps maintain uniformity in playing quality from day to day. During peak growth periods, mow three to six days per week. Remove clippings.

6.1.3 *Cutting Direction*—Use alternate mowing directions to promote upright growth.

6.2 *Fertilization*—Use soil testing every three to four years (every one or two years on very sandy soils) to obtain guidelines for maintenance fertilization and liming. Turfgrass growth and color are largely affected by nitrogen fertilization. Slow-release or quick-release, or a combination of these types of nitrogen fertilizers, can be used. More frequent, lighter applications should be used with quick-release sources. The total annual requirement of nitrogen will vary with grass species, soil type, type of nitrogen source, irrigation practices, clipping removal practices, length of growing season, and intensity of use (wear). Annual nitrogen requirements can range from 100 to 200 kg/ha (2 to 4 lb/1000 ft^2) for cool season turfgrasses and from 300 to 600 kg/ha (6 to 12 lb/1000 ft^2) for warm-season turfgrass sites. If soil test results are not available, use a complete fertilizer that contains phosphorus and potassium, as well as nitrogen, with a ratio of N, P_2O_5, K_2O equal to approximately 3-1-2 or 4-1-2.

6.3 *Irrigation*—Consideration should be given to the installation (preferably during court construction) of a permanent, automatic irrigation system. There will be considerably less need for irrigation on medium-textured soils than on coarse-textured soils. Portable systems (sprinklers and hoses) may be appropriate for areas with medium-textured soils.

6.3.1 Use irrigation to supplement rainfall to provide the turfgrass with adequate water. During periods of high evapotranspiration, daily water use by turfgrasses may approach 8 mm.

6.3.2 Irrigation may be used or withheld to affect impact attenuation (hardness) of the surface. Most soils become harder as they dry as experienced by the player and the ball. Water is usually withheld during playing periods to provide a firmer surface. On very sandy soil with little clay to provide cohesiveness, drying may cause the soil to lose firmness and be less stable underfoot. This effect would be more apparent as turfgrass density decreases and the soil is exposed at the surface. In such cases, irrigation can be used to firm the soil. It should be noted that particle size distribution and shape of sands in such soils will also affect stability.

6.3.3 Irrigation should be used in conjunction with other management practices: to wash in fertilizer or pesticides, when required; withheld in the case of some pesticides; to encourage germination after overseeding; to provide adequate soil moisture prior to cultivation or rolling procedures; and to remove frost prior to play or performance of maintenance practices.

6.4 *Rolling*—Rolling may be used for leveling, smoothing, and firming the playing surface. When frost heaving of the turf occurs during the winter, rolling in the spring will smooth and firm the surface. Rolling is also appropriate when cultivation techniques have caused an uneven surface. When used following core cultivation, rolling will help to alleviate high spots on the surface. During tournaments, courts are sometimes rolled daily to maintain a smooth, firm surface. If soils are too wet when rolled, ridging may occur; if too dry, desired smoothing and firming may not occur. Water content of the soil should be just great enough to allow for ease in compressibility and compaction of the soil. Rolling is a compaction process, and the need for cultivation will be related to rolling practices. Rolling is detrimental to soil structure, especially on wet soils. When natural aggregation is destroyed, low permeability of the soil limits both air and water movement in the soil and creates conditions that lead to deterioration of the turfgrass stand.

6.5 *Cultivation*—Various cultivation techniques can be used to alleviate soil compaction, reduce thatch, and prepare the soil prior to overseeding. Coring, drilling, and punching are used where penetration to depths of 6 to 25 cm (2.5 to 10 in.) are desired. Grooving and spiking are effective for loosening soil to shallower depths. Cultivation techniques injure turfgrasses and should be utilized only when soil moisture and climatic conditions favor rapid turf recovery. Frequency of cultivation is dependent on soil type and the amount of traffic (whether from play or maintenance activities). Normally, cultivation once or twice per season is sufficient. Depending on the spacing of tines, multiple passes may be required during cultivation procedures.

6.6 *Thatch Management*—If thatch accumulates to a depth that adversely affects play or turfgrass quality, it can be removed or minimized, or both, by combinations of core cultivation, grooving, vertical mowing (vertical, rotating blades), and topdressing.

6.7 *Topdressing*—Topdressing can be used to smooth and firm the playing surface. Applications of topdressing materials should be brushed or dragged into the turf surface. Also, by selecting an appropriate material, the texture of the surface soil can be altered by utilizing core cultivation and topdressing. General topdressing during the playing season is not recommended because of the abrasive effects on turf during application and later on turf in areas of concentrated play. Topdressing can also be used to fill divots on the playing surface.

6.8 *Overseeding*—Overseeding of turf areas can be used to increase turf cover and density, to introduce different grass species, and to provide green turf on dormant warm-season grasses. Overseeding is usually one procedure used in renovation of tennis courts.

6.9 *Renovation*—Severely worn turf on tennis courts, especially along baselines, will require renovation—a combination of cultivation, thatch removal, overseeding or replanting vegetatively, topdressing, and irrigation. The need for each procedure is dependent on local conditions and the type of grass.

Renovation should occur when growing conditions are favorable for the existing turfgrass.

6.10 *Pest Management*—Weed, insect, and disease infestations may adversely affect turf and playing quality. Identify the problem, and select appropriate cultural or chemical means, or both, to correct it. Personnel at cooperative extension offices can provide assistance in diagnosing and correcting such problems. Pesticides should be used in compliance with label information and local, state, and federal laws and regulations.

6.11 *Use Management*—Wear on courts can be distributed over the turf area by rotating play among courts, by allowing a rest period for recovery of worn turf, and by utilizing multiple court locations within a site (see Appendix X3). Restrict play on wet soils and when the surface is frosted or frozen.

7. Report

7.1 Reports dealing with construction should include drawings related to layout, soil profile, drainage system, irrigation system, and so forth; results of soil/gravel physical and chemical testing; data related to seed or vegetative material, such as species, cultivars, certification, seed lot, supplier; chronological accounting of steps during construction; and a listing of all materials used.

7.2 Reports dealing with maintenance should give dates and details of each management procedure. List all materials used, and in the case of pesticides include copies of records maintained as required by governmental regulations. A summary should indicate time and materials allocated to each procedure during the season.

8. Keywords

8.1 grass; soil; tennis; topsoil; turfgrass

APPENDIXES

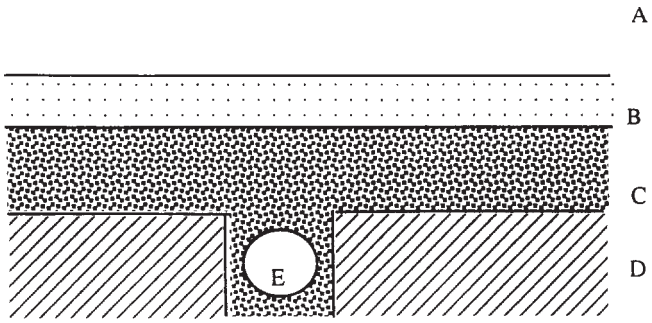
(Nonmandatory Information)

X1. RELATIONSHIP OF TEXTURAL TERMS (7) AND PERMEABILITY

	General Terms	Soil Textural Class	Expected Permeability
Sandy soils	Coarse-textured	Sands Loamy sands	Greatest
Loamy soils	Moderately coarse-textured	Sandy loam Fine sandy loam	
	Medium-textured	Very fine sandy loam Loam Silt loam Silt	
	Moderately fine-textured	Clay loam Sandy clay loam Silty clay loam	
Clayey soils	Fine-textured soils	Sandy clay Silty clay Clay	 Least

X2. SUGGESTED ARTIFICIAL PROFILE FOR GRASS TENNIS COURTS

X2.1 See Fig. X2.1.



A. Coarse-textured soil or prepared top mix: 25 cm
B. Intermediate layer: 5 to 7 cm of material having a minimum of 90 % of the particles between 1 and 4 mm
C. Gravel drainage blanket: 7 to 10 cm
D. Compacted subgrade
E. Perforated drainage pipe: approximately 10-cm diameter

FIG. X2.1 Artificial Profile for Grass Tennis Courts

X3. METHODS TO CREATE ALTERNATE COURT POSITIONS

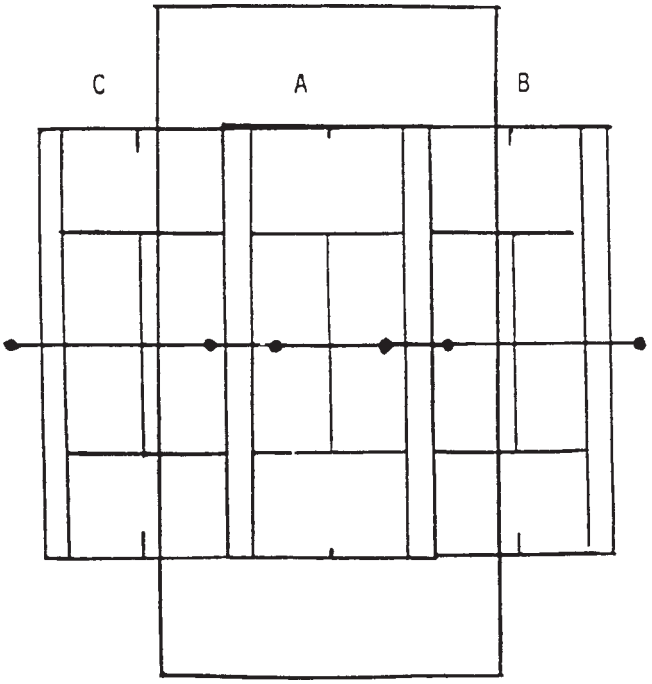


FIG. X3.1 Alternate Court Positions to Allow Sidewise Movements

X3.1 To allow sidewise movement on the court, use multiple net posts sleeves with alley lines that are common to both courts. Court A (see Fig. X3.1) may be shifted to right or left to create Courts B or C, respectively. Base, center, and service lines remain the same.

X3.2 Lengthwise movement places former base line (area of wear) of Court A (see Fig. X3.2) beneath the net of Court B and provides fewer worn areas at the new base lines.

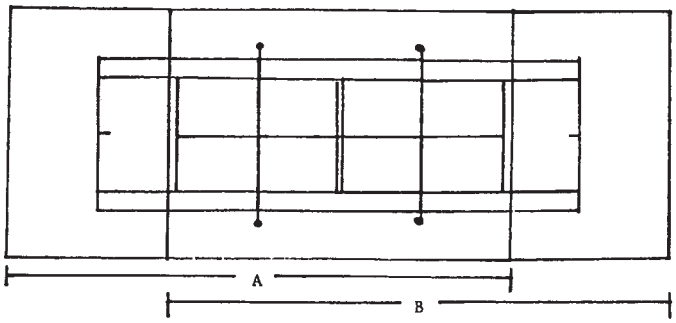


FIG. X3.2 Alternate Court Positions to Allow Lengthwise Movements

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(**5**) USGA Green Section Staff, "USGA Recommendations for a Method of Putting Green Construction," *USGA Green Section Record*, Vol. 31, No. 2, March/April 1993, pp. 1-3.

(**6**) Tennis Facilities Committee, *The United States Tennis Association 1987-88 Grass Tennis Court Survey*, USTA Tennis Facilities Committee, 707 Alexander Rd., Princeton, NJ, 1989.

(**7**) Soil Survey Staff, *Soil Survey Manual*, U.S. Department of Agriculture Handbook, No. 18, U.S. Government Printing Office, Washington, DC, 1951.