DOCUMENT RESUME

ED 433 676		EF 005 375

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TITLE	Track Construction Manual.
INSTITUTION	United States Tennis Court & Track Builders Association.; National Federation of State High School Associations, Kansas City, MO.
PUB DATE	1996-00-00
NOTE	121p.; Contributing organizations are the International Amateur Athletic Federation, National Federation of State High School Associations, National Collegiate Athletic Association, and USA Track & Field.
AVAILABLE FROM	U.S. Tennis Court & Track Builders Association, 3525 Ellicott Mills Dr., Suite N., Ellicott City, MD 21043-4547. Tel: 410-418-4800; Fax: 410-418-4805; Web site: <http://www.ustctba.com>.
PUB TYPE	Guides - Non-Classroom (055) -- Reports - Descriptive (141)
EDRS PRICE	MF01/PC05 Plus Postage.
DESCRIPTORS	Construction Materials; Diagrams; *Facility Guidelines; *Facility Planning; High Schools; Maintenance; Resources; *Track and Field
IDENTIFIERS	*Athletic Facilities; Drainage; Fence Building

ABSTRACT

This book establishes guidelines for the construction and maintenance of tracks by providing information for building new tracks or upgrading existing tracks. Subjects covered include running track planning and construction, physical layout, available surfaces, and maintenance. General track requirements and construction specifications are provided, as are more specific specifications on curbing and drains, fencing, track surface systems, calibration and marking, and conversion of existing 440 yard running tracks to 400 meter tracks. Track specifications for indoor facilities are also addressed. The final chapter discusses the advisability of seeking professional assistance in track construction. Appendices list the governing bodies of track organizations which can provide assistance with track construction specifications, and suggested conversion factors. Contains a glossary of terms. (GR)

TRACK CONSTRUCTION MANUAL

U.S. TENNIS COURT AND TRACK BUILDERS ASSOCIATION

Track Construction Manual

Published by
U. S. Tennis Court & Track Builders Association
3525 Ellicott Mills Drive, Suite N
Ellicott City, MD 21043-4547

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PREFACE

This book is published by the U.S. Tennis Court & Track Builders Association, in cooperation with the National Federation of State High School Associations, in an effort to inform and educate organizations, schools, coaches, architects, engineers, contractors and other interested parties regarding running tracks -- their construction, physical layout, available surfaces, maintenance and striping.

It is hoped that this book will help establish guidelines for the construction and maintenance of tracks by providing information for those building new tracks or upgrading existing tracks. In this book, we will cover everything involved from the planning for a new track to the upkeep of an existing track.

Running tracks are constructed for three basic reasons -- jogging for the community, competition between schools and individuals, and training. Selecting a surface for the track would seem to be the most important aspect of a project. However, what is usually not understood is that the surface is only as good as the base beneath it. Local soil conditions, surface and sub-surface drainage, and the close tolerances prescribed by the industry, all must be carefully considered in the construction of the foundation.

The same care is necessary in selecting the most suitable surface materials as is necessary in preparing the foundation. No one surface on the market today is ideal for all uses -- jogging, training, competition, distance running, hurdling and sprinting. If you follow these guidelines and standards, your initial investment should produce a facility that will meet all necessary requirements and offer the best performance within the prescribed budget. However, because individual needs and conditions vary widely and because the guide specifications contained in this book are general guideline specifications only, the U.S. Tennis Court & Track Builders Association and the National Federation of State High School Associations and their members and staffs cannot warrant that specifications and information in this book are proper under all circumstances and, accordingly, these organizations disclaim all liability whatsoever.

While every effort has been made to ensure that the rules and dimensions compiled in this book are complete and accurate, they are constantly changing and the authors and publishers are not responsible for errors or inaccuracies.

FOREWORD

The U.S. Tennis Court & Track Builders Association (USTC&TBA) has played an important role in setting standards for construction since 1964. The Association consists of contractors who build and maintain both tennis courts and running tracks, associate and affiliate members who are the manufacturers, suppliers and installers of materials used in the construction of these facilities, professional members who are architects and engineers, and ancillaries, who are others interested in the field. As an Association, we have found the need to publish this book to give schools and others interested in constructing a track information on where to begin, whom to contact, and what track might fulfill their needs.

The USTC&TBA publishes guideline specifications for track construction. Through its Technical Meeting each year, the Association offers technical programming on new developments in the track industry. Regular technical articles in the Association's newsletter further the goal of providing continuing education and information on track construction topics. Within the Association, the Track Division and its Track Technical Committee are responsible for developing information and keeping up-to-date on emerging technology.

The USTC&TBA is located at 3525 Ellicott Mills Drive, Suite N, Ellicott City, MD 21043-4547, (410) 418-4875, FAX (410) 418-4805.

The National Federation of State High School Associations (NFSHSA) consists of 50 individual state high school athletic and/or activity associations, as well as the association of the District of Columbia. Also benefiting from National Federation services as affiliate members are nine Canadian provincial associations, as well as similar groups in the Philippines, Puerto Rico and Guam. Policies for high school athletics and the rules for high school competition emanate from the National Federation and its members. The National Federation, which encompasses the largest body of amateur sport organizations in the world, is responsible for writing the track and field rules that govern competition for over 1,000,000 athletes and more than 20,000 junior and senior high schools.

While the National Federation's Track and Field Rules Committee maintains a liaison with other national and international track and field rules-writing bodies to ensure the rules at the interscholastic level are in harmony with the codes written for other levels of competition, its first priority is to write rules that meet the specific needs of interscholastic competition. Consequently, there are some variances in the events conducted for interscholastic competition, as well as in facility and equipment specifications.

The NFSHSA is located at P. O. Box 20626, Kansas City, MO 64195, 816-464-5400.

ACKNOWLEDGMENTS

In 1984, the U.S. Tennis Court & Track Builders Association addressed the need for individuals knowledgeable in all phases of track construction. The answer was a certification program established to improve the practice of track construction and to help raise professional standards. The program consists of experience qualifications, a comprehensive written exam and structured recertification requirements. The Certification Committee is currently revising the program to insure consistency with the latest rule changes, equipment developments and construction techniques.

This book was written in part, reviewed and edited by members of the U.S. Tennis Court & Track Builders Association who have received the Certified Track Builder (CTB) designation. The Track Construction Manual represents the commitment of the Certified Track Builders to the above-stated goals. Their role in the development of this publication is hereby acknowledged.

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In addition, several other organizations have contributed to the formation and development of this publication. It is a pleasure to acknowledge their help here:

International Amateur Athletic Federation
National Federation of State High School Associations
National Collegiate Athletic Association
USA Track & Field

CHAPTER 1

GOVERNING BODIES OF TRACK

This chapter is a comparison of track rules from the four organizations who are responsible for determining the rules and standards by which competition is conducted. More complete information is available in the rule books published by each organization.

IAAF	International Amateur Athletic Federation. 17, Rue Princesse Florestine MC 98000 Monaco 011-339-330-7070 These rules govern international competition.
NCAA	National Collegiate Athletic Association. 6201 College Blvd. Overland Park, KS 66211 913-339-1906 These rules govern college competition.
NFSHSA	National Federation of State High School Associations. P. O. Box 20626 Kansas City, MO 64195 816-464-5400 These rules govern high school competition.
USAT&F	USA Track & Field One Hoosier Dome Suite 140 Indianapolis, IN 46225 317-261-0500 These rules govern open competition in the United States.

TRACK SPECIFICATIONS

Length of Track

IAAF	Not less than 400 m.
USAT&F	No specified length.
NCAA	No specified length.
NFSHSA	400 m is standard.

Width of Track:

IAAF	7.32 m (6 lanes) minimum. Recommended 8 lanes of 1.22 m.
USAT&F	No specified width.
NCAA	6.40 m (6 minimum width lanes) minimum. Recommend 9 lanes for larger meets.
NFSHSA	No minimum width.

Radius Requirements:

IAAF	World records cannot be set on a track which has an outside lane with a curve radius greater than 60 m. (See IAAF Rule 148 for two radii curve regulations).
USAT&F	Same as IAAF.
NCAA	No recommendation.
NFSHSA	No recommendation.

Inclination:

IAAF	Maximum lateral inclination is 1:100; maximum down ward inclination in the running direction is 1:1000. Lateral inclination should be down toward the inside lane.
USAT&F	Same as IAAF.
NCAA	Same as IAAF.
NFSHSA	Maximum lateral inclination is 2:100; maximum inclination in the running direction is 1:1000.

Lane Width:

IAAF	Minimum width of 1.22 m (48 in.); maximum width of 1.25 m(49.25 in.). The 5 cm wide right hand lane line is included in the width of the lane.
USAT&F	Same as IAAF, but will permit lanes of at least 91.4 cm (3 ft.) if track is not wide enough to accommodate at least eight wider lanes.
NCAA	Width of 1.07 m (42 in.) recommended. The 5 cm wide right lane line is included in the width of the lane.
NFSHSA	Width of 1.07 m (42 in.) is recommended. The 5 cm wide right hand lane line is included in the width of the lane.

Curb Dimensions:

IAAF	Should be 5 cm x 5 cm. If curb is raised to allow drainage under it, maximum height is 6.5 cm.
USAT&F	Same as IAAF.
NCAA	The minimum height is 5.08 cm (2 in.) and the maximum width is 10.16 cm (4 in.). Edges of the curb must be rounded.
NFSHSA	Curb will be 5 cm (2 in.) in height with a rounded top.

Curb Material:

IAAF	Concrete or other suitable material.
USAT&F	Same as IAAF, except must be unbroken on curves and straightaways.
NCAA	Concrete, wood or other suitable material.
NFSHSA	Solid.

If No Curb:

IAAF	Mark with 5 cm wide lane line.
USAT&F	Curb is mandatory.
NCAA	Same as IAAF, except a curb is mandatory to set NCAA records.
NFSHSA	A 5 cm (2 in.) or wider painted line on all-weather tracks.

Measurements:

IAAF	Measure lane 1 30 cm out from inner border of track with curb; 20 cm out from inner border of track with no curb. Other lanes to be measured 20 cm out from outer edges of left hand lane lines. All race distances are measured from the edge of the 5 cm wide starting line farther from the finish line to the edge of the 5 cm wide finish line nearer the start. Race courses must be the prescribed distance or longer. No tolerance is allowed for under-distance.
USAT&F	Same as IAAF.
NCAA	Same as IAAF.
NFSHSA	Same as IAAF.

Finish Line Location:

IAAF	No recommendation. General practice is to place this line at the juncture of the straight and curve (or within 10 meters of it) so that all athletes in lane races run nearly the same distance on the curve.
USAT&F	Same as IAAF.
NCAA	Same as IAAF.
NFSHSA	Recommended at juncture of curve and straight, or within 20 meters of that point.

Steeplechase Course and Water Jump:

IAAF

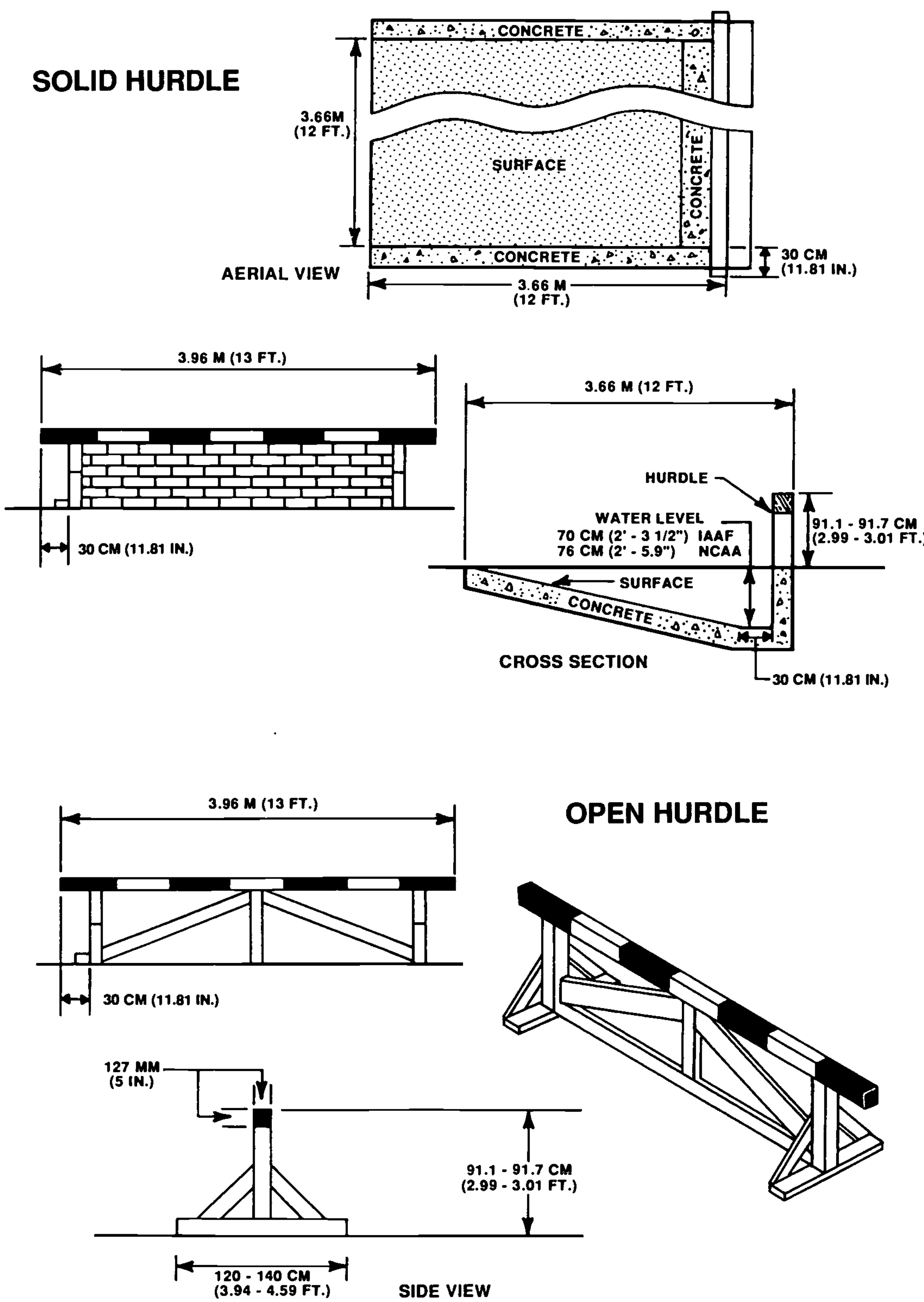
The standard distances shall be: 2000 m and 3000 m. (Note: 2000 m steeplechase is for junior events only.) There shall be 28 hurdle jumps and 7 water jumps included in the 3000 m event, and 18 hurdle jumps and 5 water jumps in the 2000 m event. For both races, the water jump shall be the fourth jump in each lap. If necessary, the finish line shall be moved to another part of the track. It is recommended that in the 2000 m, the water jump be the second jump of the first lap, and thereafter the fourth jump.

Owing to the water jump having to be constructed on the area inside or, preferably, outside the track, thereby lessening or lengthening the normal distance of the laps, it is not possible to lay down any rule specifying the exact length of the laps nor to state precisely the position of the water jump. It should be borne in mind that there must be enough distance from the starting line to the first hurdle to prevent the competitors from overcrowding, and there should be approximately 68 m from the last hurdle to the finish line.

The following measurements are given as a guide and any adjustments necessary should be made by lengthening or shortening the distance of the starting point of the race. It is assumed that a lap of 400 m has been shortened or lengthened by up to 10 m by constructing the water jump inside or outside the track. See IAAF Rule 164 for further suggestions for construction of a good steeplechase course.

In the 3000 m steeplechase, the distance from the start to the beginning of the first lap shall not include any jumps, the hurdles being removed until the competitors have entered the first lap.

FIGURE 1-1


SOLID HURDLE
CONCRETE
3.66M
(12 FT.)
SURFACE
CONCRETE
CONCRETE
AERIAL VIEW
30 CM
(11.81 IN.)
3.66 M
(12 FT.)
3.96 M (13 FT.)
30 CM (11.81 IN.)
3.66 M (12 FT.)
HURDLE
WATER LEVEL
70 CM (2' - 3 1/2") IAAF
76 CM (2' - 5.9") NCAA
91.1 - 91.7 CM
(2.99 - 3.01 FT.)
SURFACE
CONCRETE
CROSS SECTION
30 CM (11.81 IN.)
3.96 M (13 FT.)
OPEN HURDLE
30 CM (11.81 IN.)
127 MM
(5 IN.)
91.1 - 91.7 CM
(2.99 - 3.01 FT.)
120 - 140 CM
(3.94 - 4.59 FT.)
SIDE VIEW

	Lap of 390 m	Lap of 410 m
Distance from start to beginning of 1st lap, to be run without jumps	270 m	130 m
Seven laps at distance	2730 m	2870 m
Race distance	3000 m	3000 m
Hurdle Space: Distance from beginning of 1st lap to 1st hurdle	10 m	10 m
From 1st to 2nd hurdle	78 m	82 m
From 2nd to 3rd hurdle	78 m	82 m
From 3rd hurdle to water jump	78 m	82 m
From water jump to 4th hurdle	78 m	82 m
From 4th hurdle to finishing line	68 m	72 m

The water jump, including the hurdle, shall be 3.66 m in length and width. The water shall be level with the track surface, and at the hurdle end shall be .70 m deep for a space of 30 cm. From this point the bottom shall have a regular slope upward to the level of the track at the farther end of the water jump. The hurdle shall be firmly fixed in front of the water and shall be of the same height as the others in the competition. (See IAAF Rule 164 for dimensions.)

To ensure safe landing of the competitors, the bottom of the water jump shall be covered at the further end with suitable material, at least 3.66 m wide and 2.50 m long, the thickness of which should not exceed approximately 25 mm.

USAT&F — Same as IAAF.

NCAA — Same as IAAF. Recommend water jump inside the track. Top bar of hurdle must have no sharp edges. NCAA rules currently state that the water depth measured closest to the hurdle is 76 cm rather than the 70cm prescribed by the IAAF and USAT&F.

NFSHSA	No recommendation.

General Recommendation

400 m track with a common finish line for all events at the juncture of the straight and curve. Direction of running the straight races should be with the prevailing wind. Direction of running around the 400 m race course is counter clockwise, i.e., inside lane line boundary to runner's left.

FIELD EVENT SPECIFICATIONS

High Jump:

IAAF	Run-up unlimited. Minimum distance is 15 m; 20 - 25 m is recommended. Takeoff area must be level. The maximum inclination of the run-up and takeoff area shall not exceed 1:250 (0.4%) in the direction of the center of the crossbar.
USAT&F	Same as IAAF, except 18 m run-up is recommended.
NCAA	Run-up shall provide a recommended minimum of 21.3 m (70 ft.) of level surface from any direction within a 150 degree arc. Unlimited maximum length. Minimum length is 15 m. The maximum inclination shall not exceed 1:250 in the direction of the center of the crossbar.
NFSHSA	Run-up area should provide a minimum of a semicircle of 15.24 m (50 ft.) radius of level and unvarying surface, the center of which is the midpoint between the standards. The inclination in the high jump approach shall not exceed 1:100 (1%).

Pole Vault - Runway:

IAAF	Length unlimited; minimum length 40 m; 45 m or longer recommended. Maximum lateral inclination of 1:100 and maximum overall inclination in direction of running of 1:1000. Minimum width of 1.22 m and maximum width of 1.25 m.
USAT&F	Length unlimited; minimum length for championship meets is 45 m. Other specifications the same as IAAF.
NCAA	Same as IAAF except minimum length is 38.1 m (125 ft.).
NFSHSA	Same as IAAF except recommended width is 1.07 m (42 in.) and maximum lateral inclination is 2:100 (2%). Minimum length 40 m (130 ft.); recommended 45 m (147 ft. 6 in.).

Pole Vault - Vaulting Box:

IAAF	Shall be constructed of some suitable rigid material, sunk level with the ground and shall be 1 m in length, measured along the inside of the bottom of the box, 60

	cm in width at the front end and tapering to 15 cm in width at the bottom of the stopboard. The length of the box at ground level and the depth of the stopboard are determined by the angle formed between the base and stopboard which shall be 105 degrees. The base of the box shall slope from ground level at the front end to a vertical distance below ground level of 20 cm at the point where it meets the stopboard. The box should be constructed in such a manner that the sides slope outward and end next to the stopboard at an angle of approximately 120 degrees to the base. If the box is constructed of wood, the bottom shall be lined with 2.5 mm sheet metal for a distance of 80 cm from the front of the box.
USAT&F	Same as IAAF.
NCAA	May be constructed of wood, metal or other suitable materials. Its dimensions and shape shall be those specified by the IAAF. The box shall be painted white and shall be immovably fixed in the ground just in front of the vaulting pit so that all its upper edges are flush with the takeoff area. The angle between the bottom of the box and the stopboard shall be 105 degrees.
NFSHSA	Same as IAAF and NCAA except that it is recommended that it be a color which contrasts with that of the runway and landing pit.

Pole Vault - Landing Pit Area:

IAAF	Flat space at least 5 m wide x 6.3 m long from the end of the vaulting box. Space for vault standards.
USAT&F	Same as IAAF.
NCAA	Provision for a landing surface of 4.88 m wide x 4.88 m long and for vault standards.
NFSHSA	Provision for a landing pad is 16 ft. wide and a minimum of 16 ft. long. Space for standards.

Long and Triple Jump - Runway: (Length measured to long jump foul line.)

IAAF	Length unlimited; minimum length 40 m; 45 m or longer recommended. Maximum lateral inclination of 1:100 and maximum downward inclination in the direction of running of 1:1000. Minimum width of 1.22 m, and maximum width of 1.25 m.
USAT&F	Same as IAAF
NCAA	Minimum length of 39.62 m (130 ft.). Recommended width is 1.22 m. Runway to extend beyond takeoff board to nearer edge of the landing pit. Inclinations same as IAAF.
NFSHSA	Minimum length of 39.62 m (130 ft.). Recommended 45 m (147 ft. 6 in.) length. Recommended width of 1.07 m (3 ft. 6 in.). Maximum inclination in the running direction

is 1:1000 and 2:100 laterally.

Long and Triple Jump - Takeoff Board:

IAAF

A board of wood or some other suitable rigid material, painted white and set flush with the runway. For the long jump set at least 1 m from the near edge of the landing pit and at least 10 m from the far edge of the landing pit. For the triple jump set at least 13 m from the near edge of the landing pit and at least 21 m from the far edge of the landing pit. The board shall be 1.21 m to 1.22 m long, 19.8 cm to 20.32 cm wide and a maximum of 10 cm deep. Provision must be made to place a plasticine foul-indicator board in runway adjacent to the takeoff board on the side nearer the landing pit.

USAT&F

A board, made of wood or other suitable material 19.8 cm - 20.2 cm wide and 1.21 to 1.22 m long and 10 cm deep, sunk level with the runway and the surface of the landing area. The takeoff board should be not less than 1 m, nor more than 4.50 m from the landing area for the long jump, and at least 13 m from the landing area for the men's triple jump and at least 8.5 m for the women's triple jump. In front of the takeoff line or attached thereto there shall be placed a board of plasticine or other suitable material for recording the athlete's footprint when he has foot fouled.

NCAA

A board made of wood or other suitable material 20 cm (8 in.) wide and minimum of 1.22 m (4 ft.) long shall be firmly set flush with the runway and painted white. Minimum distance from the board to the near edge of the landing pit is 1 m for the long jump, 3.66 m is the maximum distance allowed. Minimum distance (32.81 ft.) from the board to the far edge of the pit is 10 m. For the men's and women's triple jump, boards of the same specifications should be set as follows--men: A minimum of 10.97 m (36 ft.) from the near edge of the landing pit (12.5 m is recommended) and at least 10 m from the far edge; women: a minimum of 8.53 m (28 ft.) from the near edge of the pit (10 m recommended) and at least 10 m from the far edge of the landing pit.

NFSHSA

A wood or synthetic rectangular board a minimum of 1.22 m (4 ft.) long and 20 cm (8 in.) to 61 cm (24 in.) wide set firmly in the ground, level with the runway. For the long jump, set scratch line approximately 2.44 m (8 ft.) from the near edge of the landing pit for girls and 3.66 m (12 ft.) from the near edge of the landing pit for the boys. For the triple jump, set it 9.75 m (32 ft.) for boys and 7.31 m (24 ft.) for girls. On hard surfaced runways, a painted scratch line of a contrasting color and with the same specifications may be used in lieu of takeoff board.

Long and Triple Jump - Landing Pit:

IAAF	Minimum width of 2.75 m. Running axis should coincide with the axis of the pit. The sand level in the pit shall be the same as that of the top surface of the takeoff board.
USAT&F	Same as IAAF.
NCAA	Same as IAAF.
NFSHSA	Minimum width 2.74 m (9 ft.) and minimum length 4.57 m (15 ft.). Sand or other soft material may be used and must be at the same level as the top surface of the takeoff board or the painted takeoff line (on synthetic runways).

Shot Put, Discus and Hammer Throw - Circle:

IAAF	Shall be made of band iron, steel or other suitable material the top of which shall be flush with the ground outside. It shall be at least 6 mm in thickness and shall be painted white. Interior of the circle may be constructed of concrete, asphalt or some other firm but not slippery material. The surface of the interior shall be level and 2 cm +/- 6 mm lower than the upper edge of the rim of the circle. The rim shall be at least 6 mm thick and painted white.
USAT&F	Same as IAAF, and maximum inclination may not exceed 1:100 lateral or 1:1000 in the throwing direction.
NCAA	Shall be made of band or angle iron or steel, the top of which shall be flush with the concrete outside the circle. The metal circle shall be 6 mm in thickness and 2 cm in height and firmly secured flush with the throwing surface. The interior surface should be of concrete or similar material and shall be 2 cm lower than the concrete outside the circle. Maximum lateral inclination 1:100, maximum inclination in the throwing direction 1:1000.
NFSHSA	Circumference shall be marked with a metal, wood or plastic band which shall not rise more than 1.9 cm above the level of the circle. If the circle has a surface of asphalt, concrete, wood or other hard material, a painted line 5 cm (2 in.) wide may be substituted for the band. Maximum inclination in the throwing direction is 1:1000 (0.1%). A concrete surface with a 1 mm roughness is recommended for shot put.

Circle Measurements:

IAAF	Shot Put: Inside diameter 2.135 m +/- 5 mm. Discus: Inside diameter 2.50 m +/- 5 mm. Hammer: Inside diameter 2.135 m +/- 5 mm.
USAT&F	Same as IAAF, but no tolerances.
NCAA	Same as IAAF.
NFSHSA	Same as IAAF, but no tolerances.

Shot Put Stopboard:

IAAF	The board shall be made of wood or other suitable material in the shape of an arc so that the inner edge coincides with the inner edge of the circle. It shall be painted white and constructed so the that it can be firmly fixed to the ground (or concrete). The board shall measure 1.21 m to 1.23 m long on the inside, 11.2 cm to 13 cm wide and 9.8 cm to 10.2 cm high in relation to the level of the inside of the circle.
USAT&F	Same as IAAF.
NCAA	Same as IAAF, except that no color specified.
NFSHSA	Same as NCAA.

Implement Landing Areas (Shot, Discus, Hammer):

IAAF	40 degree sectors composed of cinders (for shot put only), grass or some suitable material on which the implement makes an imprint. The landing area must be level with the top edge of the circle and the maximum inclination allowed in the throwing direction is 1:1000.
USAT&F	Same as IAAF, except that the level of the landing surface will be on approximately the same plane as that of the circle.
NCAA	Radial lines 5.08 cm wide shall form a 40 degree angle extended from the center of the circle. The inside edges of these lines shall mark the sector. The surface within the landing area shall be on the same level as the throwing surface. Sector flags shall mark the ends of the lines.
NFSHSA	For the shot put, the sector shall be formed by lines from the center of the throwing circle extended through the extremities of the stopboard. This is 65.50 degrees. For the discus, the sector is 60 degrees. No sector is specified for the hammer. Maximum inclination in the throwing direction is 1:100.

Javelin Throw - Runway:

IAAF	Length not less than 30 m nor more than 36.5 m; 4 m wide. Maximum lateral inclination 1:100. Maximum inclination in the running direction is 1:1000. Recommended runway be not less then 33.5 m.
USAT&F	Same as IAAF.
NCAA	Minimum length 36.58 m (120 ft.). Recommend synthetic runways extend 1 m beyond foul line. Maximum inclinations 1:100 laterally and 1:1000 in the running direction. The runway shall be marked by two parallel lines 5.08 cm in width and 1.22 m apart for 21.34 m, widening to 4 m apart for the 15.24 m before the foul line.
NFSHSA	Minimum length 36.58 m (120 ft.); 4 m wide. Maximum lateral inclination 2:100. Usual practice is to build the 50 ft.

of the runway nearest the foul line 4 m wide and the rest of the runway 1.22 m wide.

Javelin Throw - Foul Line:

IAAF	An arc of a circle of 8 m radius made of a 7 cm wide strip of white paint or white painted wood or metal. It shall be flush with the ground (runway) and shall extend the width of the runway.
USAT&F	Same as IAAF.
NCAA	Shall be made in the shape of an arc with radius of 8 m (26 ft. 3 in.). The distance between its extremities shall be 4 m (13 ft. 1 1/2 in.), measured straight across from end to end. It shall be made of wood or other suitable material 7 cm (2 3/4 in.) wide, painted white and sunk flush with the surface. A painted white line is legal on a synthetic surface.
NFSHSA	Same as IAAF.

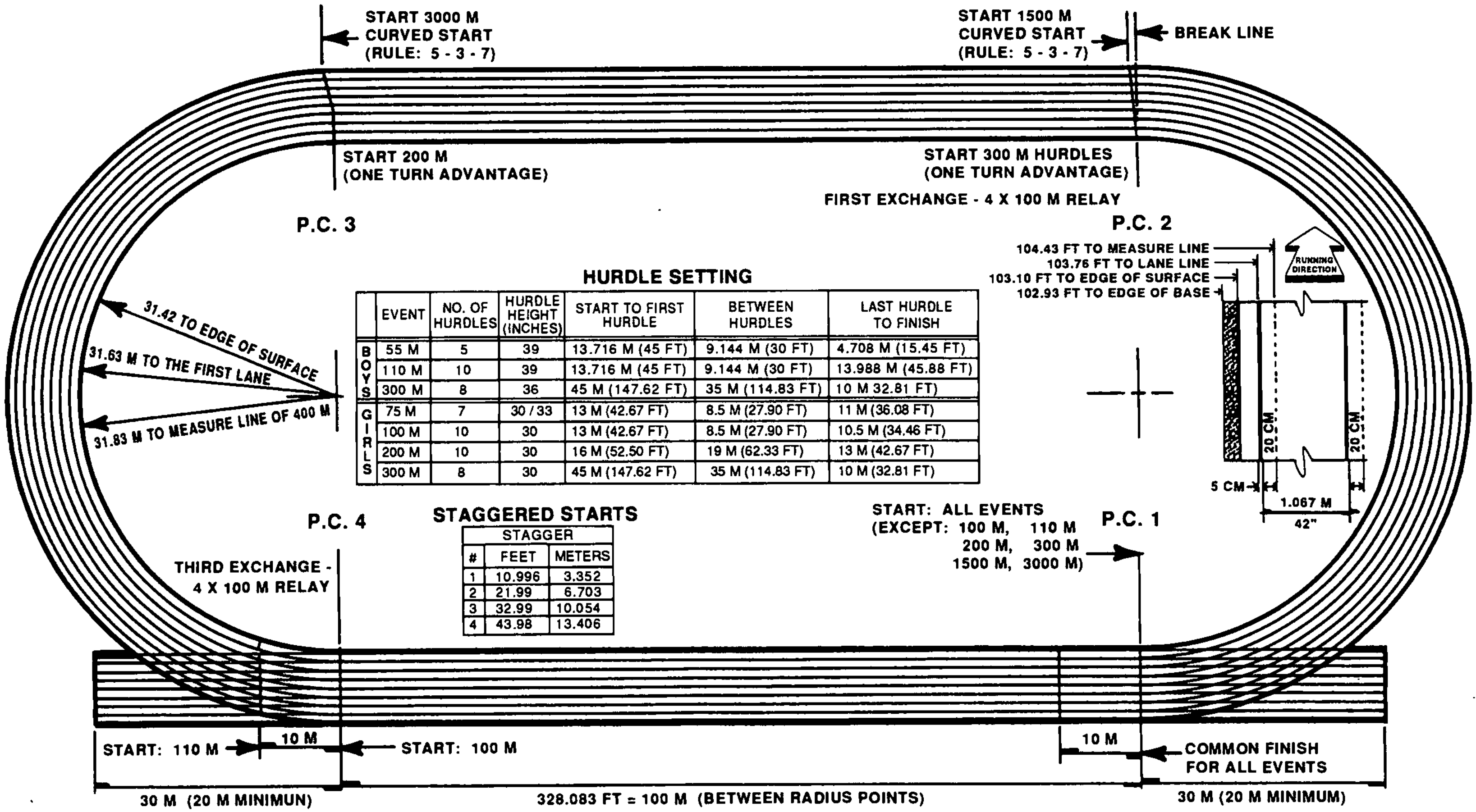
Javelin Throw - Implement Landing Area:

IAAF	The landing sector is delineated by extending white lines from the center of the foul line arc radius (8 m) through each end of the foul line (4 m across). Maximum inclination in the throwing direction 1:1000.
USAT&F	Same as IAAF.
NCAA	Same as IAAF, except that the level of the landing surface will be on the same level as the throwing surface. Maximum lateral inclination is set at 1:100. Radial lines shall be extended from the center of the circle of which the arc of the foul board is a part through the extremities of the arc. The inside edges of these lines shall mark the sector. The surface within the landing area shall be on the same level as the throwing surface. Maximum lateral inclination 1:100; maximum inclination in the throwing direction 1:1000.
NFSHSA	Same as NCAA except maximum lateral inclination 2:100 (2%) and maximum inclination in the throwing direction shall be 1:100 (1%).

Notes: The USTC&TBA makes every effort to keep up to date on the various rules changes from each association. However, these rules are subject to change without notice to the USTC&TBA, and there is no assurance that the current rules are included in this volume. If you have a need to make a specific rules determination, you are advised to contact the appropriate governing body for its current rules book.

The forms of track construction referred to in this manual are the types of construction that are the norm for the industry today. The USTC&TBA does have available from its archives information relating to natural material running track surfaces such as shale, cinder, dirt, clay, etc.

FIGURE 2-1
400 METER EVENTS



HURDLE SETTING

	EVENT	NO. OF HURDLES	HURDLE HEIGHT (INCHES)	START TO FIRST HURDLE	BETWEEN HURDLES	LAST HURDLE TO FINISH
BOYS	55 M	5	39	13.716 M (45 FT)	9.144 M (30 FT)	4.708 M (15.45 FT)
	110 M	10	39	13.716 M (45 FT)	9.144 M (30 FT)	13.988 M (45.88 FT)
	300 M	8	36	45 M (147.62 FT)	35 M (114.83 FT)	10 M 32.81 FT)
GIRLS	75 M	7	30 / 33	13 M (42.67 FT)	8.5 M (27.90 FT)	11 M (36.08 FT)
	100 M	10	30	13 M (42.67 FT)	8.5 M (27.90 FT)	10.5 M (34.46 FT)
	200 M	10	30	16 M (52.50 FT)	19 M (62.33 FT)	13 M (42.67 FT)
	300 M	8	30	45 M (147.62 FT)	35 M (114.83 FT)	10 M (32.81 FT)

STAGGERED STARTS

#	STAGGER FEET	STAGGER METERS
1	10.996	3.352
2	21.99	6.703
3	32.99	10.054
4	43.98	13.406

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CHAPTER 2

GENERAL SPECIFICATIONS

GENERAL REQUIREMENTS

The first stage in the development of an athletic facility is to prepare a preliminary plan, to select a location which will best allow for accessibility both for construction and use, and to incorporate the necessary layout.

The standard for the width of the site, preferably in the east/west direction, may be from 69 m to 98 m and the length, preferably in the north/south direction, may range from 182 m to 173 m respectively. For the recommended equal quadrant facility, these dimensions must be 182 m x 82 m for an eight lane track and 177 m x 77 m for a six lane track. These dimensions are to assist in the determination of the outer limit of the track area. Additional area should be considered for such facilities as grandstands, bleachers, etc.

In the investigation of the site, it is essential to determine the locations of all utility lines, (i.e. electric, gas, water, sewer and telephone), and to avoid construction over them when possible. Note other obstructions such as fences, trees, buildings, grandstands, and bleachers.

If possible, the facility should be laid out where the straightaways are parallel to the prevailing winds. This is especially important for all dashes and hurdle races, as they need to be run either with the wind or against it.

In the preliminary plan, a primary concern is to acquire proper drainage away from the track. Attempt to locate the track on a relatively level plane higher than the surrounding terrain in order to avoid excessive earth balancing. Extensive fill is not recommended, and excessive cuts are usually cost prohibitive.

After review of the available sites, evaluate the stability of the soil conditions by running a soil analysis on the available locations. Select the site with the best soil for good, hard, non-heaving sub-grade and avoid peat, topsoil, clay, shear sand or other decomposed materials.

SOIL PROPERTIES

The important soil properties are:

1) Permeability
2) Elasticity
3) Plasticity
4) Shearing Strength
5) Cohesion

6) Compressibility
7) Shrinkage and Swell
8) Frost Susceptibility

Permeability - usually means the ease with which water will flow or pass through the pores of a soil. Soil texture, gradation, degree of compaction and primary structure strongly influence a given soil's relative permeability.

Elasticity - refers to the ability of a soil to return to its original shape after having been deformed by a load for a short period of time.

Plasticity - refers to the ability of a material to be deformed without cracking or crumbling and then maintain that deformed shape after the deforming force has been released.

Shearing Strength - of a soil is the result of friction between the particles and cohesion.

Cohesion - of a soil is all of the shearing strength not due to friction.

Compressibility - refers to that portion of the volume change deformation resulting from the expulsion of the pore water. Compressibility is influenced by the soil structure. Frequently volume change deformations occur in soil masses without any application of external loads. This can be caused by two phenomena. The lowering of the ground water table in an area would, as a result, increase the soil stresses that are effective in producing a volume change within compressible layers below the original ground water level and lead to the settlement of fills. Other volume change deformations that occur in soils independent of any externally applied load may be the result of what is known as shrinkage or swelling.

Shrinking and Swelling - are more pronounced in clay soils. Both shrinking and swelling result from a build up and release of capillary tensile stresses within the soil. Clays have high volume change capacity and frequently have high liquid limits. With water limits in soil freezing conditions, it will cause possible problems for a track.

Frost Susceptibility - where freezing temperatures are prolonged and the frost line penetrates deep into the soil, ice layers form in the soil and cause the soil to heave at the surface, equivalent to the thickness of the ice layers.

Some methods for reducing the probability of detrimental heave in frost susceptible soils are:

1) Full depth asphalt construction, which tends to reduce variation of moisture content in sub-grade.
2) Uniform blending of sub-grade soils.
3) Impermeable membranes to prevent or reduce moisture migration.
4) Lowered water table.

5) Good surface drainage.
6) Granular sub-base that is designed for non-frost susceptibility.

TRACK DIMENSIONS

There are two basic track designs to be considered:

1) **Equal Quadrant Tracks** - which are 400 m or 1312.34 ft. (minimum distance) tracks, with 100 m along each curve and 100 m along each straightaway measured along the measure line of lane 1 (see Figure 2-1).

2) **Non-Equal Quadrant Tracks** - which are 400 m or 1312.34 ft. (minimum distance) tracks measured along the measure line of lane 1, with two curved ends equal in length and two straightaways equal in length but longer or shorter than the curves. This is based on the calculations for the 400 m or 1312.34 ft.(minimum distance) race course (see Figure 2-2).

Figure 2-2 will assist in the determination of acceptable dimensions. Note that the radius to the measure line of lane 1 should not be less than 90 ft. nor more than 130 ft.

In designing and calculating for the accuracy of the 400 meter track, it is an acceptable standard to allow for a 1/2 in. plus tolerance for each lap in its final state. No minus tolerance may be accepted from the prescribed distance.

TRACK/PLAYING FIELD CONFIGURATION

In designing new facilities or in constructing a new 400 meter track around existing facilities, attention should be directed toward the official sizes and needs of the interior playing fields, and consideration given to the location and layout of the field events.

FIELD MEASUREMENTS FOR 400 METER TRACKS

Figure 2-2

RADIUS TO MEASURE LINE	DISTANCE BETWEEN RADII
90	373.423
95	357.715
97	351.432
100	342.007
101	338.865
102	335.724
103	332.582
103.50	331.011
104	329.441
104.43 (for equal quadrant - 400 meter track)	328.083
105	326.299
105.04	326.173
106	323.157
106.50	321.587
107	320.016
108	316.874
109	313.733
110	310.591
110.50	309.020
111	307.449
115	294.883
120	279.175
125	263.467
130	247.759

NOTE: Measure line is defined as a line located 20 cm from the inside of the painted line of each lane or 30 cm from the raised curb of lane one and 20 cm from the inside of the remaining lanes.

Formulas to calculate distance for a 400 meter track:
400M = 2 x distance between radius points + 2 x arc length
Arc length = Pi x radius to measure line

FIGURE 2-3
TRACK / PLAYING FIELD CONFIGURATION

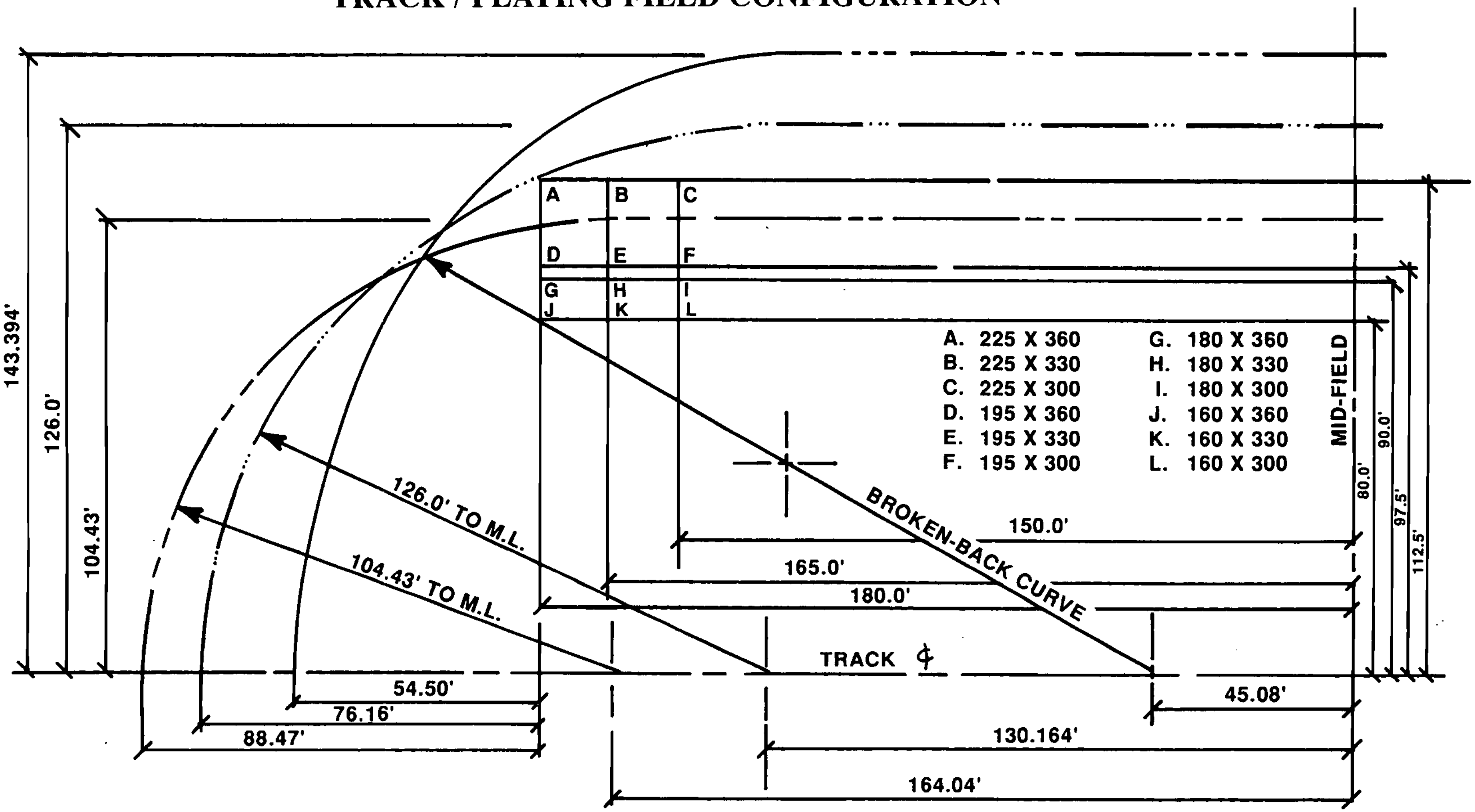


Figure 2-3 shows the needed radii dimension with respect to the desired playing field. It should be noted that the equal quadrant track with a radius of 104.43 ft. to the measure line of lane 1 will accommodate the official dimensions for football and high school soccer. In order to accommodate college soccer and senior soccer, the minimum radius needed is 126 ft.

The effect of the sidelines has a direct bearing on the type of playing field you intend to use inside your track. To help assist you in the determination of the track dimensions, the following chart should be used (see Figure 2-3).

MINIMUM FIELD SIZES

	Min. Length	Max. Length	Min. Width	Max. Width
1. Football (High School)	360	360	160	160
2. Soccer (High School)	330	360	165	225
3. Soccer (College)	330	360	195	240
4. Soccer (Senior)	330	360	195	240

It is important to allow the necessary sideline area for safety and comfort. The use of the International Broken-Back Curve design can allow for the wider facility and maintain the necessary layout to meet all rules. This method of layout must be used with close attention to the rule that pertains to this type layout.

The radius of the outside lane does not exceed 60 m (196.85 ft.) except where the bend is formed with two different radii, in which case the longer of the two arcs should not account for more than 60 degrees of the 180 degree turn.

This type layout can assist a facility in offering a regulation track in an area that is almost square in dimensions, or on a site that may be wider but not as long as normal.

Careful review of this method may prove to be helpful.

COMPUTING WORKABLE MEASUREMENTS

When computing workable measurements for metric tracks, some very important facts should be remembered if accuracy is desired:

7.87 in. (not 8 in.)	=	20 cm
11.81 in. (not 12 in.)	=	30 cm
42 in.	=	1.0668 m
48 in.	=	1.2192 m

3.28083 ft. (min. conversion factor)	=	1 m
3.1416	=	pi
1312.34 ft. (minimum distance)	=	400 m

It is suggested that you calculate to the nearest .0001 m so measuring can be done to the nearest .001 m. If using feet, calculate to the nearest .001 ft. so the measuring can be done to the nearest .01 ft.

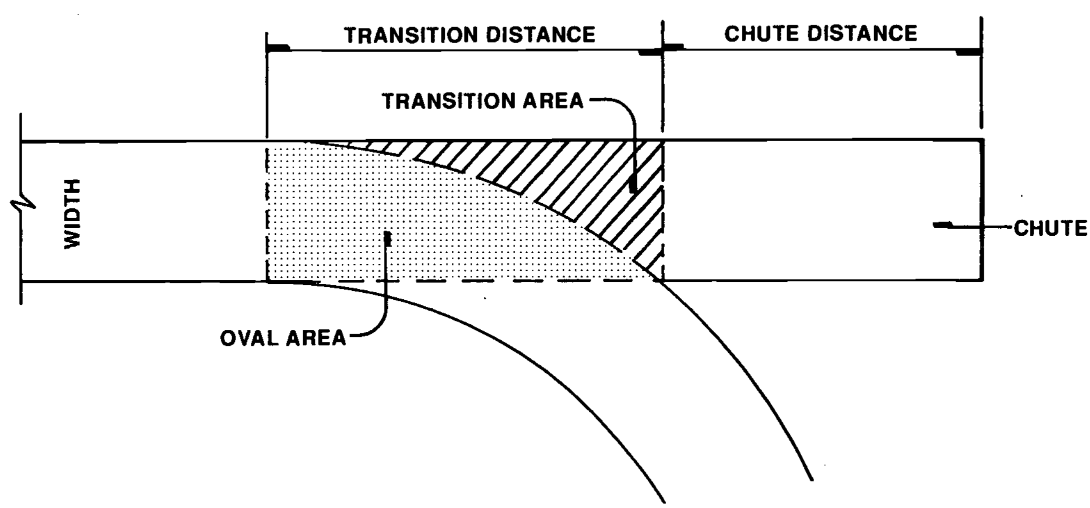
A complete knowledge of governing rules and their differences, the prescribed path of runner, break line compensation requirements and basic mathematical formulae is essential.

COMPUTING SQUARE YARDAGE

Figure 2-5 is furnished as a guide for the surface area of a running track. Calculations assume an equal quadrant track without a raised curb using the base extension method.

The 'oval area' includes both straightaways and both curves. The 'transition area' (Figure 2-4) covers that portion of the straightaway extension shown below. The 'transition distance' is the length of the transition area. The 'chute area' is a rectangle and can easily be calculated.

FIGURE 2-4
TRANSITION DETAIL



SQUARE YARDAGE OF 400 METER TRACKS
Figure 2-5

Width (in ft.)	Track Oval Square Yards	Transition Area Sq. Yards	Distance
18	2725	42	64
19	2883	45	66
20	3042	49	68
21	3201	52	70
22	3362	56	71
23	3522	60	73
24	3684	64	75
25	3846	68	77
26	4009	72	78
27	4173	76	80
28	4337	81	82
29	4502	85	83
30	4668	89	85
31	4834	94	86
32	5001	99	88
33	5169	103	89
34	5337	108	91
35	5507	113	92
36	5677	118	94

(Add chutes and field events separately)

FIELD EVENT DIMENSIONS

HIGH JUMP

Dimensions	Square Yards
50 ft. Radius - Semicircle/15 degree cut off	363
50 ft. Radius - Semicircle	436
70 ft. Radius - Semicircle	855
50 ft. x 50 ft. Square	278
50 ft. x 80 ft. Rectangle	444
50 ft. x 100 ft. Rectangle	556

POLE VAULT - LONG JUMP - TRIPLE JUMP

Dimensions	Square Yards
130 ft. x 4 ft.	58
150 ft. x 4 ft.	67
160 ft. x 4 ft.	71

The following are suggested track and field layouts that may be of assistance to you. Figure 2-6 through 2-10 provide different ideas for laying out the events. Figure 2-11 is a detail of a radius point monument that is often used for a permanent fixture in facility construction.

FIGURE 2-6
TRACK USE ONLY

Note: For equal quadrant track

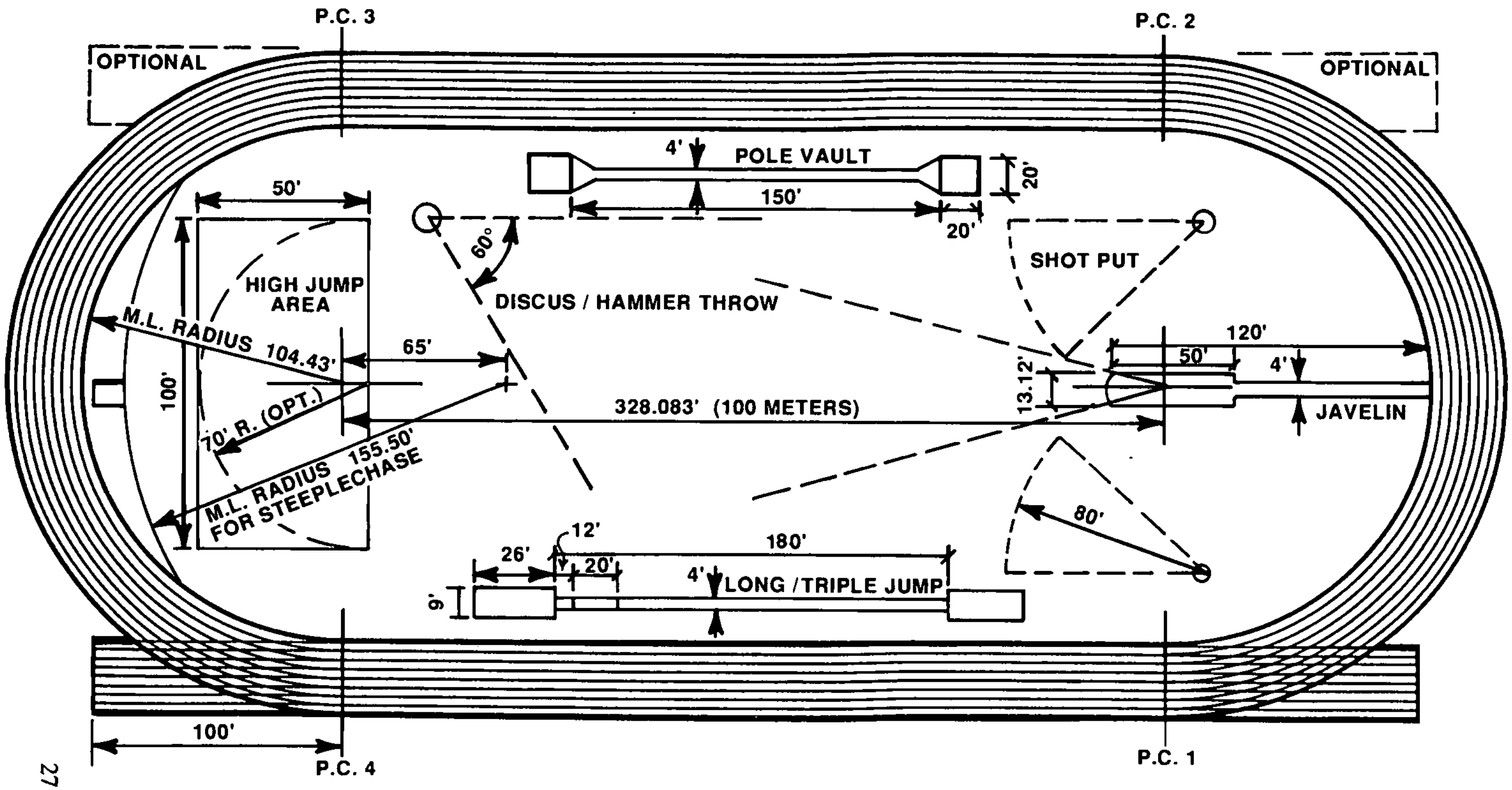


FIGURE 2-7
RUNWAYS ON BACK STRAIGHT

Note: For equal quadrant track

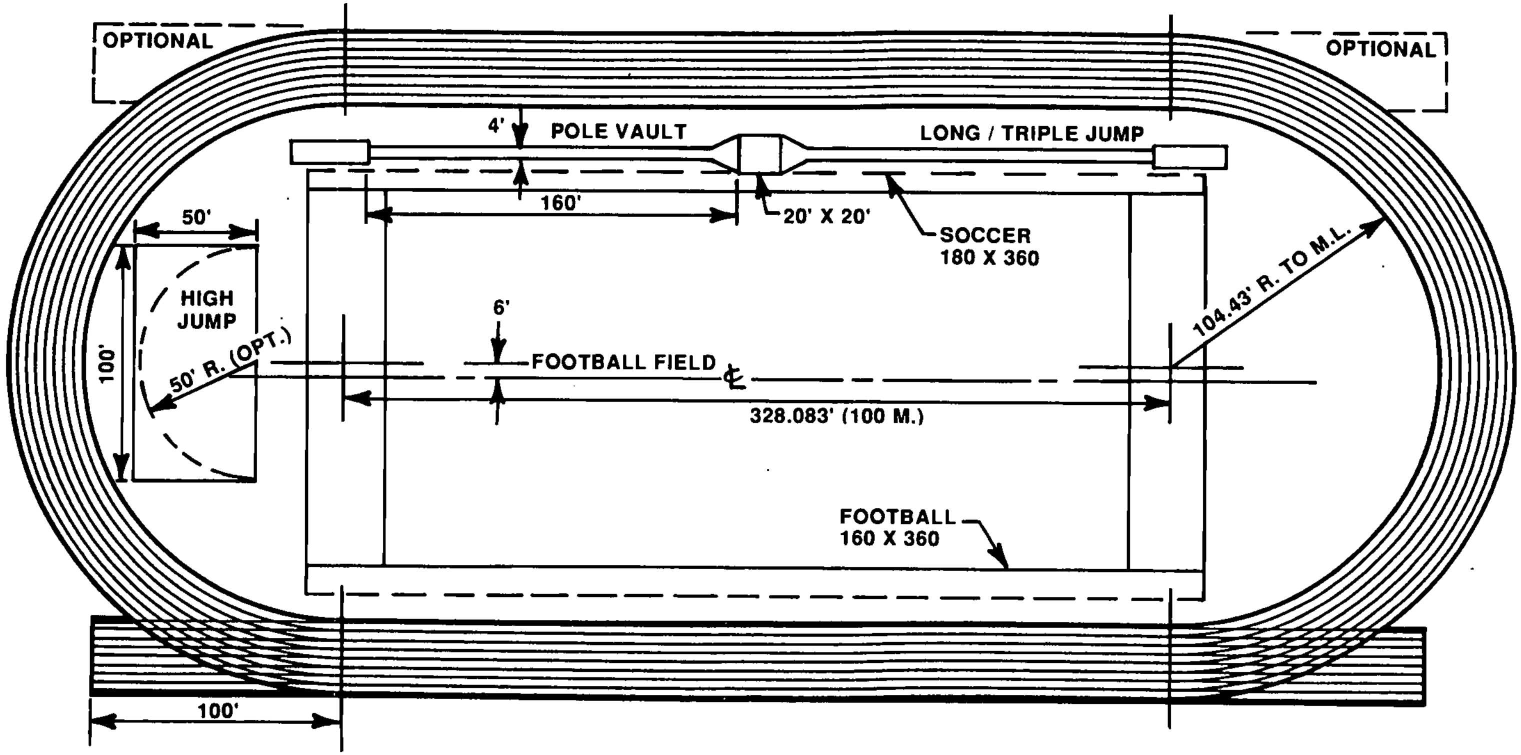


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FIGURE 2-8
RUNWAYS OUTSIDE OF TRACK

Note: For equal quadrant track

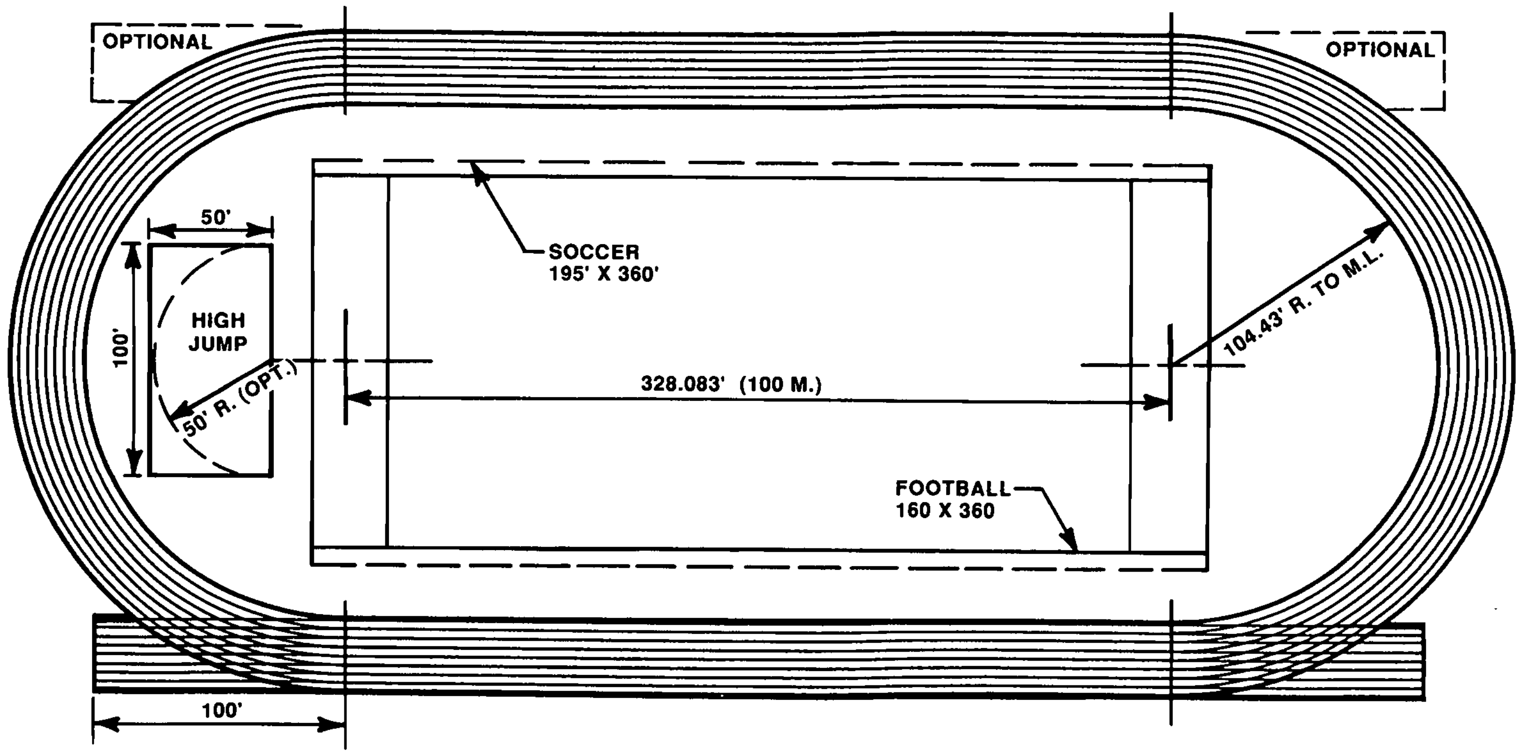

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FIGURE 2-9
RUNWAYS INSIDE CURVE

Note: For equal quadrant track

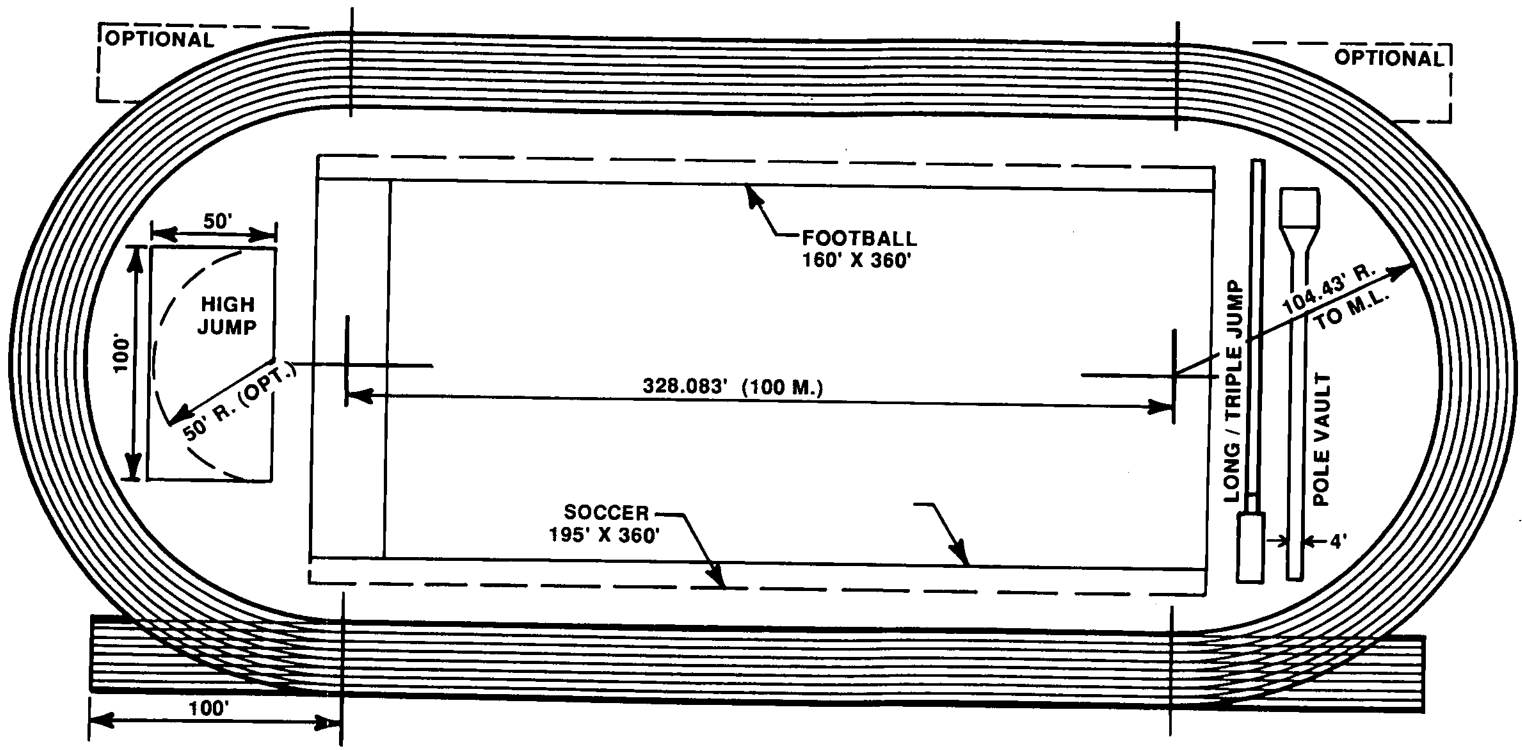

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FIGURE 2-10
INTERNATIONAL BROKEN-BACK CURVE

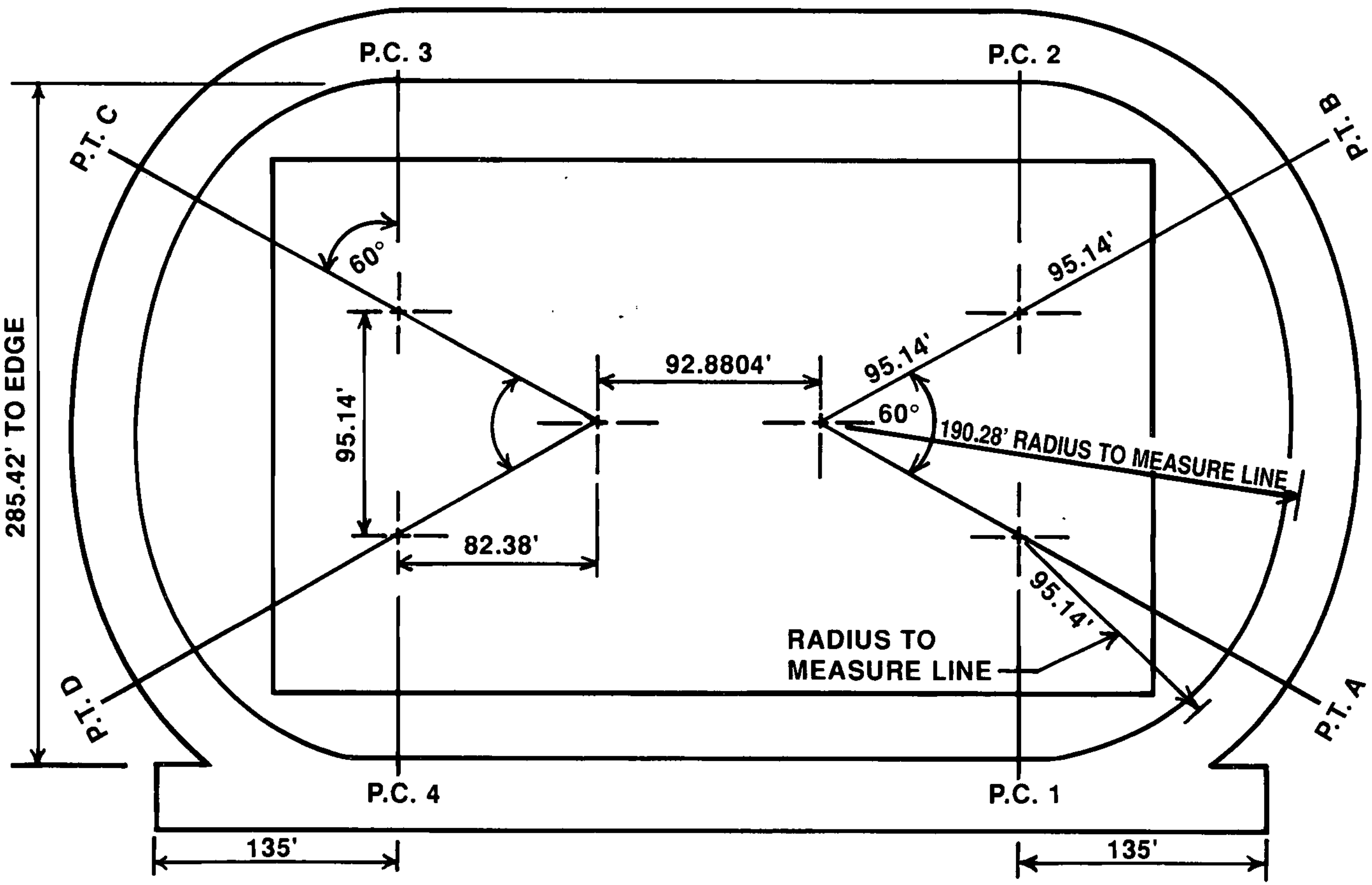

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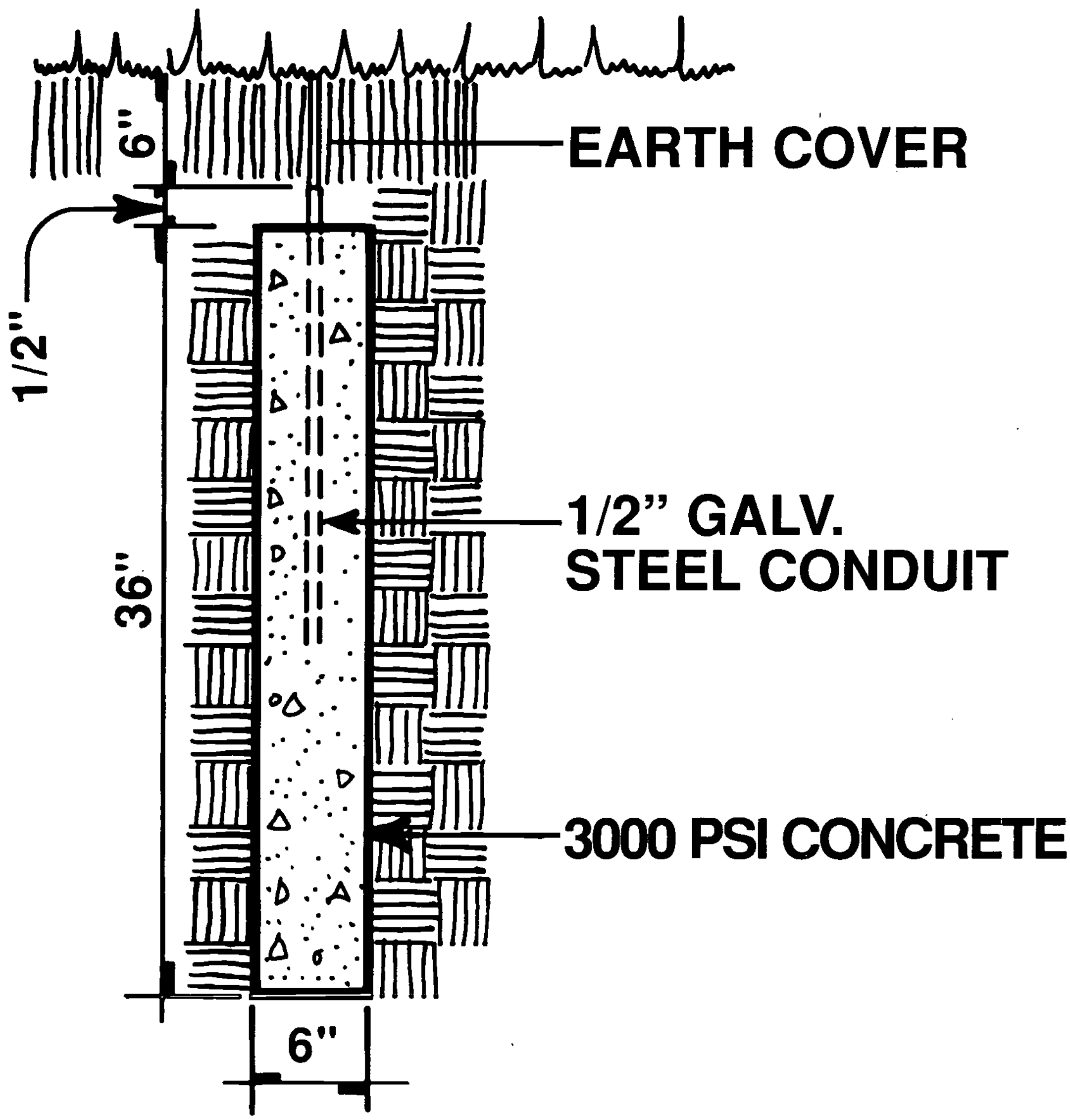
FIGURE 2-11
RADIUS MONUMENT
NOTE: RADIUS MONUMENT IS PERMANENT
MARKER FOR RADIUS POINT



CHAPTER 3

GENERAL CONSTRUCTION REQUIREMENTS

SITE INVESTIGATION

The ultimate performance of any running track depends to an important degree on the subsoil and drainage conditions.

Expansive soils and use of expansive materials such as open hearth slag in the base course can create problems. Frost action is exaggerated where frost susceptible materials have enough moisture to create frost heave.

It is, therefore, necessary to identify soil conditions existing at the site and to take these into account when designing the running track. Site preparation, including stripping, placement of back-fill and base construction must be properly performed to minimize the risk of problems due to subsoil and subgrade conditions.

The more serious conditions that require an adequate soil study include:

1. The existence of peat and other organic soils at the site.
2. Uncontrolled fill materials or waste materials.
3. Expansive soils.
4. High ground water conditions.

If there are no anticipated problems with the site, it is still suggested that it be investigated to the extent that shallow hand dug test pits, hand auger borings or backhoe excavations be performed. This will allow identification of conditions that might create problems and will serve as a basis for determining the amount of topsoil removal and placement of fill and drainage.

If a site is expected to present some problems, it is recommended that to have a sounder basis for design, an auger investigation be done. Auger borings should be made at approximately 200 ft. intervals or closer if it appears necessary to secure adequate site information.

If the site has some of the problem materials previously discussed, such as fill material or organic material, it is recommended that the owner retain a geotechnical consultant to take borings, analyze the information and provide recommendations for site preparation.

DRAINAGE PRINCIPLES

Good surface and subsurface drainage are necessary to properly support a paving structure. The basic objective of a surface drainage system is to ensure that the only water that falls on the track surface is that which comes in the form of rain, and that all other water be directed around the surface. The objective of a subsurface drainage system is to prevent excessive moisture buildup underneath the soil and to keep it as dry as possible, especially in frost areas, so that the frost susceptibility of the soil is minimized.

It should be recognized that a poorly designed drainage system may do more harm to the surface than no system at all. It should also be recognized that surface and subsurface drainage problems are often interrelated.

A series of swales is an economical and effective way to redirect surface water that might otherwise flow over the track surface. It will also help to prevent seepage of water beneath the surface. Specific drainage systems are discussed in Chapter 4.

SOIL STERILIZATION

It is first necessary to determine whether soil conditions make sterilization necessary or desirable. Adjacent pavements provide good indications of the possible need for treatment. Tracks that are two or more years old in the same vicinity also attest to the problem if it exists.

There are three main causes for weed growth under and through the track surface.

1. Excavation cuts existing weed growth but does not entirely eliminate it.

2. Excavation uncovers ungerminated seeds but does not remove all of them. These dormant seeds might germinate due to increased moisture in the soil and warmer soil temperatures following construction. This is especially true with asphalt construction.

3. Fill materials brought in to raise the subgrade or back-fill excavations may contain ungerminated seeds.

Herbicides used for soil sterilization come in liquid, pellet and powder form. Liquid herbicides are mixed with water or other substances to facilitate application. A water mixture is designed to permit root systems to absorb the herbicide. An oil mixture works best for absorption through the foliage. Herbicides in pellet form are useful where rainfall is sufficient to carry them to root systems. Depending on the type of herbicide, it can be applied either to the subgrade prior to installing the aggregate base, or installed on top of the aggregate base prior to installing the asphalt or concrete. In some cases, it is possible to mix herbicide with asphalt cut backs that are used as primers.

The timing of the herbicide application is very important. Liquid herbicide should not be sprayed during windy conditions. This can damage vegetation adjacent to the construction site. If rain or surface water washes onto the sterilized area before it is covered, some of the herbicide will leach or wash into the surrounding ground, causing harm to desirable vegetation. Leaching may also occur if herbicides are applied to water-saturated soils such as those that may exist immediately after a rainfall. The herbicide application should be performed in accordance with the manufacturers' directions and in a manner which complies with all applicable environmental laws and regulations.

Top soil and other unsuitable materials normally should be removed to a minimum distance of 5 ft. beyond the surfaced area. This should be done in such a manner so as to minimize disturbance of the remaining subgrade soils and facilitate placement of embankment materials for fill.

Fill is normally well graded, granular soil or material with similar properties that is locally available. Such materials should be free of organic or expansive material and free of particles greater than 1 1/2 in. in size. It should be placed in lifts not to exceed 6 in. in thickness and properly compacted. Water content should be reduced or increased as necessary to achieve optimum compaction.

Back-fill of all trenches should be granular material. Where trenching or drain tile is used under existing permanent pavement, compaction should be adequate to 100% to prevent settlement that could affect the final surface.

For unusually difficult soil conditions, geotextile membranes may be considered.

AGGREGATE BASE

A base course of bituminous asphaltic mixture; crushed aggregate; hot-mixed, hot laid asphaltic concrete; or penetration macadam shall be installed over the subgrade as indicated on drawings. The specified material shall meet applicable ASTM specifications. Compacted thickness shall be as shown on drawings to satisfy local soil and climatic conditions but in no case shall the thickness be less than the equivalent of four inches (4 in.) of thoroughly compacted crushed stone.

The material shall be spread by methods and in a manner proposed by the contractor to produce a uniform density and thickness with the grades and dimensions shown on drawings and elaborated below.

The material as thus spread shall be compacted with a powered steel wheel tandem roller weighing not less than eight (8) and not more than ten (10) tons or by other equipment producing equivalent density.
The surface of the base course after compaction shall not vary more than 1/2 in. in 10 ft. measured in any direction.

ASPHALT

A leveling course of hot plant mix having a maximum aggregate size of 3/8 in. to 3/4 in. in accordance with specifications of the Asphalt Institute shall be constructed over the base course to a compacted thickness of not less than 1 in. as indicated on drawings. Any areas under 1 in. shall be repaired to the proper depth before the surface is applied.

This hot plant mix shall be spread by methods and in a manner proposed by the contractor to meet the tolerances specified herein.

After spreading, the mix as thus spread shall be thoroughly compacted by breakdown rolling with a powered steel wheel tandem roller weighing not less than six (6) tons.

The finished surface of the leveling course shall not vary more than 1/4 in. in 10 ft. when measured in any direction.

A surface course of a hot plant mix having a maximum aggregate size of 3/8 in. in accordance with specifications of the Asphalt Institute shall be constructed over the leveling course to a compacted thickness of not less than 1 in. as shown on the drawings.

This hot plant mix shall be spread by methods and in a manner proposed by the contractor to meet the tolerances specified herein.

The mix shall be thoroughly compacted by breakdown rolling with a powered steel wheel tandem roller weighing not less than six (6) tons. Finish rolling shall be done with a powered steel wheel roller weighing not less than one (1) ton.

The finished surface course shall not vary more than 1/4 in. in 10 ft. when measured with a 10 ft. straightedge in any direction.

The proper type of asphalt used for the surface course will vary from state-to-state if using the standard norm of the Department of Transportation (DOT) or State Highway Department standards. The following is a typical mix design which has succeeded in providing quality facilities.

Thickness: Not less than 1 in.

Liquid Asphalt or Bitumen: 5.5% by weight (+/- 0.5%)

Asphalt Penetration or Type: (85 - 100 penetration)

Aggregate Type: Crushed stone, gravel, shale, limestone, etc. Slag is unacceptable unless other materials cannot be obtained, and then only blast furnace slag is acceptable.

Aggregate Sieve Analysis	% Passing
1/2 in.	100%
3/8 in.	70 - 80%
1/4 in.	60 - 80%
No. 4	60 - 70%
No. 8	50 - 70%
No. 12	40 - 60%
No. 16	30 - 50%
No. 30	20 - 40%
No. 50	20 - 30%
No. 100	10 - 20%
No. 200	2 - 6%
Washed	0 - 2%

Installation Equipment: Self-propelled paving machine with vibratory screed

Breakdown Rolling: Not less than 6 ton tandem steel wheel roller with working watering system

Finish Rolling: Not less than 1 ton tandem steel wheel finish roller

CONCRETE

Cement shall conform to one of the Standard Specifications for Portland Cement, ASTM C - 150 or Specification for Blending Hydraulic Cements, ASTM C - 595, excluding slag cements types S and SA.

Air entrainment by total volume of concrete shall be:

4 to 6% for 1 1/2 in. maximum size coarse aggregate;
5 to 7% for 3/4 or 1 in. maximum size coarse aggregate;
6 1/2 to 8 1/2% for 3/8 or 1/2 in. maximum size coarse aggregate.

Aggregate shall conform to Standard Specifications for Concrete Aggregates ASTM C - 33. For concrete work that is 5 in. thick, the nominal size of the coarse aggregate shall not exceed 1 1/2 in.; for concrete work that is 4 in. thick, the nominal size of the coarse aggregate shall be not greater than 1 in.

Concrete work shall be 5 in. thick if the location of the structure is such that it will be subject to more than three freeze-thaw cycles annually. If the location is such that not more than three freeze-thaw cycles occur annually, concrete work may be 4 in. thick.

Steel reinforcement bars shall conform to Standard Specifications for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement ASTM A - 615, Grade 60 or 40. For concrete work that is 5 in. thick, the recommended bars shall be No. 5 size in both directions at 12 in. on center. For concrete work that is 4 in. thick, the recommended bars shall be No. 5 size in both directions at 15 in. on center. Bars shall be accurately positioned at mid-depth, terminating 2 in. away from edges and joints, and shall be adequately supported by chairs with sand plates provided to prevent bar supports from sinking into the subbase. Bars shall be lapped 18 in. and also be securely tied or otherwise secured so that there is no possibility of displacement when concrete is placed. Reinforcement at time of concrete placement shall be free of loose, flaky rust and other coatings or films that could interfere with bonding to the concrete.

The concrete shall have a compressive strength of not less than 3,000 psi at the 28th day after casting. The minimum cement content for finishability shall be not less than 470 lb. per cubic yard for 1 1/2 in. maximum size coarse aggregate or 520 lb. for 1 in. In freeze-thaw environments, the minimum cement content shall be not less than 560 lb. per cubic yard. The slump shall not be more than 4 in. Ready-mixed concrete shall be mixed and delivered in accordance with ASTM C - 94, Specification for Ready-Mixed Concrete.

Concrete shall be spread, consolidated, screeded, bull-floated and finished in accordance with Section 7.2 of ACT Standard 302, Recommended Practice for Concrete Floor and Slab Construction. When concrete is sufficiently set to withstand foot pressure with only about 1/4 in. indentation and the water sheen has left the surface, the slab shall be uniformly finished by power floating and troweling. The final finish texture shall be in accordance with manufacturing recommendations, but must have at least a medium broom finish to improve the mechanical bond to the surface.

It is recommended that immediately after brooming, the concrete be kept continuously moist for 7 days by covering with polyethylene film or waterproof curing paper. Curing compounds should not be utilized. Curing time shall be in accordance with surfacing systems manufacturer's recommendations, but in no case less than 28 days.

The concrete surface shall be finished so that the tolerance shall not vary more than 1/4 in. in 10 ft. when measured with a 10 ft. straightedge in all directions.

DYNAMIC BASE STRUCTURES

A relatively new development is the construction of all-weather tracks without the use of asphalt or concrete. Upon a properly graded and compacted stone base, a dynamic base normally comprised of polyurethane binder, rubber aggregate and fine stone aggregate is constructed, usually to a thickness of 1 1/4 in. to 1 3/4 in.

This appears to be a desirable option where asphalt or concrete is difficult or impossible to obtain, where access is difficult or where the base is expected to provide some buffering between a subgrade that has minor movement. In certain cases it may also be possible to modify the all-weather surfacing system to make it more economical since some of the characteristics are already being provided by the dynamic base.

By varying the mix percentages of rubber, stone and polyurethane binder, it is possible to achieve a wide range of flexibility in the dynamic base to suit your particular needs. This system can be installed using conventional asphalt paving equipment or polyurethane track surfacing pavers.

Since the formulas are variable, you should contact a knowledgeable track contractor, design professional or consultant for more detailed specifications.

CHAPTER 4

CURBS AND DRAINS

An important part of running track construction is the area separating the track and the infield. This perimeter allows for drainage of the track and infield as well as being the control point for leveling, grading and establishing the correct length and width of the track.

PERIMETER EDGING

Pavement Extension - (See Figure 4-1).

The aggregate base course shall be constructed so that its inside perimeter is parallel to and 28 in. inside of the track measure line, and 16 in. from the outer side of the outside lane line, as indicated on Figure 4-1.

The asphaltic concrete course(s) shall be constructed so that the inside perimeter is parallel to and 22 in. inside of the track measure line, and its outside perimeter parallel to and 10 in. from the outer side of the outside lane line, as indicated on Figure 4-1.

The synthetic surfacing course shall be constructed so that its inside perimeter is parallel to and 16 in. inside of the track measure line and its outside perimeter parallel to and 4 in. from the outer side of the outside lane line, as indicated on Figure 4-1.

Flush Curb - (See Figures 4-2A and 4-2B).

A solid curb as specified in the rules shall be installed for both the inside and outside (or inside only) perimeter of the track. The curb shall be flush with the top elevation of the synthetic surface for an impermeable installation. For a permeable installation, the curb is to be flush with the final elevation of the asphalt. The distance between the track side of the inside curb and the measure line shall not be less than 16 in. The distance between the track side of the outside curb and the lane line shall not be less than 4 in.

Permanent Raised Curb - (See Figure 4-3).

A solid curb as specified in the rules shall be installed to provide a curb for both the outside and inside perimeter of the track. The distance between the track side of the curb and the track measure line shall be 30 cm.

The distance between the track side of the outside curb and the lane line shall not be less than 4 in.

The permanent raised curb is used primarily for cinder, fired clay, expanded shale, decomposed granite, and natural clay running tracks.

Removable Raised Curb - (See Figure 4-4)

Removable raised curbs are available in various materials. Among these are aluminum, polyurethane, or aluminum with a firm rubber top. The curbs are designed so that the curb sits on pads that allow for movement of water from the track surface to the drain channel or infield. These systems are relatively easy to install and can be stored during the off season.

FIGURE 4-1
PAVEMENT EXTENSION

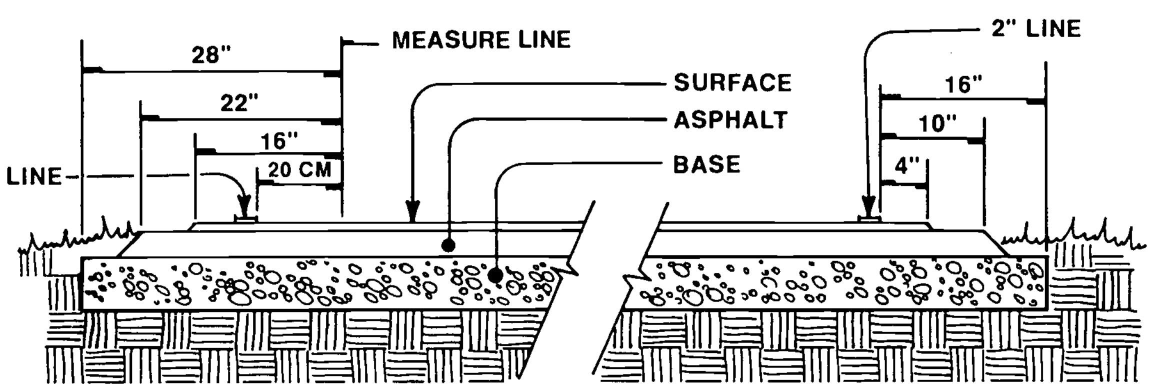


FIGURE 4-2A
FLUSH CURB - IMPERMEABLE SURFACE

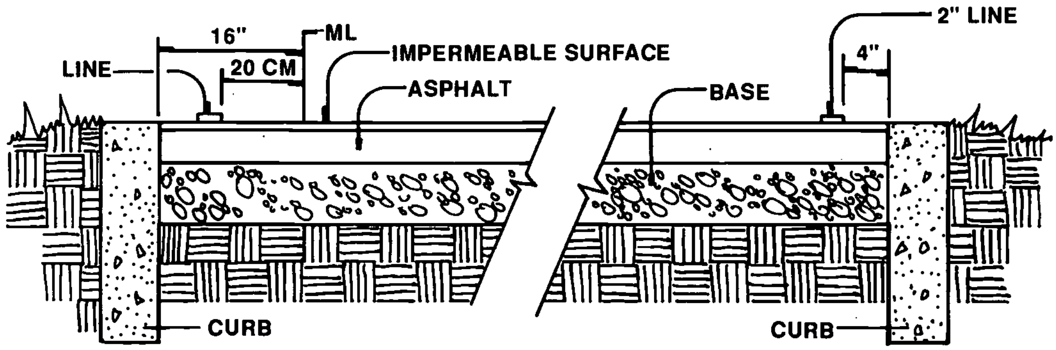


FIGURE 4-2B
FLUSH CURB - PERMEABLE SURFACE

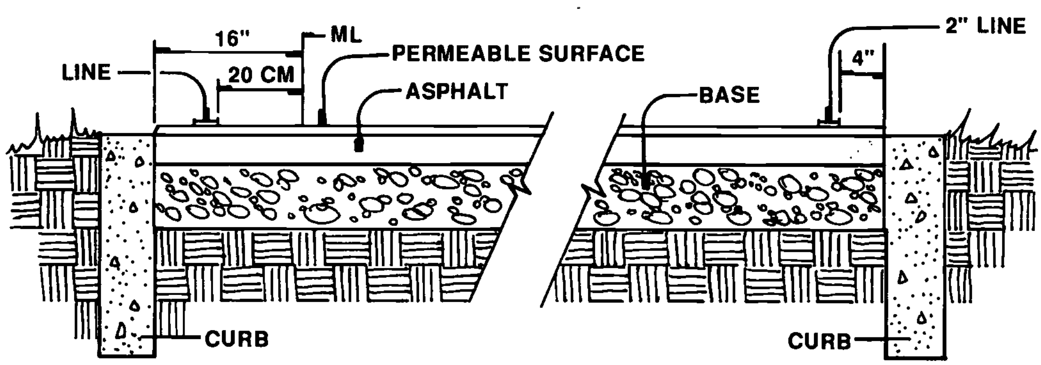


FIGURE 4-3
PERMANENT RAISED CURB

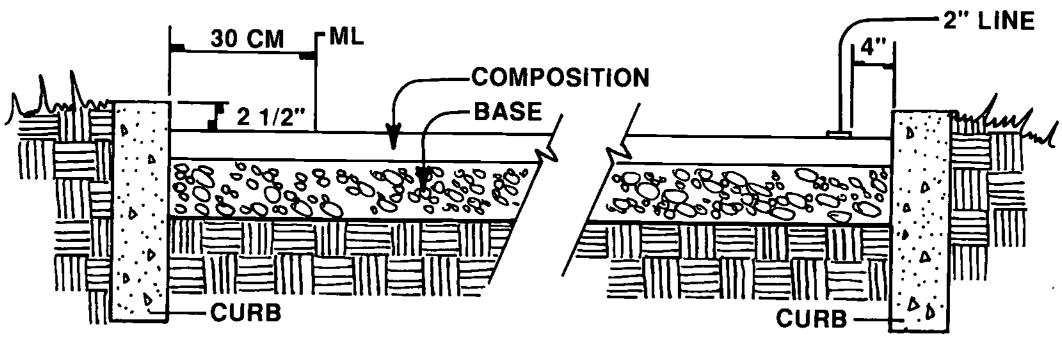
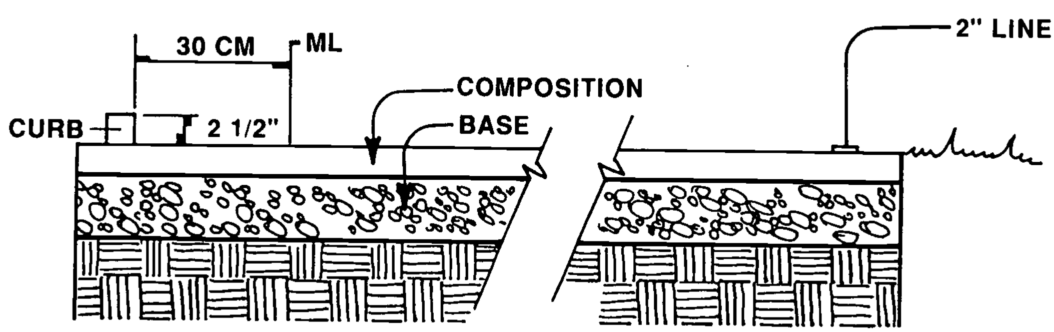


FIGURE 4-4
REMOVABLE RAISED CURB



Pavement Extension and Flush Curb may be installed initially with a portable raised curb with the track side edge located 30 cm from the track measure line.

Pavement Extension and Flush Curb may also be converted to a portable raised curb at a later date by locating the track side edge of the curb 10 cm inside the original edge of lane 1, or 30 cm from the track measure line (see Figure 4-4). In this case lane 1 will become 10 cm wider than the other lanes if the entire track is not restriped.

DRAINAGE

Calculations should be done to determine the amount of subsurface and surface drainage that must be handled. Following are several systems that have worked effectively for running track construction.

1. A perimeter drain tile system is an effective way of intercepting and redirecting the flow of surface and subsurface water that would otherwise accumulate beneath the track surface. Such a system normally terminates either in a storm sewer connection or through an end wall to direct water to an area of the site that is lower in elevation. The following sketch has proven to be an effective and economical system for providing subsurface drainage and also providing some residual surface drainage. Normally this would form a perimeter drain around the inside of the running track (see Figure 4-5).

2. Four to eight catch basins can be located around the inside edge of the track to intercept surface water and direct it to a storm sewer, drain pit, or end-wall outlet. The swale in this area should be graded to allow track and infield water to flow to the catch basins.

3. Curb and gutter drainage consists typically of a 6 in. x 18 in. interior curb with 12 in. wide gutter pan. In most applications, the track is sloped 6 in. (maximum of 8 in.) toward the lower end of the existing exterior terrain. Water from the track surface, as well as the infield, flows on the gutter pan to the low end, where it enters multiple catch basins located in the gutter pan. Catch basins are connected to a concrete or PVC pipe installed under the radius of the track.

4. A permeable system allows surface water to flow through the track surface, asphalt, and aggregate base to a collector system that directs it to a storm drainage outlet.

5. Continuous trench drains can be used around the inside edge of the track surface. This system allows for rapid movement of water. It typically has several outlets to a storm drainage system. This drain can also serve as a termination point for artificial turf on the infield. (Figure 4-6)

FIGURE 4-5
PERIMETER DRAIN

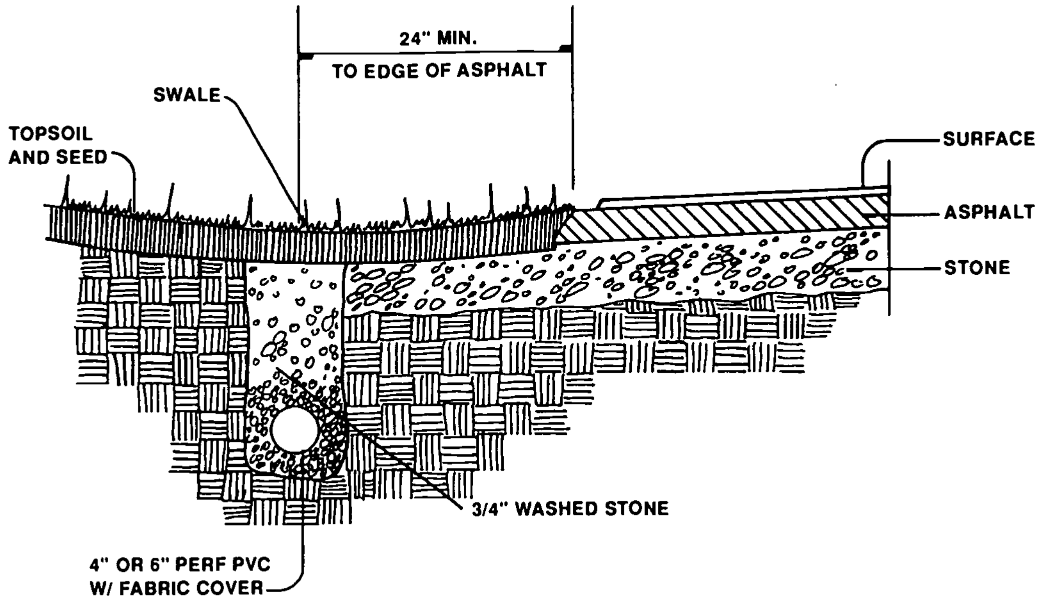
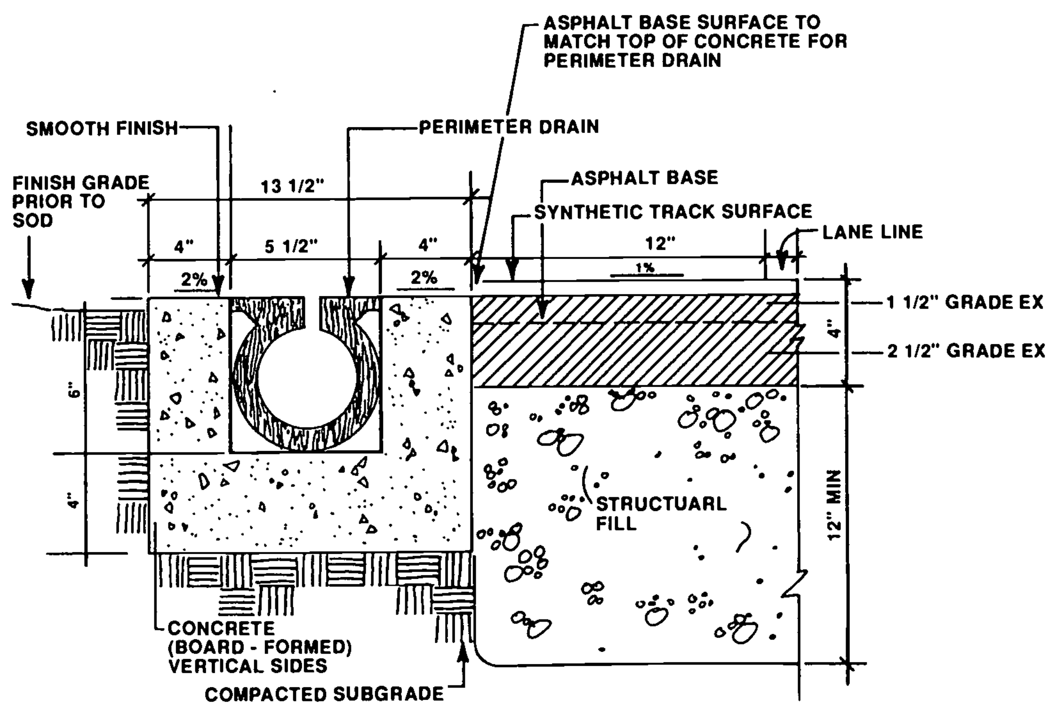


FIGURE 4-6
INTEGRAL CURB / DRAIN



CHAPTER 5

FIELD EVENTS

Construction of field events areas is as important as the construction of the running track. Each event is scored as an equal to an individual running event; therefore, the importance of proper construction, location, safety and accessibility is paramount. The purpose of this chapter is to provide the user with guidelines for the placement and construction of the event areas.

SAFETY

Safety for the athletes is the highest priority. Every effort should be made to keep event landing areas away from the edge of the track. Likewise, the runways and landing areas should not interfere with finish and starting areas. Throwing events should be adequately marked by either fencing or a flagged rope barrier. Discus and hammer throwing circles must be protected with a safety cage of energy absorbing material. (see Figure 5-8). All landing areas which are located within or near a football and/or soccer field need to have adequate protective coverings for the participants that use the field during non-track activities.

LOCATION

The location of the field events is often determined by the area available for the construction of the facility. The following must be considered in the placement of field events.

1. Prevailing winds.
2. Sun or lighting reflection.
3. Accessibility to storage shelters.
4. Viewing for spectators.
5. Accessibility for athletes.
6. Non-interference with other activities.

PREVAILING WINDS

Every effort needs to be made so that jumping events are run with the wind. Cross winds can be very dangerous, especially for pole vaulters. Throwing events are preferably located so that participants are throwing into the wind (the new college and international javelin can be effectively thrown with the wind).

SUN OR LIGHTING REFLECTION

It is very important for high jump and pole vault landing areas to be located in a position so that the athlete does not have to look directly into the sun or into lighting as the jump or vault is attempted. Sun or lights can temporarily blur the athlete's vision, causing an improper takeoff which can result in injury.

ACCESSIBILITY TO STORAGE SHELTERS

Storage shelters should be located in an inconspicuous place near the field event areas so that the equipment can be stored in a safe, centralized location after use.

VIEWING FOR SPECTATORS

Every effort should be made to locate each event so that it is either accessible for spectators viewing in the event area or viewable from the grandstands. This is frequently dictated by site conditions.

ACCESSIBILITY FOR ATHLETES

The field event areas need to be easily accessible to the athlete. Long jump/triple jump areas should be near the high jump, as many times an athlete will participate in a combination of these events. Likewise, the shot put and discus areas should be close together. Grouping the field events allows for ease of meet administration and athlete participation.

DESIGN CONSIDERATIONS BY EVENT

In addition to the general considerations listed above, the following considerations may be helpful in the layout of field events.

High Jump

For high schools, a 50 ft. x 100 ft. (Figure 5-1) high jump rectangle offers several advantages.

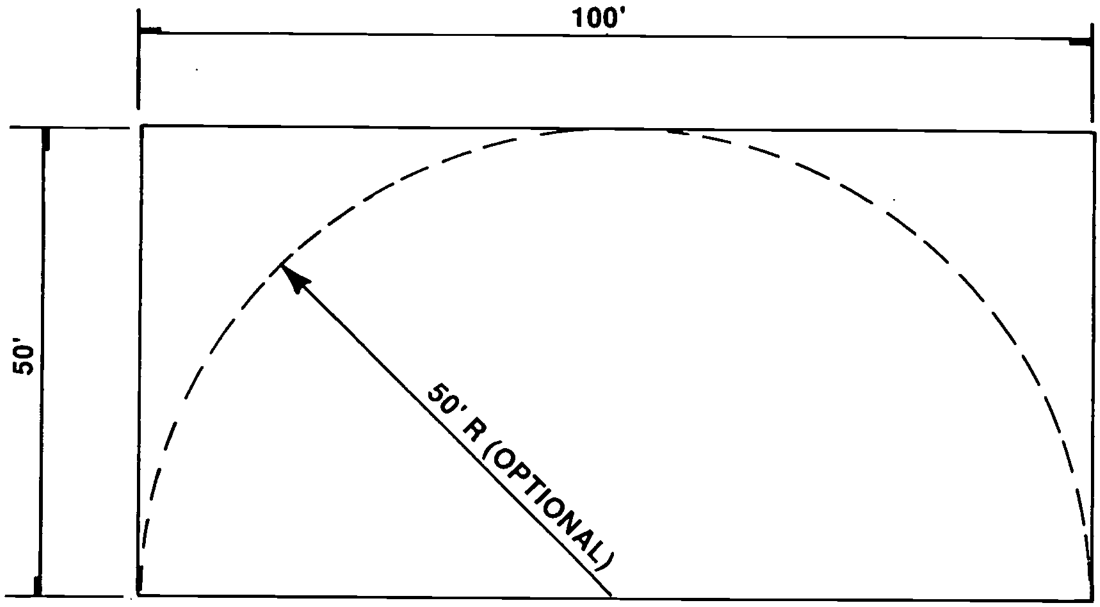
1. A high jump landing pad can be placed in several locations for consistent wear of surface.

2. The high jump landing pad can be placed according to wind direction.

3. A semi-circle line can be painted on the rectangle if preferred.

4. Trades involved in the construction of the high jump area can perform their work more efficiently.

FIGURE 5-1
HIGH JUMP DETAIL



Long Jump/Triple Jump

1. Use a common takeoff board for men and women when permanent wood boards are used.

2. Consider removable boards which can be replaced with covers with synthetic surfaces.

3. Consider painted lines for the triple jump marks.

4. Consider minimum width of 4 ft. for synthetic surfacing (Figure 5-2).

5. Consider concrete curbs for the sand pit to reduce edge deterioration (Figure 5-3).

6. Consider a concrete base runway.

7. In the landing pits, install drain tubing so water will not accumulate in the pits (Figure 5-4).

FIGURE 5-2
ASPHALT RUNWAY

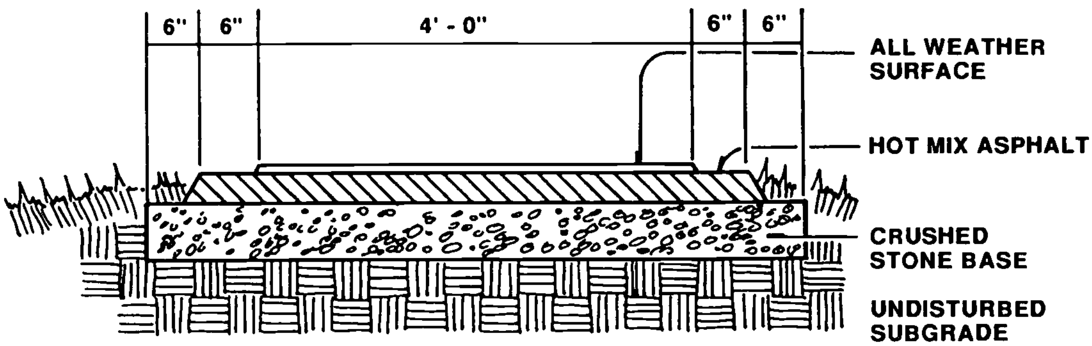


FIGURE 5-3
LONG JUMP / TRIPLE JUMP
PIT PLAN

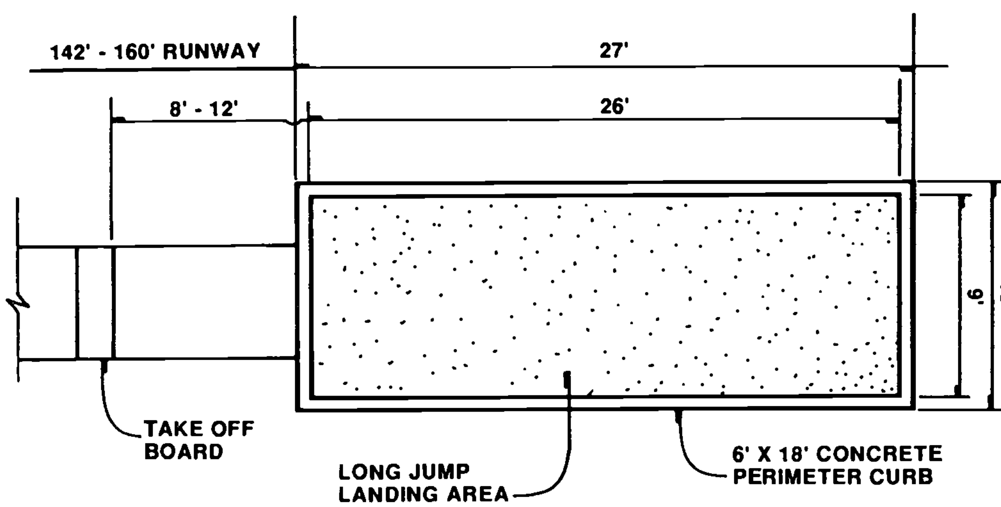
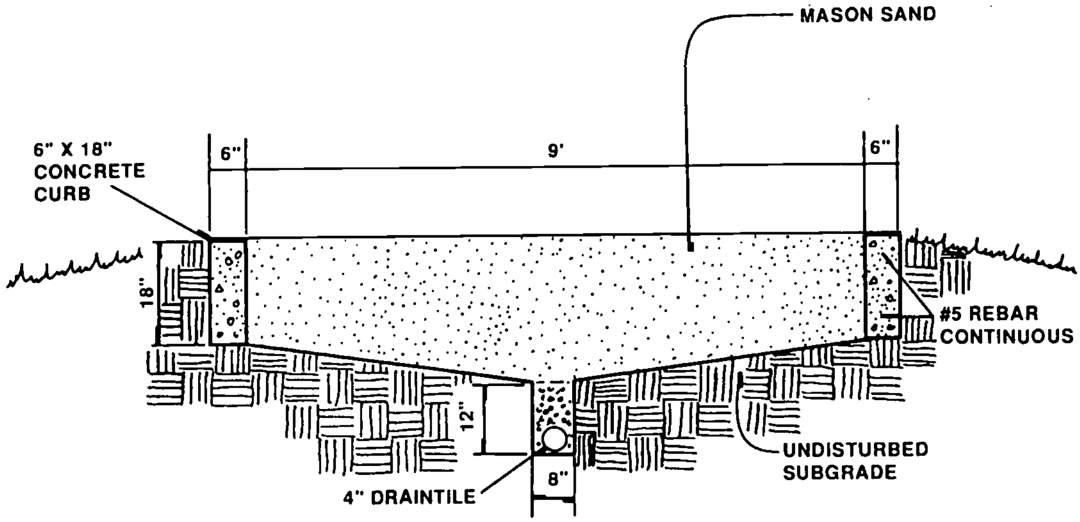


FIGURE 5-4
LONG JUMP / TRIPLE JUMP
PIT SECTION



Pole Vault

1. Consider minimum width of 4 ft. for synthetic surfacing.
2. Consider concrete curbs to reduce edge deterioration.
3. Consider a concrete base runway.
4. Consider a small drain pipe in the corner of the pole vault box which flows to a small dry well (Figure 5-5).
5. Consider a cover or a synthetic plug to cover or fill the vault box when not in use.
6. By using two runways with a common landing area, you can very quickly set up according to the wind without having to move the landing mats to the opposite end of the runway.
7. When using the common landing area, plan on at least 12 ft. - 16 ft. distance between the backs of the vault boxes (Figure 5-6).
8. With consistent design changes in equipment, plan on an area for the landing mats and standard pads of at least 20 ft. by 20 ft.

FIGURE 5-5
VAULT BOX SECTION

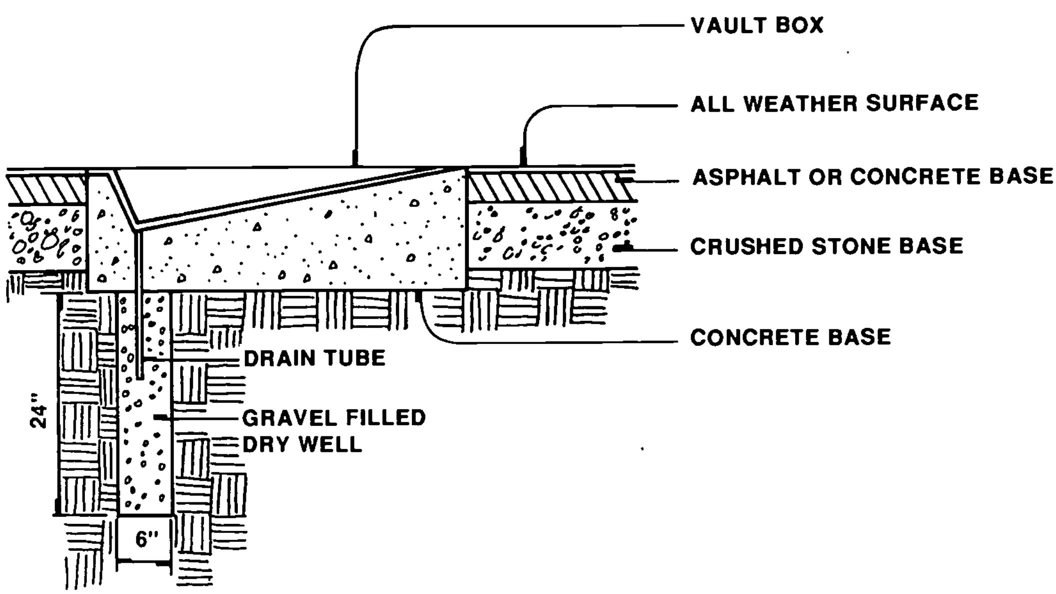
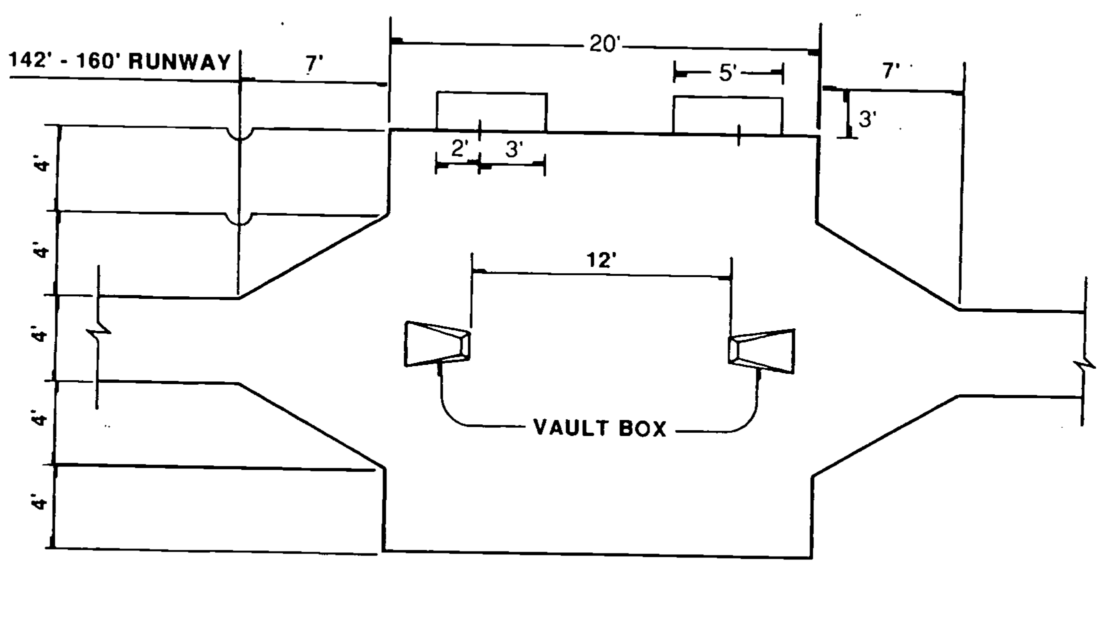


FIGURE 5-6
POLE VAULT LANDING AREA DETAIL

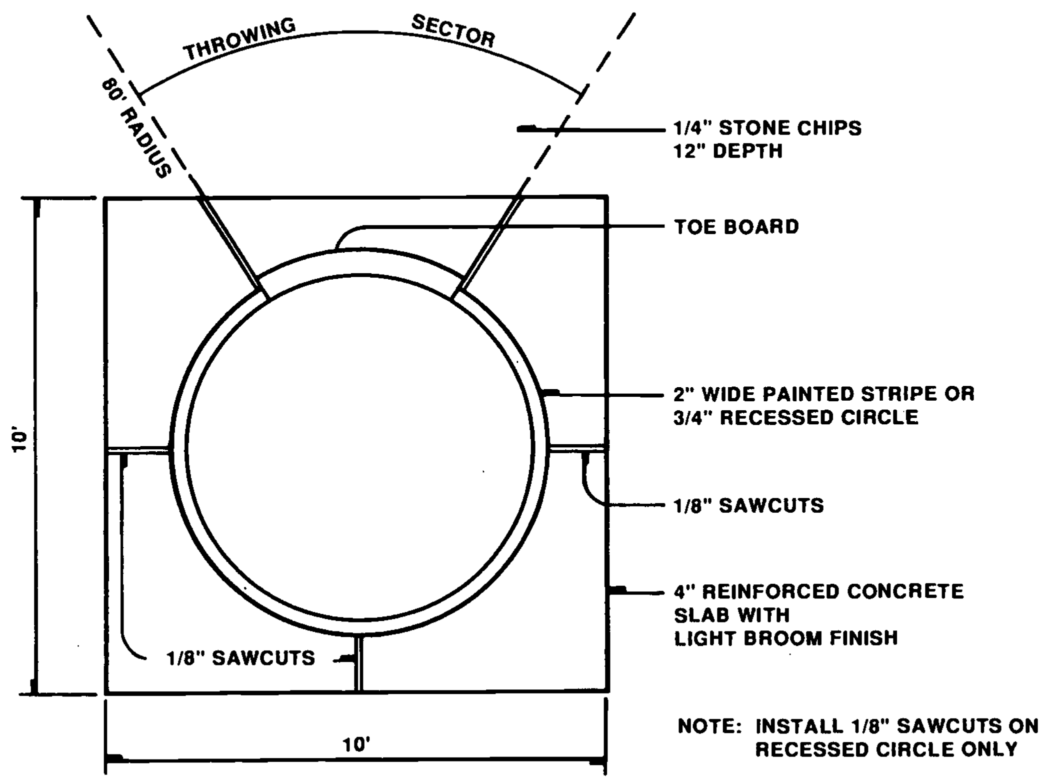


Shot Put

1. When using a depressed shot put circle, sawcut 3 grooves in the concrete pad which will provide drainage from the depressed area (Figure 5-7).

2. Recommend using an aggregate in the landing sector.

FIGURE 5-7
SHOT PUT PAD (HIGH SCHOOL)

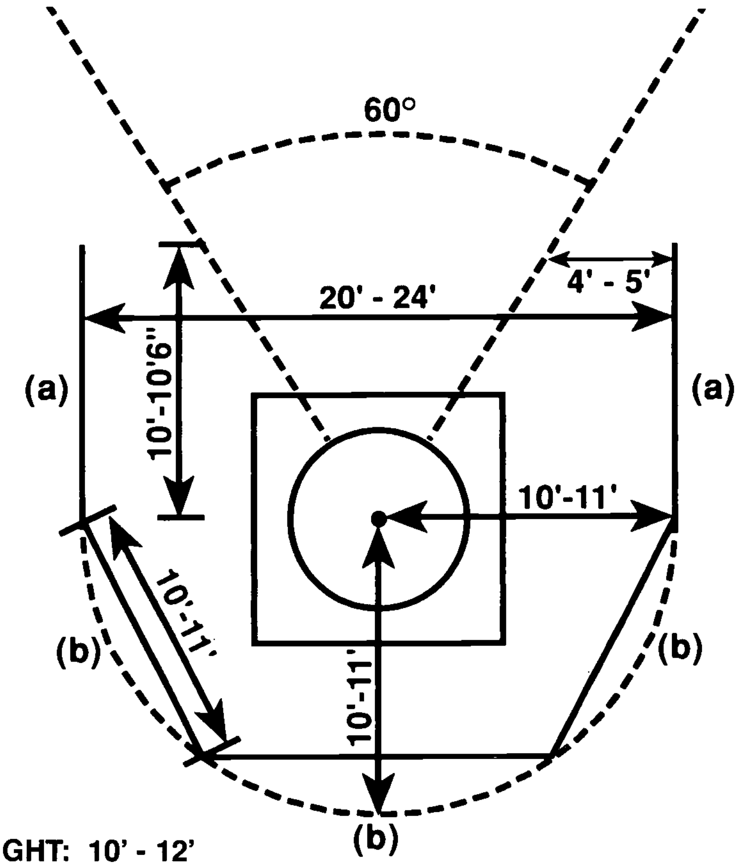


Discus/Hammer

1. An appropriate discus cage of netting or other energy absorbing material should be considered for safety. (Figure 5-8)

2. The landing sector should be level and covered with natural turf.

FIGURE 5-8
SUGGESTED DISCUS / HAMMER CAGE
(HIGH SCHOOL)



HEIGHT: 10' - 12'
FRONT OPENING: 20' - 24'
4' - 5' : DISTANCE CORNER POST TO SECTOR LINE
10' - 11' : DISTANCE CENTER OF CIRCLE TO FENCING

`D' Area

By surfacing the area, which is made up of all or part of the semicircle inside the curve, multiple events can be located. The events could include the high jump, pole vault, long jump/triple jump, and javelin.

Advantages are:

1. All accesses to the events are on synthetic surface.
2. High jump pad may be located in several areas.
3. Events are in close proximity to one another.
4. Lighting for night meets is relatively easy.

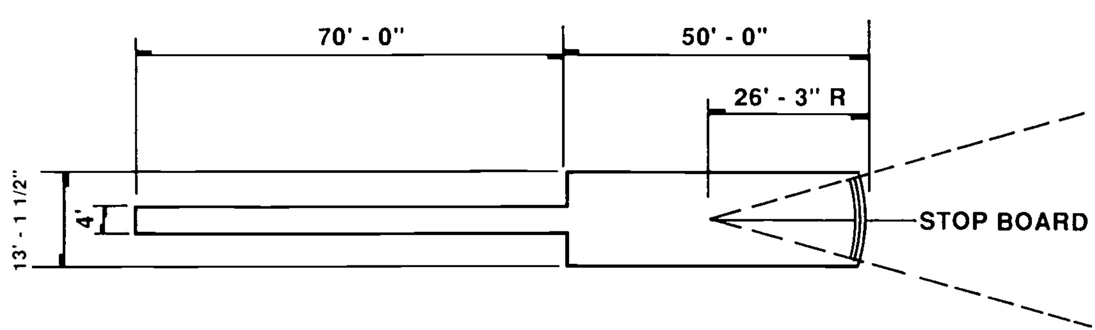
Disadvantages:

1. Potential congestion.
2. Additional construction costs.

Javelin Throw

1. If a synthetic infield is used, the javelin landing area should be placed outside of the track area (Figure 5-9). This should be considered regardless of the type of infield turf due to safety.
2. Consider painting the foul line instead of installing wood or metal.
3. Consider concrete base construction.
4. Consider flare where 4 ft. run-up meets 13 1/4 ft. throwing area.
5. Recommend synthetic runways extend at least 1 m beyond foul line.
6. Recommend surface within landing area be on same level as the throwing surface.

FIGURE 5-9
JAVELIN RUNWAY (NCAA)



CHAPTER 6

FENCING

Running tracks and the athletic facilities that normally accompany running tracks represent a substantial investment. A major reason for fencing a facility is to protect that investment against unauthorized use, vandalism, theft, etc. Fencing also can be necessary for crowd control and direction, and to provide for safety of spectators and athletes.

Chain link fencing is the most common type of material used for these facilities. It is readily available, durable, reasonably economical, and is effective in providing the functions desired by the owner. At the end of this chapter are some guideline specifications for chain link fencing. See Figures 6-1 through 6-5.

RUNNING TRACK

It is usually desirable to surround the outside of a running track with a fence approximately 4 ft. high. This fence can be used to keep spectators away from the competition areas, to confine athletes to the areas they are using, and to protect the track surface from excessive foot traffic, wheeled vehicles and implements.

For safety reasons, it is recommended that there be a clearance between the fence and the outermost lane line of the track of 2 ft. on the straightaways and 3 ft. on the turns. The IAAF recommends that there be no obstruction along both the interior and the exterior edges of the track surface for a distance of 1 meter. Normally it is not desirable to have any fencing inside of the running track itself.

SITE FENCING

This fence is normally 6 ft. to 8 ft. high and is designed to provide overall protection for the facility. It may enclose just a portion, such as the running track and football field or may enclose a complete athletic facility. Its purpose is to ensure that use of the facility is restricted to the people and the equipment for which it was designed.

GATES

Position of gates in both of the above fences is an important consideration to handle the volume of pedestrian traffic that is expected and to direct this traffic in an orderly fashion to the appropriate parts of the facility.

Maze gates or turnstiles can be used to allow continual pedestrian access to the facility while restricting such items as bicycles and motorcycles. Several effective designs are included in the sketches accompanying this chapter.

Gates in the fence surrounding the track should be located to allow easy team access to the infield. With both fences, it is necessary to allow for a large gate for equipment and vehicles such as construction equipment, emergency vehicles and grounds maintenance equipment.

It is desirable, from a safety standpoint, to provide a cage constructed of netting or other energy absorbing material around the discus and hammer throwing area. It must be designed to allow a competitor an unrestricted throwing path to the landing sector for either a right handed or left handed athlete while at the same time providing containment of wild throws. For detailed information see Chapter 5, Figure 5-1.

For ease of maintenance, it is recommended that the fencing design be done in such a way that small and narrow strips of sod or other high maintenance coverings are avoided. For example, if the track fence is located 3 ft. outside the track, do not attempt to maintain a grassy area between the fence and the track. Instead, pave it with asphalt.

FIGURE 6-1
TYPICAL HIGH FENCE

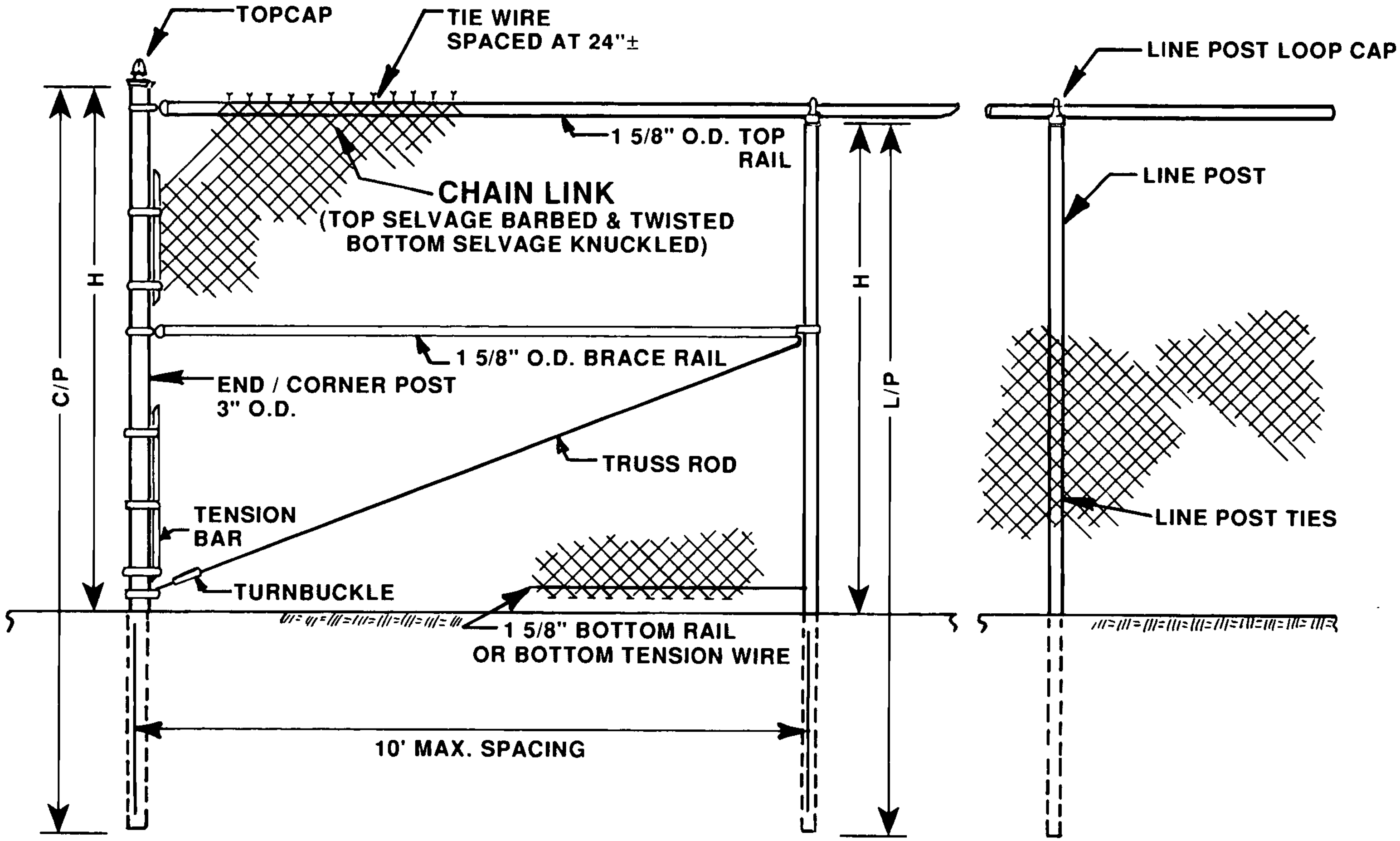


FIGURE 6-2
SINGLE GATE

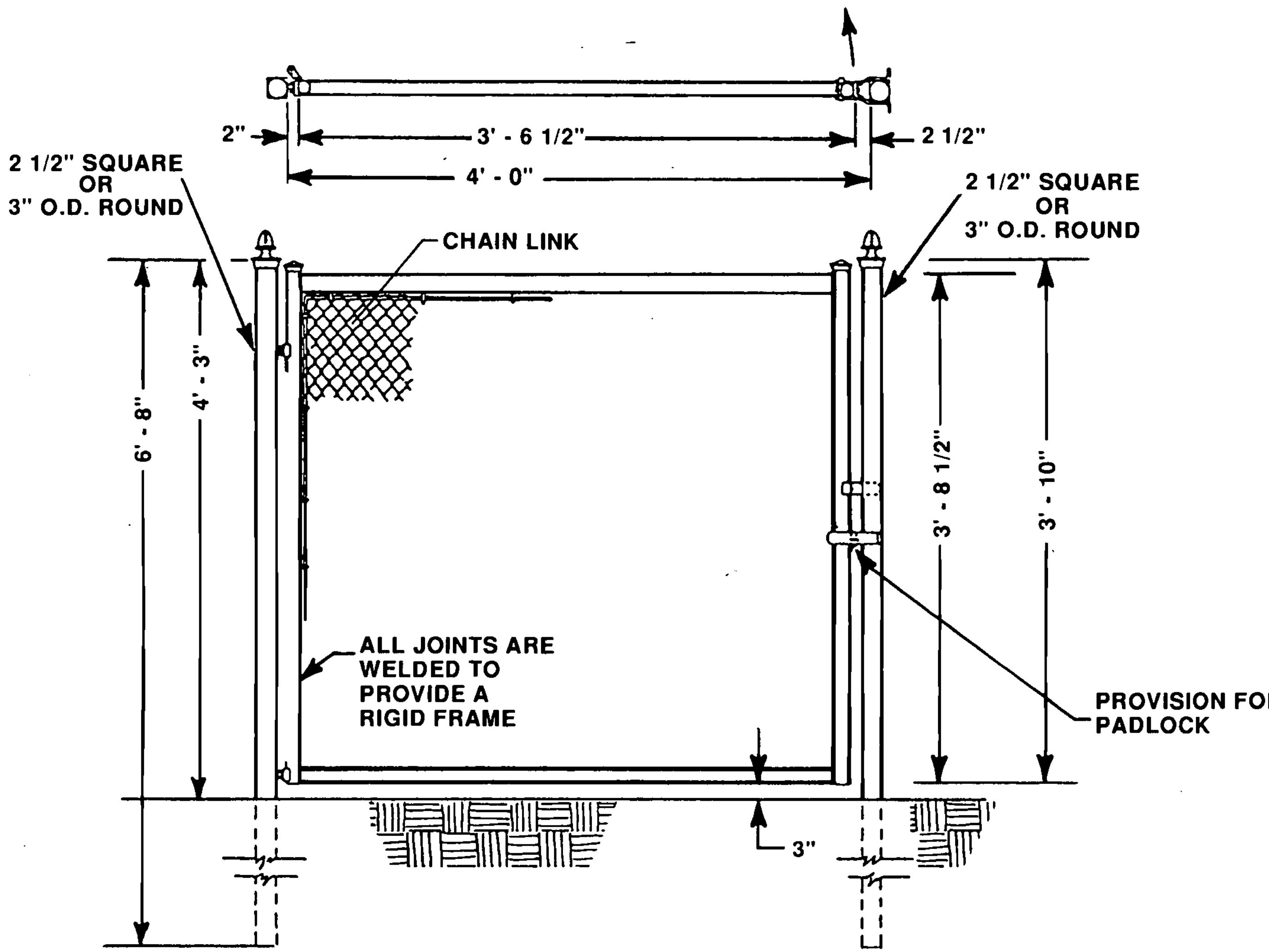


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FIGURE 6-3
DOUBLE GATE

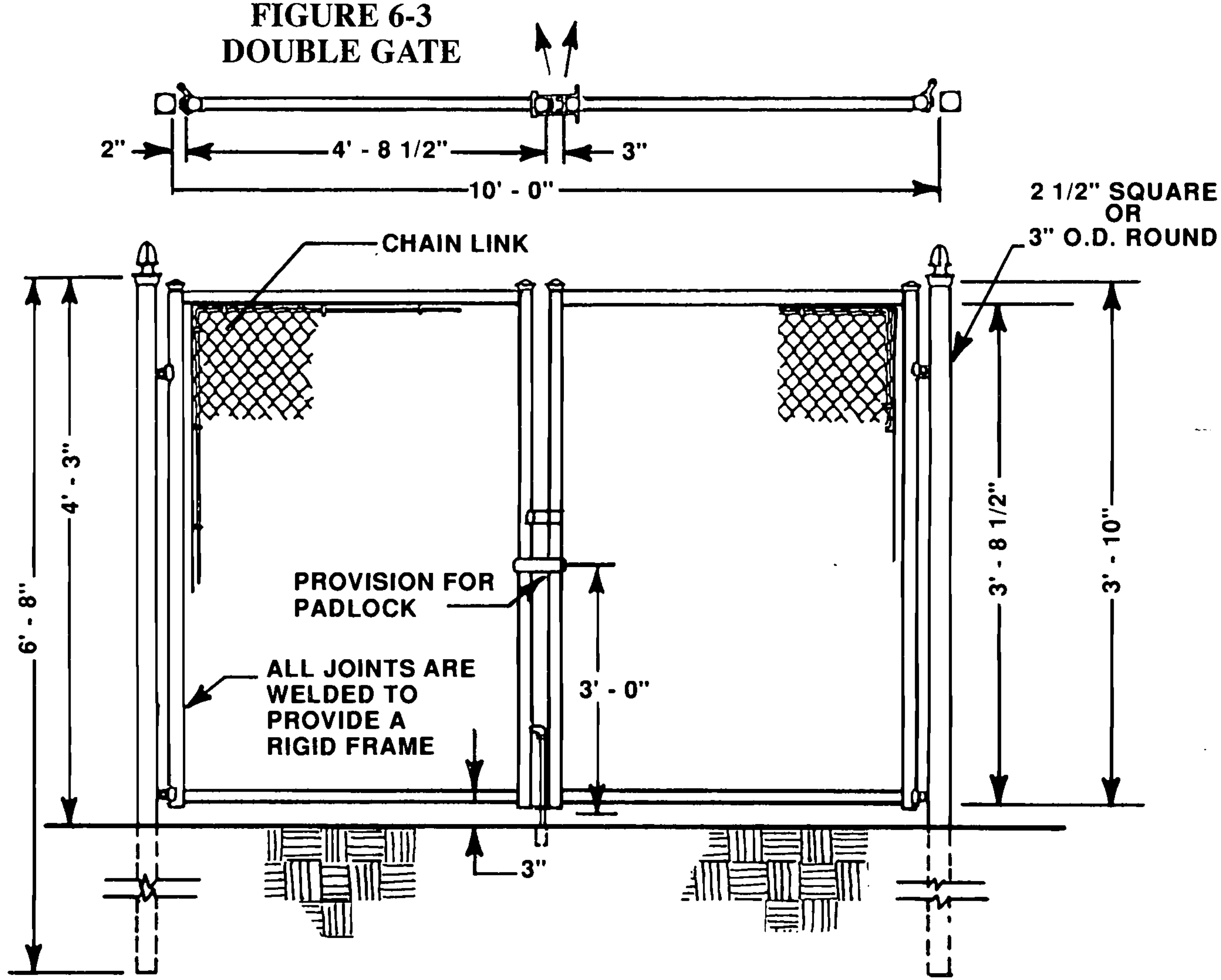


FIGURE 6-4
FENCE MAZES

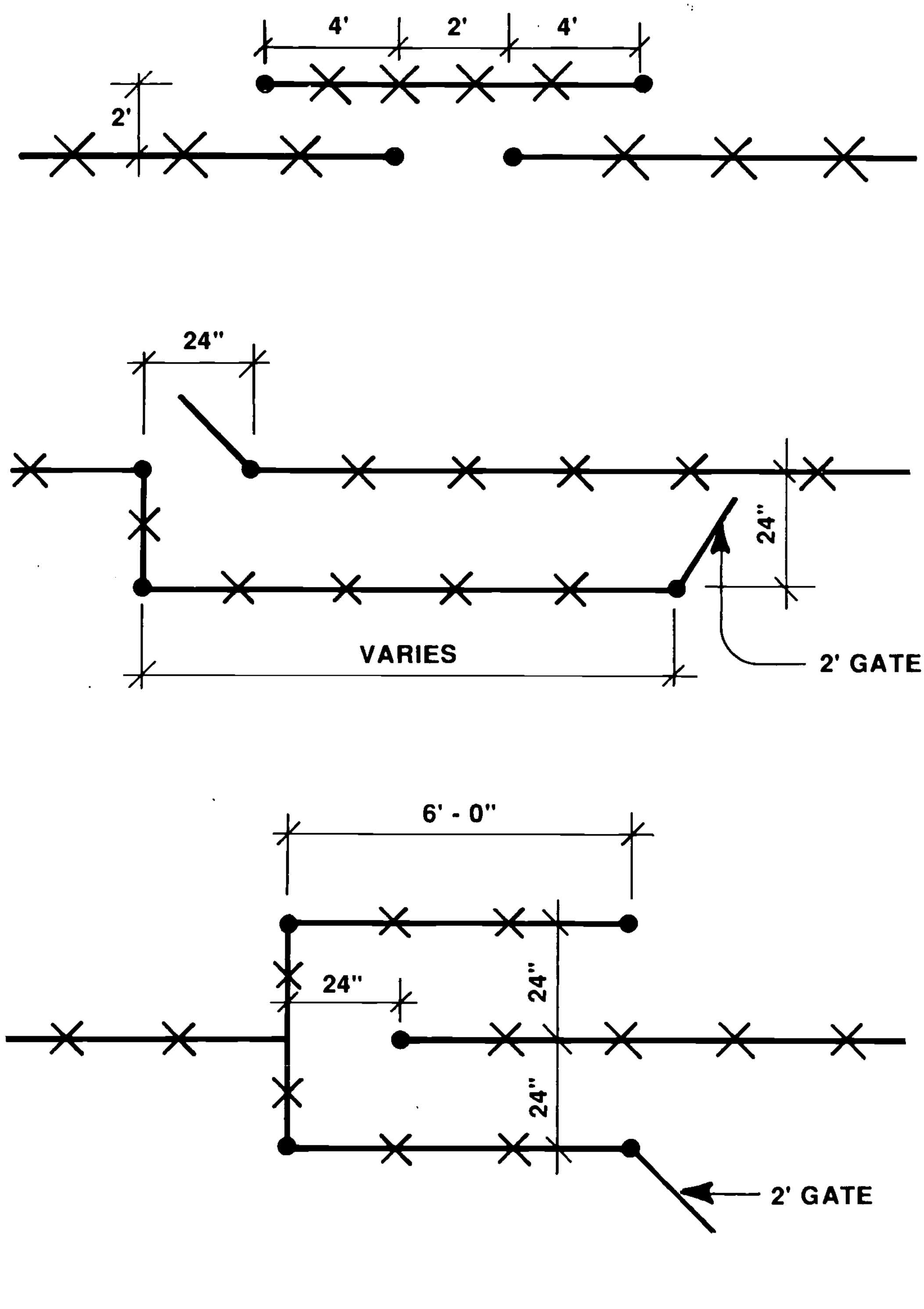
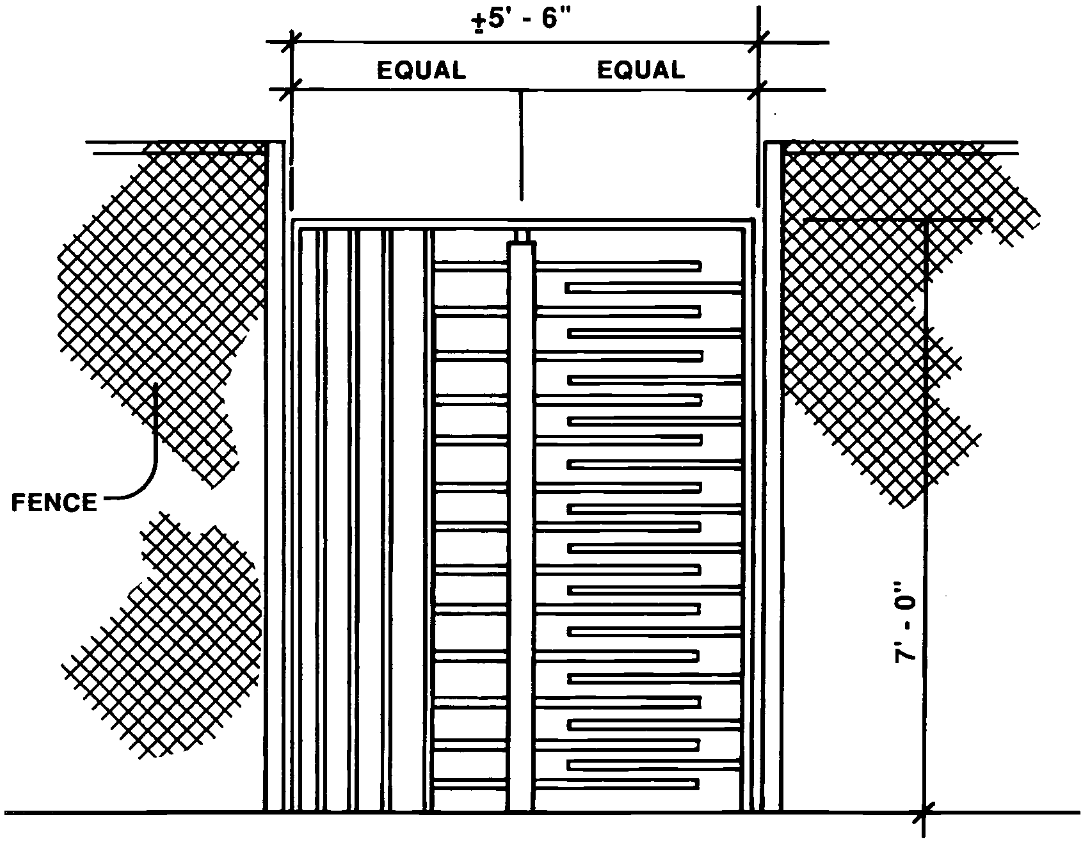
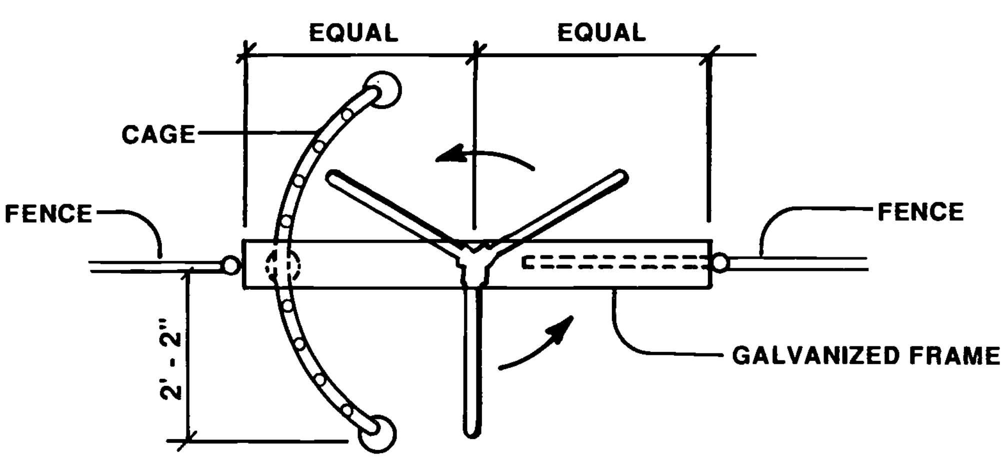


FIGURE 6-5
TURNSTILE



TURNSTILE ELEVATION



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CHAPTER 7

TRACK SURFACING SYSTEMS

The purpose of this chapter is to provide a framework for classifying, discussing and evaluating surfacing systems.

There is a seemingly endless variety of systems and/or brand names currently in existence with new ones continually appearing. The emphasis in this chapter will be on all-weather systems classified by the type of binder or binding system that holds the rubber or other resilient material together.

ASPHALT

Asphalt-bound systems were the most common from the late 1960's into the early 1980's. Most were either sand-asphalt-rubber (SAR), asphalt emulsion and rubber, or roofing asphalt and rubber.

SAR systems typically consist of 9 - 14% rubber, 11 - 15% high penetration asphalt oil, and sand aggregate. They are mixed and installed similar to hot mix asphalt usually to a compacted thickness of one inch. They often tend to lose resiliency as they age.

Asphalt emulsion and rubber systems are mixed on-site and installed at ambient temperature to a depth of 3/8 to 1/2 in. They contain little or no sand aggregate which usually makes them more resilient than SAR systems.

Roofing asphalt and rubber systems are similar except that heated roofing asphalt is used as the binder.

Relatively few colored asphalt systems have been installed and these usually consist of a colored sealer applied to one of the above systems.

LATEX

These systems were developed in the 1970's and became very common in the 1980's. They are mixed and installed on-site to a depth of 3/8 to 1/2 in. Some are installed in layers and others in a single lift, some premixed and others applied by spraying latex over rubber that has been spread on the surface or vice versa. Virtually all are porous to some degree.

Generally, the basic system is black, although three types of colored latex systems are available:

1. Colored binder where the latex is pigmented to the desired color and used to bind black rubber. This is an economical color system but wears through to expose the black rubber fairly quickly.

2. Color sandwich where the top layer or layers consist of colored binder and colored rubber. This system maintains its colored appearance until the top layers are worn through.

3. Full-depth color where all latex and rubber is colored.

POLYURETHANE

These systems have been used throughout the 1970's and 1980's. Most are somewhat higher in cost than asphalt or latex systems but offer a wide range of characteristics to meet varying objectives.

Most are mixed and installed on-site, although some premanufactured systems are available. The systems available include permeable, which allow movement of liquids and gas throughout the system, or impermeable. Depth is usually 3/8 to 1/2 in.

The four most common types of polyurethane-bound systems are:

1. Base mat - rubber particles bound with polyurethane to form a permeable system. May be colored or black. May be premanufactured or mixed and spread on site.

2. Structural spray - base mat sprayed with a mixture of polyurethane and rubber. System is permeable and may be colored or black. Provides a textured surface.

3. Sandwich - base mat with a nonpermeable flood coat of polyurethane and rubber. May be colored or black. Provides a textured surface.

4. Full-pour - nonpermeable system of solid polyurethane and rubber. Polyurethane binder and surface rubber are normally colored. Base rubber may be black or colored. Provides a textured surface.

PREMANUFACTURED RUBBER

These systems consist of nonpermeable, vulcanized rubber prepared with various surface textures and colors. The base portion is normally black. They are considered to be very durable and to provide good performance.

These systems are especially popular where site conditions make it difficult to apply systems that are mixed and/or sprayed on-site (i.e., confined areas, elevated indoor facilities).

GUIDELINE SPECIFICATIONS FOR BLACK RUBBER PARTICLES

Scope

The scope of this section is to outline the types and categories of black rubber. Each specification type will identify the particles in a generic form.

Characteristics

The black rubber particles are made from the recycling of black rubber scraps (example: tire or technical parts/molded goods). In general, the black rubber granules are made from EPDM (ethylene-propylene-diene rubber), SBR (styrene-butadiene rubber) or NR (natural rubber).

Classifications

Type 1: Black stranded rubber particles. The particle characteristics are elongated strands of black rubber. The material should have a specific gravity of 1.15 to 1.40.

Type 2: Black rubber granules (SBR/NR). The characteristics are proportionally square, sharp cut particles whose dimensions are specified in the particle sieve analysis, Figure 7-1. The black rubber granules should maintain a specific gravity of 1.15 to 1.40.

Type 3: Black EPDM granules. The characteristics are proportionally square, sharp cut particles, whose dimensions are specified in the particle sieve analysis, Figure 7-1. The black EPDM rubber granules should maintain a specific gravity of 1.10 to 1.50.

Type 4: Black rubber particles for special applications. It is possible to provide black rubber particles produced from scrap other than SBR, NR or EPDM. It is also possible to provide black rubber particles in a blown or cellular form.

Applications for black rubber particles.

Rubberized asphalt.

Acrylic cushion systems.

Latex bound surfaces.

Polyurethane bound systems.

Shock pads.

Filler for synthetic surfaces.

It should be noted that the quality of the black rubber granules depends on the care taken in the separation of the different types of scrap before grinding. The chemical composition of the black rubber granules (including plasticizer and sulphur content) may vary with feedstock, and compatibility with the binder system should, therefore, be verified prior to installation.

GUIDELINE SPECIFICATIONS FOR COLORED RUBBER GRANULES

Scope

The scope of this section is to outline the types and categories of colored rubber granules. Each specification type will identify the granules in a generic form.

Characteristics

In general, the colored rubber granules are an EPDM (ethylene-propylene-diene rubber) or SBR (styrene-butadiene rubber) based product. They are not made from scrap, but from virgin compounds designed for application in outdoor recreational surfaces.

Classifications

Type 5 Colored EPDM granules. EPDM rubber granules are most frequently used because of their better resistance to weathering and outdoor aging than almost all other elastomers. Their environmental resistance to ozone, oxidation and water is excellent. The granules are available in different colors, because nearly any color can be incorporated into the formulation of the virgin compound. The hydrocarbon content of the compound should be not less than 20%. More meaningful for the quality are the tensile strength and the elongation at break of the material. The specific gravity is between 1.40 and 1.60. The hardness (shore A) should be within a range of 55 - 70. EPDM rubber granules have to be proportionally square, sharp cut particles whose dimensions are specified in the particle sieve analysis, Figure 7-1.

Type 6 Colored SBR granules. If not made from virgin compound, these granules are made from colored scrap, depending on availability. The specific gravity could range from 1.15 to 1.50. Applications for colored rubber granules:

Acrylic cushion systems.

Latex bound surfaces.

Polyurethane bound systems.

Fillers for synthetic surfaces.

SIEVE ANALYSIS
Figure 7-1

Mesh	MM	1 - 5 mm (% Retained)	1 - 4 mm (% Retained)	1 - 3 mm (% Retained)
4	4.76	0 - 5		
5	4.00		0 - 5	
6	3.36	20 - 40		0 - 15
8	2.38	40 - 55	60 - 80	
10	2.00	5 - 15	5 - 20	60 - 85
16	1.19	0 - 15		
18	1.00		5 - 20	10 - 30
PAN	1.00	0 - 5	0 - 5	0 - 5

Less than 4% dust.

APPLICATION OF TRACK SURFACE

There are six steps to follow when installing a running track system.

1. Curing - The asphalt or concrete base must be properly cured in accordance with the system specifications prior to the application of the synthetic surface. Usually asphalt should be allowed to cure for 14 days and concrete for 28 days.

2. Surface Inspection - The asphalt or concrete base shall be inspected for conformity to allow tolerances for inclination. Also, the surface shall not deviate more than 1/4 in. in 10 ft. from the specified grade when checked with a 10 ft. straightedge in all directions. The surface may also be flooded with water to detect low areas or "bird baths".

3. Cleaning - The area to be surfaced shall be clean and free of any loose or foreign particles (dirt, oil, etc.) prior to the synthetic surface installation.

4. Priming - A primer or k coat may need to be applied to the asphalt or concrete base in accordance with the system specifications. Some systems do not require a primer.

5. Surface Installation - The track surface shall be installed in strict compliance with the system specifications. All equipment is to be kept clean. All daily work shall be finished in a uniform manner. All cured joints are to be properly prepared prior to commencement of new work. All layers are to be properly cured prior to subsequent applications.

6. Line Markings - All line and event markings shall be applied in conformance to the specification of the proper governing body for tracks. All paint shall be approved by the installer. See Chapter 8.

TRACK SURFACING SYSTEM EVALUATION

There are four areas of classification that should be used in the evaluation of the all-weather track surfacing system. These areas are:

1. Performance Characteristics
2. Physical Characteristics
3. Cost Aspects
4. Maintenance Aspects

Figure 7-2 is intended to provide a format for a working document that can be used to review, analyze, and evaluate specific surfaces under consideration.

NATURAL MATERIAL TRACK SYSTEMS

Natural material track systems, such as cinder, natural clay, fired clay, expanded shale and decomposed granite, are still installed in some regions. Information regarding these surfaces may be obtained through the USTC & TBA.

FINAL CONSIDERATIONS

1. Consulting with a knowledgeable professional or an experienced contractor can assist you in choosing the appropriate surfacing system for your project.

2. All the surfacing systems described in this section must be installed over a properly constructed base by experienced personnel.

3. A track surface is that coating installed over base construction which is not less than 1/8 in. in thickness and which provides resiliency/cushion to the track.

4. To enhance the life of the track surface, the maximum length of spikes used by runners on the track should not exceed 1/8 in.

FIGURE 7-2
TRACK SURFACING EVALUATION

PERFORMANCE CHARACTERISTICS		ASPHALT BOUND	LATEX	POLYURETHANE	SYNTHETIC PRE-MANUFACTURE
1. Tensile Strength (ASTM D - 412)					
2. Elongation (ASTM D - 412)					
3. Hardness (ASTM SHORE A - 2632)	A. 30°F				
	B. 85°F				
4. Resiliency / Cushion					
5. Compression (Load Deflection) (ASTM 575)					
6. Abrasive Resistance (ASTM E- 501)					
7. Flamability (ASTM C -)					
8. Consistency:	A. 30°F				
	B. 85°F				
9. Uniformity					
10. Traction:	A. Wet w/spikes 1/8"				
	B. Dry w/spikes 1/8"				
	C. Wet w/o spikes				
	D. Dry w/o spikes				
11. Porosity					
12. Appearance					
13. Cosmetic Retention					
14. Durability					
15. Repairability					
16. Spike Tear					
17. Toxicity					
18. Adhesion					
PHYSICAL CHARACTERISTICS					
1. Composition					
2. Binders					
3. Thickness					
4. Color Selection					
5. Joints					
6. Initial Appearance					
7. Cosmetic Retention					
8. Use:	A. Wet				
	B. Dry				
COST ASPECTS					
1. Initial Cost					
2. Upkeep					
3. Repairs					
4. Color Selection					
MAINTENANCE ASPECTS (after 5 years)					
1. Repairable					
2. Relining					
3. Appearance					
4. Longevity	A. Surface				
	B. Base Mat				
5. Availability of Materials					

E = EXCELLENT G = VERY GOOD A = AVERAGE F = FAIR P = POOR

CHAPTER 8

CALIBRATING AND MARKING

Calibrating and marking a track is done for the ultimate benefit of those who compete on that track. Individuals who are responsible for this aspect of a track should keep this in mind, whether they be coaches, owners, designers, or contractors. This chapter is intended to be used in conjunction with official publications and drawings available from the different governing bodies. These comments and recommendations are appropriate for calibrating and marking all running tracks.

The markings on any track are the most important single aspect when the track is used for competition. They represent distances that are very important both to competitors and to governing bodies who certify records. Many errors have been made in the past because of misinterpretation of rules, drawings, and incompetent workmanship (see end of chapter for a list of common errors). In many cases, the owners did not fully realize the importance of accuracy when having their tracks calibrated. Past errors have resulted in costly corrective work, unfair competition, uncertifiable records, and the denial of deserving racers' chances to realize their full potential. Uniform accuracy for all running track markings can be attained by utilizing a uniform method and procedure for calibrating tracks worldwide.

Three separate phases in calibrating a track are:

1. Converting given distances into workable measurements and angles.

2. Measuring distances and angles precisely and marking required distances on the track.

3. Painting permanent markings.

CERTIFICATION OF ACCURACY

When a track is completely calibrated, the owner expects that it is accurate and correct in accordance with the chosen governing rules and that if a record is made and applied for in any race on that track, it will be certifiable. To have a record certified, the length of the race and related markings must be verified to be the required distance from the finish line when measured as prescribed in the rules. No minus tolerance is allowed for the length of any race by any of the governing bodies.

CALIBRATING A TRACK

The owner will be given all applicable options, such as locations of finish line or lines, races to be accommodated, color code, design of markings, incorporation of local variances, etc., when applicable.

All calculations, measurements, and markings will be done by qualified and experienced specialist(s) approved by the owner and/or designer and will be certified to be accurately located in accordance with governing rules and owner's desires.

SELECTION OF THE SPECIALIST

The selection of the specialist(s) should be influenced by his credentials, his past performance and proof of his ability. References, years of experience, and knowledge of the governing rules are several of the basic considerations. Qualified and experienced individuals are not necessarily licensed design professionals, nor do such professionals necessarily have the expertise to accomplish this type of intricate and extremely precise work.

If proper effort is applied to the selection of the specialist(s) and the work is guaranteed to be accurate and correct by the specialist, the track should meet the standard required by the appropriate governing body so that records set on the track will be certifiable. For a record to be recognized, one of the prerequisites is that the distances must be measured and certified by a professional engineer or licensed land surveyor.

PHASE I - COMPUTATIONS

Computations should be done by one who specializes in computing and tabulating the necessary measurements for field work.

Basic Measurements

Basically, a track must have two equal and parallel straight sections connected to two equal "turns" which together should add up to a specified distance when measured in accordance with the governing rules. Each individual lane for each race must be evaluated to determine where the start line and any intermediate markings should appear and to ascertain that all lanes equal the designated distance from the finish line. It is necessary to convert the distances given in the official governing publications to workable measurements. It is good practice to make measurements for each designated distance from a common starting point to prevent accumulative errors. The most accurate procedure is to calculate the distance of each point of curve from the finish line. Using these as the common control points for calculations for related distances, each point in each lane can be determined by a specific distance or angle from one of the points of curve. For lane lines, the radius points are used as the common control point for measurements and calculations.

Please note that it is unlikely to find any existing track that has the same measurements, same races accommodated or same class of competition. If by chance the dimensions from an old track are being used for another track, all measurements should be recalculated.

Calculations

Calculations are usually done using a calculator or computer. Knowledge of the governing rules and use of proper conversion factors are a must for anyone using this technology for calculations. The closer the starting line is to the exact designated distance from the finish line, the more chance a record can be made and the fairer the track is to competitors. Since the introduction and common use of the fully automatic timer, the plus tolerances (the extra distance deliberately included at the starting point) become very important to recorded times of records. From a practical point of view, a plus tolerance for a 400 m lap of 1.2 cm (about 1/2 in.) is recognized to be within attainable accuracy.

Options

Before any calculations are made, the specialist should be given the opportunity to consult with the owner (and/or track coach) to offer all options available. It should be noted the IAAF, USAT&F, NCAA, and NFSHSA track committees have adopted the policy of running the 200 m race with all racers starting on a turn for championships. This fact, plus the increasingly prevalent use of fully automatic timers, has influenced the positioning of a common finish line on the point of curve at the end of the "home" or "front" straightaway.

Computing Workable Measurements

When computing workable measurements for metric tracks, some very important facts should be remembered if accuracy is desirable:

20 cm = 7.87 in. = 0.656 ft.
30 cm = 11.81 in. = 0.984 ft.
1.0668 m = 42 in. = 3.5 ft.
1.22 m = 48 in. = 4.0 ft.
1 m = 3.28083 ft. (minimum conversion factor)
pi = 3.1416
400 m = 1312.34 ft.

It is suggested to calculate to the nearest .0001 m so measuring can be done to the nearest .001 m. If using feet, calculate to the nearest .001 ft. so the measuring can be done to the nearest .01 ft.

A complete knowledge of governing rules and their differences, prescribed path of runner, break line compensation requirements, and basic mathematical formulae is essential.

PHASE II - MEASURING DESIGNATED DISTANCES

The measurer should be experienced in making accurate measurements and should be knowledgeable of tolerance standards set by the governing bodies.

Physical Measurements

When all calculations have been made, checked and tabulated for field work, the physical measurements can be started by the specialist. It is his responsibility to see that the radius points used for the field work are accurately positioned according to the computation requirements. Then the points of curve should be placed and the straightaway distances verified. The lane line radii should then be marked on each point curve.

It is generally recognized that the most reliable methods of measuring distances are with a good quality engineer's steel tape and with transits or theodolites capable of reading at least to the nearest 20 seconds. If distances are measured in feet, the measurements should be made to the nearest .01 ft. If distances are measured in meters, the measurements should be made to the nearest .001 m. All engineers' metric tapes are calibrated to permit this accuracy. Temperature corrections are recommended as needed, especially on all markings that relate to times such as straightaway distances, start lines, finish lines, and lane line radii.

Arc distances measured by short chords when done properly, i.e. taut tape and corrections for arc and chord differences, can be within acceptable tolerances. Cloth tapes and measuring wheels are generally considered unsatisfactory for accurately measuring distance for this type of work.

Designated Distances

Setting marks to designate the lane lines on a turn can be done by measuring from the radius points and placing a mark for each lane radius at short intervals around the full turn. The experience of the specialist should determine the intervals used when marking line radii on turns. The marking specialist has to judge the radius between each mark when guiding his machine during the actual painting.

It is suggested that all points that fall on a curve or turn be set by measuring horizontal angles with a good quality surveying instrument. At a radius of 40 m, 20 seconds represents .004 m (1/8 in.) distance on the arc. Thus, when angles are set to the nearest 20 seconds, the designated distance should be certifiable. Some specialists have mastered the use of chord measurements and the measurements of arc distances with a steel tape. All other measurements should be made with a steel tape to the nearest .01 ft.

On a cinder track, the curb could be marked and color coded for every necessary designated distance and used in conjunction with the radius point and the radius line. After the curb has been marked, a taut line connected to the radius point and placed over the curb markings will designate the specified part of the marking (i.e., the front edge, center, etc.) for the proper lane. Groundskeepers should have available a drawing to use as a reference tool showing critical dimensions and color codes related to the positioning of the track markings.

PHASE III - PAINTING THE MARKINGS

Application of painted markings should be done by an experienced track painter who has suitable equipment and is knowledgeable about the relative position of the designated points to the painted markings.

Painting Techniques

All rules specify a width of 5 cm (2 in.) for lane lines as well as for certain other markings such as start lines, etc. The machine must be capable of dispensing specified widths. The rate of application of the paint will vary with the type of surface. Caution should be taken so that the paint is not applied too thickly, which could result in cracking, chipping, and curling. Normally one coat of paint applied at a rate of 200 to 250 square feet per gallon will give excellent results. The manufacturer's recommendations should prevail. Oil based paint should never be used unless the manufacturer of the surface specifically requests it.

All governing rules specify what part of a marking each measurement represents. One edge of all lane lines, start and finish lines, and exchange zone markings is the critical edge of the painted marking and the paint must be accurately applied. For an example, the painted part of the exchange zone marking is presently considered part of the passing zone by the NCAA. The knowledge and ability of the painter and the performance of his machine are extremely important to achieve the accuracy necessary to permit a record to be certified.

Painting Procedures

Usually several reference points showing lane lines are needed in the straightaways and end chutes. Snap lines or strings are usually used for machine guides on the straightaways. The various other markings can be applied using stencils, tape, snap lines, hand brushes, hand spray guns or a combinations of these techniques.

CONCLUSION

Today's technology and the availability of specialists permit owners to demand and receive accurately calibrated and marked tracks. Owners have responsibility for fair track competition for everyone.

COMMON ERRORS IN CALIBRATING AND MARKING TRACKS

1. Copying an obsolete drawing without checking dimensions.
2. Assuming the pavement radii for both a painted pole line and a curb track are the same.
3. Assuming 8 in. = 20 cm and 12 in. = 30 cm when calculating measurements on metric tracks.
4. Expecting sample drawings to give details for calibrating and marking tracks.
5. Using painters who are not familiar with markings used to designate specific events.
6. Not knowing owner's desires and local prevailing rules before calculations and drawings are made.
7. Assuming an existing 440 yd. track is accurate and that applying the normal conversion factors in moving the radius points the specified distance will give an accurate 400 m track.
8. Not using the minimum suggested conversion factors for mathematical calculations.
9. Not being familiar with what part of the markings the measurements represent.
10. Not utilizing available sources of reliable information such as experienced track contractors or stripers, or specifications and other publications available from the U.S. Tennis Court & Track Builders Association.

SUGGESTED MARKING SYMBOLS AND GRAPHICS

1. Exchange zones:
   a. large 18 in. to 24 in. triangles (NCAA and NFSHSA);
   b. chevron type symbols are standard for IAAF;

c. larger rectangular blocks (12 in. to 24 in.).

2. Hurdle settings:

a. 2 in. tic mark on lane line;

b. 2 in. tic mark along lane line;

c. diamond shape;

d. directional triangle in the running direction.

3. Photo timing marks:

a. hash marks (5 sets) spaced 1 m apart from the finish line back.

4. Graphics - Although the graphics are not a technical need, they may offer some additional pleasing aesthetics:

a. large lane number - 36 in. to 42 in. (can be shadowed if desired);

b. lane number - 12 in. (for lane orientation);

c. event I.D. - 3 in. to 4 in. stencils in lane;

d. school logo or name stenciled along home side straight.

Other Suggestions

Back straight - Mark track for additional sprint races.

2 way - Reverse sprint race markings on the same straightaway.

CHAPTER 9

CONVERSION OF EXISTING 440 YARD RUNNING TRACKS TO 400 METERS

PHYSICAL

For the first time in 1980, the National Federation of State High School Associations listed the Order of Events in the Track & Field Rules and Records book at metric distances. The following table lists the metric distances with their length in English measure, as well as the difference in length between the English equivalent event and metric length.

METRIC LENGTH	LENGTH IN ENGLISH MEASURE	EXISTING EQUIV. EVENT	LENGTH DIFFERENCE (Metric/English)
75 m	246 ft. 3/4 in.	80 yards	6 ft. 3/4 in. longer
100 m	328 ft. 1 in.	100 yards	28 ft. 1 in. longer
100 m	328 ft. 1 in.	110 yards	1 ft. 11 in. shorter
110 m	360 ft. 10 5/8 in.	120 yards	10 5/8 in. longer
165 m	541 ft. 4 1/8 in.	180 yards	1 ft. 4 1/8 in. longer
200 m	656 ft. 2 in.	220 yards	3 ft. 10 in. shorter
300 m	984 ft. 3 in.	330 yards	5 ft. 9 in. shorter
400 m	1,312 ft. 4 in.	440 yards	7 ft. 8 in. shorter
800 m	2, 624 ft. 8 in.	880 yards	15 ft. 4 in. shorter
1500 m	4,921 ft. 3 in.	1 mile	358 ft. 9 in. shorter
1600 m	5,249 ft. 4 in.	1 mile	30 ft. 8 in. shorter
3000 m	9,842 ft. 5 7/8 in.	2 miles	717 ft. 6 1/8 in. shorter
3200 m	10,498 ft. 8 in.	2 miles	61 ft. 4 in. shorter

With the rule change, schools building a new track or refurbishing their present track facilities are encouraged to make accommodation for metric races.

LOCATION OF RADIUS POINTS

In converting a track from yards to meters, check the distance of the measuring line of the track in lane 1. This is done by finding the radius points of the track.

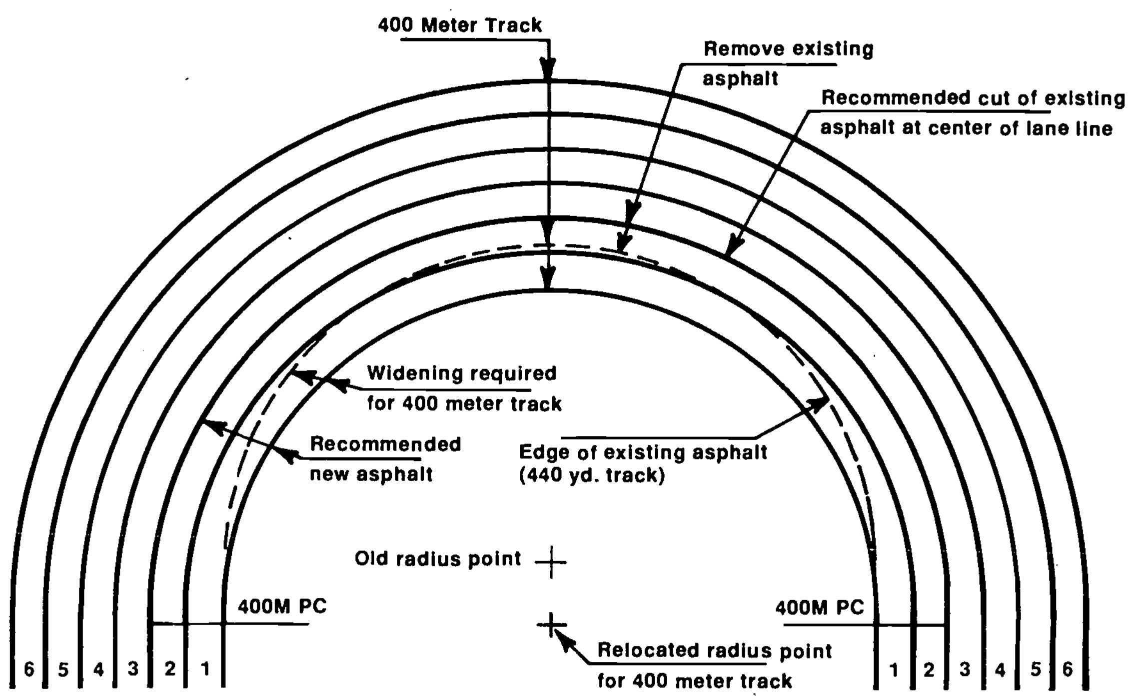
MEASURING THE TRACK

Multiply the distance between radius points (314.42 ft.) x 2 = 628.84 ft., take the radius to the measuring line (the measuring lines are located 20 cm from the outside edge of the painted line, or if the track has an existing raised curb, the measuring line is 30 cm from the outside edge of the curb). Assume the measuring line is 110.001 ft. x 3.1416 (pi) = 345.579 ft. This figure (345.579 ft.) is the distance around one end of the oval at the path of measurements in lane 1 only. Multiply 345.579 ft. x 2 for both ends of the oval = 691.158 ft. and add the distance for both straightaways, 628.84 ft., and the result is 1319.998 ft. or 440 yards.

RESULTS OF MEASUREMENT

As the result of measurement, the track is: (1) exactly 440 yards; (2) oversized; or (3) undersized. A 400 m track is 7.67 ft. shorter than a 440 yard track.

FIGURE 9-1
METRIC CONVERSION



CONVERSION METHODS

If the track's physical measurement is exactly 440 yards, conversion can be made by decreasing the distance between the radius points 3.835 ft. (see Figure 9-1). This will decrease the measuring distance in lane 1 by 7.67 ft. We suggest converting one end only to accomplish shortening the track.

If the track is found to measure more than 440 yards in lane 1, move one radius point back 3.835 ft. plus one-half the distance that is more than 440 yards toward each end.

If the track is found to measure less than 440 yards, one radius is moved back 3.835 ft. minus one-half the distance that is less than 440 yards back toward the other radius.

PROBLEMS IN CONVERSION

Drainage

A very important part of physically converting a track is to check the drainage and slope in the area where the modification is going to take place. Be sure the conversion can be done without affecting the drainage. Conversion could, on some tracks, interfere with the surface or subsurface drainage.

Slope

The slope in the conversion area should conform to the existing track. The National Federation slope maximums are 2:100 laterally and 1:1000 in the running direction.

PERMEABLE CONSTRUCTION

Permeable material is that through which water passes, such as cinder, clay, decomposed granite, stone dust, expanded shale, or fast dry fired clay, porous asphalt and certain synthetic surfaces. Most of the permeable tracks are bound by a concrete curb or a steel curbing. It is necessary to remove part of the existing curb and construct a new curb, Figure 9-1, in accordance with the conversion measurements. The base shall be compacted and leveled as equal to the existing condition of the rest of the track. The surface material shall then be added. There is approximately 71 sq. yds. of new surface area and approximately 330 ft. of new curb.

IMPERMEABLE CONSTRUCTION

Impermeable construction (water runs off) consists of hot leveling and hot cushion course, hot leveling course and cold cushion course, cold leveling course and cold cushion course, and certain synthetic surfaces. If there is an existing curb, it should be relocated per conversion measurement.

BASE CONSTRUCTION TECHNIQUE FOR PERMEABLE/IMPERMEABLE ALL-WEATHER TRACKS

With this type construction, a few realities must be faced in planning the widening of the curve. Since the inside of old lane 1 cuts diagonally across new lane 1 and some tracks have lanes less than 3.835 ft. wide; runners might get into lane 2. It is nearly impossible to make a smooth joint between new and old material so a joint along the old line of lane 1 would result in a rough and irregular joint and would hinder lanes 1 and 2. The new area in conversion creates a crescent shaped piece adjacent to the original curb which varies from zero to 3.835 ft. at the center. This will create a problem with new base material since it is not stable in narrow widths and it requires considerable compaction to produce a smooth, stable base and surface. It will most certainly settle and possibly cause a dangerous area for a runner.

The recommended way to convert the track is to cut and remove the existing surface at the inside lane of new lane 3 so that the roughness that will occur at the joint between new and old asphalt will be on a lane line. This will allow the area to have better compaction since proper machinery can be used in the construction and will help eliminate the possibility of a differential settlement. This method will require approximately 220 sq. yds. of new paving.

CONVERSION COMPUTATION

In using the conversion computation, Figure 9-2, the following information should be considered to allow for the accuracy of the final conversion.

1. The conversion example is based on a track with a raised curb. The measure line is then 30 cm from the inside face of the curb.
2. A and B are the respective distances between the inside curb faces of the existing track.
3. A and B are the respective distances between the measure lines.
4. C is the distance between the existing radius points.
5. Pi = 3.1416.

6. E is the distance around the track on the measure line of the existing track.

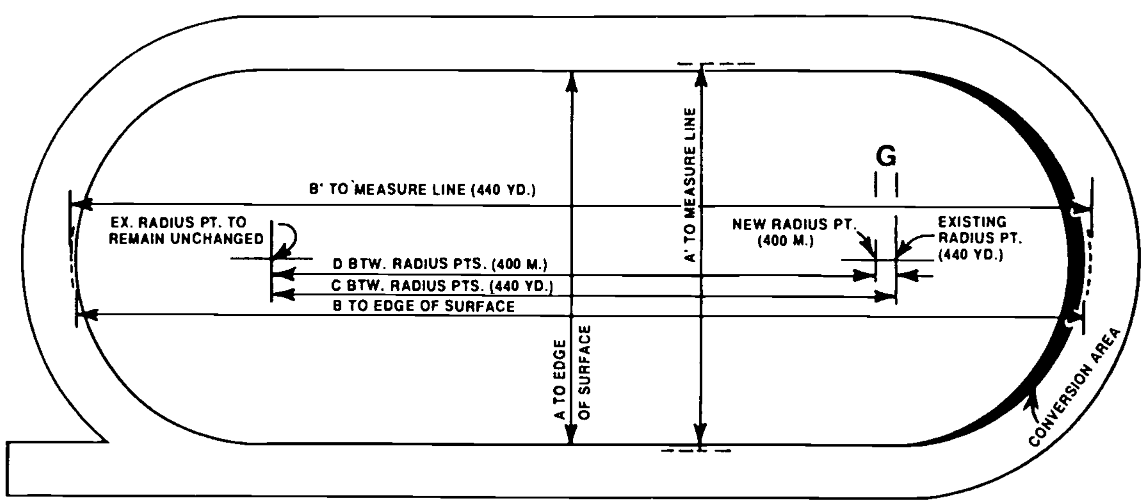
7. If E does not equal 1320 ft., then step 5 will determine if F is a plus (+) or minus (-) dimension.

8. If F is O, then the standard distance to move the existing radius at one end becomes 3.83 ft. If F is a minus, then G will be less than 3.83 ft. If F is a plus, then G will be greater than 3.83 ft.

9. Once you have moved the radius the exact distance determined, you will have a new distance between radius points, or D.

10. Using step 8, you can now determine that the new measure line equals 400 meters.

FIGURE 9-2
CONVERSION COMPUTATION



1. A + 60 CM = A'
2. B + 60 CM = B'
3. B' - A' = C
4. A' (3.1416) + 2(C) = E
5. E - 1320 FT. = F
6. F + 3.83 FT. = G
7. C - G = D
8. A' (3.1416) + 2(D) =1312.34 FT. OR 400 M

CHAPTER 10

MAINTENANCE

The usefulness, appearance, and longevity of a running track facility are closely related to the protection and maintenance practices used during its life.

There are a number of factors that cause deterioration of the track and create a need for maintenance work. These would include such items as the following:

1. Normal wear and tear due to track use.
2. Oxidation.
3. Fading and wear of the lane lines and event markings.
4. Heavy use of lanes one and two.
5. Vehicles crossing the surface for maintenance or other operations.
6. Vandalism.
7. Clogged drainage systems.
8. High stress on selected areas (i.e., the high jump take off area). Pedestrian traffic (athletes, cheerleaders, other activities). Fuel and oil spills.

It is important that reasonable protective measures be undertaken to minimize or prevent the effect these factors have on the track. Since some wear and deterioration is normal as the facility ages, it is also necessary to provide certain maintenance procedures to keep the facility in good condition.

PROTECTION

It is always necessary to cross the track with some type of vehicle to access the infield area. It is important to provide some protection to keep dirt and debris from accumulating at this point and to protect from scuffing of vehicles tires. In most cases, indoor/outdoor carpeting or a similar product is effective and economical. Plywood is not recommended unless placed over carpeting or a similar material since its sharp edges can leave cuts or indentations on the surface.

In certain areas of the country, grass encroachment can be a significant problem. It can cause the edges of the track to deteriorate structurally and can progress to where the full width of the outside lanes is no longer available for the athlete. Concrete curbing is usually effective in controlling the encroachment. Sterilization of the subgrade as well as spraying the edges of the track periodically with a strong herbicide also can be helpful.

It is important that the surface be kept clean, both for cosmetic appearance and to minimize wear. Debris that will allow moisture to accumulate for long periods of time should not be allowed to collect on the surface (i.e., leaves). Sand and stones can be particularly damaging to the surface because of their abrasive effect. If the track is properly sloped, normally wind and rain will keep the surface reasonably clean. If additional cleaning is necessary, an air-blower and/or power washer can be used.

Excessive spike length can accelerate the wear on the surface. It is generally accepted that 1/8 in. spikes of the cone or pyramid design provide a good compromise between athletic performance and surface wear.

MAINTENANCE

Repainting of lane lines and event markings normally is required every four to seven years depending on the type of surface and the quality of the painting work. Striping needs to be kept reasonably bright and clear so that the markings are evident to the athletes for whom the track was designed.

Resurfacing of some type is normally required during the life of a track. The specific procedure varies depending on surface, but might include the following:

1. Applying a rubberized sealer to a sand/asphalt/rubber track.
2. Applying a spray coat of latex or an additional layer of rubber to a layered latex track.
3. Applying an aliphatic polyurethane spray to a polyurethane track.
4 Applying a light polyurethane structural spray to a black mat/ structural spray system.
5. Adding three to five millimeters of topping to a full pour polyurethane track.

Spot repairs are also required from time to time due to wear in selected high stress areas, accidental damage or vandalism. It is recommended that the surface be carefully inspected at least once a year to check for any repairs that may be required.

In general, the following procedures will keep a track facility in good condition.

1. Protect it and keep it clean.

2. Make minor repairs annually as necessary.

3. Every four to seven years, perform major maintenance which would consist of cleaning the track surface, repairing any damaged or excessively worn areas, resurfacing with a system appropriate to the surface and line striping.

CHAPTER 11

INDOOR FACILITIES

Normally the size of the building will dictate the area allowed for the track oval and related events. There is no particular size of a building required unless an international sanctioned event is to be conducted. The following design meets the specifications necessary for an international event.

THE STRAIGHT TRACK

The maximum lateral inclination of the track shall not exceed 1:100 and the inclination in the running direction shall not exceed 1:250 at any point and 1:1000 overall.

Lanes

The track should have a minimum of 6 and a maximum of 8 lanes separated and bounded on both sides by white lines 50 mm wide. The lanes shall all have the same width with a minimum of 1.22 m and maximum of 1.25 m including the white line on the right. The lanes shall be numbered with lane 1 on the left hand side when facing the finish line.

The Start and Finish

The start and finish of a race shall each be denoted by a white line 50 mm wide at right angles to the lane lines. The distance of a race shall be from the edge of the starting line farther from the finish to the edge of the finish line nearer to the start.

There should be a clearance of at least 3 m behind the starting line free of any obstruction. There shall be a clearance of at least 10 m beyond the finishing line free of any obstruction with adequate provision beyond for an athlete to come to a halt without injury.

Note: It is strongly recommended that the minimum clearance beyond the finishing line should be 15 m.

THE OVAL TRACK

The nominal length should preferably be 200 m. It shall consist of two horizontal straights and two bends, which may be banked not greater than 15 degrees. The inside of the track shall be bordered either with a curb of suitable material, approximately 50 mm in height and width, or with a white line 50 mm wide. The outside edge of this curb or line forms the inside of lane 1. The inside edge of the line or curb shall be horizontal throughout the length of the track with a maximum slope of 1:1000.

Lanes

The track should have a minimum of 4 and a maximum of 6 lanes. The lanes should all have the same width with a minimum of 0.90 m and a maximum of 1.10 m including the lane line on the right. The lanes shall be separated by white lines 50 mm wide.

The direction of running shall be left hand inside. The lanes shall be numbered with the left hand inside lane numbered 1.

Banking

If the bends are banked, it is recommended that the maximum angle should be not more than 15 degrees. The angle of banking in all the lanes should be the same at any cross section of the track.

In order to ease the change from the flat straight to the banked bend, the change may be made with a smooth vertical transition which may be extended up to 5 m into the straight.

Bends

For a 200 m track, it is recommended that the inside radius of the bends should not be less than 11 m and not more than 21 m. Where possible, the radius should be at least 13 m. The radius of the bend need not be constant.

Marking of the Bend

Where the inside edge of the track is bordered with a white line, it shall be marked additionally with small flags or cones. The flags shall be approximately 250 mm x 200 mm in size, at least 300 mm high and set at an angle of 120 degrees to the track surface. The cones shall be at least 300 mm high. The flags or cones should be placed on the track so that the outward face of the flagstaff or the cone coincides with the outward edge of the white line.

Measurement of the Oval Track

The length of the inside lane shall be measured (the measurement line) along the surface of the track 300 mm outward from the curb, or 200 mm outward from the edge of the white line marking the inside of the track.

For the other lanes, the measurement shall be taken on the surface of the track 200 mm outward from the edge of the white line marking the outside of the next lane inside.

FIELD EVENT CONSTRUCTION

Safety in the construction of field events in an indoor facility is very important since the areas will be used for multiple activities.

Items for consideration:

1. All areas shall be flush with adjacent surface when not in use.

2. Pole vault box shall be filled with a plug or cover of synthetic material when not in use.

3. The pole vault area shall be located away from walls and other potential hazards.

4. The long jump/triple jump boards shall be replaced with synthetic covers when not in use.

5. The long jump/triple jump landing area shall be covered with a sturdy cover with synthetic surface when not in use.

6. Landing areas for the weight throws should be on dirt, composition or synthetic surface.

7. Portable barriers should be provided to stop the weight implement.

HEIGHT

The height of the building should be designed so that there will be no physical or mental barriers for the athletes. Buildings should have unobstructed clearances of at least 30 ft.

LIGHTING

Lighting should be of sufficient power and even dispersement so that athletes may run, jump, vault and throw without having to adjust their vision due to areas of light and shadow.

CHAPTER 12

PROFESSIONAL ASSISTANCE

As shown in this manual, track construction is an exact science. For this reason, it may be desirable for an owner to employ a professional consultant to assist in a track construction or renovation project. Professional assistance from an architect, civil engineer, landscape architect, Certified Track Builder (CTB) or knowledgeable contractor will allow you to identify your needs and to refine the information in this manual for the specific uses intended for your track and to the specific requirements of your site.

A professional can assist you in determining the scope of work to be included in the job, in planning the facility, in determining a realistic budget for the project, in evaluating and comparing bids, in overseeing the work of the contractor and in solving any problems which occur during construction. A professional can help an owner communicate with designers, suppliers and contractors during all phases of the work, from planning to completion, to insure that the completed facility is what the owner intended.

Often employing the services of an expert or professional can actually help control job costs by better translating the needs of the owner into proper direction for construction and by helping to avoid costly mistakes.

In employing professional assistance, it is important to consider the experience of your consultant. Track construction is not only exacting and highly technical, but the rules and technology involved are undergoing constant change. It is important to employ a professional individual or firm with extensive, current experience in the field of track construction.

To choose a qualified professional consultant:

1. Assess your needs and define the type of facility, the approximate budget and the timetable for completion.

2. Locate professionals with expertise in the field of track construction. One way to do so is by contacting professional associations such as the U.S. Tennis Court & Track Builders Association, the American Society of Landscape Architects, the American Institute of Architects and the National Society of Professional Engineers. Another way to find a qualified professional is by contacting colleagues who have recently completed similar projects and asking for recommendations.

3. Contact prospective consultants and ask for information on their firms, experience, projects and past clients.

4. Contact references, visit completed projects and talk to other

owners about their renovation or new construction projects.

5. Ask for proposals and compare them carefully. Develop an under standing of the proposed fees. What is included? What is not included?

6. Interview prospective candidates.

7. Review proposals, negotiate fees and services, and be sure to sign a letter of agreement or contract.

Your professional consultant can help with many facets of the construction or renovation project. Among these, he or she can:

1. Translate your desires into technical data, drawings and specifications.

2. Develop a proper project budget to enable you to determine the scope of work to be undertaken, or to divide the project into multiple phases to be undertaken over time.

3. Develop construction documents to clarify the scope of work, quality and performance standard of the proposed facility. This allows the owner to secure contractor proposals which better reflect the owner's intentions, and which are more consistent.

4. Assist in translating the costs, products and methods of construction shown in proposals to allow the owner to choose a contractor for the project.

5. Monitor the construction portion of the project to determine the quality and performance of the contractor.

6. Maintain an ongoing communication link between the contractor and the owner during construction.

7. Inspect the completed job and ensure that all work is performed in accordance with the owner's requirements.

Appendix

GOVERNING BODIES OF TRACK

IAAF	International Amateur Athletic Federation. 17, Rue Princesse Florestine MC 98000 Monaco 011-339-330-7070
NCAA	National Collegiate Athletic Association. 6201 College Blvd. Overland Park, KS 66211 913-339-1906
NFSHSA	National Federation of State High School Associations. P. O. Box 20626 Kansas City, MO 64195 816-464-5400
USAT&F	USA Track & Field One Hoosier Dome Suite 140 Indianapolis, IN 46225 317-261-0500

ORGANIZATIONS WHICH CAN PROVIDE ASSISTANCE WITH TRACK CONSTRUCTION SPECIFICATIONS

USTC&TBA	U. S. Tennis Court & Track Builders Association 3525 Ellicott Mills Drive, Suite N Ellicott City, MD 21043-4547 410-418-4875 FAX: 410-418-4805
NAPA	National Asphalt Pavement Association 6811 Kenilworth Avenue Riverdale, MD 20737 301-779-4880
ACI	American Concrete Institute 22400 W. Seven Mile Road Detroit, MI 48219 313-532-2600
NRCA	National Readymix Concrete Association 900 Spring Street Silver Spring, MD 20910 301-587-1400
PCA	Portland Cement Association 5420 Old Orchard Road Skokie, IL 60077 312-966-6200
ASTM	American Society for Testing and Materials 100 Barr Harbor Drive West Conshohocken, PA 19428-2959 610-832-9585

SUGGESTED CONVERSION FACTORS

20 cm = 7.87 in. = 0.656 ft.

30 cm = 11.81 in. = 0.984 ft.

1.0668 m = 42 in. = 3.5 ft.

1.2192 m = 48 in. = 4.0 ft.

1 m = 3.28083 ft. (minimum conversion factor)

pi = 3.1416

400 m = 1312.34 ft.

Glossary

GLOSSARY OF TERMS

Acrylic Cushion Systems	Surfacing designation, generally referring to acrylic and finely ground rubber mixture squeegee or spray applied.
Aggregate	Particles of construction materials, usually referring to crushed or natural sand, stone or rock products.
Base Course	Material placed over the subgrade to stabilize and level prior to placing a surface course.
Base Mat	Surfacing designation generally referring to a premanufactured or machine applied (paved) mixture of rubber granules and polyurethane binders.
Bituminous Asphaltic Mixture	Mixture of asphalt (hot or cold) and aggregate.
Broken-Back Curved Track	A track that is designed with a short distance between the radius points in order to allow for a wide soccer field inside. This design is also referred to as a double-bend track.
Calibration	Mathematical formulation utilized to determine various distances as designated by governing rules.
Cohesion	Of a soil, all of the shearing strength not due to friction.
Compressibility	That portion of the volume change deformation resulting from the expulsion of the pore water, influenced by the soil structure.
'D' Area	The area of the infield which is made up of all or part of the semicircle inside the curve of the running track.
Dynamic Base	Rubber/stone/binder mixture utilized in lieu of bituminous or concrete base.
Elasticity	Ability of a soil to return to its original shape after having been deformed by a load for a short period of time.
EPDM	Abbreviation for ethylene-propylene-diene rubber.

Equal Quadrant	Tracks with all quadrants (straights and curves) of equal track distance.
Exchange Zones	Area of a track designated for the exchange of batons between team members participating in relay events.
Frost	The degree to which soil is affected by frost; susceptibility where freezing temperatures are prolonged and the frost line penetrates deep into the soil, ice layers form in the soil and cause the soil to heave at the surface, equivalent to the thickness of the ice layers.
Full Pour	Surface designation generally referring to non-porous poured polyurethane installations.
Geotextile	Fabric used to stabilize site conditions, generally placed over Membranes a prepared subgrade.
Implement Landing Area	Landing area defined by governing bodies for discus, shotput, javelin and other implements.
Latex Bound System	Track surface made of rubber particles bound together by one or more latex products.
Leveling Course	Usually hot mix asphalt, installed to specified tolerances for slope and planarity.
Measure Line	A theoretical line from which the distance of a running track is determined. This line is located 20 cm from the running side of the painted line for each lane. In the case of a raised curb, the line is located 30 cm from the running side of the raised curb for lane 1.
Non-Equal Quadrant Tracks	Tracks where the quadrants (straights and curves) are not of equal length.
NR	Abbreviation for natural rubber.
Oxidation	Structural and cosmetic deterioration due to chemical reaction with oxygen, normally associated with long exposure to the sun.
Permeability	The ease with which water will flow or pass through the pores of particular strata. Texture, gradation, degree of compaction and primary structure strongly influence a given strata's relative permeability.

Plasticity	The ability of a material to be deformed without cracking or crumbling and then maintain that deformed shape after the deforming force has been released.
Polyurethane Bound Systems	Track surface made of rubber particles bound together by one or more polyurethane products.
Premanufactured Rubber Mat	Sheet good, normally of vulcanized rubber or polyurethane bound rubber. Usually adhered with adhesive.
Radius Points	Point used to located the curves of a track. Normally two, broken-back design has six.
Rubberized Asphalt Track	Track surface made of rubber particles, asphalt binders and, sometimes, stone or sand aggregate.
Sandwich	Track surface of two or more distinct strata, usually black base and colored top.
SBR	Abbreviation for styrene-butadiene rubber
Shearing	Of a soil is the result of friction between the particles and cohesion.
Sieve Analysis	Describes particle percentages that will pass through various sized screens (sieves).
Structural Spray	Spray material containing binder and rubber particles.
Surface Course	Usually hot mix asphalt, installed to specified tolerances for slope and planarity. Tolerance more precise than for leveling course.
Swale	Depressions in the ground designed to direct the flow of surface water.

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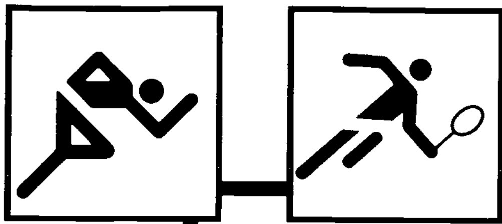

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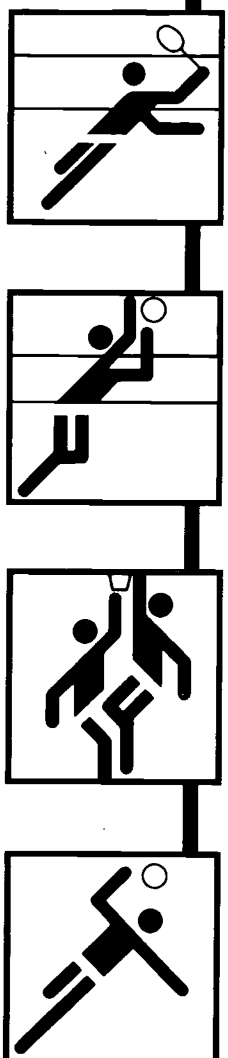

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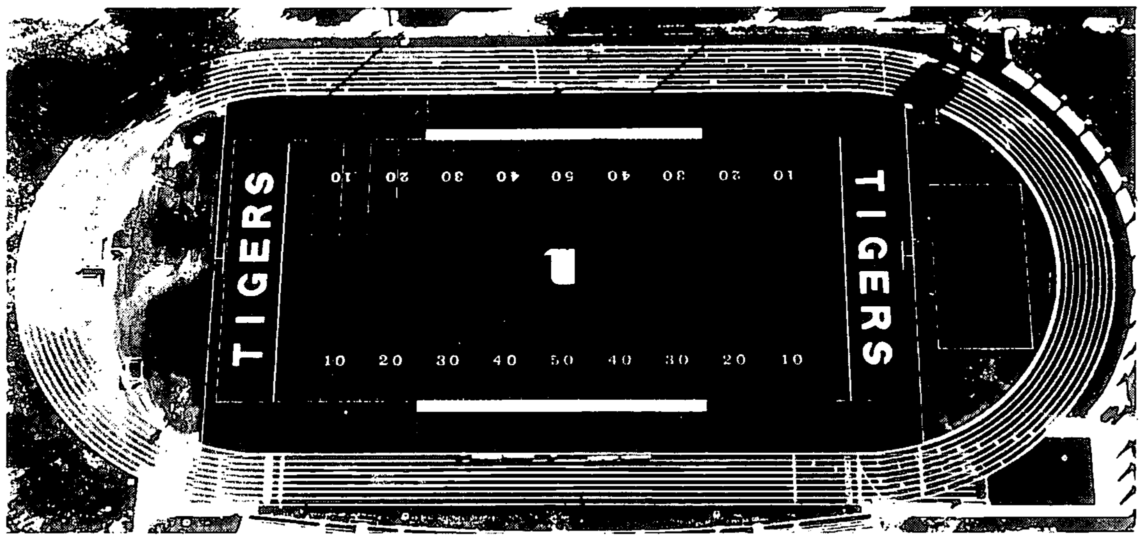

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U.S. TENNIS COURT AND TRACK BUILDERS ASSOCIATION

National Federation of State High School Associations

TRACK AND FIELD NEW RULES VIDEO

A new rules video was produced in June of 1996 with the cooperation of Blue Springs High School in Blue Springs, Missouri. Coaches Gary Parker and Carl Vun Cannon assisted with the production. The video covers lane violations, interference, proper passing procedures as well as all field events. The video is designed to provide coaches, officials and athletes a better understanding of the rules that govern track and field competition.

Video: ½'' — $39.95

VAULTING HIGHER AND SAFER

This 12-minute **video cassette** produced by the National Federation addresses common problems that occur in pole vaulting, and focuses on technique and proper facilities. Coaches and vaulters, experienced or not, will benefit from this highly informative production.

Video: ½'' — $24.95

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COMPETITORS NUMBERS

★ TRACK
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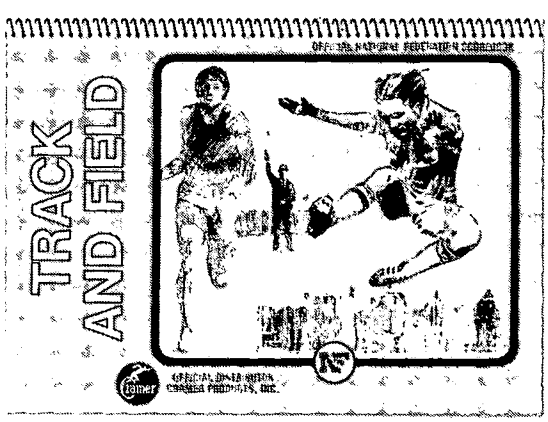
Competitors numbers are now available from the National Federation. They are made from Tyvec, a **nontearable, waterproof** paper. Numbers are from 1-1000 in bold black with the following backgrounds: White, Red Tint, Blue Tint, Green Tint and Yellow Tint. Numbers may be purchased in sets of 100. **COST (100 numbers per set)** — 1-5 sets - $11.50/set; 6-24 sets - $11.00/set; 25 or more sets - $10.50/set, **plus shipping and handling charges.** Orders up to $25.00 add $4.00; orders over $25.00 add $6.00.

TRACK AND FIELD SCOREBOOK



$4.00 EACH

Scorebooks are offered in **basketball, cross country, field hockey, gymnastics, soccer, swimming and diving, track and field, volleyball** and **wrestling** at a cost of $4.00 each. Scorebooks are available in **baseball/softball** at a cost of $3.50 each. Orders up to $25.00 add $4.00 shipping and handling, over $25.00 add $6.00

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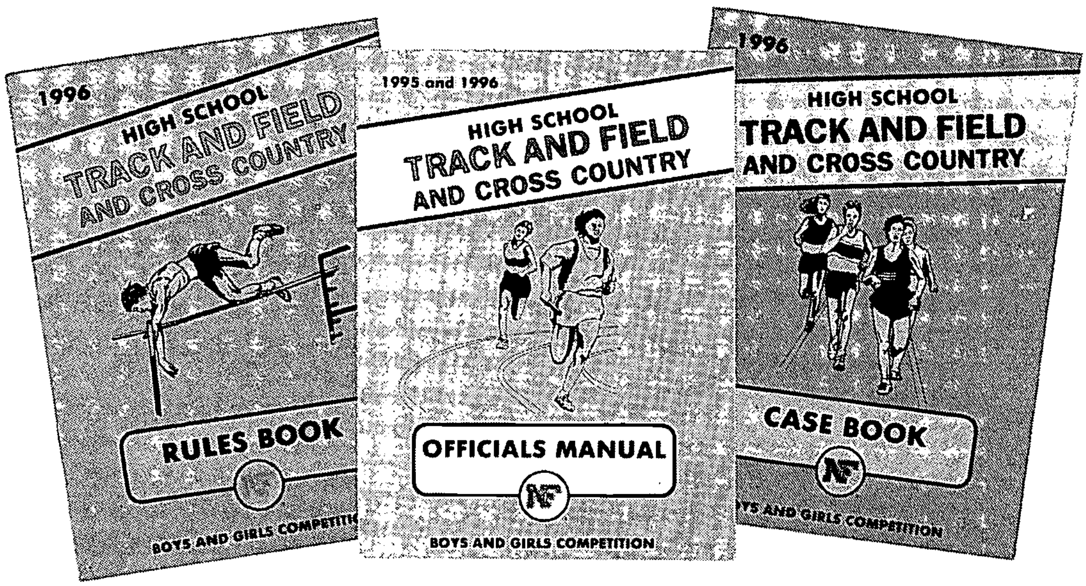
NATIONAL FEDERATION TRACK AND FIELD MATERIALS



RULES BOOK — Written and published by the National Federation. It contains all rules to administrate an interscholastic track and field and cross country program.

CASE BOOK — This book is designed to supplement the rules book and give situations on rulings on track and field.

MANUAL — This book will serve as a guide and resource to those individuals having the responsibility of administrating an interscholastic track and field meet.

COST PER BOOK — $5.00 plus shipping and handling

Shipping & handling charges up to $25.00 add $4.00
Over $25.00 add $6.00

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