SPECIFICATIONS FOR AN NCAA DIVISION I STRENGTH AND CONDITIONING FACILITY

by

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Introduction

Strength and conditioning programs are an important part in an athletic department's mission of developing competitive athletes. The facilities provided for the athletes have great bearing on how well they can prepare and the type of strength and conditioning training they can perform. The design of a facility may have an impact on the motivation and attitude towards training of both the coaches and athletes. Exercise equipment, flooring, and the dimensions of the facility all play an important part in the effectiveness and safety of the facility. Kroll (1988) stated that the particular strength programs, strength training philosophy and motivational techniques must be taken into account when designing strength and conditioning facilities. Exercise equipment selected must satisfy the needs of the strength program. Sutherland (1991) stated "No universal agreement exists as the best and only way to train. Therefore, each and every facility has its own personality and level or organization" (p. 16).

Strength and conditioning facilities must be designed to assist the strength coach in accomplishing his or her mission. The mission of the strength coach is to enhance an athlete's performance through strength and conditioning

training. This project may provide a valuable resource for strength and conditioning coaches and administrators in the development of a National Collegiate Athletic Association (NCAA) Division I strength and conditioning facility.

Purpose

The purpose of this project was to identify the specifications for a strength and conditioning facility that would meet the needs of an NCAA Division I program with 18 sports that included football.

Design and Procedure

The design of this project was descriptive in nature. The facility was divided into several areas. Each of these areas has justifications for the need of the area. Specifications found in each area include the equipment occupying the area, the dimensions of the area, and the type of flooring to be used in each area.

The design specifications of several current NCAA Division I strength and conditioning facilities were examined. The facilities of The University of Virginia, The University of Maryland, North Carolina State University, Georgia Tech, East Carolina University, The University of Tennessee, Duke University, Liberty University, The University of North Carolina at Chapel Hill and Virginia Tech were visited. A Division I NAIA school, Carson-Newman College, was also visited. A questionnaire was used to

collect personal communications data from each school (Appendix A). Literature research of the types of flooring, equipment and facility design was also completed to determine the desired specifications for the facility. These desired specifications were blended to create the recommended specifications contained in this project. Recommended size specifications are given for mandatory and optional areas. Specifications may vary according to the type of strength and conditioning program and budgetary constraints each school may have. Comparisons of the types of equipment, facility square footage, number of sports, and number of strength and conditioning facilities have been made of the school's visited.

NCAA Sports Sponsorship handbooks provided the information of which sports are more common in NCAA Division I Universities. This information was used to select the 18 sports planned for in this project.

Questionnaire Data

The personal communications data obtained from the visits to the 10 NCAA Division I schools appears in the following Tables. This data was gathered through the use of a questionnaire found in Appendix A. Table 1 provides data related to the athletic department's programs and facilities. The first two columns provide data on the number of sports and athletes each of the 10 schools

Table 1

Comparison of the Facilities at the 10 Division I Schools Visited

School	Sports	Athletes	Strength Facilities	Sports Using Primary Facility	Sports Using Other Facilities
Duke University	28	570	1	23	1
East Carolina University	17	438	1 and uses locker room	13	-
Georgia Tech	16	390	5 and uses locker room	3	11
University of North Carolina (Chapel Hill	26	430	1	25	-
North Carolina State University	21	600	2	5	17
University of Maryland	26	558	2 and uses locker room	undeter-mined	26 (now)
University of Tennessee	17	425	3	8	8
University of Virginia	24	490	2 and uses locker room	3	21
Virginia Tech	18	485	1 and uses aerobic room	18	-
Liberty University	13	330	1	13	-

currently has in their athletic department. The third column in Table 1 provides data on the number of strength facilities currently being used by each school's athletic department. Columns four and five provide data on the number of sports using the primary and other facilities at each school.

The data in Table 1 shows a diverse range in the number of sports, athletes, and strength facilities at these 10 schools. Georgia Tech has 16 sports and five strength facilities while The University of North Carolina at Chapel Hill has 26 sports and one strength facility. The University of Virginia and Georgia Tech both have three sports training in their primary facility while The University of North Carolina at Chapel Hill and Duke University have 25 and 23 sports training in their primary facility, respectively. North Carolina State University has 21 sports and 575 athletes while Liberty University has 13 sports and 330 athletes. Currently five of the schools are using one strength facility and five schools are using two or more.

The data found in Table 1 shows that, when compared, these 10 schools have very different programs and strength facility accommodations. The data found in Table 2 helps to explain and further compares these differences.

Table 2

Comparison of the Square Footage, Training, and Facility Planning at the 10 Division I Schools Visited

School	Square Footage Of Primary Facility	Total Square Footage Of Other Facilities	Square Footage Of Future Expansions	Athletes Safely Trained In Primary Facility	Strength Coach Helped Plan Facility
Duke University	3,200	-	3,500 2nd Facility	50	Yes
East Carolina University	5,000	-	-	60	Yes
Georgia Tech	10,000	6,400 Total	Eliminate One and Expand One	40	Yes
University of North Carolina (Chapel Hill	8,000	-	-	100	Yes
North Carolina State University	1,600	2,100	5,000	20	No
University of Maryland	8,000	4,700	-	40	Yes
University of Tennessee	12,000	4,500	-	40	Yes
University of Virginia	8,000	3,000	-	60	Yes
Virginia Tech	3,500	-	3,500	40	Yes
Liberty University	8,200	-	-	60	No

The data in Table 2 provides information on the square footage of the primary and other strength facilities, square footage of any future expansions, and the number of athletes that each strength coach considers he can safely train in the primary facility. There is information found in Table 2 pertaining to the strength coaches input in planning the facility. Six of the 10 schools have primary facilities between 8,000 and 12,000 square feet. The largest facilities are at The University of Tennessee and Georgia Tech which are 12,000 and 10,000 square feet respectively. Liberty University, The University of Virginia, The University of Maryland, and The University of North Carolina at Chapel Hill all have 8,000 square foot primary facilities or larger. Four of the six schools with primary facilities over 8,000 square feet also have secondary facilities between 3,000 and 6,400. This information can be seen in Table 2.

The school with the least amount of square footage for their second facility, North Carolina State University, has 2,100 square feet. The three schools with the smallest facilities, Virginia Tech, Duke University, and North Carolina State University, are all planning to either expand or take over an existing facility to increase their total square footage.

When asked about the capacity the coaches could safely train in their primary facility the majority of coaches indicated between 40 and 60 athletes. The majority of coaches claimed that they could only effectively supervise between 40 and 60 athletes regardless of the square footage of their primary facility. The strength coaches at the schools with the two largest facilities, The University of Tennessee and Georgia Tech, indicated that for supervision purposes they would prefer to have no more than 40 athletes in their facility at a time (B. Pauletto, personal communication, October 8, 1992) and (J. Lanthrop, personal communication, October 20, 1992).

Two of the 10 facilities were planned without the input of a strength coach. The facility at North Carolina State University can safely accommodate 20 athletes and is currently 1,600 square feet. The strength coach for North Carolina State University stated that there were plans to expand this facility by adding 5,000 square feet (W. Hicks, personal communication, October 23, 1992). The other facility, Liberty University, has adequate square footage for the strength facility but no storage space (D. Williams, personal communication, November 10, 1992).

The data in Table 2 shows that the size of the facility is not the only factor determining the number of athletes which can be safely trained at one time. Supervision plays

an important role in determining this number.

The data in Table 3 provides information on the number of self-contained power areas and platforms in the primary and other strength and conditioning facilities at the 10 NCAA Division I schools. Self-contained power areas are areas which allow an athlete to perform many different exercises within one area. These areas will be described in greater detail in the free weight section. Platforms are areas where free weight lifting is performed on top of a special surface. Platforms will also be described in the free weight section. The data found in Table 4 provides information on the number of strength and aerobic machines in the facilities at these schools.

The University of Maryland is the only school of the 10 which has self-contained power areas. They have 12 of these areas in their primary facility. Three of the 10 schools do not have any platforms in their primary facility. Two of these three schools use rubber mats as a substitute for the platforms. Seven of the 10 schools have between five and seven platforms in their primary facilities. An estimation of the number of strength machines was given by the strength coaches. This included estimations of the number of selectorized machines and other machines which do not require the athlete to balance the resistance while he/she performs an exercise. Eight of the 10 schools were

Table 3

Comparison of the Self Contained Power Areas at the 10 Division I Schools Visited

School	Self-Contained Power Areas		Platforms	
	Primary	Other	Primary	Other
Duke University	0	-	0	-
East Carolina University	0	-	5	-
Georgia Tech	0	0	6	4
University of North Carolina (Chapel Hill)	0	-	0	-
North Carolina State University	0	0	0	2
University of Maryland	0	0	7	2
University of Tennessee	13	0	6	3
University of Virginia	0	0	6	3
Virginia Tech	0	0	5	-
Liberty University	0	0	7	0

Table 4

Comparison of the Strength and Aerobic Machines at the 10 Division I Schools Visited

School	Strength Machines		Aerobic Machines	
	Primary	Other	Primary	Other
Duke University	27	-	0	-
East Carolina University	25	-	0	3
Georgia Tech	40	?	0	0
University of North Carolina (Chapel Hill)	35	-	7	-
North Carolina State University	9	14	0	5
University of Maryland	25	20	5	4
University of Tennessee	40	12	2	0
University of Virginia	27	?	14	?
Virginia Tech	20	2	1	6
Liberty University	40	-	2	-

NOTE. The number of strength machines were estimations given by the Strength Coaches at each school.

estimated as having twenty-five or more of these pieces of equipment. Three of the eight were estimated as having 40 strength machines in their primary facility.

Aerobic machines (Table 4) were defined as all steppers, bikes, treadmills, climbers, and upper body ergometers. The University of Virginia had a total of fourteen aerobic machines in their primary facility. Four of the schools did not have any aerobic machines in their primary facility.

The data in Table 5 provides information on the number of bench presses, incline bench presses, and hip sleds that each school has in their primary facility. Five of the 10 schools have eight or more bench presses. Four of the 10 schools have six or more incline bench presses. Four of the 10 schools have four or more hip sleds.

The data found in Table 6 provides information on the number of squat racks and power racks that each school currently has in their facilities. Eight of the 10 schools have no squat racks. Five of the 10 schools have five or more power racks. Five of the schools have two or less power racks.

The equipment found in the other facilities at each of these schools can be found in the "other" column under each heading in Tables 3-6. This data will give further insight on the equipment available to the athletes at each school.

Table 5

Comparison of the Sleds and Benches at the 10 Division I Schools Visited

	Hip Sleds		Bench Presses		Incline Bench	
	Primary	Other	Primary	Other	Primary	Other
Duke University	2	-	8	-	8	-
East Carolina University	4	-	5	-	5	-
Georgia Tech	4	2	8	4	4	2
University of North Carolina (Chapel Hill)	5	-	8	-	8	-
North Carolina State University	0	1	4	3	2	2
University of Maryland	3	2	2	4	3	3
University of Tennessee	6	2	10	3	5	2
University of Virginia	2	2	8	4	6	2
Virginia Tech	1	-	6	-	6	-
Liberty	2	-	6	-	3	-

Table 6

Comparison of the Squat and Power Racks at the 10 Division I Schools Visited

School	Squat Racks		Power Racks	
	Primary	Other	Primary	Other
Duke University	0	-	8	-
East Carolina University	0	-	5	-
Georgia Tech	8	3	0	0
University of North Carolina (Chapel Hill)	0	-	2	-
North Carolina State University	0	3	2	0
University of Maryland	0	0	0	6
University of Tennessee	13	4	0	0
University of Virginia	0	-	8	3
Virginia Tech	0	-	6	-
Liberty University	0	-	7	-

Question nine of the questionnaire asks for suggestions about building and expanding a facility from the 10 NCAA Division I strength coaches interviewed. Four of the coaches mentioned a two facility preference. The Head Strength Coach at Duke University suggested that talking to other coaches is important and two facilities are preferred over one large facility. He also mentioned a need to plan for plenty of storage space (S. Falcone, personal communication, October 22, 1992). The Head Strength Coach at East Carolina University suggested that adequate square footage be requested. He also suggested that to supervise the facility adequately it should be no larger than 10,000 square feet. He would prefer two facilities 5,000 square feet each over one facility (J. Connors, personal communication, October 21, 1992). The Head Strength Coach at Virginia Tech suggested that two facilities are needed to best serve football and still provide prime weightroom hours to the other sports (R. M. Gentry, personal communication, October 21, 1992).

The Head Strength Coach at Liberty University said to plan for 14 power rack/platform areas when space was available. He also stated that, with the proper number of staff, two facilities could serve the strength and conditioning program better than one (D. Williams, personal communication, November 10, 1992). Nine out of the 10 strength coaches

interviewed for this project are currently using or would prefer to have two or more separate strength and conditioning facilities to accommodate their athletes.

The other coaches interviewed made suggestions relating to building design, equipment, and recruiting. The Strength Coach at North Carolina University suggested that the strength coach be allowed to design the facility (W. Hicks, personal communication, October 23, 1992). The Head Strength Coach at The University of Maryland suggested a need to eliminate pillars and blind spots. He also stated that sky lights can help the lighting situation (D. Unger, personal communication, October 28, 1992). The Head Strength Coach at The University of North Carolina at Chapel Hill said to make sure a rectangle design was used (R. Tuten, October 22, 1992). The Head Strength Coach at Georgia Tech said to demand an assurance of quality in equipment and it must look good for recruiting purposes. He also suggested a need to purchase equipment that can accommodate large people (J. Lathrop, personal communication, October 20, 1992). The Head Strength Coach at The University of Virginia said to ask for more than wanted. He also suggested not to pay more for equipment than it is worth (J. Gamble, personal communication, October 6, 1992). The Head Strength Coach at The University of Tennessee said to find out what others have done and the

problems they have had with their facilities. He also stated that supervision and recruiting should be the major considerations (B. Pauletto, personal communication, October 8, 1992). These suggestions may be found useful when building or expanding a facility.

Determining the Number of Users and the Types of Equipment Needed

The specifications made in this project are for a strength and conditioning facility that would meet the needs of a NCAA Division I Program with 18 sports that includes football. The nine male and nine female sports with the largest participation number of the Division I schools are listed in Table 7 (Smale, 1991, 1992a and 1992b). The sports listed in Table 7 will be considered the 18 most common sports. The average number of athletes per school that participate in each sport are also listed in Table 7 (S. Horton, personal communication, November 22, 1992). The total number of athletes who can be expected to have access to this strength and conditioning facility is 524. The sport with the largest number of athletes on a team is football with 115. The sports with the smallest number of athletes on a team is men's and women's tennis with 12 athletes each.

There is current proposed NCAA legislation that could restrict the number of males allowed to participate on each

Table 7

The Number of NCAA Division I Schools Participating in Each Sport and The Average Number of Athletes Per School Participating in Each Sport

Men's Sports	Number of Schools	Number of Athletes	Women's Sports	Number of Schools	Number of Athletes
Basketball	198	15	Basketball	288	15
Cross Country	288	30	Indoor Track	288	30
Tennis	274	12	Cross Country	284	30
Baseball	273	40	Tennis	282	12
Golf	270	15	Volleyball	273	15
Outdoor Track	247	30	Outdoor Track	247	30
Indoor Track	232	30	Softball	182	40
Football (Div. IA & IAA)	196	115	Swimming & Diving	165	20
Soccer	194	30	Golf	162	15
	Total	317		Total	207
			Total Male and Female Athletes		524

Division I team. The 1993 NCAA Convention Publication of Proposed Legislation (1992) stated "Each institution, within the first two weeks of preseason practice, shall limit the number of student-athletes who may participate each year in men's sports ..." (p. 95). This legislation is driven by gender equity and, if passed, would reduce the numbers given for men's sports by approximately 10 percent. This information will not affect the number of male athletes using the strength and conditioning facility in this project. It should, however, be considered a factor in the future if it becomes legislation.

A major consideration that will affect the total number of people utilizing the facility is if athletic department staff, administrators, coaches, trainers, managers, cheerleaders, and dance squad members are allowed to utilize the facility. If all of these people are allowed access, this could easily add as many as 100 extra people utilizing the facility. Weight training classes may also be a consideration for some schools.

It is generally agreed among strength coaches that, despite the size of the strength and conditioning facility, the number of athletes that can be effectively coached at any one time is between forty and sixty. This preference can be seen in Table 1. Ginther (1992) stated:

> We try to arrange our workout schedule to have no more than 30 athletes in the weightroom at one time. We do this for the most effective use of equipment and space, as well as for the ability of the coaches to teach technique properly (p. 20).

Geoff Ginther is the Assistant Strength and Conditioning Coach at The University of Oregon. The strength and conditioning facility at The University of Oregon is 12,000 square feet. Kroll (1991a) stated "To calculate the amount of space needed in a proposed facility, the maximum number of persons that will be using the facility at any particular time is first established" (p. 55). If this was the sole determining factor then the strength and conditioning facility at The University of Oregon could only accommodate 30 athletes at a time even though it is 12,000 square feet. This information suggests that it is not the number of athletes using the facility at any one time that solely determines the size of the facility. The variety, number and dimensions of the equipment chosen seems to have a great deal of influence.

Determining the type of equipment to put in the facility is largely dependent on the needs of the athletes which will be training in the facility. Neck machines are needed for football players (D. Riely, personal communication, November 25, 1992). Wrestlers also need neck

machines for their training. Rotary torso, rotary shoulder and forearm/grip machines are needed for golf, tennis, baseball, and softball players. Platforms, power racks, bench and incline presses are needed for football players, basketball players, volleyball players, and track athletes. Latissimus dorsi (lat) pulldowns, pullup bars, and abduction/adduction machines are needed for swimmers and pole vaulters. Leg curl, calf, and gluteus maximus/hamstring (glut/ham) machines are needed for football players, soccer players, cross country and track athletes (M. Gentry, personal communication, October 21, 1992). Each strength coach will have his/her own ideas of the exercise equipment needed to prepare athletes.

Desired Weight Room Dimensions

An example for calculating the square footage of a facility appears in Table 8. Dimensions that create a rectangle with a total square footage of 8,000 square feet are used in this example. A number of dimensions totaling 8,000 square feet could have been used in this example. However, it may be necessary to use certain dimensions for a facility to fit aesthetically into an existing building or lot.

The percentage of free weight area to machine area shows the emphasis on compound, or multi-joint exercises. Pauletto (1991) stated "To achieve an optimal level of

Table 8

Desired Weight Room Dimensions

EXAMPLE:	8,000 Square Feet	
Dimensions	80' x 100'	
Desired percentage free weight Area to machine area		70%/30%
Free Weight Area	70' x 80' =	5,600 Sq. ft.
Free weight area walkways	4' x 80' =	320 sq. ft.
Number of walkways in free weight area		4
Number of walkways times square feet of walkways	4 x 320 =	1,280 sq. ft.
Free weight area square feet		5,600 sq. ft.
Minus total square feel of walkways		1,280 sq. ft.
Space available for free weight equipment		4,320 sq. ft.
Machine Area	30' x 80' =	2,400 sq. ft.
Machine area walkways	4 x 80' =	320 sq. ft.
Number of walkways in machine area		2
Number of walkways times square feet of walkways	2 x 320 =	640 sq. ft.
Machine area square feet		2,400 sq. ft.
Minus total square feet of walkways		640 sq. ft.
Space available for machine equipment		1,760 sq. ft.

strength and power, athletes should train with barbells, dumbbells, and machines, doing the majority of work with barbells" (p. 20). Kroll (1990a) stated "Even with all of these types of machines available, most coaches, athletes, and strength specialists still prefer to use free weights, whenever possible as the foundation of their programs" (p. 58). Free weight equipment also requires more floor space than machines due to their seven foot bars and extra space needed for spotters. This accounts for 70% of the 8,000 square feet being allocated for the free weight area.

Walkway space was determined by taking a minimum of four feet in width and multiplying it by the length of the area. The number of walkways was then estimated for each area and a total square footage needed was predicted. Kroll(1991a) recommended "The aisle, or walkway space should be a minimum of 4 to 7 feet wide to allow circuit participants to pass freely on each side" (p. 54). The walkway space was then subtracted from the square footage allowed for each area. This leaves the remaining square footage for the equipment which is to occupy each area.

The equipment needed and the square footage for each piece is defined in the following sections. Floor specifications are also addressed in these sections.

Mandatory Areas

Free Weight Area

Justification. Athletes need to train in a manner that will effectively work their muscle groups while developing power, joint stability and enhancing body coordination and timing. Free weights offer these benefits while machines are used for isolating muscle groups and providing the balancing elements for the athlete. Pauletto (1991) stated:

> Barbell exercises save time. Exercises done with barbells can train different areas of the body simultaneously, whereas it would take several different exercises using machines to do the same job. With barbells athletes are able to train more muscle areas and be more productive in the time available (p. 22).

Ginther (1992) stated "We incorporate many olympic-style lifts (cleans, snatches and jerks) to develop power, balance and flexibility" (p. 20). LeDuc and Perkins (1988) stated "Most of the weightroom is comprised of free weights. We feel this provides the athlete with the best tools for weight training" (p. 43).

Equipment. The first decision must be how to define free weight equipment. In Table 9 all plate loaded equipment are included. Plate loaded refers to equipment that requires loose olympic plates to be added to it to provide resistance. This includes equipment such as hip

Table 9

Breakdown of Free Weight Area Square Footage

Equipment	Number	Approximate Sq. Footage Needed for Each Piece	Total Sq. Feet
Self Contained Power Areas (SCPA)	15	171	2,565
Smith Machines	2	60	120
Hip Thrusters	2	80	160
Hip Sleds	4	80	320
Double Tiered Dumbbell Racks	10	40	400
Auxiliary Seats 0%-90%	3	24	72
Adjustable Benches	2	42	84
Weight Racks	3	12	36
		Approximate Equipment Square Footage	3,757
		Walkways	1,280
		Approximate Total Square Footage	5,037

Note. Square Footage includes recommended space allotted for a one to four foot border around each piece of equipment and a four foot or seven foot olympic/power bar where appropriate.

sleds and Smith machines which could easily be classified as machines because they do restrict movement and do not require the balancing elements that are traditionally thought of with free weight equipment. These pieces of equipment do, however, require multi-joint movement and free weights to be loaded on to them. The plate loaded definition was used in this example to allow for the total poundage of olympic plates to be easily calculated. Another definition may be used in other situations.

All equipment should provide self-contained plate storage to save space and for safety. This means that each power rack, Smith machine, hip sled, and hip thruster must have a place for each olympic plate that is needed at that station. The number of olympic plates needed at each station are listed in Table 10. The total number of olympic plates and their combined poundage is listed in Table 11. All olympic plates must be machine finished to provide accurate weight and tighter fit on the bar.

Rubber bumper plates are needed at the self-contained power areas. Olympic style lifting which includes cleans, snatches and jerks will be performed at these areas and the rubberized plates are needed so they can fall to the floor without damaging the floor or the plates themselves. The data in Table 12 provides information on the olympic plates and their combined poundage. Two 55 pound, six 44

Table 10

Number of Olympic Plates at Each Free Weight Station

Equipment	100 Lbs.	45 Lbs.	25 Lbs.	10 Lbs.	5 Lbs.	2 1/2 Lbs.
Self Contained Power Areas (SCPA)	0	12	2	4	2	2
Smith Machines	0	10	2	4	2	2
Hip Thrusters	2	10	2	0	0	0
Hip Sleds	4	10	2	4	0	0

Table 11

Total Number of Olympic Plates and their Combined Poundage

Equipment	Number of Stations	Total 100 Lbs.	Total 45 Lbs.	Total 25 Lbs.	Total 10 Lbs.	Total 5 Lbs.	Total 2 1/2 Lbs.
Self-Contained Power Areas (SCPA)	15	0	180	30	60	30	30
Smith Machine	2	0	20	4	8	4	4
Hip Thruster	2	4	20	4	0	0	0
Hip Sled	4	16	40	8	16	0	0
Auxiliary Area	1	0	10	10	20	10	10
	Totals	20	270	56	104	44	44
Total Poundage		2,000	2,150	1,400	1,040	220	110

Total Olympic Weight Poundage 16,920

Table 12

Rubber Bumper Plates

Plates	Number Needed At Each SCPA	Number of Stations	Total	Poundage
55 LBS. (25 KG)	2	15	30	1,650
44 LBS. (20 KG)	6	15	90	3,960
33 LBS. (15 KG)	2	15	30	990
22 LBS. (10 KG)	2	15	30	660
		Total Poundage		7,260

pound, two 33 pound, and two 22 pound rubber bumper plates are needed at each SCPA. A total of 7,260 pounds of rubber bumper plates are needed for 15 SCPA's.

Free weight accessories, pieces that either do not affect the square footage of the area or that have already been figured into the square footage, are listed in Table 13. Olympic bars are different than power bars and are needed at each self-contained power area. Pauletto (1991) stated:

> The power bar is thicker and does not flex as easily as an olympic bar. It is made to bench, squat and deadlift heavy loads. Olympic bars should be flexible but still have a very high tensile strength. Because the olympic bar is more flexible it is best for use in exercises on the platform (power cleans, snatches, jerks) (p. 17).

Self-contained power areas (SCPA's) are multi-purpose areas that can be used for benching, incline benching, behind the neck pressing, squatting, cleaning and pressing. Pullups and dumbbell work can also be performed. The area consists of a power rack mounted on top of a platform and an adjustable bench which can be used from zero degrees to 90 degrees. A power bar, olympic bar and curl bar are contained at each SCPA. A double tiered dumbbell rack is also placed near each area. Kroll (1991a) stated "The

Table 13

Total Number of Free Weight Accessories

Power Bars	15
Olympic Bars	15
Curl Bars	20
Dumbbells, 5 to 150 LBS. (5 pound increments)	10 sets
2 1/2 LBS. Olympic Collars	40
Chalk Buckets	7
Platform Weight Racks	21
Belts	10 small
	20 medium
	20 large
	20 extra large

concept of the 'self-contained power area' (SCPA) is an innovation created for the explicit purpose of saving floor space" (p. 54). Athletes can save time with the use of these self-contained power areas because they will not need to relocate to perform the variety of exercises prescribed for them. LeDuc and Perkins (1988) stated "We feel that the 16 olympic platforms are highlights of our facility because at these stations we are able to stress total body movements as well as dynamic movements" (p. 43). Kroll (1987) stated:

> In order to most efficiently and effectively utilize floor space and provide the maximum number of free weight stations, the modular system of self-contained power areas was employed. These are similar to those in the U.C.L.A. weight room (p. 29).

The U.C.L.A. facility has a total of 15 self-contained power areas. Several other schools are using variations of self-contained power areas. Two of these schools are Carson Newman College and Liberty University. The Head Strength Coach at The University of Virginia said that if he had one thing to do over regarding his facility, he would employ the self-contained power area concept used at U.C.L.A. (J. Gamble, personal communication, October 6, 1992).

Platforms are used to perform power cleans, snatches, presses, jerks and other olympic style lifts which are practiced by athletes in an effort to increase their power

out-put. Platforms are usually 3" to 6" high and anywhere from 5' x 8' to 10' x 14'. Average platform dimensions are 3" high and 8' x 8'. McClure and Borden (1991) stated "The basic concept of the surface design is to integrate a solid structure of footing, but there should be enough vertical force yield to protect the joints of the lifter during high-impact contact with the surface" (p. 30). Safety is enhanced by the platform being slightly raised off of the floor. The raised platform keeps other athletes from walking into a moving olympic or power bar as a lifter performs cleans, presses or squats on the platform. The platforms for the SCPA are to have a wooden center piece 4' x 12' with two rubber mats on each side measuring 2' x 12'. The 12' long platforms will allow an area 4' long for an athlete to perform squats in the 4' x 4' power rack while still providing an area 8' long for other lifts. This provides "an area where the strength athlete could practice cleans and jerks as separate exercises and maintain the power racks for squatting" (McClure and Borden, 1991, p. 30). The platforms are to be 3" in height.

Power racks should be 4' x 4' and 9' high. A pull-up bar should be mounted across the top. The rack should be adjustable to accommodate athletes ranging in height from 4'10" to 7'4". Each power rack must have foot holders so that it rests solidly on the floor. It may need to be

bolted to the platform for extra security.

Smith machines should be no less than 4' x 7' and 8' high. There should be safety lock hooks that rotate to engage in at least twelve positions, preferably every six inches. Linear bearings should be used to provide smooth movement. Height adjustments should be the same as the power racks.

Hip sleds must have a 45 degree angle and be able to accommodate athletes ranging in height from 4'10" to 7'4". As with Smith machines, linear bearing should be used. They must be capable of holding at least twenty eight 45 pound plates on the carriage for a total of 1260 pounds excluding the weight of the carriage. The carriage must have a platform no smaller than 2' wide and 3' long to allow for a variety of foot positions. The hip sleds must also have the capability of converting to allow athletes to perform hack squats by replacing the platform with a padded shoulder brace. The platform should be able to be relocated so the athlete can stand on it while performing hack squats.

Hip thrusters, to include all plate loaded machines designed to enhance the power in an athletes hips, must also have the capability of adjusting to accommodate athletes ranging in height from 4'10" to 7'4" Some common brand names for these pieces of equipment are Wynmore's "linebuster" and Powernetic's "the bear" and "the attacker".

These pieces of equipment vary in sizes and shapes and should be evaluated by coaches for their preference.

Kroll (1988) recommended that exercise equipment meet the following workmanship and material specifications:

1.	Frames	7 to 11 gauge steel tubing
2.	Round stock in pivot joint	3/4" to 1"
3.	Pad boards	3/4" plywood or 2" lumber
4.	Frames	electro-welded by arc or MIG weld
5.	Welds	ground smooth
6.	Upholstery	top grade naugahyde
7.	Padding	top grade high density foam rubber (pp. 11 and 12).

The author of this project further recommends:

1. The uprights for benches and incline benches should be adjustable U-supports, not pegs.
2. The equipment is powder coated, not just sprayed with paint.
3. The upholstery is sewn with double stitching.
4. Plastic chip and wear guards are placed along all points that the bar will come in contact with the equipment.
5. Rubberized padding should be placed on the bottom of all

adjustable benches to protect the floor and platform surfaces.

6. Adjustable benches are to be 12" wide.

Dimensions. The dimensions of the equipment, number of pieces of equipment, borders around the equipment, and desired walkways determine how many square feet will be necessary for each area. The free weight area must be large enough to accommodate the equipment listed in Table 9. This equipment has been selected by the author of this project in an effort to use the space available, the example of 8,000 square feet, in the most efficient way possible.

Fifteen SCPA's are to be contained in the free weight area. Each SCPA will need approximately 171 square feet. Kroll (1991a) stated "The SCPA's total area, including the between-area space, is 171 square feet, and it can accommodate four persons" (p. 55). It is necessary to have 15 of these areas to accommodate a total of 60 athletes, half of a football team, and provide them the option of performing exercises in a particular order. The total square footage of the SCPA's is 2,565 as seen in Table 9.

Two Smith machines are contained in the free weight area. These machines are plate loaded and will each require a space no less than 6' by 10' or 60 square feet.

Two hip thrusters and four hip sleds, each requiring a space approximately 8' by 10' or 80 square feet, are also to

be contained in the free weight area. These six pieces of equipment should be placed together in one area near the SCPA's because they require multi-joint movement and are plate loaded.

Eight double tiered dumbbell racks 2' by 10', are to be placed between the SCPA's. A 2' border is added to allow for extra walking space in front of each dumbbell rack. Therefore, each dumbbell rack would have an area no less than 4' by 10' or 40 square feet. Two additional double tiered dumbbell racks are to be placed in the auxiliary area. These racks are to be the same dimensions as the other eight and will be used to perform exercises away from the SCPA's.

Three auxiliary seats requiring no less than 24 square feet each, two adjustable benches requiring no less than 42 square feet each and three weight racks requiring no less than 12 square feet each make up the remainder of the free weight area. These pieces of equipment will all be contained in the auxiliary free weight area which will be used by athletes wishing to supplement their machine workouts with a few free weight exercises.

The dimensions for the free weight area total 5,037 square feet which includes four walkways 4' by 80' or 320 square feet each. Borders around each piece of equipment have also been included.

Flooring. The supporting floor of the strength and conditioning facility should be "made of reinforced concrete to support the heavy load of equipment" (Pauletto, 1991, p. 7). It is also important that the strength and conditioning facility be located on the first floor to lessen or eliminate noise that could disrupt others in the same building.

The free weight area should have a fixed rubberized floor. Pauletto (1991) stated "Rubber keeps feet from slipping and protects the floor if weights are dropped" (p. 7). Moveable rubber floors, interlocking rubber tiles fitted side by side, can collect dirt and mildew between the cracks. Fixed rubber floors are usually more sanitary because they are easier to clean (Kroll, 1990b). The author of this project prefers a fixed poured rubber floor for the free weight area. This type of floor insures safety and easy cleaning. School colors may also be ordered for aesthetic reasons.

It may be wise to place large rubber mats or a small section of moveable rubber flooring on top of the fixed rubber floor in the auxiliary area where weights may be dropped frequently. The addition of rubber mats should help protect the fixed floor and allow floor repairs in heavily used areas. The platforms at the self-contained power areas will protect the fixed floor in the other free weight area.

Machine Area

Justifications. Machines are needed in the strength and conditioning facility for a variety of reasons. Machines can be used for in-season circuit training. They offer easy selection of resistance which requires less time for adjustments when compared to free weights. Machines provide resistance to isolated muscles and muscle groups. The resistance provided by machines is evenly distributed through the complete range of motion. Evenly distributed resistance keeps tension on the muscles or muscle groups in a manner which is difficult, if not impossible in some instances, to duplicate with free weights.

Machines are easy for the beginner because there are no balancing elements involved and they do not require someone to provide assistance if the weight becomes too heavy or if the lifter loses his or her balance. Injured athletes may not be able to perform exercises with barbells but can perform similar exercises with machines. Pauletto (1991) stated:

> Machines are especially useful when your athlete has an injury and you want him or her to continue strength training. For example, an athlete with an ankle injury cannot do squats but can still train the legs by doing leg curls and leg extensions with machines (p. 21).

Machines typically require less space than free weight equipment and they are considered safer due to the fact that there are no loose weights or bars to drop. Machines in the the strength and conditioning facility offer the athlete the opportunity to supplement his or her free weight training.

Equipment. The definition used for machines in this project is all exercise equipment that is not plate loaded. Kroll (1990a) stated "Numerous brands of equipment utilize water pressure, air pressure, springs, rubber bands, surgical tubing, hydraulic pressure and electromagnetic devices to create resistance for strength training exercises" (p. 57). Other machines use selectorized weight stacks for resistance. The selectorized equipment, such as Nautilus, Polaris, and Universal, are recommended by the author of this project for the NCAA Division I weight room environment. These types of machines require low maintenance, are easy to learn and use and do not require extra pieces such as compressors or computers. In Table 14 there is a list of the lower body machines and the square footage for each piece of equipment. In Table 15 there is a list of the upper body machines and the square footage for each piece of equipment. The total square footage for each of these areas is also included in these two tables.

The machines which appear in these tables were chosen by the author of this project in an effort to accommodate

Table 14

Breakdown of Lower Body Machine Area Square Footage

Equipment	Number	Approximate Sq. Footage Needed for Each Piece	Total Sq. Feet
Leg Extension	2	42	84
Leg Curl (lying)	2	42	84
Calf Raise	2	42	84
Multi-Hip	2	42	84
Jumper	2	42	84
Abduction/ Adduction	1	42	42
Glut/Ham	4	42	168
Standing Leg Curl	2	30	60
Approximate Lower Body Machine Areas			690

NOTE. Approximate square footage for each piece includes a one foot border around machines

Table 15

Breakdown of Upper Body Machine Area Square Footage

Equipment	Number	Approximate Sq. Footage Needed for Each Piece	Total Sq. Feet
Multipurpose Exerciser	1	42	42
Neck	4	30	120
Rotary Shoulder	2	42	84
Rotary Torso	2	42	84
Cable Crossover	2	42	84
Dip/Pullup Rack	1	42	42
Lat Pulldown	5	42	210
Cable Row	2	42	42
Abdominal	2	42	42
Forearm/Grip	1	30	30
Low Back	1	42	42
Pullover	1	42	42
Tricep	1	42	42
Bicep	1	42	42
Chest	1	42	42
Shoulder	1	42	42
Abdominal Board	2	42	84
Approximate Upper Body Machine Area			1,116

the athletes participating in the 18 sports previously defined. Each piece of equipment chosen should strengthen an area of the body used in some or all of the 18 sports. The author of this project relied on his years of experience and the information gathered from each of the 10 schools visited to make these selections.

The selectorized machines should have a cover over the weight stacks to keep the working parts clean and free of dust. This cover will also keep athletes from putting their hands near the weight stacks. Rubberized divider plates should be placed between all metal plates to keep the metal plates from breaking and to cut down on noise.

The decision to purchase machines using chains, straps or cables must be made by each coach. The author of this project prefers nylon coated aircraft cable and fiberglass pulleys for smooth and quiet movement. Specifications for the frames, padding, upholstery, paint, and welding are the same as for the free weight equipment.

The machines must be able to adjust to accommodate athletes with a wide range of heights. Moran (1988) stated "The equipment produced by Superior Gym Equipment is adjustable for a 4'10" person to the 6'8" athlete without sacrificing function or movement" (p. 32). Many Division I schools have athletes as tall as seven feet or more and this factor may need to be considered.

Another special feature is to have weight stacks with more plates than the standard equipment. An example of this would be to have lat pulldown machines with 300 pound weight stacks instead of a more standard 250 pound weight stack. This special feature is necessary to accommodate football players and other athletes who are capable of easily performing the prescribed number of repetitions with the entire stack on certain machines. Selectorized equipment can offer odd or even increments to allow more choices in weight selection (D. Redding, personal communication, October 8, 1992). An example is having two lat pulldown machines. One would have odd numbers from five to 305 pounds and the other would have even number plates from 10 to 300 pounds. The alternating of odd and even plates on machines will provide the athletes with a smoother progression in increasing their strength.

Dimensions. Kroll (1991a) stated a "space of 6 feet by 7 feet or 42 square feet is a predictable average floor space to allot for a selectorized machine" (p. 54). This average includes an allowance for a one foot border around each machine. Kroll (1991a) stated "The minimum size of a strength machine is approximately 3 feet by 3 feet or 3 feet by 4 feet for a grip or neck machine or a free standing tricep pushdown pulley" (p. 52). Adding the one foot border, the space needed for a neck or grip machine is five

feet by six feet or 30 square feet. This same space would also be needed for a free standing leg curl machine. These approximations are used in Tables 14 and 15 to calculate the total square footage needed for the lower and upper body machine areas.

The total space required for the lower body machine area was 690 square feet as seen in Table 14. The total space required for the upper body machine area is 1,116 square feet as seen in Table 15.

The number of each piece of equipment was determined according to projected needs of the previously mentioned 18 sports. The pieces of equipment with no duplicates found in Tables 14 and 15 are to be part of a total body circuit. Other selected equipment will join these machines to complete the circuit. The pieces of equipment with one duplicate, two pieces total, were considered specialty machines with no acceptable way to perform their isolation movement with free weight equipment. Two pieces of each of these machines was determined as necessary to expedite the athletes training. The neck, lat pulldown, and glut/ham machines are pieces of equipment which also strengthen muscles crucial to an athlete's performance. There are four neck and four glut/ham machines in this area to accommodate the 40 to 60 football players expected to be in the room at the same time. The five lat pulldown machines will also be

used at this time to accommodate the heavy linemen and other athletes that are not capable of performing pull-ups due to their body weight.

In Table 16 information is provided on the total square footage of the machine area. The total space needed for this area, including walkways, is 2,446 square feet.

The data found in Table 17 shows a comparison of the desired square footage and the estimated square footage. There was a difference of 517 square feet which will be used for entry ways, areas around water fountains and for the records and viewing area.

Flooring. An anti-bacterial spike resistant carpet will be used in the machine area for aesthetic and sanitary reasons. Pauletto (1991) stated "if you use carpet choose a short-pile industrial grade. It is easier to clean than a higher pile and safer because it does not grab the soles of the shoes" (p. 7). The University of Virginia has anti-bacterial carpet over the entire floor of their strength and conditioning facility and the Head Strength Coach is very pleased with it (J. Gamble, personal communication, October 6, 1922). Kroll (1990b) stated "It is generally accepted that carpet presents the best appearance. Therefore it is sometimes advisable to use a combination of carpet and rubberized surfaces." (p. 70). Kroll (1990b) also stated:

Table 16

Total Machine Area Square Footage

	Square Feet
Approximate lower body machine area square footage	690
Approximate upper body machine area square footage	1,116
Approximate total machine area square footage	1,806
Walkways (two, 4' x 80' each)	640
Total square footage	2,446

Table 17

Square Footage Comparison

Desired free weight area	5,600 sq. ft.
Estimated free weight area	- 5,037 sq. ft.
Difference	563 sq. ft.
Desired machine area	2,400 sq. ft.
Estimated machine area	- 2,446 sq. ft.
Difference	- 46 sq. ft.
Desired Total	8,000 sq. ft.
Estimated Total	7,483 sq. ft.
Extra	517 sq. ft.

> In areas where free weights are not used, it may be desirable to install carpet. Heavy duty industrial carpet or a product especially designed for this purpose are recommended. There are also underlay materials that can be used under carpet in areas containing selectorized machines (p. 70).

Using different colors for the flooring in the free weight and machine areas can add to the aesthetics of the facility. An example would be an orange poured rubber floor in the free weight area, similar to that in the facility at The University of Tennessee, and a maroon carpet in the machine area. This type of color combination will not only add to the attractiveness of the facility but also will show off the school's colors.

Records and Viewing Area

Justification. Records boards provide coaches with a means to reward and acknowledge athletes for superior accomplishments. They serve as motivational tools because they provide a challenge to other athletes. Breaking a record can become a goal and in their attempt to break the record, the athletes will push themselves closer to their true potential.

Records and viewing areas can be used to help with recruiting and also to get information to athletes through the use of bulletin and chalk boards. It is necessary to

set aside space where people can stand and observe records boards, bulletin boards, and chalk boards without being in the way of the exercise areas.

Equipment. Seven 3' by 5' magnetic records boards are needed for this area. These boards will list the all time best records in the 40 yard dash, 300 yard shuttle, vertical jump, broad jump, power or hang clean, back squat and bench press. Other record boards may be added as needed.

Other equipment needed for this area include two 4' by 8' chalk boards, four 4' by 8' bulletin boards, one 10' by 2' by 6' book cabinet, two 6' tall coat racks, one standard sized file cabinet and one 2' by 2' by 4' trophy case.

Dimensions. The records and viewing area should be large enough to contain the previously mentioned equipment and still be able to comfortably accommodate small groups of at least eight observers at any one time. This is a normal size group of visitors who would tour a strength and conditioning facility on a recruiting trip. Each observer will require approximately nine square feet of standing space. The square footage for the entryway and records board area should be 120 and 72 square feet respectively (Kroll, 1991a, p. 58). The combination of these two areas equals 192 square feet.

The information in Table 17 on square footage comparison shows an extra 517 square feet not used by either

the free weight or machine area. This extra 517 square feet is what is left of the 8,000 square feet originally allocated for the mandatory areas. The area which can be used for the book cabinet, file cabinet, coat racks and trophy case can be calculated by taking the entryway and records board square footage from the extra 517 square feet. An area of 325 square feet is left for this equipment.

These calculations have been made in an effort to keep the total square footage of the free weight machine and records and viewing areas under 8,000 and should be considered a minimum. Additional space for these areas may be desired and will therefore require a facility larger than 8,000 square feet.

The records boards are to be placed on the same wall as the main entrance. They are to be 9' from the floor and extend up to the 14' ceiling. The chalk and bulletin boards are to be placed near the office. The book cabinets, file cabinet, coat racks and trophy case are to be placed near the main entrance but should not obstruct traffic coming in and out of the doorway.

Flooring. The flooring in this area is to be anti-bacterial carpet. This is the same flooring found in the machine area.

Office Areas

Justifications. Strength coaches are easily accessible to athletes when their offices are in the weightroom. The strength coach can hold motivational, disciplinary and teaching conversations with athletes in a private atmosphere without relocating. Training materials, records and other information can be kept in the office for quick reference.

Equipment. The typical equipment found in any office area needs to be included such as desks, chairs, file cabinets, shelves, telephone and computer. A large interior window should be placed in the office so the coaches can have a clear view of the weightroom.

Dimensions. First it must be determined if one or more offices are to be placed in the area. If there is more than one strength and conditioning facility at the school there may be one office at each facility. If the facility is the only strength and conditioning facility for the athletes there may be justifications for two or more separate offices in this one facility. The head strength coach and assistant or assistants may all need their own offices. This would be the case particularly if the duties with the sports were divided among the coaches.

The recommendations of this project are to have two strength and conditioning facilities. There is to be one 300 square foot office next to the main entrance to each of

these facilities. The office at the primary facility will accommodate the head strength coach. The office at the second facility will accommodate the assistants. The office area is not included in the total square footage of the mandatory areas.

Flooring. The same anti-bacterial carpet used in the machine area will be used here as well. Sweat from athletes and others will still be a factor in this area creating the need for this type of flooring.

Storage Area

Justification. One of the most common complaints from the strength coaches interviewed for this project was that they did not have enough storage space (S. Falcone, personal communication, October 22, 1992), (W. Hicks, personal communication, October 22, 1992), (D. Williams, personal communication, November 10, 1992), (M. Gentry, personal communication, October 21, 1992). Pauletto (1991) stated:

> It is important to have a storage room in or near the weight room. It should be large enough to store extra equipment so it is not left lying around the weight room. If it is large enough you can also use it as a place to repair equipment" (p. 10).

Equipment. Cleaning equipment such as brooms, mops, cleaners and rags should be kept in this area. Shelves and a work bench should also be provided. A complete tool kit

and first aid kit should also be stored in this area.

Dimensions. A storage area between 300 and 500 square feet should be adequate for the needs of the free weight and machine area. If equipment from other areas, such as hurdles, medicine balls and cones are to be stored in this area, the space should be between 500 and 700 square feet. The storage area is not included in the total square footage of the mandatory areas.

Flooring. The flooring for this area can be concrete to keep costs down. Carpet or rubber can also be used if preferred.

Optional Areas

Aerobic Machine Area

Justifications. There are many benefits of having an aerobic area within or near the strength and conditioning facility. Athletes can increase their physical work capacity and reduce fatigue through an increase in cardiovascular fitness. Cardiovascular fitness can enhance an athlete's performance (Astrand and Rodahl, 1970, p. 56). Athletes can increase their cardiovascular fitness through the use of aerobic machines. Aerobic machines allow coaches to monitor exercise intensity and test fitness levels of athletes without relocating to another facility or going outdoors. Athletes with injuries are provided a means to rehabilitate and/or work around their injuries through the

use of aerobic machines. Overweight athletes can use the machines under the watchful eyes of the strength and conditioning staff.

Equipment. The equipment needed for this area appears in Table 18 along with the approximate square footage needed for each piece of equipment. The equipment chosen will provide a variety of aerobic options for the athletes.

Dimensions. Kroll (1991a) stated:

> Aerobic equipment requires the following floor space estimates which include the between area spaces:
>
> Bikes . . . . . 24 square feet
>
> Stair Steppers . . . . . 24 square feet
>
> Skiers . . . . . 6 square feet
>
> Rowers . . . . . 40 square feet
>
> Treadmills . . . . . 45 square feet (p. 55).

Kroll's (1991a) recommendations have been used in Table 18 to determine the total square footage needed for the aerobic area. The climbers and upper body ergometer were estimated according to this author's experience with these types of equipment. The number of aerobic machines at The University of Virginia was used as a guide when determining how many machines were to be contained in the area. The total number of aerobic machines in The University of Virginia's strength and conditioning facility is 14. There are a total of 18 aerobic machines in the aerobic area included in this

Table 18

Aerobic Machine Area Square Footage

Equipment	Number	Approximate Sq. Feet Each Piece	Needed Total Sq. Feet
Stepper	5	24	120
Stationary Bike	5	24	120
Climber	5	6	30
Treadmill	2	45	90
Upper Body Ergometer (U.B.E.)	1	12	12
Approximate Equipment Square Footage			372
	Walkway 4' x 40' =		160
Approximate Total Square Footage			532

project. The addition of an upper body ergometer was made to provide athletes with lower body injures an opportunity to obtain cardiovascular conditioning.

Flooring. The flooring in this area can be either rubber or anti-bacterial carpet. Each piece of aerobic machine must have a plastic mat between it and the floor. The mat should be large enough to catch all sweat from the user and keep the floor underneath dry. These mats should be moveable for easy cleaning and disinfecting.

Sprint and Plyometric Area

Justification. A sprint and plyometric area will provide an indoor place for athletes to train their speed and explosiveness. Plyometric exercises include variations of bounding, jumping, and hopping. A major purpose of plyometric exercises is to heighten the excitability of the nervous system for improved reactive ability of the neuromuscular mechanism. Plyometrics help to link strength with speed (Chu, 1982, p. 20). Texas A&M has a two lane 40 yard track in their strength and conditioning facility. The University of Nebraska has an area in its' strength and conditioning facility 20 yards by 12 yards and the head strength coach indicated that this area should be 30 yards by 12 yards (B. Eply, personal communication, October 2, 1992).

Valuable time can be lost when athletes are relocating to a field house or gymnasium to perform speed and plyometric training. Strength coaches have an extremely limited time with their athletes each day and having this area in or very near the strength and conditioning facility is necessary to facilitate training.

Stretching can also be performed in the sprint and plyometric area. Careful thought must be given to determine the space needed for the drills and sprints to be performed in this area.

Equipment. The following equipment is needed in this area: four 16" tall boxes, four 20" tall boxes, four 24" tall boxes, two 30" tall boxes, two 36" tall boxes, two 40" tall boxes, twelve 9" tall cones, twelve 12" tall cones, twelve 15" tall cones, twelve 18"-30" tall adjustable hurdles, one each 6,8,10,25,30 pound medicine balls, three each 12,15,20 pound medicine balls, one medicine ball rack and 60 jump ropes. This equipment should be kept in a storage closet. Pads should be placed on the walls around the area for safety. These wall pads should be made of a nylon coated material and should be filled with 2" of bonded foam.

Dimensions. The suggested dimensions for this area are 15 yards by 30 yards or 4,050 square feet. Thirty yards in length provides an area where athletes can run 20 yard

sprints with an extra 10 yards for deceleration. Fifteen yards in width allows 10 athletes a lane 4.5 feet wide. An area this size will also allow 10 athletes to practice the 300 yard shuttle run.

The shuttle run is a common fitness test practiced in many strength and conditioning programs. In this test the athlete runs 25 yards and returns to the starting line a total of six times for a total of 300 yards. There will only be a deceleration area of five yards when this shuttle run is practiced. The pads on the walls should certainly be needed for this run.

Flooring. The flooring for this area is astro-turf. Football players and other athletes may need to become accustomed to this type of surface.

Stretching Area

Justifications. Stretching is a crucial part of an athletes' preparation. Wilmore (1982) states "Flexibility is a major importance to the athlete. It is presently believed that the flexible athlete not only is more proficient, but less prone to serious injury. Flexibility in the antagonistic muscles is important in preventing muscle injuries, particularly with rapid limb movement. Muscle pulls and joint injuries occur when the muscles and joints have poor or limited flexibility" (p. 103). If an

area is not provided for the sole purpose of stretching, many athletes may fail to stretch.

Equipment. Vinyl coated nylon mats that are tear-resistant and washable should be placed on the floor of the area. These mats should be filled with 1 1/2" thick polyethylene foam. Many companies offer these mats in a wide variety of colors and color combinations. School colors should be chosen when possible to add to the aesthetics of the area.

Two stretching trees should be placed in the area. These trees are to be between 6' wide and 6' tall. Cords are stretched from one end of the frame to the other end of the frame. These stretchable cords are placed approximately one foot apart and are attached to the frame. These stretching trees provide an athlete with the capability of performing a variety of stretches.

Dimensions. The stretching area should be large enough to safely accommodate 12 athletes and the two stretching trees. The teams with the lower numbers of participants, men's and women's tennis, have 12 athletes each. Kroll (1991) stated "Stretching/warm-up areas require approximately 7 feet by 7 feet or 49 square feet. The per person space allotment for both aerobic and stretching areas in one per area" (p. 55). The total square footage needed for 12 athletes and the two stretching trees is 686. This

minimum square footage will be used for later calculation of the total square footage needed for both the mandatory and optional areas together.

Sixty athletes, approximately half of a football squad, and the two stretching trees would need 3,038 square feet. It may be impractical to have an area this large for stretching in many facilities. Several of the schools visited used a locker room for stretching and this may be an option for some schools. The schools using their locker rooms for stretching include The University of Virginia, The University of Maryland, Georgia Tech and East Carolina University.

The stretching area should be located as far away from the free weight area as possible. Athletes training in the free weight area may accidentally drop weights or other objects. If the stretching area is placed too close to the free weight area, an athlete stretching may be injured by one of these weights or other objects. If the stretching area must be placed by the free weight area, it may be necessary to place a walkway between these areas to provide a buffer.

Flooring. The flooring underneath the mats in the area should be anti-bacterial carpet. This type of flooring may provide additional comfort for the athletes.

Video Area

Justifications. A video area can be used to motivate and educate athletes. Video tapes of past athletes training in the strength facility can be used to help motivate current athletes into developing better work habits. Motivational tapes showing feats of strength and success stories can be shown to athletes prior to their training sessions for inspiration. Tapes showing the proper form needed when performing certain exercises can be shown with the strength coach available for immediate reinforcement of this information. The strength coach can also hold training sessions and conferences with his staff in this room (J. Gamble, personal communication, October 6, 1992).

Equipment. The equipment needed in the area is as follows: one 24" television, one VCR, one video camera, one large table (suggested minimum 8' by 5'), eight to ten chairs, and one chalk board. Shelves, cabinets and a large window are also needed. The window is necessary to allow the coaches a clear view of the weightroom.

Dimensions. The video area should be large enough to accommodate between eight and 10 people and the previously mentioned equipment. There should be a minimum of 16 square feet allotted for each person. Eight people would require a minimum of 128 square feet. The equipment will require a minimum of 100 square feet and there should be walking space

provided in this area as well. The minimum size this area should be is 300 square feet.

Flooring. The flooring should be anti-bacterial carpet. This is the same flooring found in the machine, office, and records and viewing areas.

Locker Area

Justifications. A locker area may be used for the strength and conditioning staff to keep their personal belongings. This area would not necessarily require a shower, toilet, and sink. Coats, extra clothes and other personal items could be conveniently stored in the area and this would aid in preventing the coaches' offices from becoming cluttered. The strength and conditioning staff could still use the shower and other facilities in the main locker room. The area could also be used as a snack/lunch area.

Equipment. Six or more lockers, depending on the current and projected staff size, are needed for the area. Stools should be provided for each of the lockers. A coat rack, full size refrigerator and a table with four chairs are also possibilities for the area.

Dimensions. Lockers should be a minimum of 2' wide, 2' deep and 6' tall. Six lockers will require an area of 24 square feet. The coat rack will require an area of 16 square feet. The refrigerator will require an area of 15

square feet. The table and four chairs will require an area of 45 square feet. The minimum space required for these areas is 100 square feet. A 50 square foot walkway area is added to the locker areas to make the minimum space requirement for the area 150 square feet.

Flooring. Anti-bacterial carpet will be used in the area. Sweating from coaches will be a factor in the area creating the need for this type of flooring.

Rest Room Area

Justifications. Two small rest rooms, male and female, may be desired within the strength and conditioning facility. Pauletto (1991) stated "Rest rooms should also be located in or very close to the weight room. Such placement will discourage athletes from using rest room excuses to delay exercises and prolong workouts" (p. 10).

Equipment. Each of these rest rooms should contain one toilet, one sink, one paper dispenser, one soap dispenser, and one towel dispenser. The doors to the rest room should have the capability of being locked from the inside while a coach or athlete is using the facility.

Dimensions. Each rest room should be a minimum of 25 square feet. The rest rooms should be located next to each other for plumbing reasons. A water fountain should be located outside the rest rooms.

Flooring. The flooring for the rest room area should be vinyl tile for easy cleaning. The floor should slope downward to a drain placed in the middle of the floor. The drain is to prevent flooding in the event of plumbing problems.

Total Square Footage

The minimum recommended square footage for a strength and conditioning facility to meet the needs of an NCAA Division I program with 18 sports that includes football can be found by totaling the square footage of each mandatory area. This information appears in Table 19. The minimum recommendation for the mandatory areas is 8,600 square feet.

Optional areas can be added to the total square footage of the primary facility. Certain areas may be seen as unnecessary or cost prohibitive. These areas can be left out of the total square footage calculation. When all optional areas are included the recommended total square footage for the optional areas is 5,768. The total recommended square footage for the primary facility, including the mandatory and optional areas combined, is 14,368. This information can also be found in Table 19.

Essentials

Ceiling Height

Pauletto (1991) stated "The ceiling should be high enough to clear the equipment (suggested minimum: 11 feet).

Table 19

Total Square Footage

Mandatory Areas	Square Footage
Free Weight Area	5,037
Machine Area	2,446
Records and Viewing Area	517
Office Area	300
Storage Area	300
Total Mandatory Area	8,600
Optional Areas	
Aerobic Machine Area	532
Sprint and Pylometric Area	4,050
Stretching Area	686
Video Area	300
Locker Area	150
Rest Room Area	50
Total Optional Areas	5,768
Total Square Footage	14,368

A higher ceiling gives the room a more open feel" (p. 7). Kroll (1991b) stated:

> The recommended ceiling height for a strength training facility is from 12 to 14 feet. Consider that an individual who is seven feet tall, or more, should have enough room to life an olympic barbell overhead with some room to spare. It's also necessary to allow for the thickness of a lifting platform and whatever flooring might exist. Consideration also needs to be given for whatever might be hanging from the ceiling (p. 53).

A ceiling height of 14' is needed for this project to allow for the records boards area. Another reason for having a 14' ceiling is for the testing of vertical jumps.

The architect and the mechanical engineer should work together to insure that enough room is provided above the designated ceiling height for mechanical items. Kroll (1991b) stated "The error commonly made is the failure to allow space at the top of the room for mechanical items such as heating and cooling ducts, light fixtures and other wiring" (p. 53). The problem of not properly planning the placement of mechanical items can be seen at Liberty University (D. Williams, personal communication, November 10, 1992).

Windows

Pauletto (1991) stated:

> Windows let in natural light and fresh air, but you must make sure the room is arranged so that there is no direct sunlight on the athletes. Trainees will be disturbed by the sun shining in their faces while they perform exercises (p. 8).

Kroll (1991b) stated:

> Place windows at a height so that objects at floor level cannot strike them (a minimum of 20 inches from the floor). Arrange the floor plan so that spotters or exercisers are not encouraged, or likely to be in a position, to lean or fall against a window. An excellent place for cardiovascular machines is next to or facing the windows (p. 54).

The windows for this project are to meet the following specifications. All windows are to be placed a minimum of 7' from the floor, have the capability of being opened or closed and be made of blocked glass to help reduce glare. All the windows in The University of Virginia's strength facility and some of the windows at The University of Tennessee are made of blocked glass.

Temperature and Humidity Control

The temperature of the strength and conditioning facility should not be dependent on the temperature control

for the rest of the building. Kroll (1991b) stated:

> The weightroom should be kept at a constant temperature between 72 and 78 degrees F. A zone heating and cooling system is preferable because the weightroom temperature can vary greatly depending upon how many people are exercising at once (p. 55).

The ability to control the humidity level is important for safety and the maintenance of equipment. Kroll (1991b) stated "The build-up of humidity can cause equipment and floors to become slick, creating a safety problem and erosion to metal equipment" (p. 55). Dehumidifiers may need to be used and the drainage systems they require should be planned for in the designing stages of the facility (Kroll, 1991b, p. 55).

Fresh Air Return System

The University of Virginia used a fresh air return system "for the obvious purpose of clearing out stale and humid air" (J. Gamble, 1991, p. 26). Kroll (1991b) stated "Ventilation systems should function at a minimum level of eight to 10 air exchanges per hour and an optimal level of 12 to 15 air exchanges per hour" (p. 55). Bruno Pauletto, Head Strength Coach at The University of Tennessee, stated that the strength facility needed to have three times the regular amount of air flow in an office building due to the

activities that take place in such a facility (B. Pauletto, personal communication, October 8, 1992).

The fresh air return system will also help to reduce the number of germs that collect in such an environment. Reducing the number of germs is important because athletes need to stay healthy in order to perform well.

Water Fountains

Providing water to athletes while they are training is essential for their performance and total well being. Water fountains should be placed in easily accessible areas so that they can be used without disrupting the traffic flow in the room. Kroll (1991b) stated "They (water fountains) should probably not be placed within the free weight areas of the room but rather near or at the room entrance" (p. 57).

A water fountain area will be placed at each of the three entrances. Each of these areas will have two identical water fountains three to four feet apart to prevent crowding and long lines.

Trash Cans

A minimum of seven 30 gallon trash cans are to be placed around the room. There will be one can at each entrance and the other cans will be spaced out around the room.

Mirrors

Mirrors are to be placed on the walls of the auxiliary free weight area and machine area. They are not to be placed on the walls near the self-contained power areas. Pauletto (1991d) stated:

> Use as many mirrors as you can but not in areas where they might disrupt the lifters. If you place mirrors near squats or platforms, athletes tend to watch themselves do the exercises instead of feeling the movements (p. 10).

Mirrors should be 20" off of the floor to keep 45 pound olympic plates, which measure 18" in diameter, from being leaned against them (Kroll, 1991b). The mirrors used are to be 8' tall and should be made of shatterproof glass. The mirrors will be placed side by side and cover the whole wall in each of the free weight and machine areas (Pauletto, 1991).

Entrances

The first consideration is to make the facility accessible to the handicapped. Ramps must be installed at entrances where stairs are needed and the doorway thresholds should be flat or beveled.

The entrances must have double doors and if it is necessary for a center post to be placed between the doors

it should be removable (Pauletto, 1991, p. 8). Kroll (1991b) stated: "Wide accessways are a part of this consideration. The 6-foot double doors don't do much good if the only way to get to them is through a 4-foot hallway, or a 3-foot doorway somewhere else" (p. 53).

There is to be one main entrance near the office and a minimum of two other entrances at the end of the walkways in the free weight and/or machine areas. One of the entrances must be at least six feet wide and eight feet tall to allow equipment to be moved in and out of the facility.

Utilities

Lighting. The strength and conditioning facility should have adequate lighting for aesthetics and safety. Kroll (1991b) stated:

> It is generally agreed that metal halide lighting, because of its intensity and white color-balanced light, is best. The problem of glare for those performing supine exercises again becomes a problem. This can be solved through the use of indirect lighting, with translucent screens or shades. In any case it's best if the weightroom is lit to the level of 75 to 100 foot-candles, which is generally brighter than that required for a classroom or office (p. 54).

The control switches for the lights should be located near the entrances. The lights themselves should be contained in

the ceiling and not hanging from the ceiling.

Electrical Outlets. The location of electrical outlets requires careful planning. Cardiovascular equipment, computers, stereo equipment, tools and cleaning appliances all require electricity. Some types of equipment will require 220-volt outlets instead of the usual 110-volts. The free weight and machine areas should have an outlet every 12 feet alternating between 110 and 220-volts. If an aerobic machine area is to be included, a minimum of twelve 220-volt outlets will be needed for this area.

Computers. The office should have adequate outlets for a computer, stereo and cleaning appliances. A minimum of one 220-volt outlet should be placed in the office area.

Intercom. An intercom system will be included to make announcements. This system will be connected with the stereo system so that the same speakers are used for each.

Telephones. Telephones are to be located in each office. Kroll (1991b) stated "Having a telephone within easy access is a safety necessity" (p. 57).

Recommendations

The following recommendations are made based on the information gathered from the 10 schools visited, a review of related literature and the experience of the author of this project.

1. Two facilities, one primary facility 8,000 to 15,000 square feet and a secondary facility 3,000 to 4,000 square feet, are needed to adequately serve the needs of an NCAA Division I school with 18 sports that includes football.
2. A free weight area, machine area, records and viewing area, office area and storage area should all be considered mandatory for each of the two facilities.
3. Optional areas for the primary facility include an aerobic area, sprint and plyometric area, stretching area, video area, locker area, and rest room area.
4. The concept of the self-contained power area is to be used in the primary facility.
5. Equipment costs, not building costs, should be cut first if finances become a problem. Equipment can always be upgraded or added later.

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Appendix A
Questionnaire

School Name _____

Date _____

1. How many sports does your athletic department currently have?

_____

How many of these sports use your facility/ facilities?

_____

2. Approximately how many athletes train in your facility/facilities?

_____

3. Do all athletes train in one facility?

Yes No

4. How many square feet is/are your facility/facilities?

_____
1st.

_____
2nd.

_____
3rd.

_____
School
Page 2

5. How many teams, other than football, train in your primary facility?

_____

Do they train 1) individually or as a 2) team.

Does more than one team train at the same time?

Yes No

Explain:

6. How many athletes do you feel that you can safely and effectively train in your primary facility at one time?

_____

7. Do you feel that future expansions will be necessary to accommodate your athletes?

Yes No

If yes, how many square feet?

_____

_____
School
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8. Did a strength and conditioning coach work in conjunction with the athletic directors when planning your facility?

Yes No

If yes to what extent?

_____ a) worked with architects as primary consultant
b) turned in a formal proposal to athletic directors
c) sat in on meetings with a planning committee
d) participated in informal conversation

9. What is the first suggestion you would make to someone building or expanding a facility?

10. How many of the following pieces of equipment do you have in your facility/facilities?

platforms	_____	_____	_____
squat racks	_____	_____	_____
leg presses	_____	_____	_____
benches	_____	_____	_____
inclines	_____	_____	_____
aerobic m.	_____	_____	_____
strength m.	_____	_____	_____
offices	_____	_____	_____
storage areas	_____	_____	_____
cond. areas	_____	_____	_____

_____
School
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11. How many square feet do you allocate for each of the following areas?

_____ free weights (benches, squat racks, platforms, etc...)

_____ strength and aerobic machines (bikes, steppers, nautilus, hammer, etc...)

_____ conditioning (plyometrics, shuttle, 40 yard dash, etc...)

_____ other (offices, storage, video, etc...)

12. If you were to expand an area or add a new area what area would you choose?

a) free weights _____
b) strength and aerobic machines _____
c) conditioning _____
d) other _____

13. If you had to reduce the size of another area to expand or put in a new area, which would you choose?

a) free weights _____
b) strength and aerobic machines _____
c) conditioning _____
d) other _____

14. What type of flooring do you have in each area?

1) carpet 2) rubber 3) wood
4) astroturf 5) other (specify _____)

a) free weights _____
b) strength machines _____
c) conditioning _____
d) aerobics machines _____
e) other _____

_____
School
Page 5

15. What equipment would you add or change if you had the opportunity?

16. Do you have any self contained power areas? (platforms, adjustable bench, squat rack, and bars all at one station)

Yes No

If so, how many and do you like them?

17. Comments