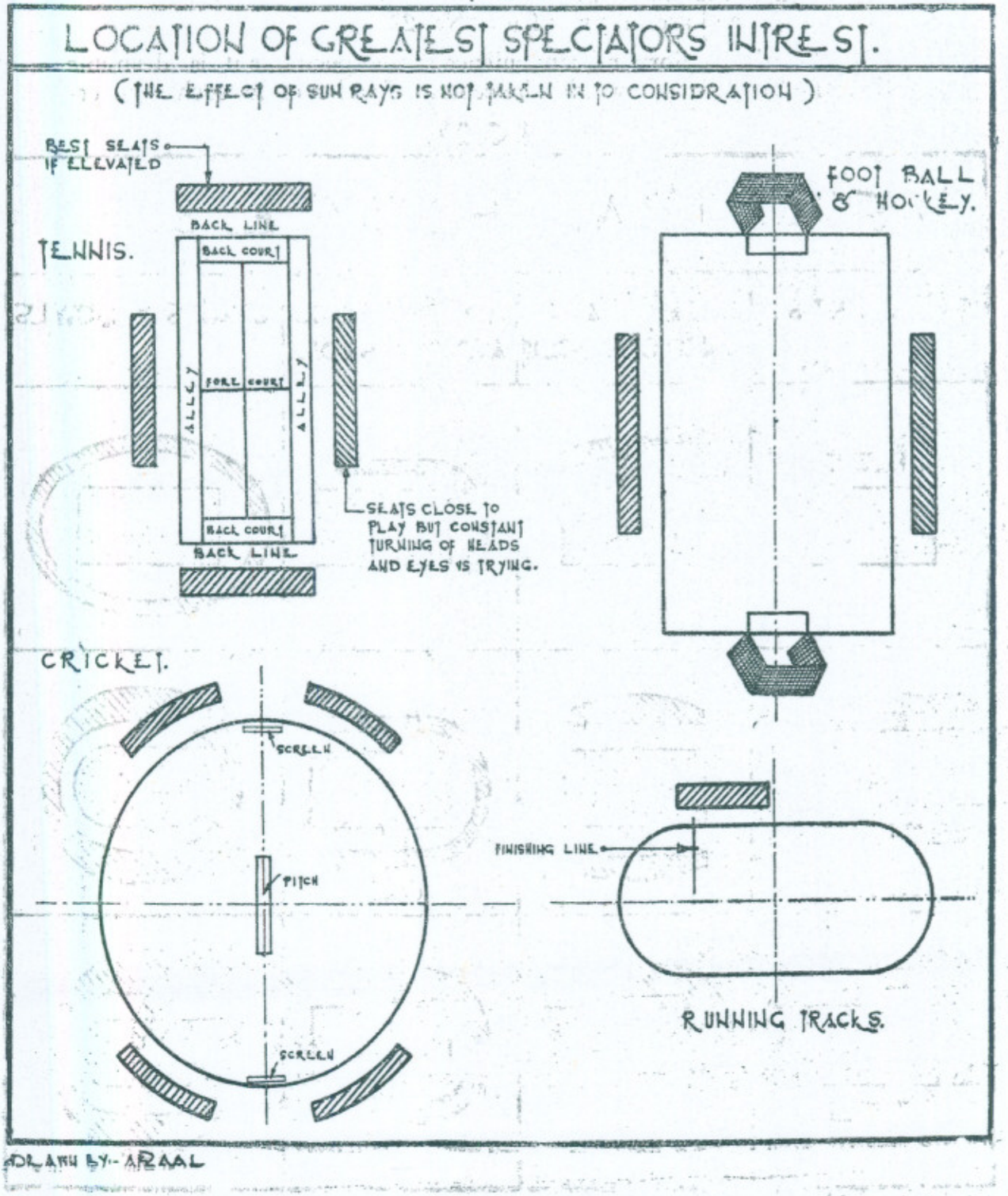
watch the flight of the ball is trying on the spectators. Seats at the back of the base line give the best view particularly if well elevated. For cricket the best seats are indicated in Figure 21 and for large crowds the stadium can form a complete circle.

FIG: 21.



The shapes usually adopted are

(a) Straights.

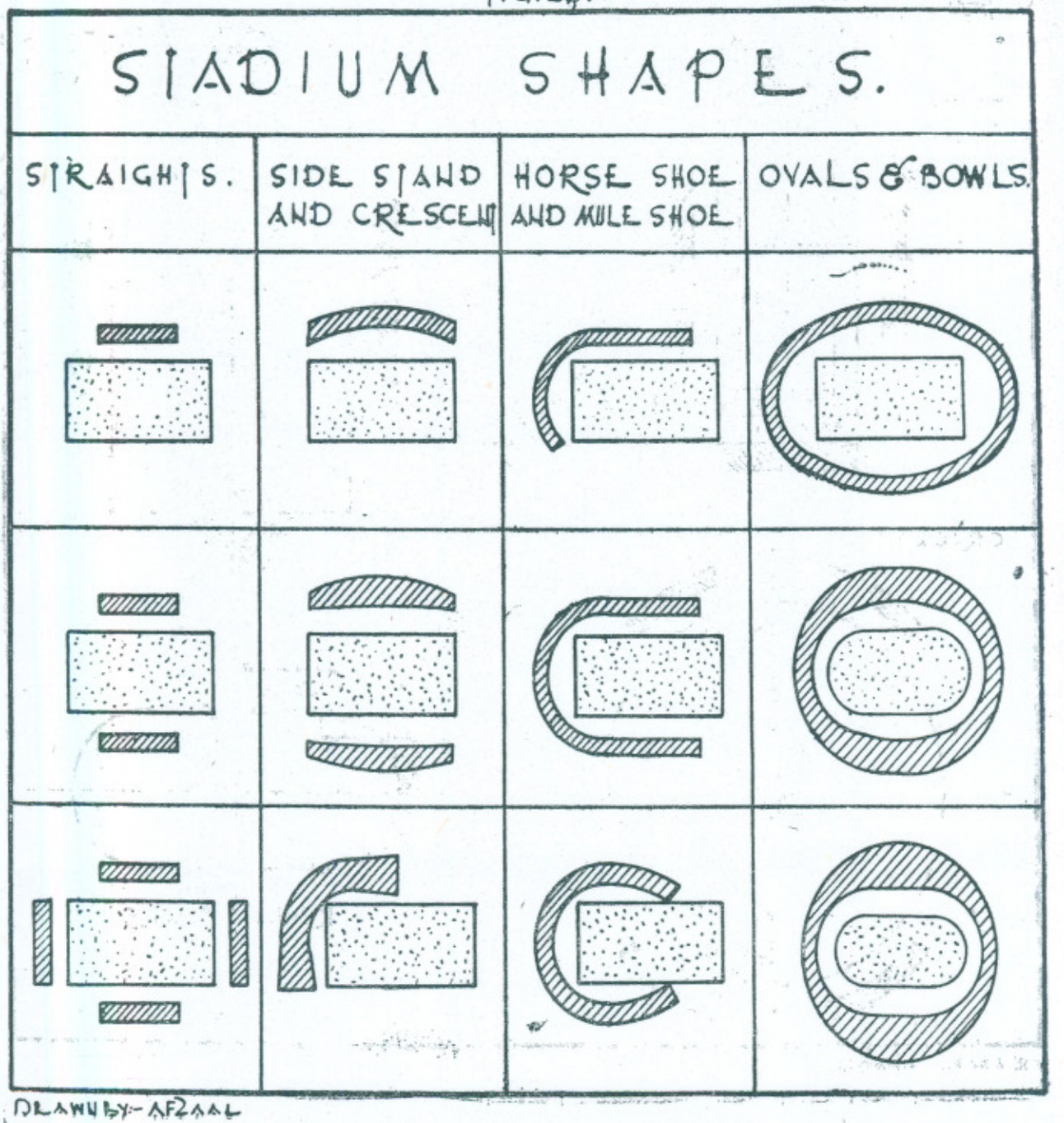
(b) Side stands and crescents.

(c) Horse shoes and mule shoes.

(d) Ovals and Bowls
and are shown in figure No. 22

For the comfort and convenience of the spectators it is desirable that the seats face towards the centre of action or in such a direc-

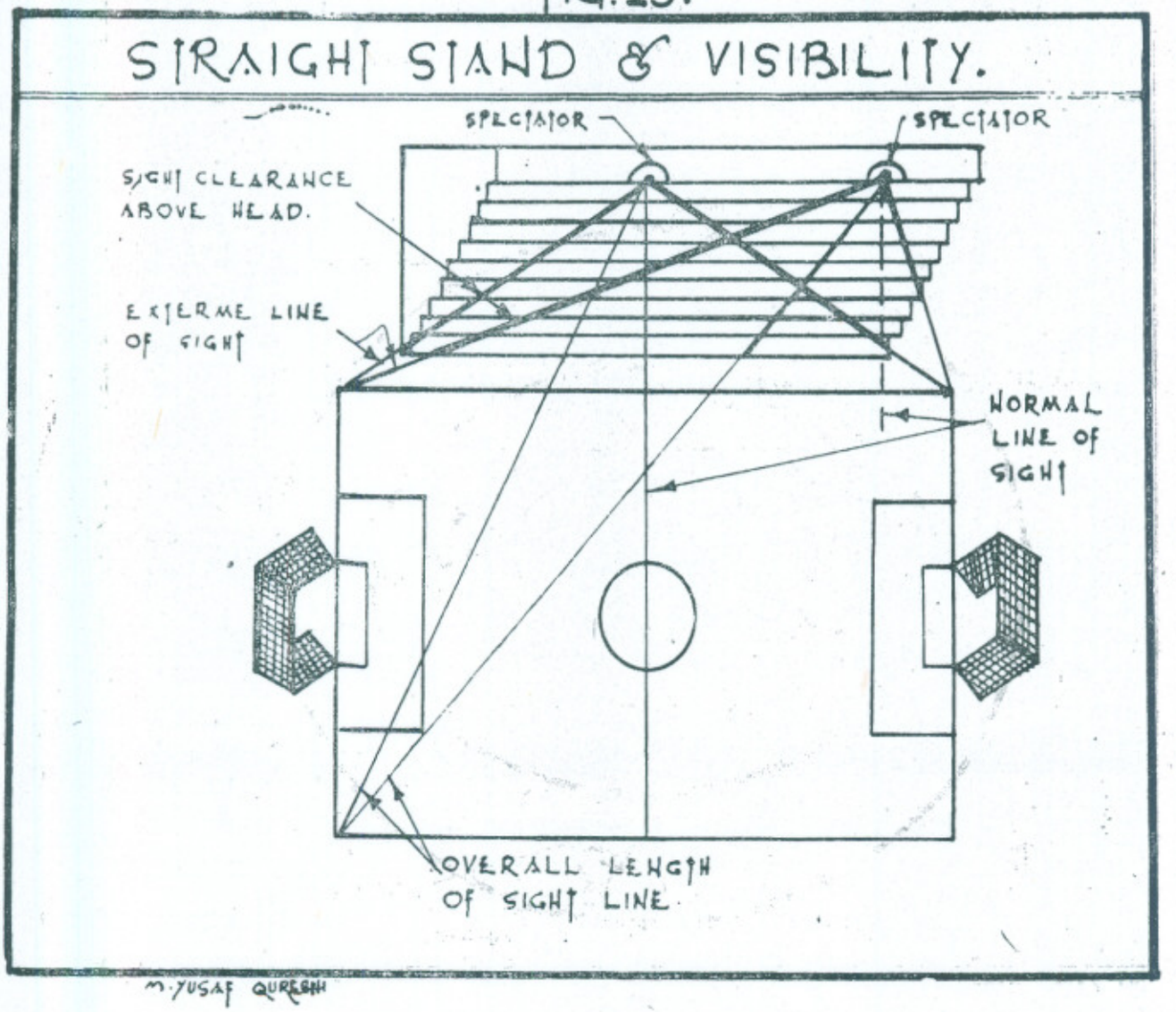
FIG: 22.



tion that the extremes of play may be observed by turning equally one way or the other. Ideally expressed the spectator should face so that his normal line of sight bisects the angle from his seat to the extreme limits of play. This depends on the sport or combination of sports involved. The result obtained expresses the designers attempt to assemble the greatest number of seats in the most favourable condition.

In foot ball, hockey or kabbadi exciting play may occur at any point and may move quickly from one end of the field to the other. The seat near the middle faces the centre of the play and views each goal line equally well. But a seat on a straight stand opposite the goal line faces one extreme end of the play and the view of the other goal increases the overall length of the sight line as well as the sight clearance line above the heads and hence becomes in-comfortable as shown in figure No. 23.

FIG: 23.



To overcome this difficulty elliptical shape is adopted. This is somewhat similar to the running track thus making it possible to build a combined stadium for foot ball hockey and track events. This also result in the heightened enjoyment of occasional altercations between the inebriated members of the audiences as practically all the seats become within the view range of the audience. The ellipse is usually modified with the employment of segments of circle to simplify construction. Geometrically a line normal to tangent on an ellipse at any point bisects the angle formed by the line drawn through focal points. The seats are placed normal to tangents as in Fig. 24 and give ideal view.

7. Future Extension.

Our Nation is becoming more and more sports minded and gatherings at the contests are increasing every year. During planning failure to

FIG: 24.

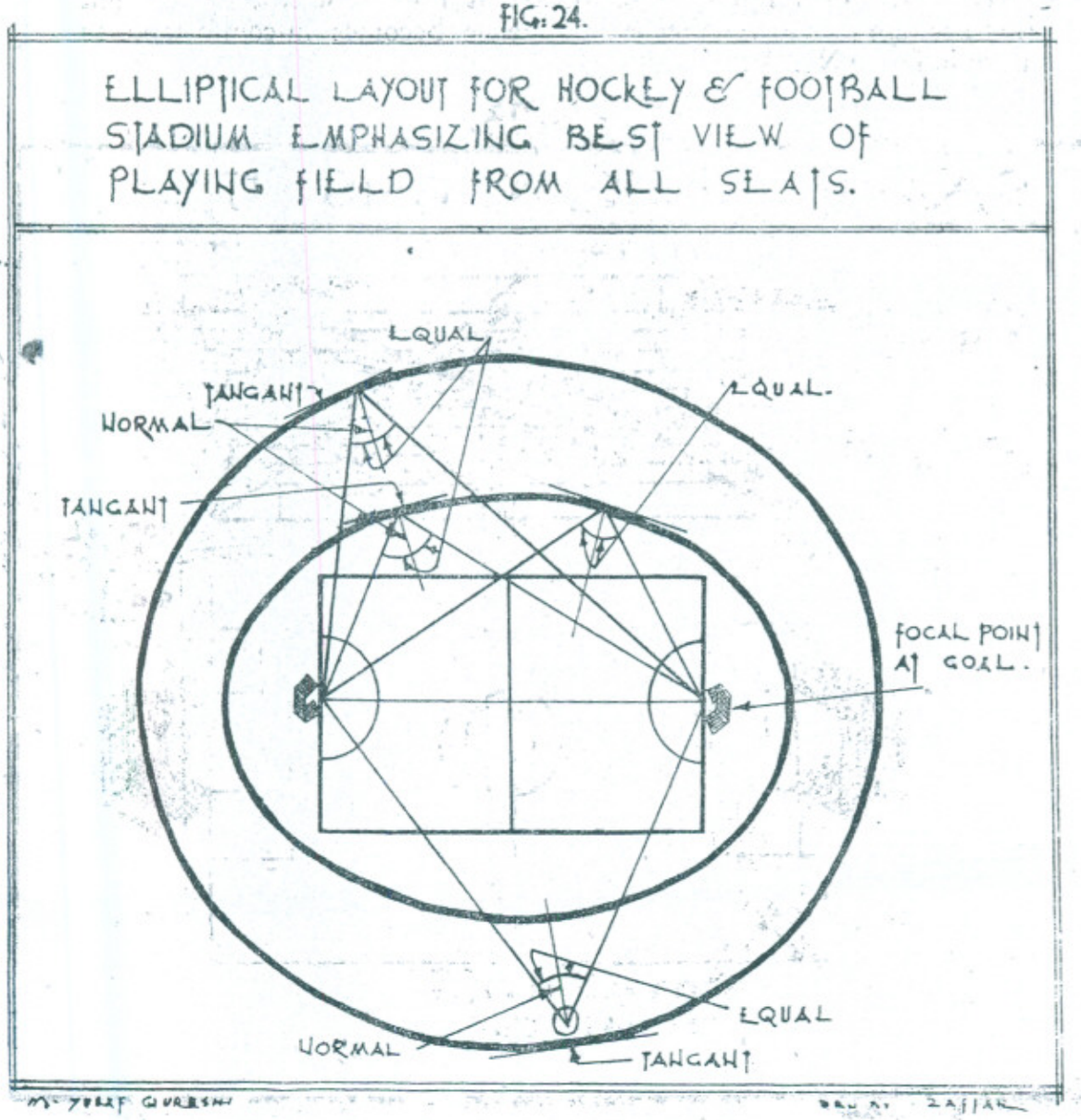
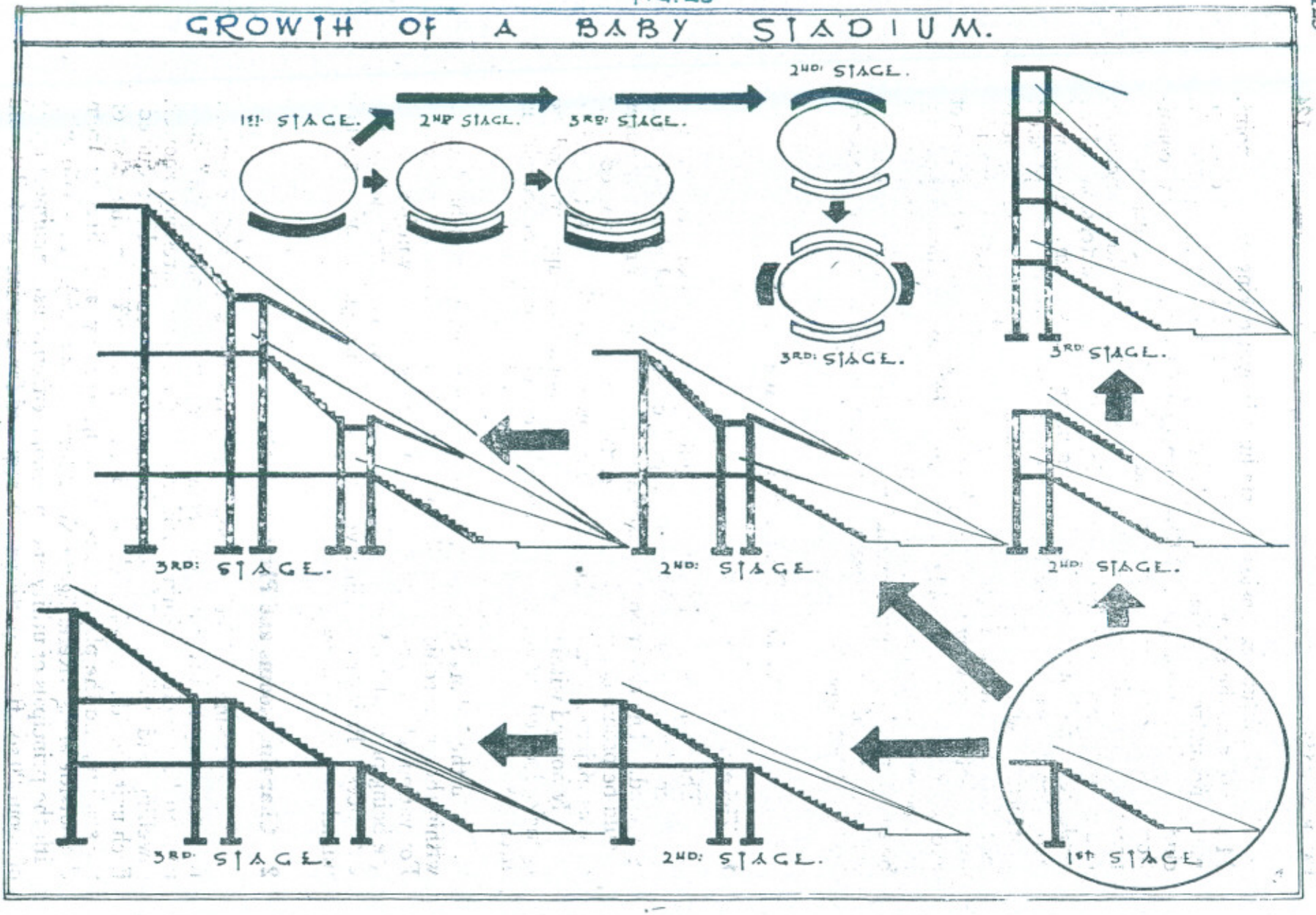


FIG: 25


GROWTH OF A BABY STADIUM.
1ST: STAGE.
2ND STAGE.
3RD: STAGE.
2ND: STAGE.
3RD: STAGE.
3RD: STAGE.
2ND: STAGE.
2ND: STAGE.
3RD: STAGE.
3RD: STAGE.
2ND: STAGE.
1ST STAGE

consider the future expansion of a stadium is overlooking a vital point. Master plan of the entire area be prepared in initial stage of development and future extension contemplated from every angle, should be included in the origioal plan. Minor changes can be made later as conditions make them advisable. Stadium without a definite ultimate plan presents a difficult problem as to how the capacity should be increased and many factors enter into the working out of future extension which could be carried out by adding in length, depth or height. Horizontal extension means progressively poor seats and is limited by physical obstructions such as adjoining roads, canals, buildings and other property as well as the extent af playing field. The vertical extension provides some what better view in middle tiers, is more expensive to construct and is associated with problems of stairs and ramps. When a stadium is to be built in instalments, each step in the building programme should be so arranged that future extension can be made without serious rearrangement of what has already been done and some arrangements are indicated in figure No. 25

VI. DESIGN OF BASIC FACILITIES

1. Tickets.

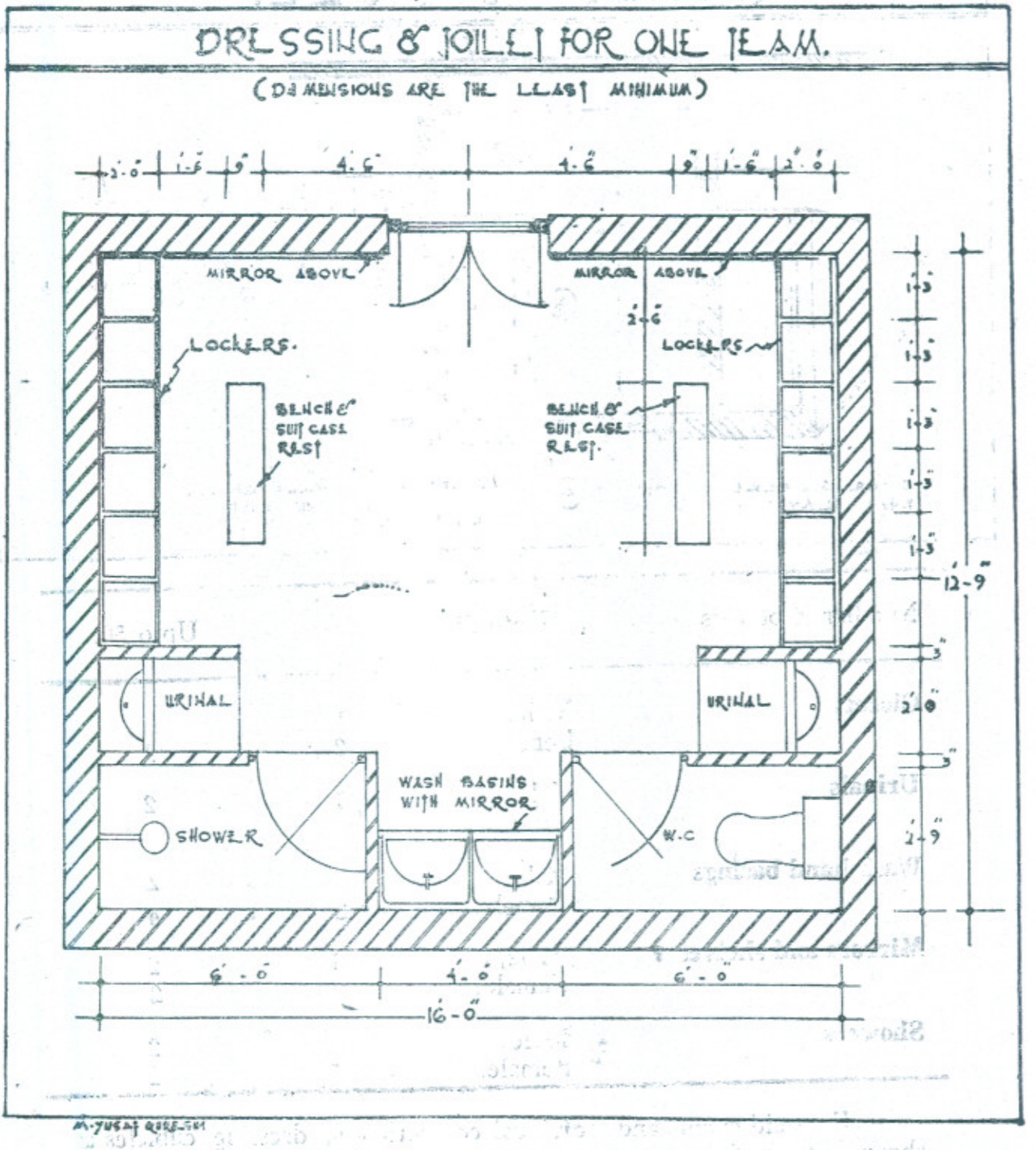
The number, distribution and types of ticket offices are influenced by so many variables that specific pattern and design cannot be stated. The ticket booths which are part of the stadium structures should be prominently and conveniently located and distributed near various major entrances. Under any circumstances the ticket services actually housed within the stadium walls should be supplemented by agencies located outside the stadium where tickets could be bought in advance.

In the Lahore Stadium the proposed ticket effices will be located within the main edifice and will command all the important entrances. For various classes and sectors there will be seperate windows which are being planned to permit "Q" formation without obstructing the entrances. Pedestrians will have direct access through an under ground tunnel to ticket windows.

2. Changing Rooms and Players Toilets.

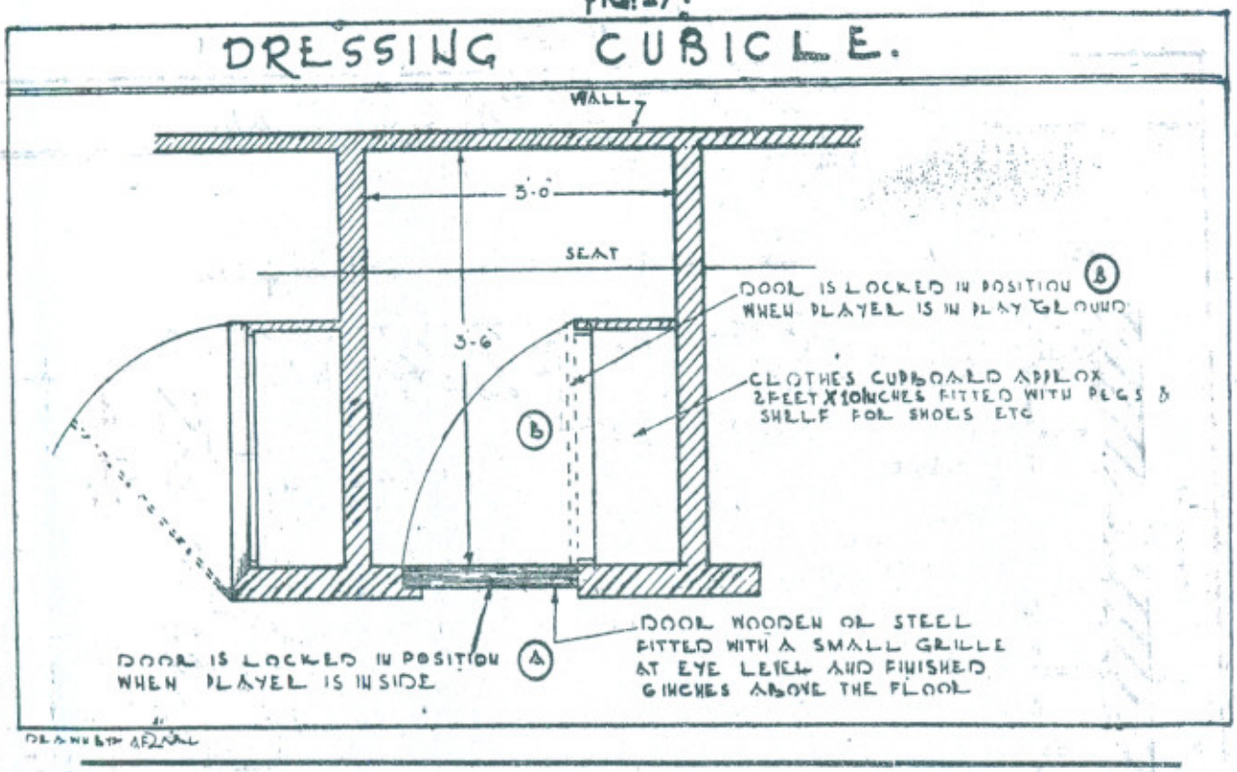
A dressing and locker room for participants is most essential. It is necessary to provide each team a seperate dressing unit. Each unit to be complete within itself and should include dressing, shower, towelling and toilets. Three such units will probably be required. Each unit should be so planned that it can be shut off from the rest of the stadium and the players can reach them easily and directly from the outside areas (Refer figure No. 2 for plan analysis). In conformity with the principals of utility and maximum effective use, minimum space of about 20 sq. ft per participant is required for dressing and toilets and

FIG. 26.



a typical toilet station for about 12 players is shown in figure 26. The minimum number of sanitary fixtures required for players are given on the next page.

FIG: 27.



Number of players		Upto 25	Upto 50.
Closets	Male,	1	2
	Female.	2	3
Urinals	Male	1	2
	Female.	—	—
Wash hand basings	Male	2	4
	Female.	2	4
Mirrors and shelves	Male,	1	2
	Female.	1	2
Showers	Male,	1	2
	Female.	1	2

For field events and individual competitions, dressing cubicles as shown in figure 27 have proved very popular in Western countries.

3. Public Toilets.

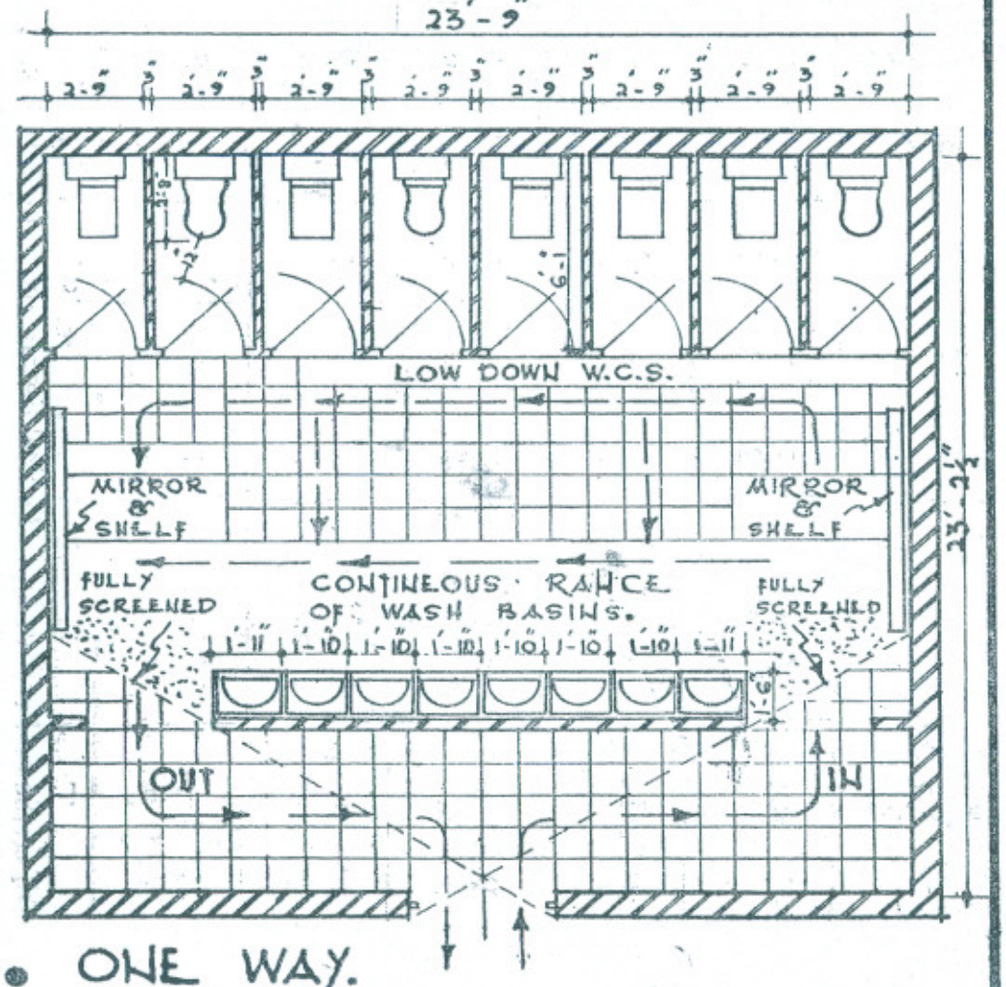
Climatic conditions have considerable bearing on the requirements of sanitary accommodation. All stadiums which attract large spectatórs cause maximum crowding of sanitary facilities. The use of toilets will be very concentrated at the intervals and to some extent at

FIG: 28.

TOILET STATION FOR 1000 FEMALE SPECTATORS.

8. W.C.S.
8. WASH BASINS.

DRINKING FOUNTAINS LOCATED SEPARATELY.
(DIMENSIONS ARE THE LEAST MINIMUM)

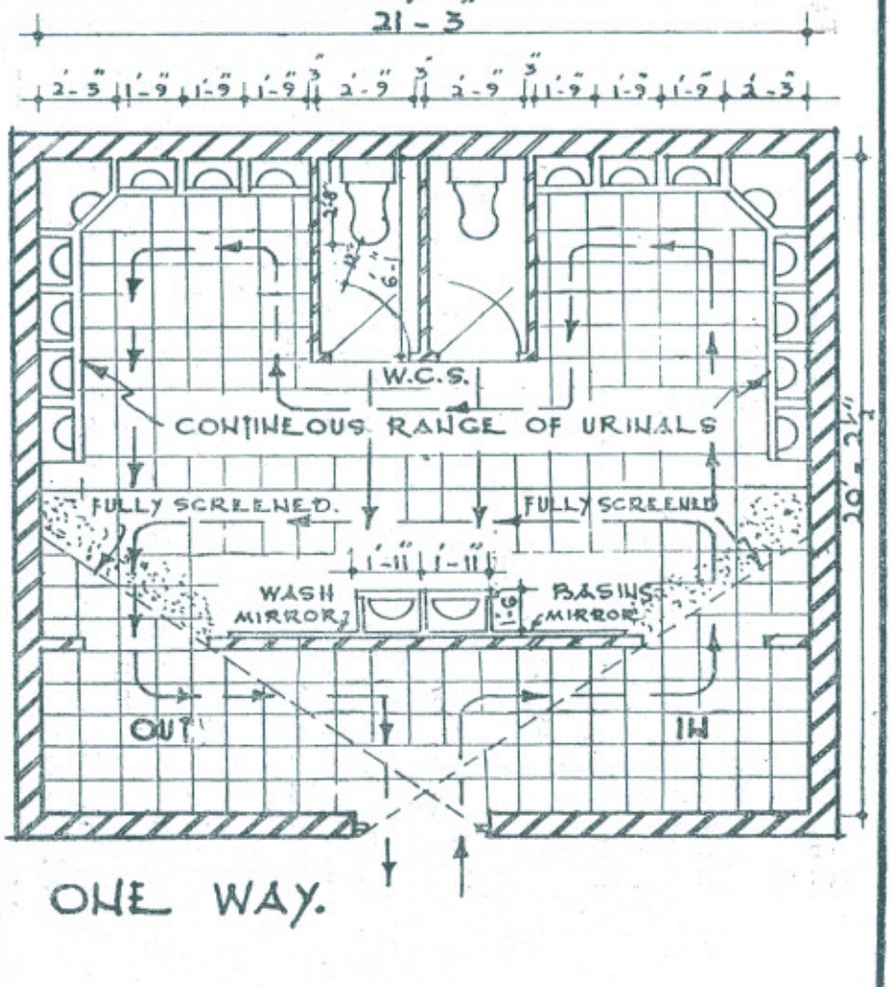


ONE WAY.

TOILET STATION FOR 2000 MALE SPECTATORS

2. W.C.S.
2. WASH BASINS.
16. URINALS.

DRINKING FOUNTAINS LOCATED SEPARATELY.
(DIMENSIONS ARE THE LEAST MINIMUM)



ONE WAY.

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the close of events. Adequate facilities are very essential otherwise the spectators will relieve themselves at any convenient corner. To meet these requirements, the toilet facilities, preferably with water carriage system, should be evenly distributed throughout the structure and readily accessible from any location.

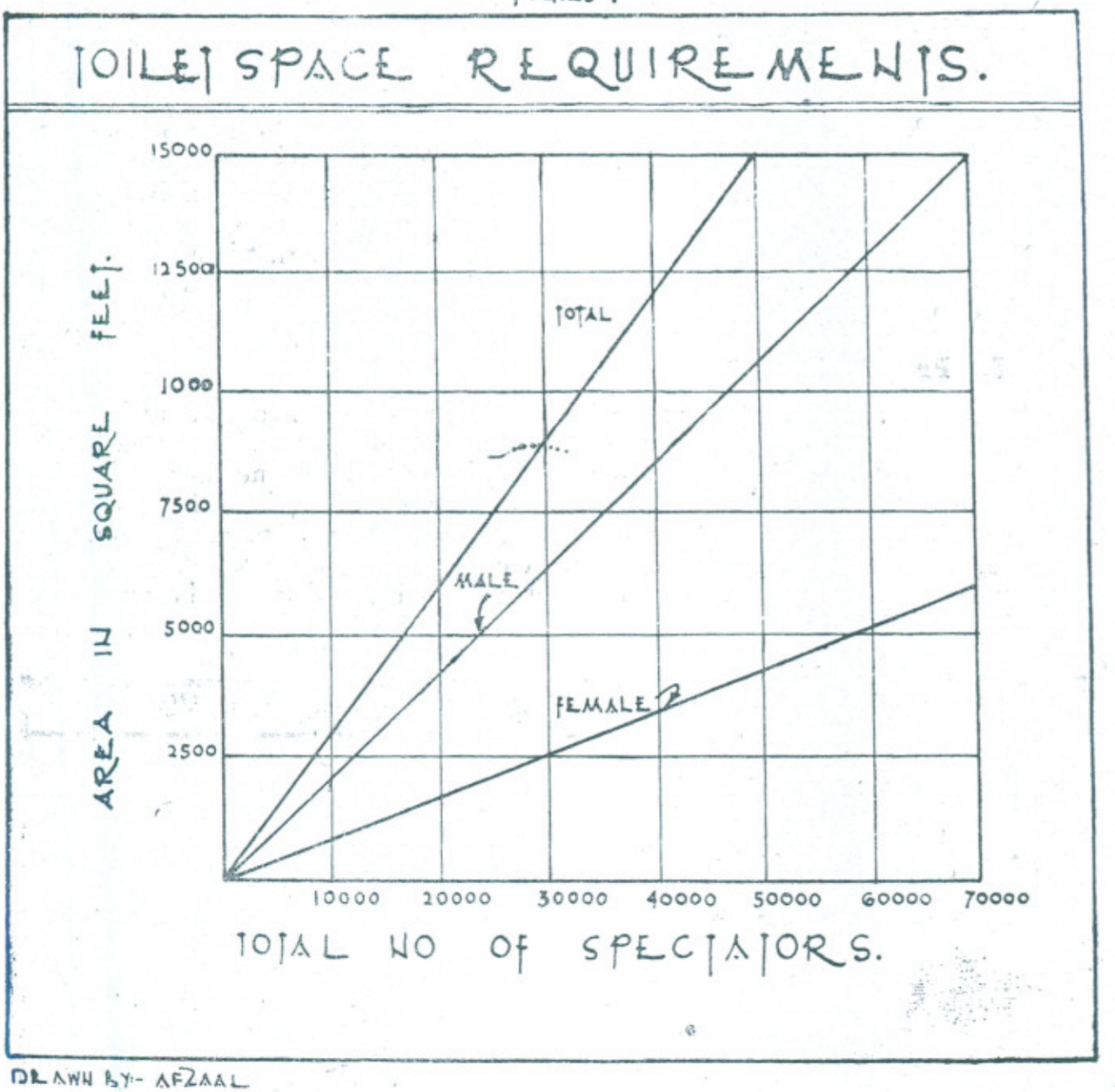
Accurate knowledge on the use of sanitary accommodation is not available. For the purpose of estimation it is assumed that men will spend an average about 1½ minutes in the toilet, whereas the women will consume about 3 minutes. In public places, large percentage of men than women will avail of the sanitary accommodation. Proportion of men to women in matches will vary according to the type of contest and will increase in the years to come. Unless more accurate data becomes available, toilets for at least 10 to 15% women must be provided. It is reasonable to assume that the toilets will have maximum concentration during match intervals averaging about 10—15% of the spectators. The number of toilets required can be worked out according to the duration of intervals. The following chart which is based on actual observation in Westren counties gives an absolute minimum of fixtures and avoids undue extravagance but if the finances permit provision may be made on a fairly generous scale.

Number of persons		Upto 100	201-300	301-400	401-600	601-800	801-1000	1001-2000
Closets.	Male	1	1	1	1	1	1	2
	Female.	2	3	4	5	6	7	14
Urinals.	Male	2	3	4	5	6	7	14
	Female.	—	—	—	—	—	—	—
Wash hand basins.	Male	1	1	1	1	1	1	2
	Female.	2	3	4	5	6	7	14
Mirrors and shelves.	Male	1	1	1	1	1	1	2
	Female.	2	3	4	5	6	7	14
Drinking fountain.	Male	1	1	1	2	2	2	4
	Female.	1	1	1	2	2	2	4

Toilet stations with orderly circulation will avoid cross currents of traffic and confusion. Typical details of a toilet stations for 2000 male

and 1000 female spectaters are given in figure 28. It will be seen that average convenient space per female spectator is about 2½ times of that required for a male spectator. For the purpose of space estimation, it is assumed that about 15% of the spectators are women and figure No. 29 gives minimum plinth area required for toilets of stadiums of various capacitie s.

FIG:29.



DRAWN BY- AFZAAL

4. Refreshments.

The provision of accommodation for refreshments of all kinds is a matter that must be governed entirely by the peculiarities of each stadium. Much will depend upon the type of contest. The cricket

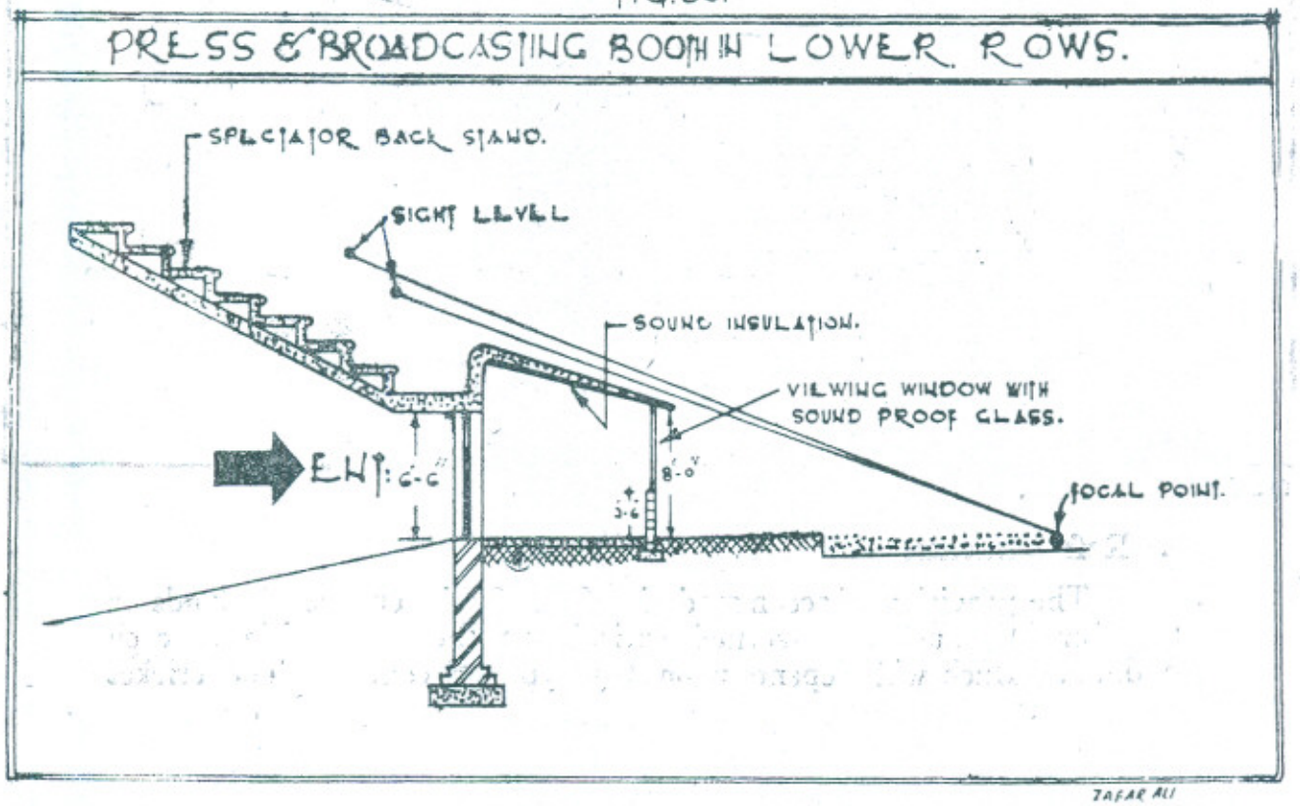
match will create greater demand for refreshments than football or hockey for which the duration of play extends over fixed periods. The situation of a stadium will also have some bearing on the intensity of demand for meals as the proximity of other facilities for refreshments outside the stadium estate will decrease the demand to some extent. However ample and attractive accommodation if provided within the stadium will boost the demand but the provision of permanent and elaborate catering accommodation for large crowds will be uneconomical if the playing season extends over a very short period or the important meets are held rarely.

Refreshment facilities for large stadiums should be comprehensive because a number of people attending the big events come from considerable distances and will create a demand for meals both before and after the contests. Ordinarily the provision for the sale of soft drinks, teas, light refreshments, pack luncheons is all that is necessary with the addition of canteen for the administrative staff and seperare facilities for the participants and their friends.

5. Press Box.

The growing popularity of all sports and the increased number of sports reporters who cover the contests have necessitated mueh larger and more elaborate accommodation for the press and should be provided in the original design. In the choice of location, the press should be given priority next to broad casting. Convenient ingress and egress, seperate toilet arrangements, clear view of score boards, telephone service, writing desks and stools, form integral part of the press box planning.

FIG: 30.



6. Broad Casting Booth.

Accommodation for broad casting should be the best that the stadium can afford. Well located with unobstructed view of the playing field is a primary requirement. Where possible the broad casting booth should be isolated from the crowd and every effort should be made to prevent extraneous sounds from causing interference with the broadcasting. Walls are sound proofed and glass fronts are used. Access to booths should be by independent walk or stairs. Before the planning is finalised it should be whetted by a representative from the Radio Pakistan.

7. Photographers Gallery.

Some convenient place. preferably at the roof, with good view of the place can be arranged to serve as photographers gallery. With a view to get good photographs from various positions the press gallery should extend to the full length of the stadium if possible. The space for cameras should have a wooden floor so that tripiods can be readily fixed in position. Ample walking width for photographers to pass from one end to the other without interference should be allowed.

FIG. 31.

PRESS & BROADCASTING CHAMBER AND PHOTOGRAPHER GALLERY IN UPPER TIERS.

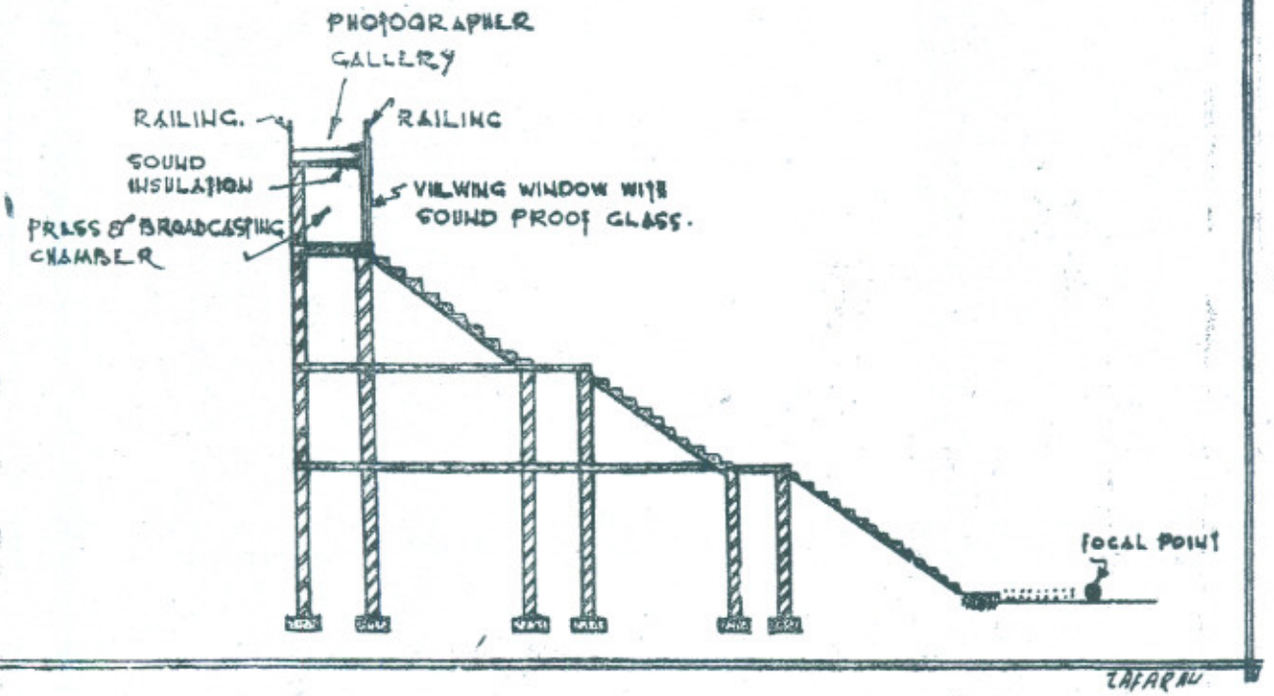
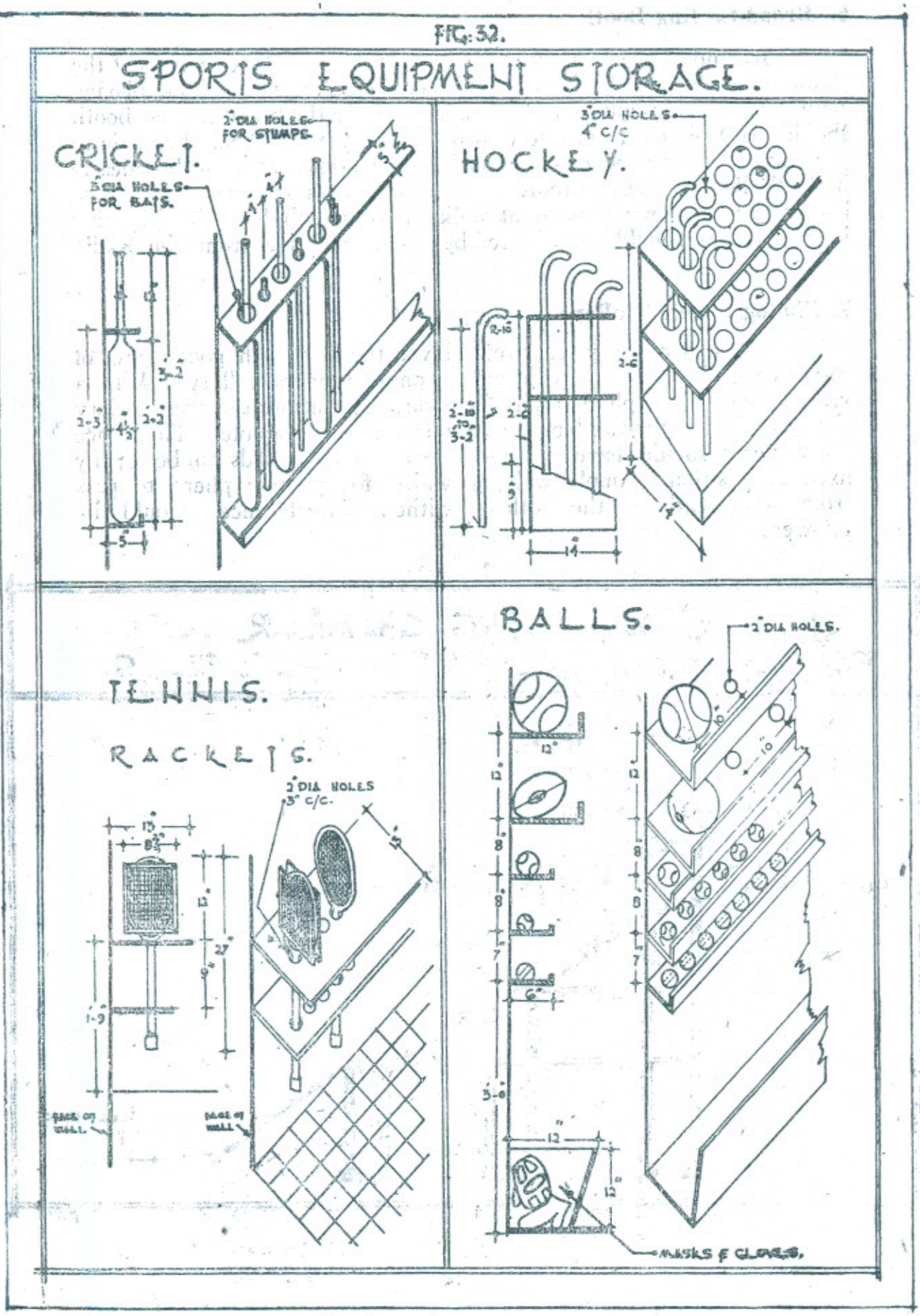


FIG: 32.


SPORTS EQUIPMENT STORAGE.
CRICKET.
2" DIA HOLES FOR STUMPS
3" DIA HOLES FOR BATS.
HOCKEY.
3" DIA HOLES 4" C/C
TENNIS.
RACKETS.
2" DIA HOLES 3" C/C.
BACK OF WALL
BACK OF WALL
BALLS.
2" DIA HOLES.
MASKS & GLOVES.

8. Storage.

Equipment storage rooms for accommodation of such things as track and field equipment, foot ball, hockey and cricket paraphernalia etcetra are needed in every stadium. Figure 32 gives general details of the way in which suitable racks may be provided to meet the needs of different games. Cricket bats require a shelf with raised edge about 5 inches wide with a similar shelf fixed at 2 ft 3 in above it and perfortated with holes at 4 in centres which should be 3 in diameter for bats and 2 in diameter for stumps. Cricket, hockey and similar balls can either be kept in cupboards or on racks. It is advantageous if the balls are raised off the shelves to permit of adequate air circulation by resting them on three pointed supports. Foot balls and volley balls can be stored on shelves about 11 in wide with a high front edge. Holes 2 in diameter and 10 in centres should be made in these shelves. Hockey sticks require 3 in diameter holes spaced 4 in apart in a rack placed above a sloping base as shown in Figure 32. A shelf 1 ft 2 in will accommodate three rows of sticks. Tennis rackets require a shelf about 13 in wide with 2 in diameter holes placed at 3 in centres. All these shelves and fittings must be strongly made and very securely fixed to the walls. Cupboards are also needed for storage of cricket pads, gloves, score books and similar articles. Average stadium will also require separate storage for removable seats and knock down chairs, curtains and *shamianas*. Tools and maintenance equipment will also need some place along with shops for painters, electricians, carpenters, water supply fitters and plumbers etc.

9. Water Supply and Sanitation.

Water has many uses in stadium. It is needed for spraying or flooding the turf in playing arena. It is required for sprinkling the racing tracks and disinfecting the sand pits. It is essential for arboriculture. Considerable water supply is required for toilets and drinking. Sprinkling of water in dry season stops dust nuisance in approach roads and parking areas. A definite plan, to care for water needs, should be made before development is taken in hand. An early removal of excremental matter from the stadium is very important. Our tropical climate accelerates the decomposition and without water carriage system, the foul smell will persist making the stadium locality unhygienic and unpleasant. If funds permit and plentyful supply of water is available, the water carriage system is the best.

VII. REGULATION OF CROWD MOVEMENTS.

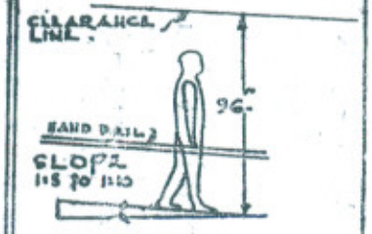
1. Ingress and Egress.

During sports performances the crowds will present various problems. The size, location and arrangement of means of ingress and egress involve study of crowd movements, crowd psychology and crowd safety. The problem of ingress and egress is successfully solved if any

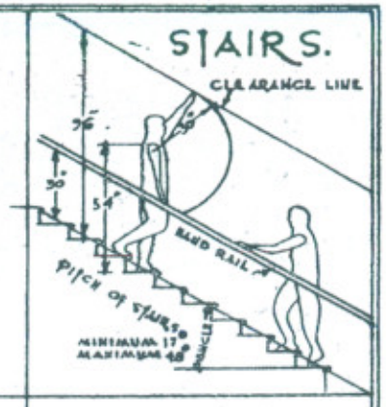
FIG:33.

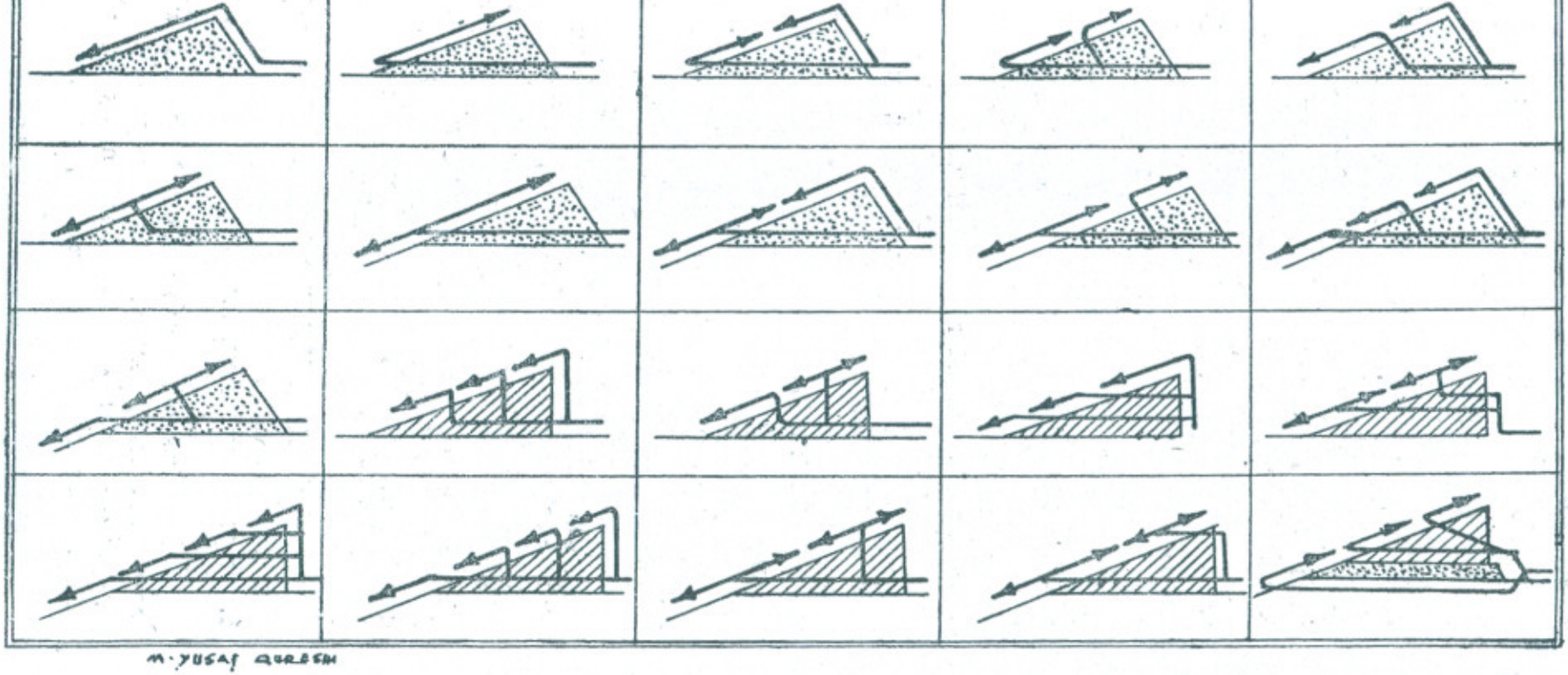
STAIRS & RAMPS SYSTEMS.

RAMP.



STAIRS.





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conflict of crowds moving in opposite directions or all trying to go in the same direction at the same time is reduced to minimum. Arrival occurs successively extending over an hour or so but all are desirous of leaving at the same time. Emptying of the stand proper generally requires 10 to 20 minutes but getting away from the vicinity of area of congestion by such means of transpotation as are available may require an hour or more. The problem is to move the crowd from the seats to beyond the sphere of congestion in as short a time as possible. There is no advantage in designing the stadium to be emptied in say 10 minutes if the corresponding efficiency in the means of moving the corwd from points outside the stadium to destination does not exist. The stadium planner should provide adequate means to get the spectators in and out in a reasonable time consistent with bottle necks in parking ar eas and remote points along the approaches which the spectators will use.

2. Entrances and Exits

The design and disposition of entrances and exits is related to convenience, safety, crowd appeal, and public relations. Arrival occurs successively and not all atonce but involves the problem of ticket selling, ticket taking, and ushering all of which retard the crowd movements. Crowd regulation is simpler when there is a separate entrance for each seating. The entrance should preferably open to the parts which they serve at their heighest points as at the opening the crowd will find its way down ward with greater ease and at the close the pressure of people around the openings will be less severe. The number of entrances is also dependent upon the arrangements of ticket selling and the attendants available.

At dispersal the difficulties are greater. All persons are desirous of leaving at the same moment and liberal provision of exits is necessary. A large number of small exits is preferable to concentrations at a few wide exits. Thier even spacing will ensure that the spectators leave at a uniform rate and are not encouraged to make for a particular exit as a quicker way out. It is desirable to have a large open circulating space outside the stand proper in order to allow an immediate release of the pressure of people leaving the exits. Minimum exit openings should be provided as under :—

1. Level openings—8" per 100 people.
2. Sloping opening—10" per 100 people.
3. Stair opening—12" per 100 people.

3. Stairs and Ramps.

Up and down movements require the provision of stairs and ramps and figure No. 33 shows some arrangements for stadiums. When space under the deck is required for other purpose the stairs concentrate the crowd movements in a smaller area. They have the further

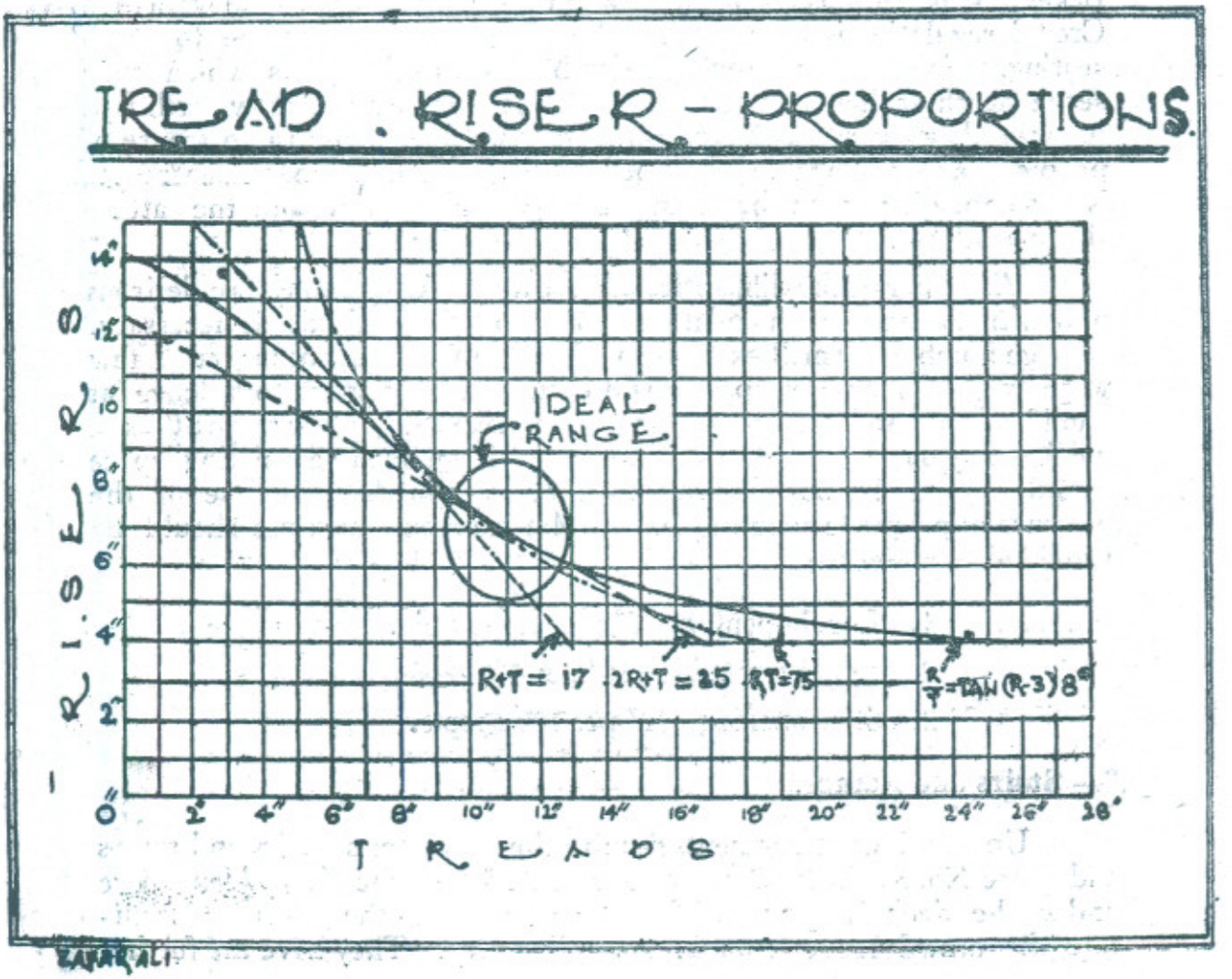
advantage of requiring less travel to accomplish any change in level. However stairs involve an accident hazard, the rate of travel on them is slower, upward progress is more tiring and downward passage takes more mental effort than with ramps. Stairs require more than 50% greater total width than the ramps to give the same time of emptying the stand. In designing the stadium stairs the following common rules are used.

1. $R+T=17$
2. $2R+T=25$
3. $RT=75$
4. $\frac{R}{T}=\text{Tang}\,(R-3)\,8^{\circ}$

Where R is the riser height in inches and T the tread width in inches.

Graph vide figure No. 34 gives comparison of tread riser proportions obtained by the above formulæ. For stairs the upward travel

FIG: 34.



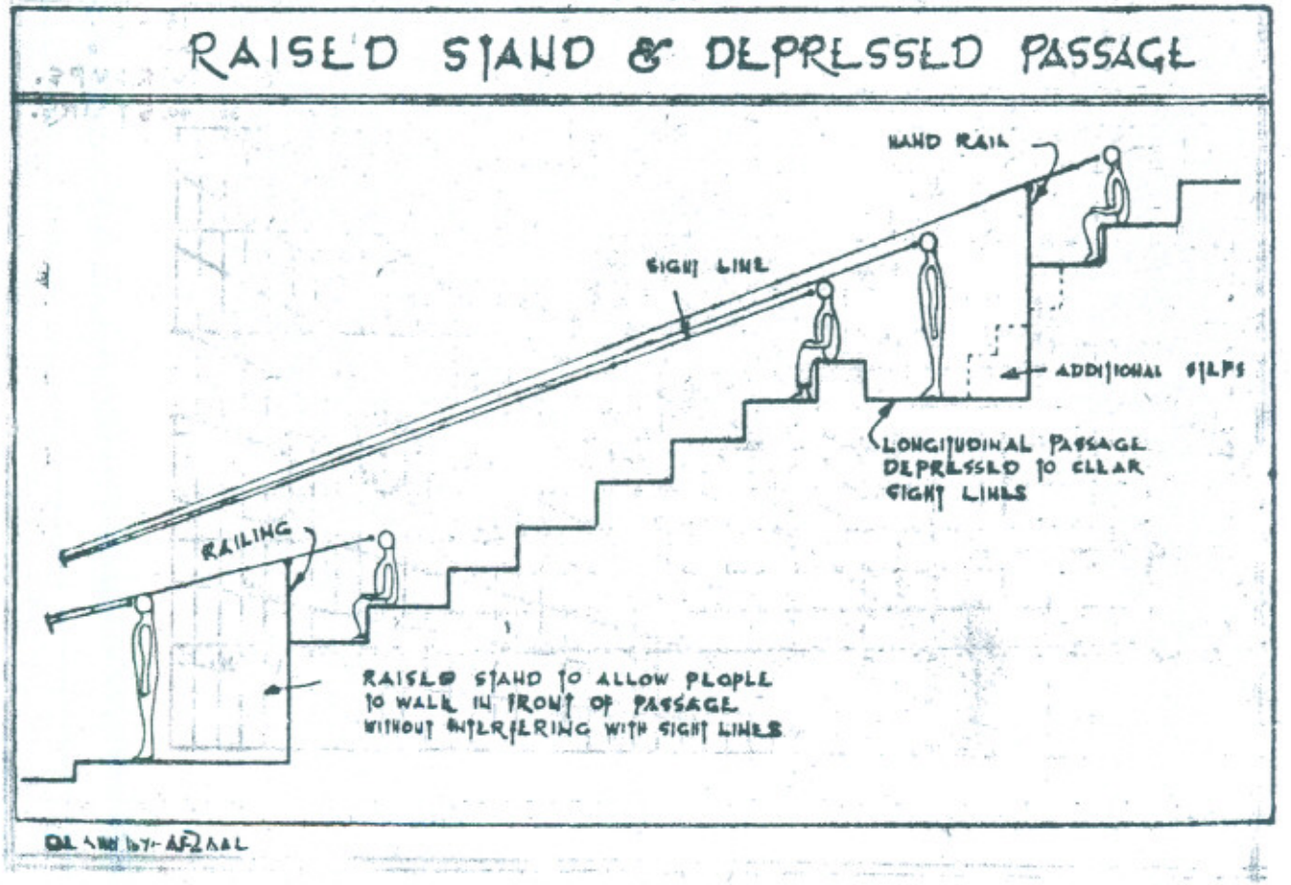
ranges from 40 to 52 and downward from 65 to 75 persons per minute per traffic lane provided the tread riser proportions are restricted within the best limits as indicated by the graph.

The ramps are more efficient than stairs. They require about 40% less total width but have greather length than stairs of same height. Ramps are primarily recommended for safety and their gradients vary from 1 in 5 to 1 in 10 with landings at 15′ to 20′ intervals. For the purpose of design an average flow of 80 persons per minute per traffic lane of 22″ width is recommended.

4. Longitudinal and Transverse Passages.

Stadiums are generally divided into sections by transverse passages. The width of these sections in terms of number of seats varies from 24 to 32 seats per row. Longitudinal passages on ground level in front of seats are considerably convenient to the crowds but these as well as other longitudinal passages at part way up interfere with sight lines and should preferably be avoided. Raising the seats to clear the sight lines above the heads of walking persons increases the overall height of the stadium and is expensive. Sometimes the longitudinal passages are depressed to overcome these difficulties but this necessitates wider passages as additional stair steps protrude into the passage as shown in figure 35.

FIG.35.



5. Design of width of stairs passages and exits etcetra.

Widths of stairs, passages and exits are dependent on the number of persons to be served and the desired rate of travel. Movements of crowds in and out of stadiums can best be expressed as follows :—

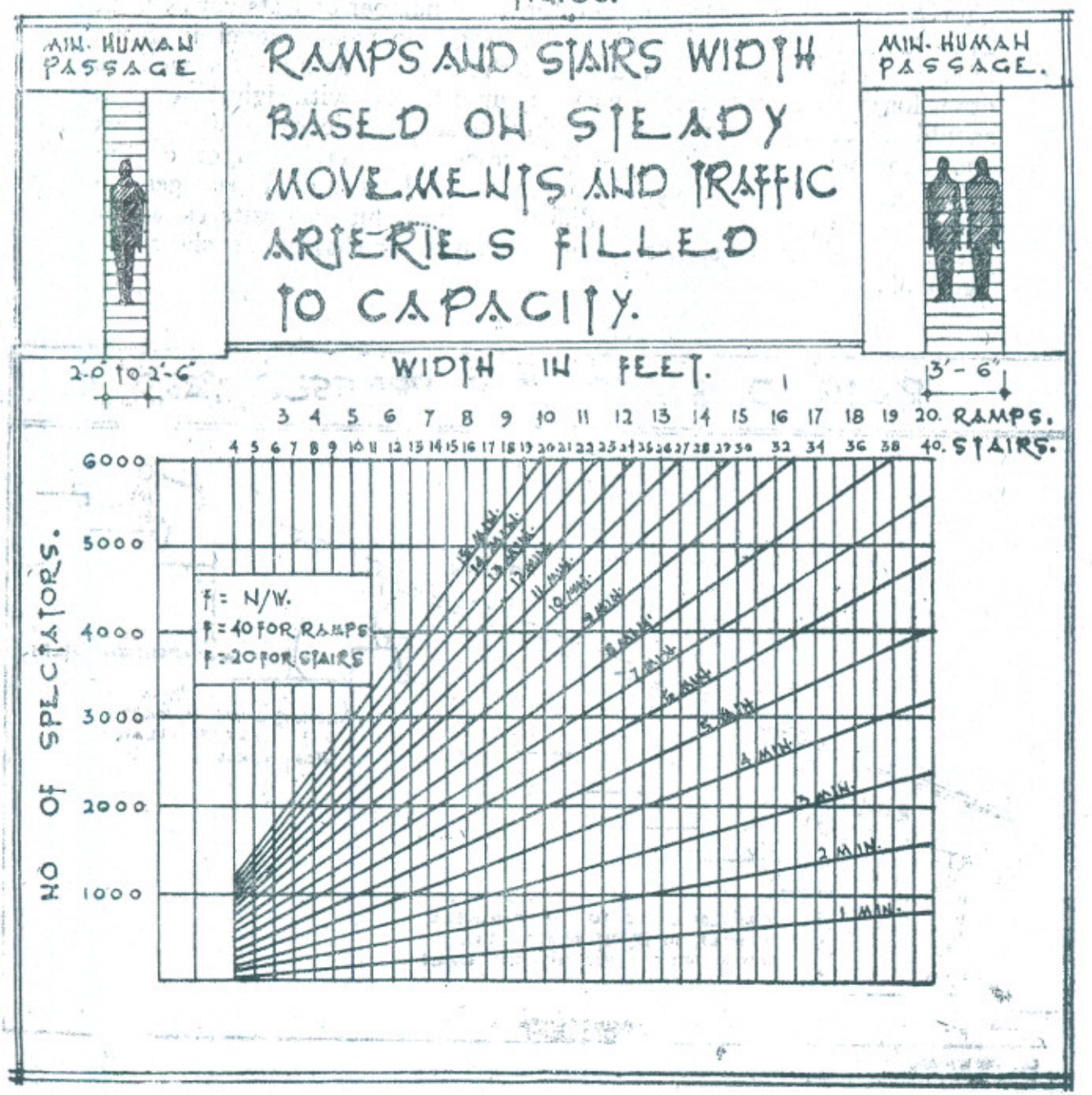
$$T = \frac{P}{FW} + \frac{L}{S}$$

T = Time of emptying in minutes.

P = No. of persons.

W = Width of passage in feet.

FIG: 36.



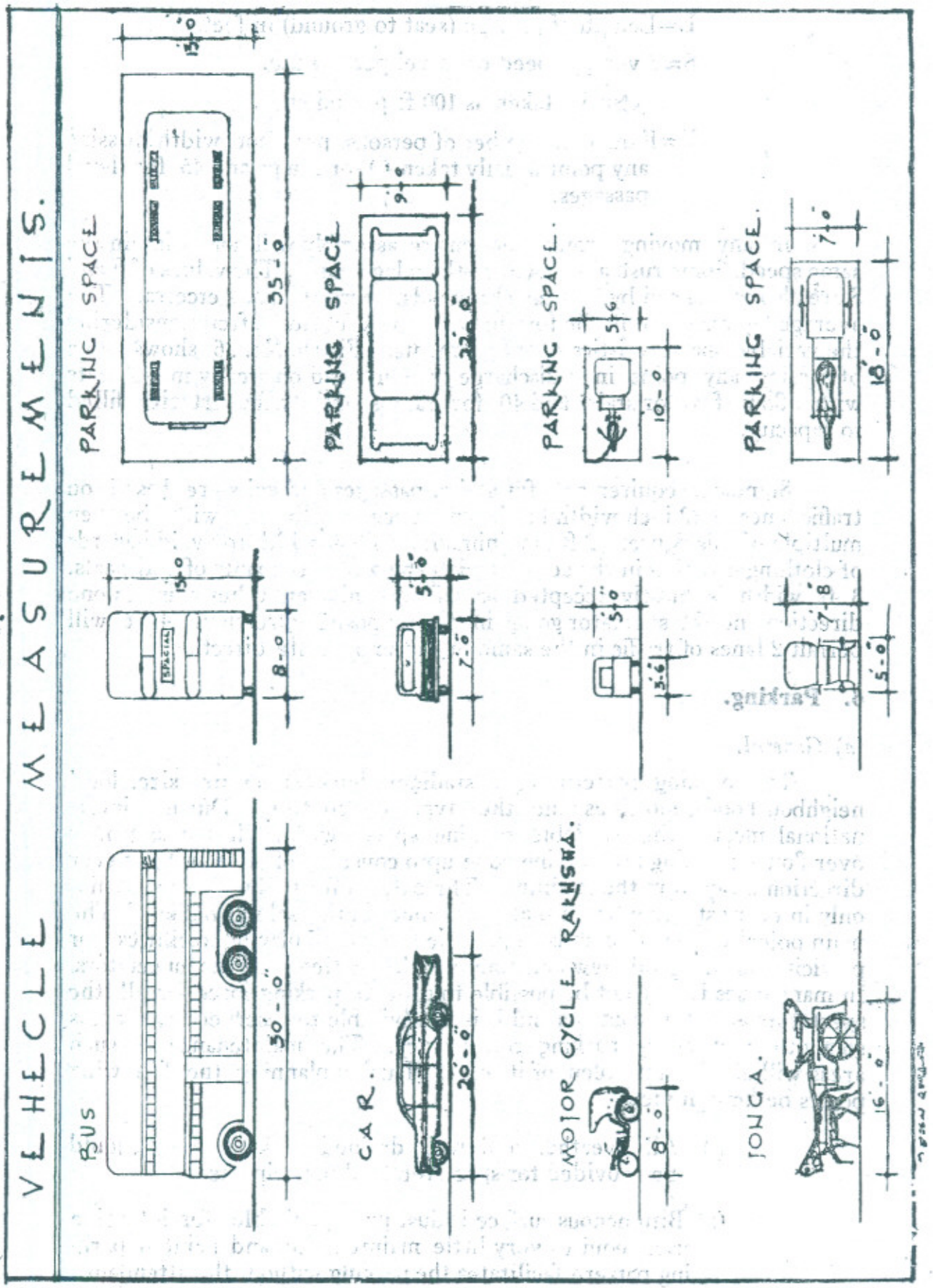

VEHECLE MEASUREMENTS.
BUS
50'-0"
8'-0
13'-0
PARKING SPACE
35'-0
CAR.
20'-0"
5'-0
7'-0
PARKING SPACE
22'-0
9'-0
MOTOR CYCLE RICKSHA.
8'-0
3'-6
5'-0
PARKING SPACE.
10'-0
5'-6
TONGA.
16'-0
5'-0
7'-8
PARKING SPACE.
18'-0
7'-0

FIG. 37

L=Length of passage (seat to ground) in feet.

S=Average speed of travel per minute.

(Usually taken as 100 ft per minute).

F=Flow i.e., number of persons per foot width passing any point usually taken 40 for ramps and 45 for level passages.

In any moving crowd the entire assembly will not maintain the same speed. Some rush ahead while others lag behind. The values of F and S are also influenced by bottlenecks, bends, encroachments etcetra. The average figures given in the formula are on safe side after considering the variable characteristics of the elements. Figure No. 36 shows time of passing any point in a discharge system based on steady movements with a flow of 20 for stairs and 40 for ramps and traffic arteries filled to capacity.

Standard requirements for stairs, passages and exits are based on traffic lanes of 22 inch width but it is not necessary that the width be even multiple of this figure. 2 ft is minimum possible width to avoid hazards of clothing catching in the seats or disturbing the occupants of end seats. 3 ft width is mostly accepted as this permits an usher going in one direction and the spectator going in the opposite direction. 4 ft will permit 2 lanes of traffic in the same or in the opposite direction.

6. Parking.

(*a*) *General.*

The parking pattern of a stadium depends on its size, local neighbourhood conditions and the type of contest. During international meets, the available parking space within the estate may over flow extending the parking zone upto considerable distance in every direction away from the stadium. The pattern for parking will vary not only in every stadium but also at every meet in the same stadium. The main object of the stadium is to provide adequate playing facilities for participants and good view and comfortable seating for the spectators. In many cases it may not be possible to provide parking space for all the spectators at all the contests and it is inadvisable to reserve large areas solely to meet every parking contingency. The maintenance of such areas will also be a problem of its own. During planning the following points be kept in view.

(i) All weather and well drained parking areas should be provided for spectators and participants.

(ii) Bitumenous surface is dust proof, suitable for intensive use, requires very little maintenance and painted parking pattern facilitates the parking without the attendant.

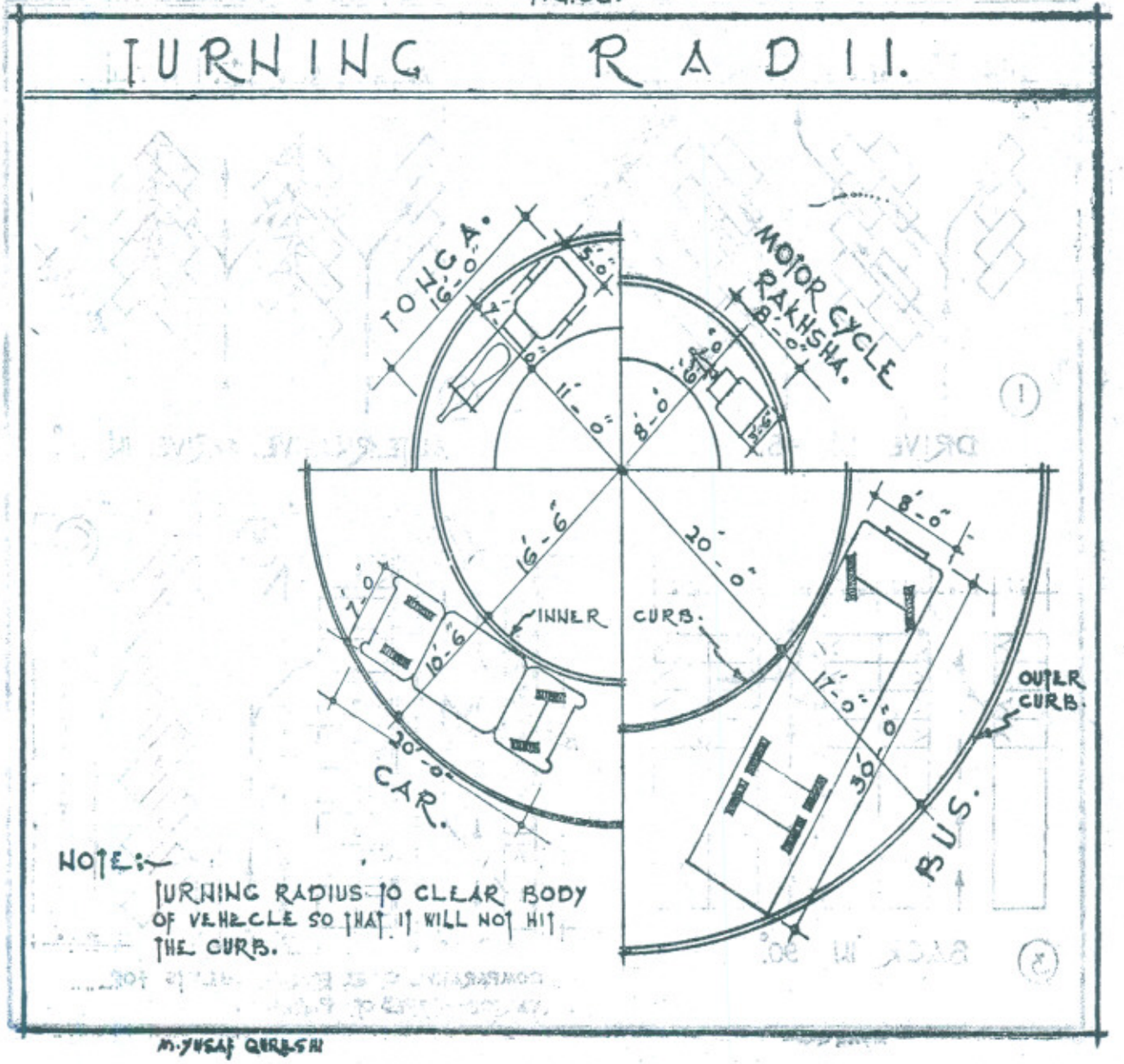
(iii) The kind and location of parking areas should fecilitate the flow of pedestrians and high way traffic on or near the stadium with that of adjacent and out lying areas.

(iv) The parks should be easily accessible from the approach roads and conveniently near the seats. Drives to parks should avoid cross currents of traffic.

(v) Entrances and exits may be in different locations. Possibilities of several well distributed parking areas serving various approach roads may also be considered.

In Lahore Stadium the proposed development of approach roads, junctions and crossings is so arranged to stream line the outflow of traffic

FIG. 38.

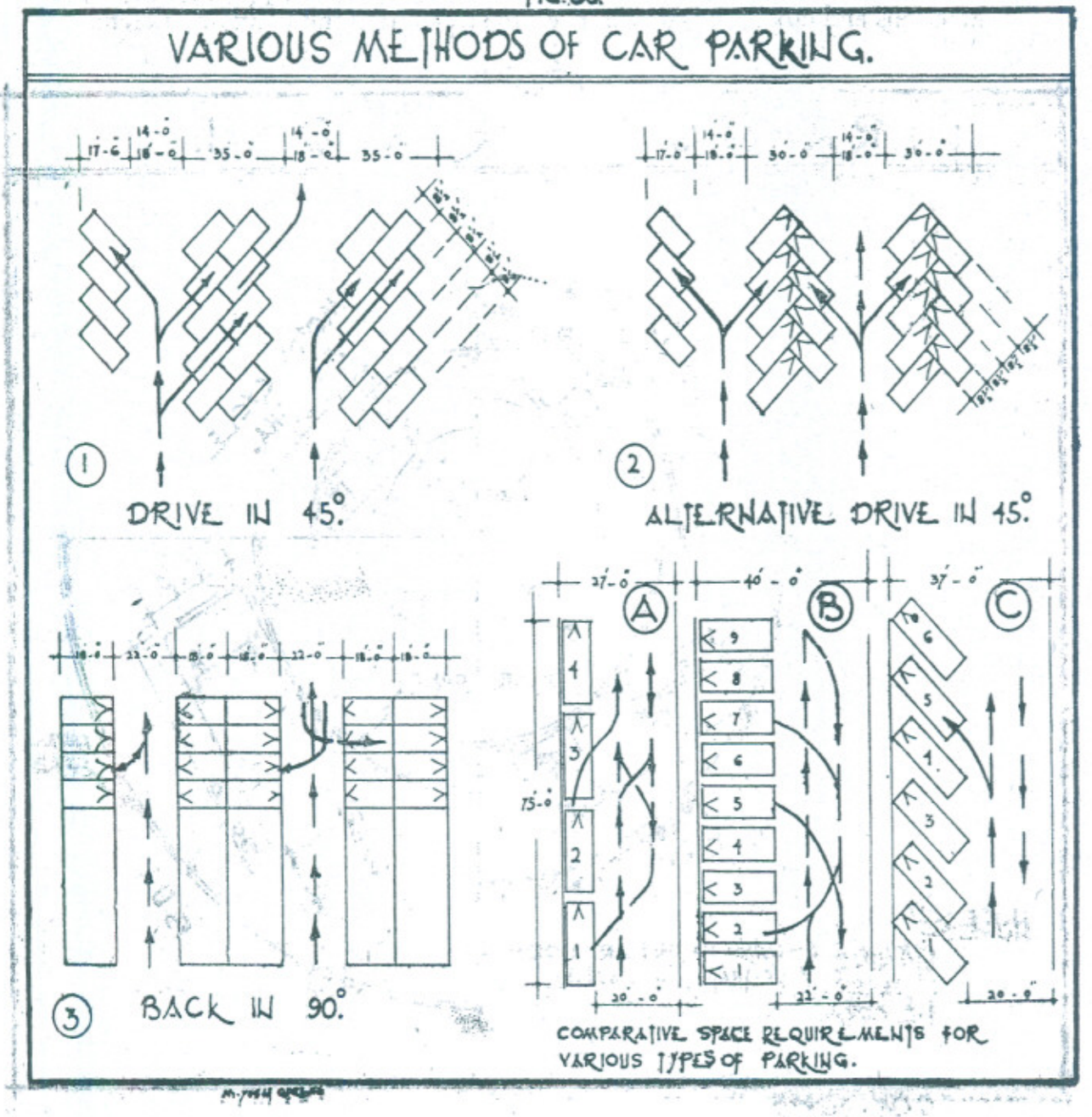


and eliminate any potential hazards. Generous provision for car parking has heen provided but tonga stand in the estate itself is omitted as it is unhygienic and unsightly. It is also presumed that in the near future, in Lahore, the tongas will be replaced by auto rickshaws. For easy movements of vehicles and pedestrians, the mechanical and the foot traffics have been separated by providing an underground access tunnel for pedestrians to the main stadium.

(*a*) *Public Vehicles.*

Figure No. 37 gives average sizes and berthing spaces for various public vehicles such as buses, cars, motor cycle rickshaws and tongas.

FIG: 39.



The minimum turning radii are shown in Figure No. 38. Public vehicles need only small stand which can even be dispensed with if a good circular drive with facilities for loading and unloading and access to main road is provided.

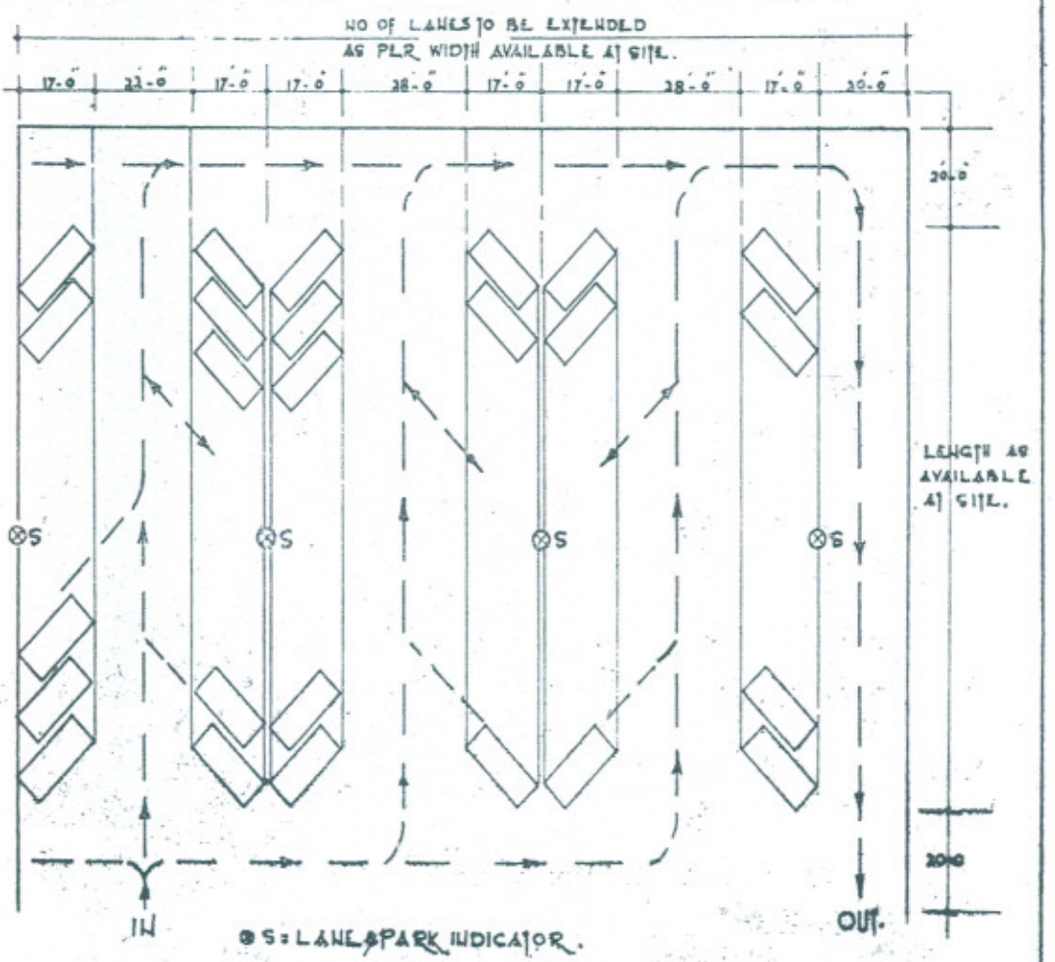
(b) *Private Cars.*

Percentage of car ownership and the size of cars are rapidly increasing. Average dimensions of a car, its berthing space and minimum turning radius are given in Figures No. 37 and 38. Various types of parking are shown in Figure No. 39 which also gives comparative space requirements for each type of parking. Large cars will protrude into passages and will have less space for door swings. Types A & B show "SQUARE" parking. Type "A" is some what wasteful while type "B" is cuber some and disturbing to other vehicles.

FIG:40.

TYPICAL CAR PARK.

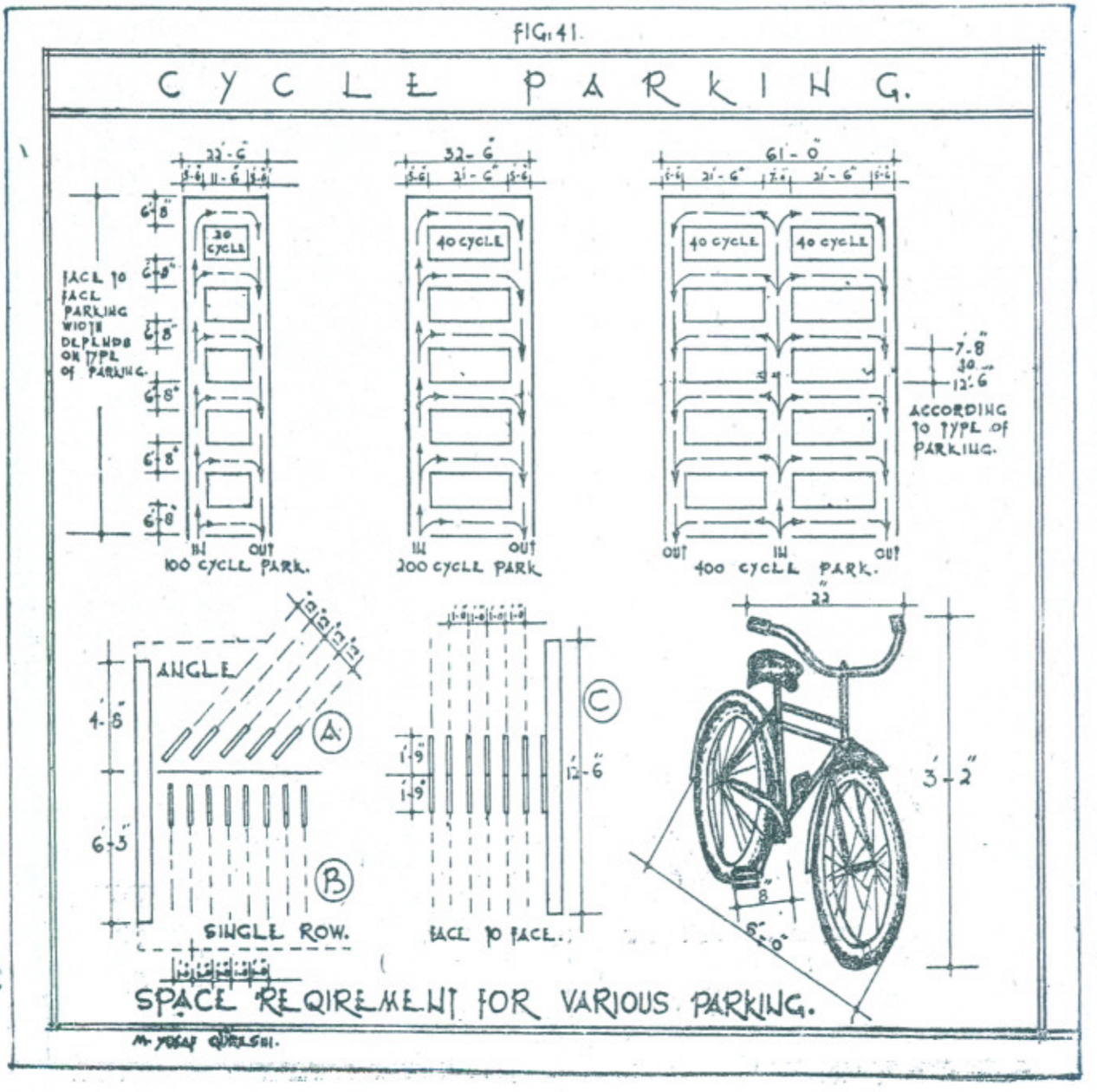
(ADOPTABLE FOR ANY TYPE OF PARKING AS DETAILED IN FIGURE 39)



Type "C", angle parking is the easiest for entry, parking and exits and should be preferred as far as possible. Figure No. 40 shows a typical lay out of one way vehicle park which is most suitable when in and out movements are likely to continue throughout the day as in cricket matches.

(c) *Bicycle Parking.*

The average bicycle is 6 ft long 20 in across the handle bars and 16 in across the pedals as shown in figure No. 41. Parking may be arranged in a variety of ways some of which are shown in this Figure. The arrangements shown are based on the use of racks in which alternative machines are raised and unless systems such as these are used spacing must be increased to 24 inches, instead of 12 with a consequent considerable increase in the size of parking area. Diagram "A" shows the racks arranged diagonally thus reducing the depth

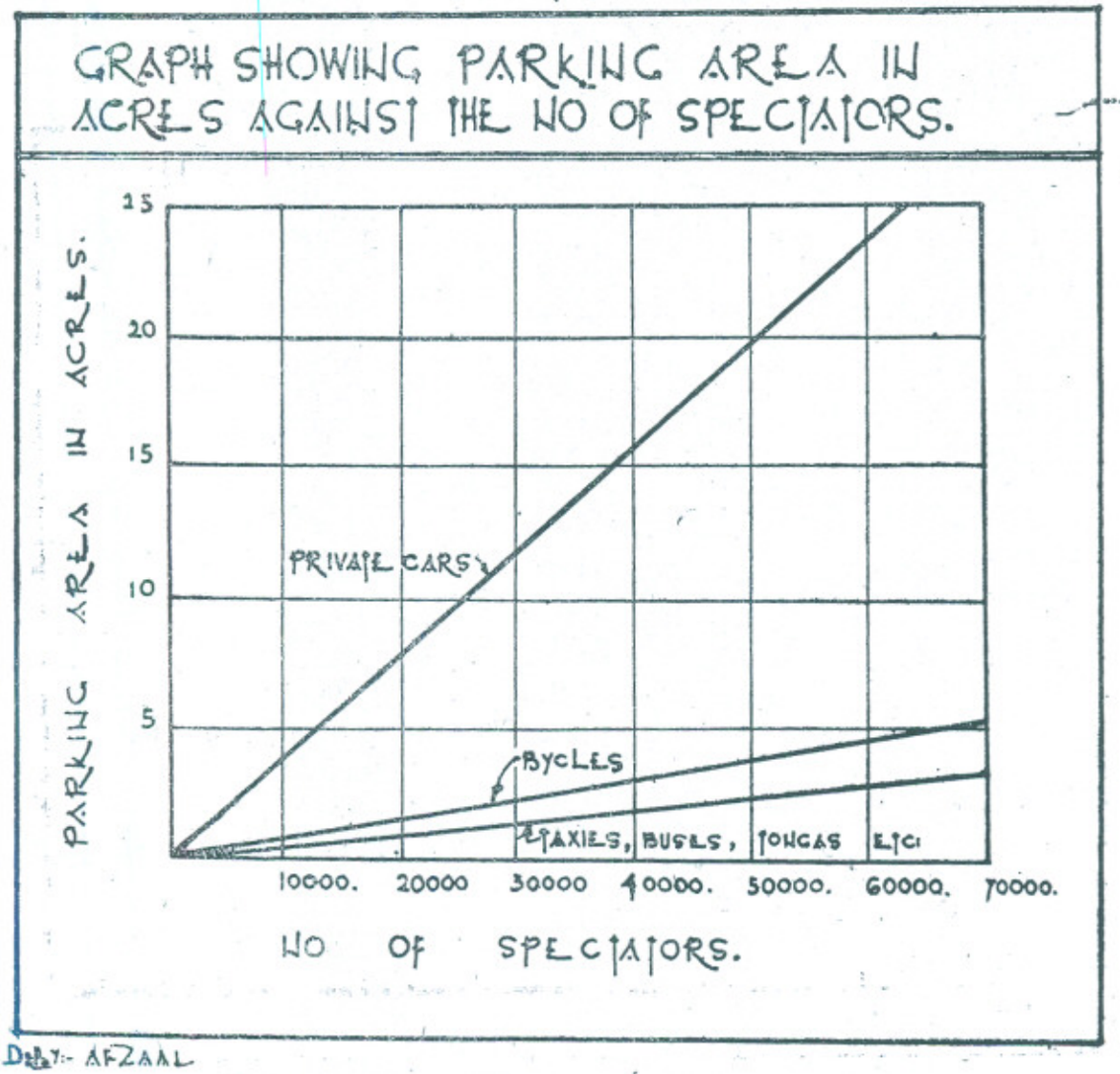


of the stand. Diagram 'B" shows the machines placed at right angles to the outer edge and in diagram "C" the machines are placed facing one another on either side of a central rack. Spacing between rows of machine should be about 7 ft. There are many types of racks wooden, R.C.C. and steel in which machines are tipped up and staggered in various ways. Care should be taken to select such racks which will with stand the rough usage and produce a minimum of damage to the wheels of bicycles. Layouts for typical one way parks of various capacities are also shown in Figure No. 41.

(*d*) *Space Estimation.*

For the purpose of stadium planning it is reasonable to assume that 10% to 20% spectators will travel by cars and the average occupancy of a car as 2 spectators. This will give about 60

FIG. 42.



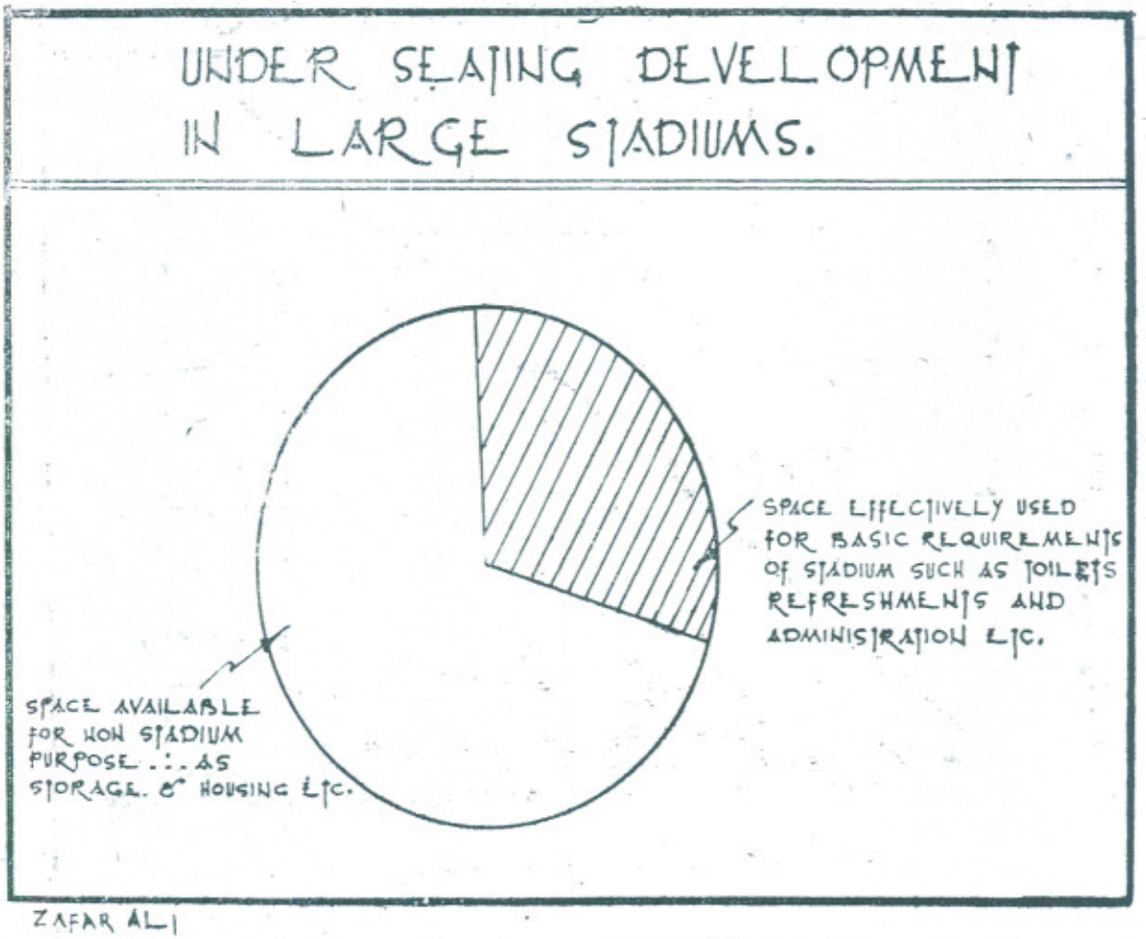
cars per 1000 spectators. The type of parking within the area will be determined on the basis of local conditions but for the purpose of estimating one acre of parking space is sufficient for 160 cars.

Similarly assume that about 15% people will travel by cycles and will need space for parking. About 2000 cycles can be conveniently parked in one acre and parking space required can be estimated. Taxis, buses and tongas etectra need only circuit drives and seperate parking space for about half a dozen vehicles of each type. Figure No. 42 shows a graph giving space requirements for various types of vehicles for stadiums of different capacities.

IX. UNDER SEAT DEVELOPMENT

The initial conception and design of stadium should be contemplated for the immediate and future development of all space beneath the stands. Consistent with the basic requirements of safety and comfort of spectators, adequate playing courts and other allied facilities for participants, some arrangements can be made to permit effective use of the space under neath. Rooms which border on the rear have ample

FIG:43.



light and air and in large stadiums the rear wall is of such height that several stories may be built. As the interior features increase in importance the complete structure becomes as much a building as a stadium. Instead of presenting a deserted look, as is the case in Karachi, the stadium can hum with activity even when there are no contests in progress and can also earn hand some revenue.

America is the country which can boast of the throbbing net work of stadiums and has successfully used the under seat space by accommodating ware houses, godowns, cold storages, clubs, cinemas, dormitories, and flats. The stadium of Louisiana Universisy has five storey flats under the seats providing additional income of about six lacs rupees per year. It is understood that one stadium is sheltering important developments in connection with atomic energy. In stadiums of 20,000 and upward capacities, maximum of about 30% underseat space can be effectively utilized for basic requirements such as :

1. Public tickets, access and egress, toilets, refreshments and telephones.
2. Players reception, lounge, medical check up, first aid, dressing and toilets.
3. Administration, operation, and maintenance offices and shops.
4. Residential accommodation for the essential staff.

Upward of 70% roofed space can be put to some other effective use and should not be wasted for the sake of aesthetics or "expression" i.e., the outward manifestation of the main purpose of the building. In our country there is an acute shortage of building material and built up space. If for the sake of privacy the housing is considered undesireable for our country, grain storage, cold storage, ware housing and light factories etcetra are no mean purposes for which the covered space can be economically adopted.

It is proposed to develope an ultimate seating capacity for 70,000 spectators in the main arena of Lahore Stadium. However, during the 1st phase, about 25,000 seats will be built and the under seating accommodation in this phase will be utilised as under :—

(i) Offices for stadium administration and sports promotions.

(ii) Baths and latrines for the public and the participants.

(iii) Hostel for players and facilities for the medical check up, messaging etcetra.

(iv) Refreshment facilities for public, participants and staff.

(v) Sports museum, lecture hall and storage space.

(vi) Halls for indoor games such as badmington and table tennis.

(vii) Observation Tower and accommodation for press and Radio.

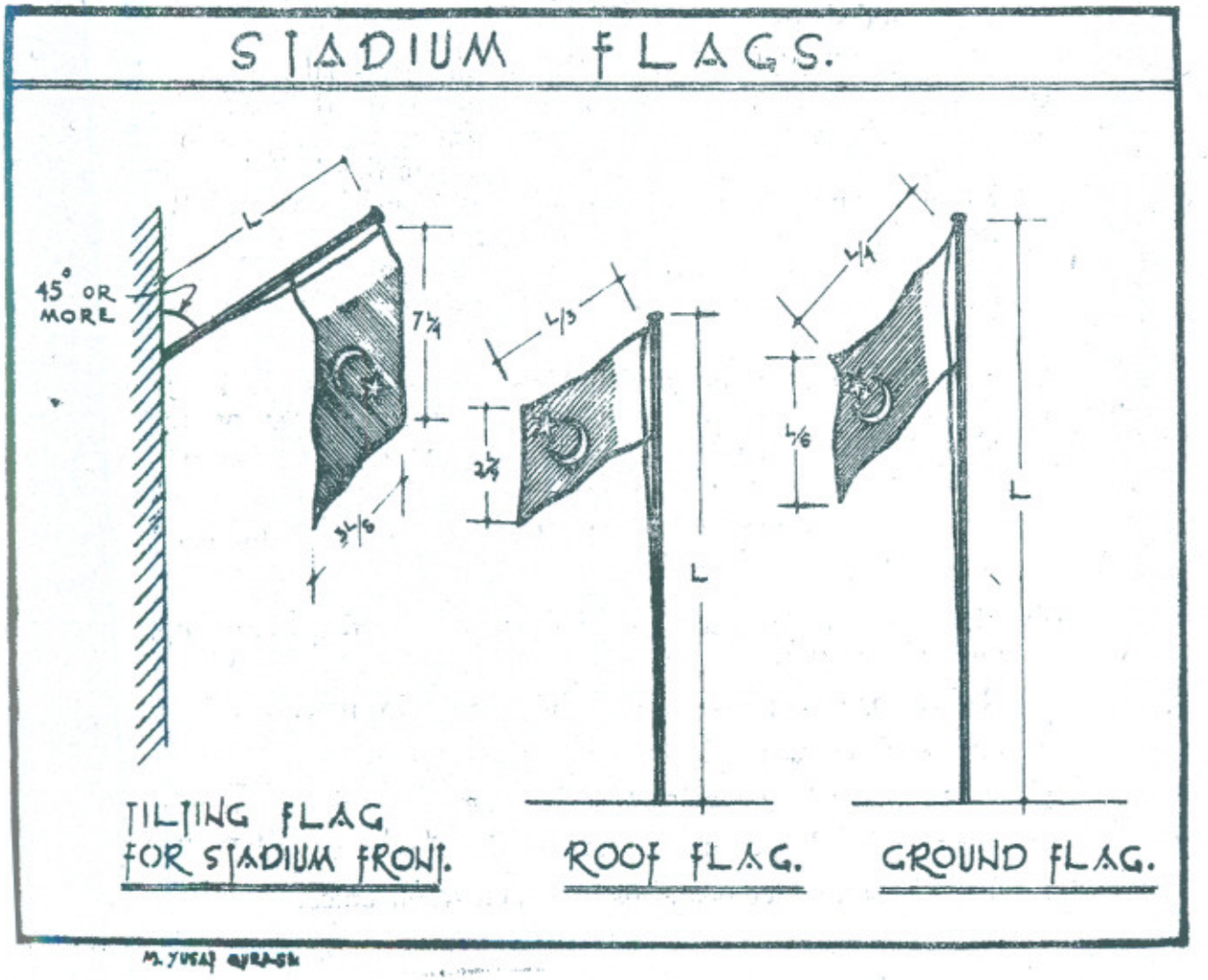
(viii) Ist aid post, police post, Post and Telegraph office.

X. ACCESSORIES

1. Railings.

Railings are essential for public safety and have average height of about 3 ft. The front and side railings sometimes interfere with sight lines. This is partially evercome by providing open type railing. The spectators in the front rows see through the railing and in the back rows over the railing. The open type railing is usually made of steel angles, pipes, wire grill, or woven and welded fabric. The railings are subjected to rough handling by the crowd and severe ex-position to sun. rain and wind. Use of wood is unwise which also gives thicker sections for equivalent stability and this causes greater interference with sight lines. The front and side walks are sometimes depressed to keep low the railing heights. Many people experience dizzy feeling on exposed elevated structures and therefore the exposed rear and sides should be provided with solid railings.

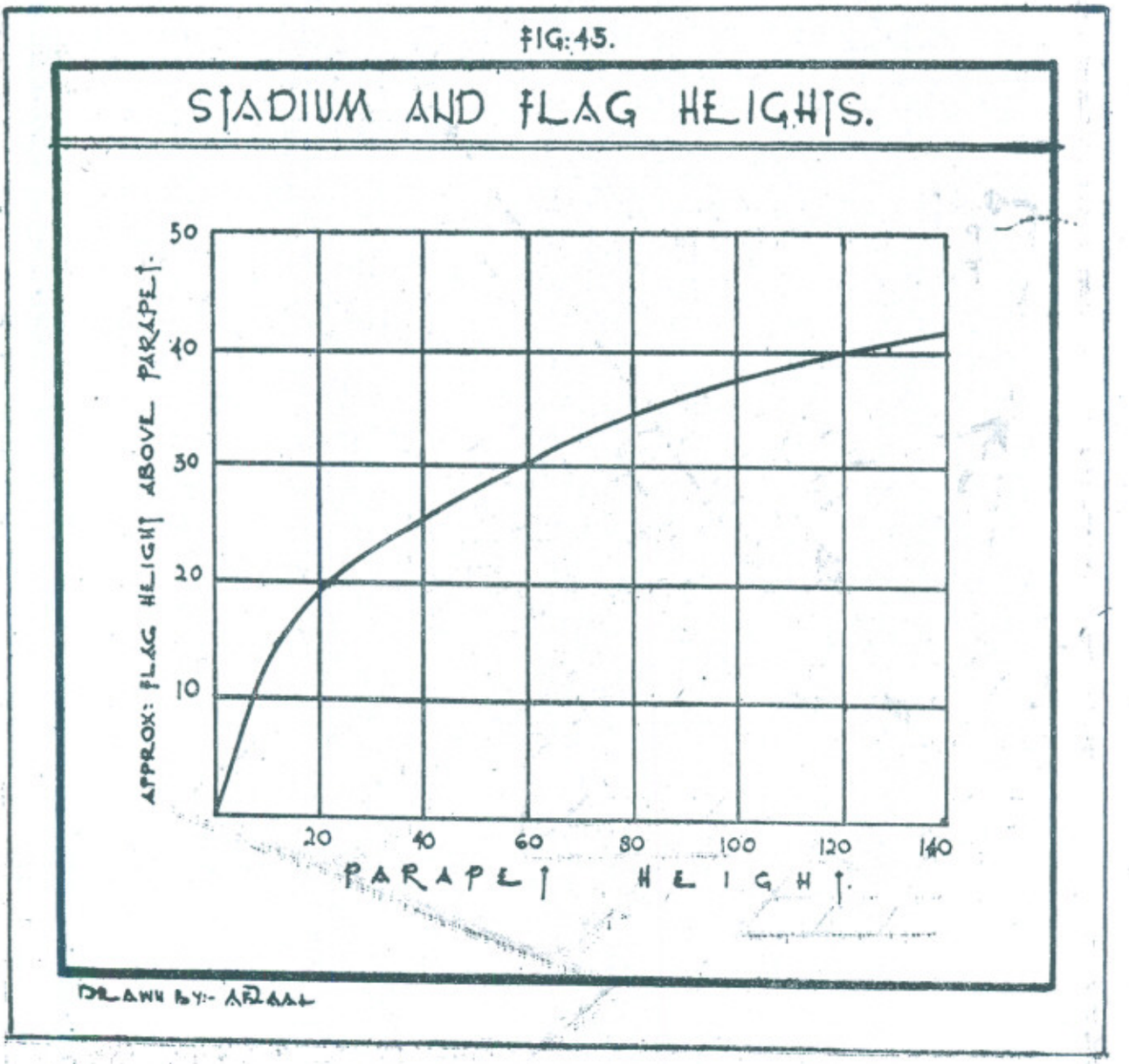
FIG: 44.



2. Flags.

During important meets, the stadium is decorated with flags. The flag poles involve wind stresses and this is the determining factor for their design. Flags can be made integral with railing system, harmonised with architectural treatment or fixed with structural system. The flags could be centered around one end of the edifice to serve as a gathering point for ceremonies or spaced around the entire inner or outer perimeter. The height should be such that the flags are inaccessible to the spectators and should be proportionate with the building height. These proportions are approximately given in figure No. 44. The poles could be vertical or pitched at an angle. The pole height and corresponding approximately flag sizes for tilting, roof and ground flags are given in figure No. 45.

FIG: 45.



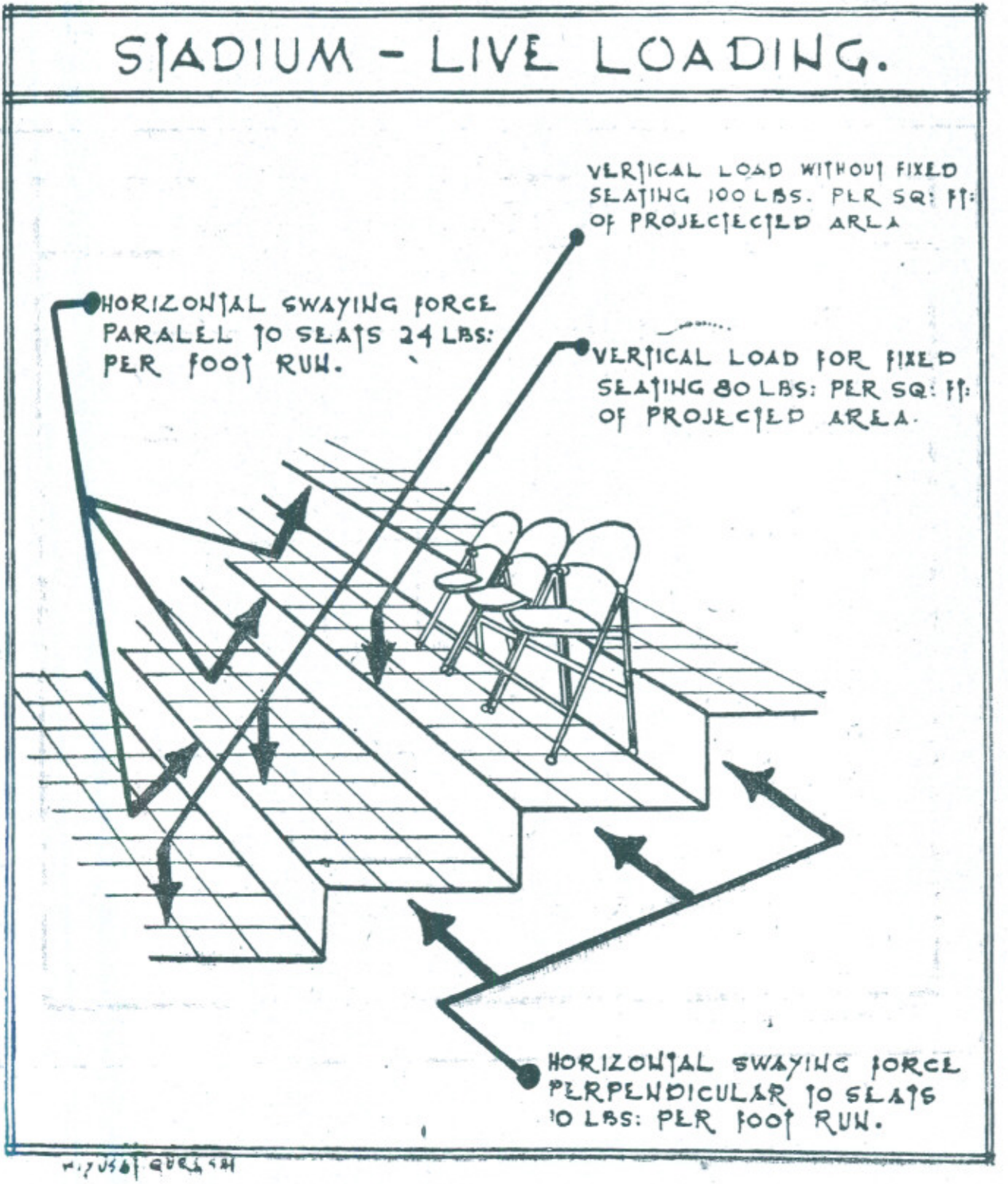
3. Score Boards.

Illuminated score boards and tower clocks, readily visible to all spectators should form integral part of the stadium design. In Western countries, centrally controlled and electrically operated score boards with loud speaker systems are becoming standard equipment for every modest stadium and this greatly increases the enjoyment of on lookers.

4. Public Address System.

Public address system controlled from press box or broad casting

FIG: 46.



booth is also very essential for announcements to the spectators. It should preferably be housed in elevated tower with clear view of arena and outsihe approaches. Crowd hand ling in our country is somewhat difficult and public address system with clear view of crowds inside and outside can control the traffic, prevent breaking of gates and overcrowding, and eliminate potential hazards. Grim tragedies of Rawalpindi Foot Bridge and Lahore Badshahi Mosque were caused by uncontrolled milling crowds.

XI. SELECTION OF MATERIAL.

The stadium will be subjected to rough handling by the crowds and severe exposition to heat, cold, rain, and wind. It should be built of materials which are durable, difficult to deface and easy to maintain. The paucity of timber and steel does not leave much choice for a Pakistani designer. He will have little deviation from earth embankments, traditional masonry and some combination of concrete framing. Finish will consist of cement concrete or tile topping. Toilets, baths, lockers, changing rooms etcetra may be given mosaic flooring and dado. For major part of the year, the stadium will be a deserted structure with closed interior. The use of wood is unwise and steel doors and windows are preferable.

XII. STRUCTURAL DESIGN

Safety in the design and operation of a stadium is of prime importance for the strcuture. The basic live loads and sway loads must be taken into consideration. Normally, the seated spectator occupies an area of about 3 sq. ft., each and the quiescent load does not exceed an average 40 lbs per sq. ft. In athletic contests large number of spectators may rise suddenly to watch an exciting play producing an impact and vibration on the structural system. Also in crowding towards an exit the density of persons in the adjacent area may greatly exceed the normal load. Various tests were carried out in England and in the U.S.A. to determine the effect of vibration and impact under sudden concertad motion of spectators. In light of these observations the following superimposed loads are recommended.

1. Seating.

(a) Vertical load without fixed. seating.	100 lbs. per sq. ft. of gross horizontal projection.
(b) Vertical load with fixed seating.	80 lbs. per sq. ft. of horizontal projection.
(c) Horizontal swaying force parallel to seats.	24 lbs. per foot run.
(d) Horizontal swaying force perpendicular to seat.	10 ibs. per foot run.

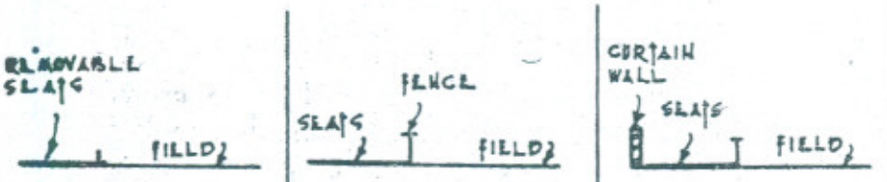
2. Stairs, Rams, Landings, and Corridors.

Vertical.	100 lbs per sq. ft. of gross horizontal projection.

FIG: 47.

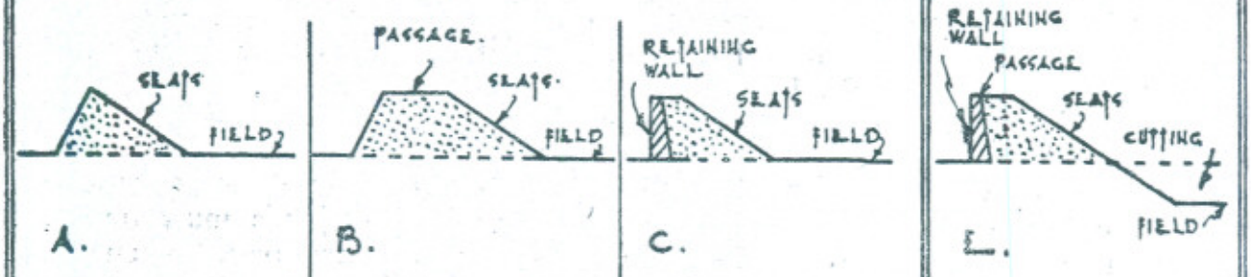
STRUCTURAL SYSTEM.

1. SIMPLE LEVELING.

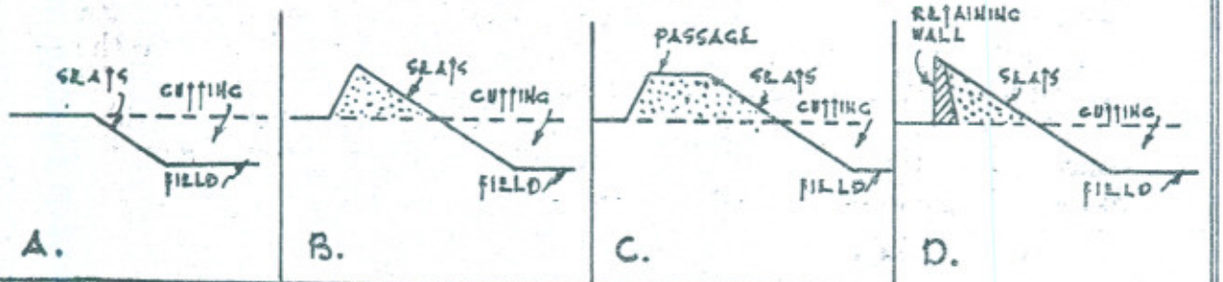


LEGEND.
ORIGINAL GROUND LEVEL SHOWN
PUCCA STRUCTURE
EMBANKMENT

2. EMBANKMENT & LEVELING.



3. CUTTING & EMBANKMENT.



4. SUPERSTRUCTURE & EMBANKMENT.

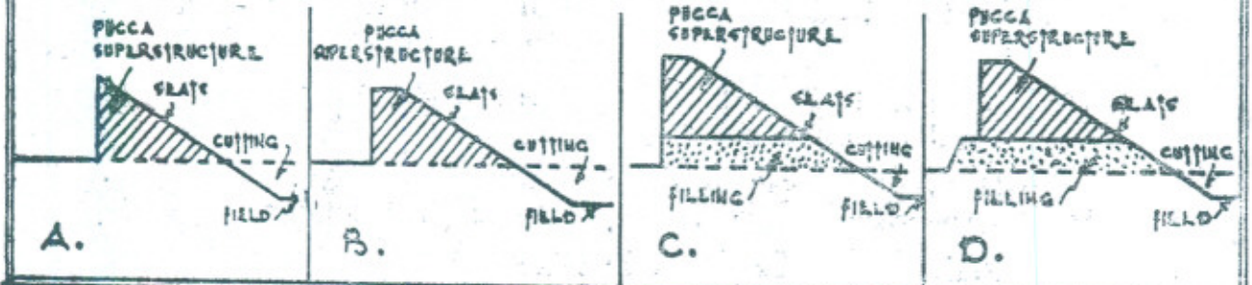


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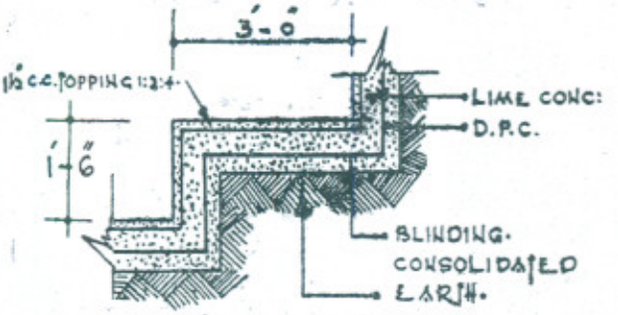
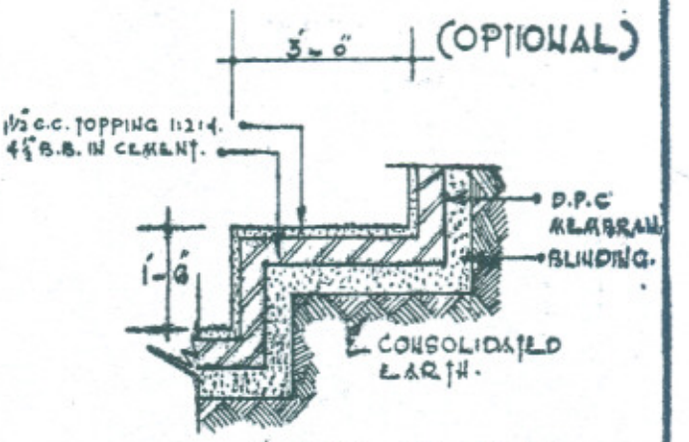
FIG 18

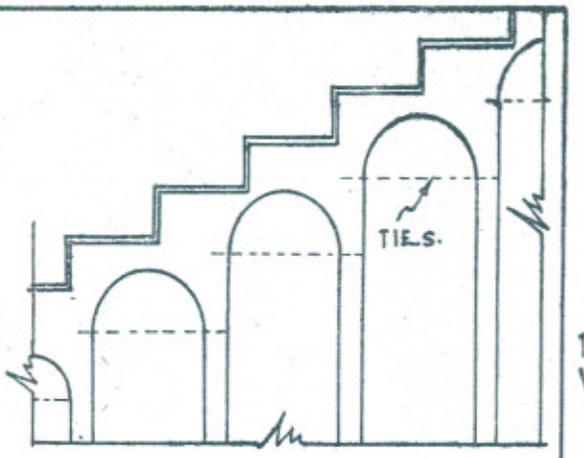
STRUCTURAL SYSTEM. (MASONARY)



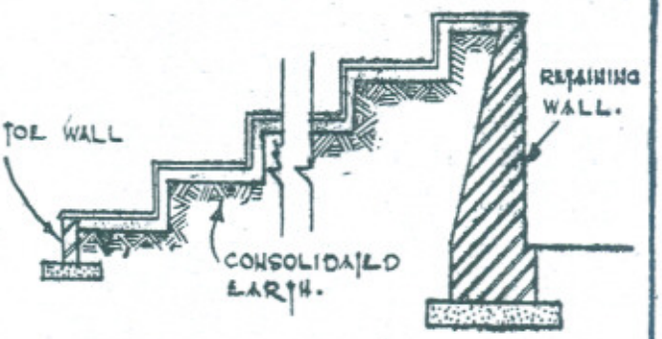
ALTERNATIVE DETAIL OF SEAT.



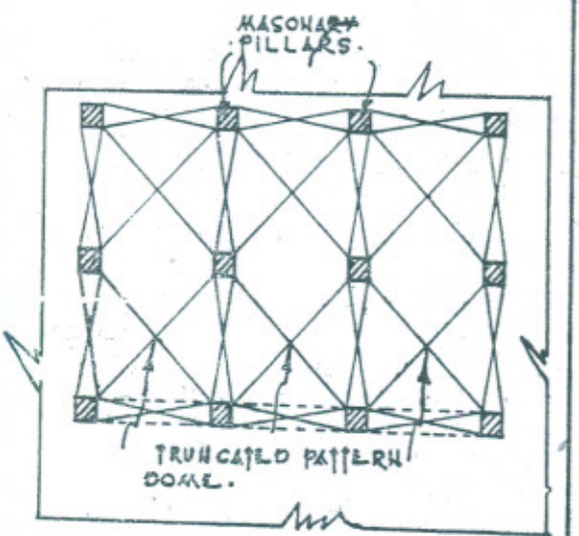
DETAIL OF SEAT.



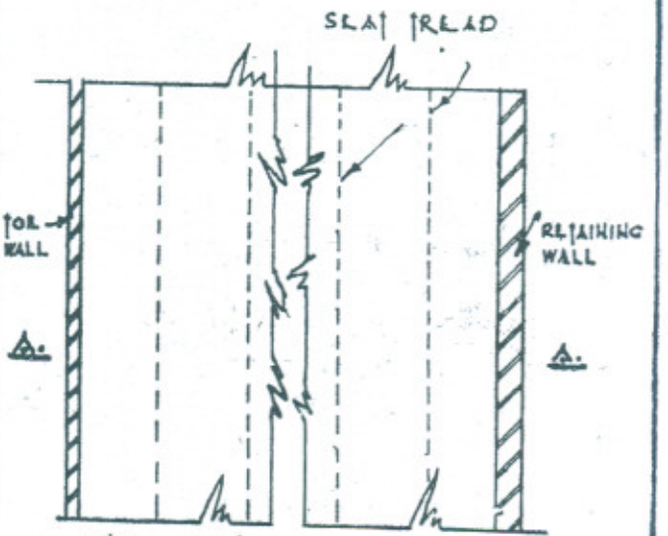
ELEVATION.



SECTION AT A.A.



PLAN.

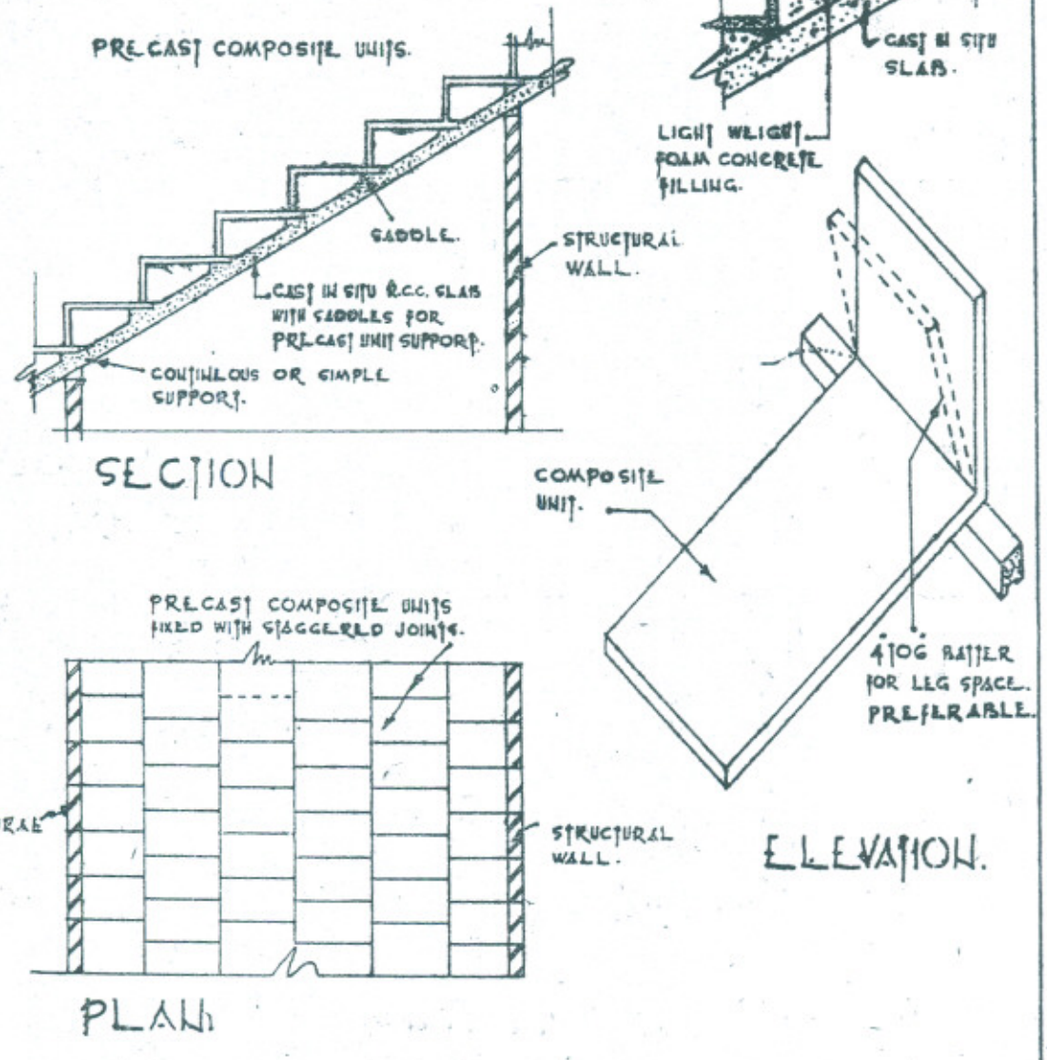


PLAN.

M. YUSAF QURESHI

FIG:49.

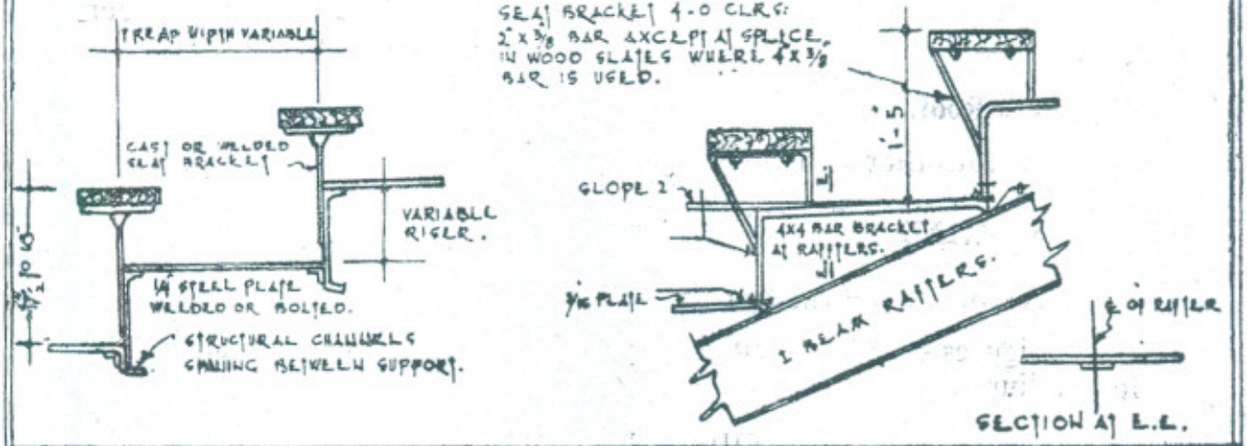
STRUCTURAL SYSTEM. (CONCRETE)



DRAWN BY- MUZAFAR QURESHI

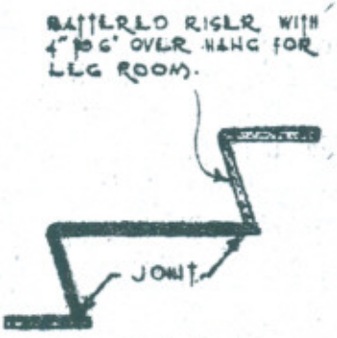
FIG:50.

STRUCTURAL SYSTEM. (STEEL)

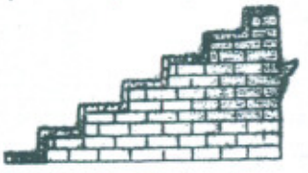


STRUCTURAL SYSTEM. (CONCRETE)

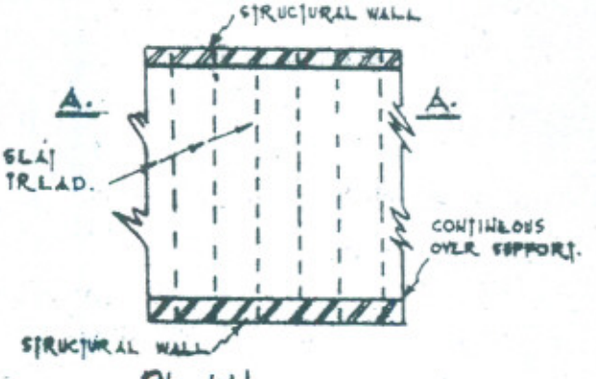
DETAIL OF SEAT.



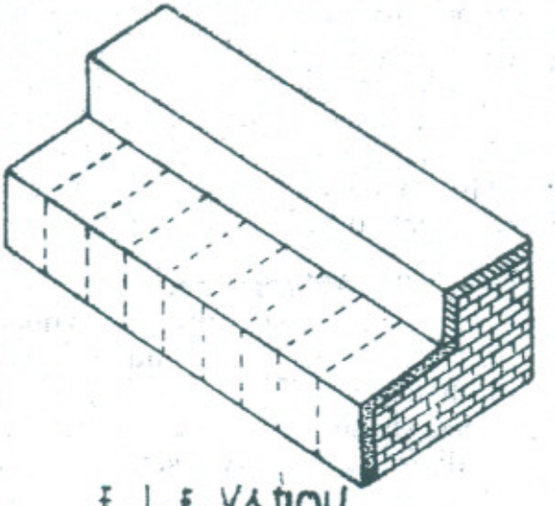
ALTERNATIVE DETAIL.



SECTION AT A.A.



PLAN.



ELEVATION.

3. Railings, Parapets and Balustrades.

(a) Vertical.	100 lbs. per ft. run.
(b) Horizontal.	30 lbs. per foot run applied at rail level or 3 ft. above floor level which ever is greater.

4. Roof.

As for other structures.

5. WIND.

As for other structures.

Figures 48, 49, and 50 give typical structural systems adaptable for stadiums.

XIII. AESTHETICS

1. Appearance.

The architectural treatment of stadium should be given wide attention. Structure should be pleasing, imposing and should give an appearance of a sports edifice. Beauty of the stadium should be the beauty of its utility, and size, rather than the elaborate treatment of its gates, entrances or ornate detailing of its outer walls. The architecture should be clean, simple and straight forward but bright and functional and should stand magnificiently free of needless ornaments and complications. Its charm should be in its simple combination of colour and form, poize of structure against land scape, conformity of setting against surroundings.

2. Land Scaping.

Beauty and behaviour are not unrelated. It is easier to keep order in beautiful and attractive surroundings. The site, its size, shape, topography and the natural surroungdings, and the size and placement of present and future deve lopments etc., form the majore factors in determining the overall general development plan. Roads, foot paths, trees, shrubs, and achitectural accessories such as benches, fountains, walls, railings, and paragolas, add interest to the composition. The arrangement of these and their relation to one another are the elements on which depend the maximum, use, beauty and orderliness.

3. Arboriclture.

The arboriculture is primarily concerned with the improvement of land for human use and enjoyment and combines maximum beauty with utility. The very constituents of arboriculture composition, trees, shrubs, and grass are delightful. Arboriculture will make the stadium area a city asset rather than an undesireable neighbourhood

feature. A comprehensive plan permitting a progressive seasonal and annual approach is recommended. Planting and lawn development taken up simaltaneously with construction is somewhat expensive but accelerates the completion as trees and shrubs take much longer to develope and mature than the construction work.

XIV. MULTI USES OF STADIUM

In the design of a stadium, special consideration should be given to its multiuse. Events of wide and varied interests as Independence day and Republic day march pasts and other allied observations, mass meetings and demonstrations, open air plays, pageants and *musharas*, parades and drills, police tatoos and scout rallies, special exhibitions, flower and fruit shows, *Id* and *Jumma* prayers etcetra can be held practically in any stadium. In case of an enclosed stadium, it is essential to provide one or more openings capable of accommodating vehicular traffic and ambulance service in order to cope with various contingencies.

XV. COST

In any stadium project the question of cost per seat is of primary concern and usually overshadows the factors of comfort, convenience, permanence and in extreme cases safety. The cost per seat depends upon the following factors.

(a) Seating Capacity.

The larger the seating capacity the greater the height of superstructure and higher the cost per seat.

(b) Arrangement.

The cost depends upon the economic use of space in the arrangement of seats, passages, ramps, and stairs and the effective and attractive arrangement depends upon the ingenuity and skill of the designer. The average gross plinth area per seat varies from 3 to 8 sq. ft. and the space conscious designer can scale down the cost by over 50% by eliminating the useless or rarely used areas without scarificing the comfort and safety. The area should not be larger than is required for its purpose or for reasonable future expansion.

(c) Material and the Structural System.

The gross cost per seat will depend on the selection of material, structural system and the type of finish.

(d) The Architecture.

The superimposed architectural features such as imposing towers, pretentious gate ways, and impressive ramps, passages and stairs etcetra add substantially to the beauty of structure and to the pride of locality. They charm the spectator but cost good deal of money without increasing capacity or attendance which fluctuates according to the quality of play.

(e) Under Seating Development.

The development of certain percentage of under seating accommodation is necessary for the basic requirements of the stadium. Development of all available space will *cost* good deal more without increasing the stadium capacity and will be wasteful to some extent. If this space is utilixed for some other purpose such as storage and housing etc., the proportionate cost be assigned to that purpose thus substantially reducing the cost per seat.

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