

Guide to Safety at Sports Grounds

Worked Example A: Football/Rugby

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Introduction

As has been long established, the principal objective of the *Guide to Safety at Sports Grounds* is to provide guidance on the calculation of how many people can be safely accommodated within a ground while it is hosting an event, sporting or otherwise.

Such a calculation is the most important step towards the achievement of reasonable safety.

This Worked Example shows the capacity calculations for a typical ground designed to host sports such as football or rugby and should be read in conjunction with **Chapter 2** and **Figures 1** and **2** of the *Guide*.

It is recognised that capacity calculations can be presented in different formats, for example as spreadsheets. However all the steps identified here must nevertheless be followed.

For further guidance on capacity calculations may be found on the SGSA website in the form of Worked Examples for a cricket ground (Worked Example B) and a racecourse (Worked Example C), together with Annex A on the assessment of the (P) factors and Annex B on the assessment of (S) factors.

Both the *Guide to Safety at Sports Grounds* and this Worked Example are compiled and published by the Sports Grounds Safety Authority, Fleetbank House, 2-6 Salisbury Square, London EC4Y 8JX

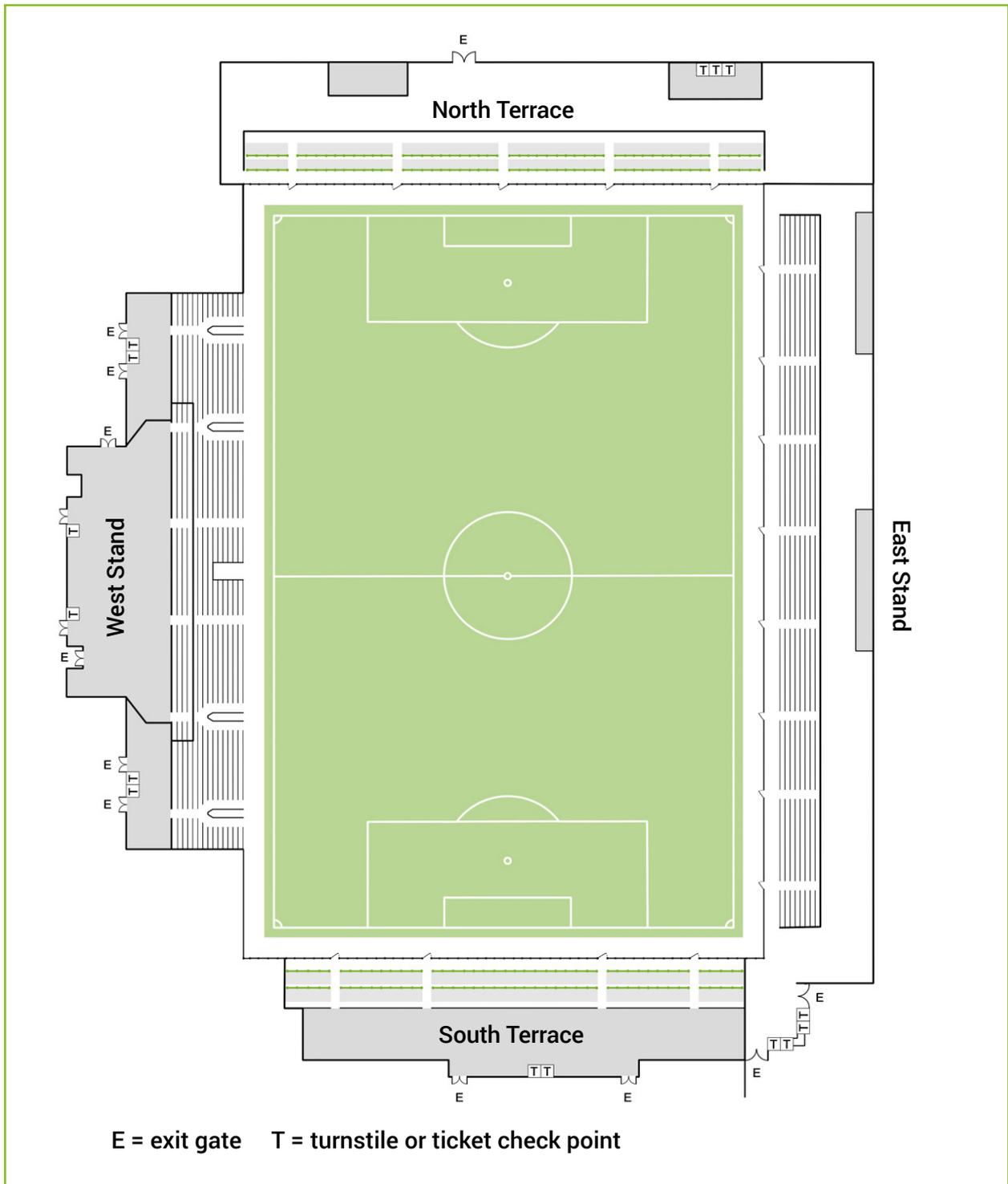
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WEA.1 Introduction

This example shows a football or rugby ground offering reserved seating on both sides of the pitch, and terraces for standing at each end. All the spectator accommodation is covered. The circulation system is restricted so that spectators can enter only the stand or terrace for which they have purchased tickets.

The calculations that follow are based upon the stages outlined in Chapter Two of the *Guide to Safety at Sports Grounds*. The step numbers cited correspond with the steps set out in **Figure 1** (seated accommodation) and **Figure 2** (standing accommodation).



WEA.2 West Stand

a. Step 1 – calculate the number of usable seats

This step is explained in Sections 2.6, 12.15 and **Figure 1** of the *Guide*.

The West Stand contains two sections with the following numbers of seats:

Main tier: $1536 + 8 \text{ wheelchair spaces} + 8 \text{ helpers} = 1552$

Executive: $288 + 4 \text{ wheelchair spaces} + 4 \text{ helpers} = 296$

There are no damaged seats and none with restricted views. There are no rows with seats in excess of the recommended number between radial gangways.

Therefore the number of usable seats in the West Stand is: **1848**

b. Step 2 – calculate the holding capacity

This step is explained in Section 2.6 and **Figure 1** of the *Guide*.

The West Stand is well maintained and in good order. All seats are covered and offer reasonable sightlines. No unreserved seats are on sale. The management have assessed both the (P) and (S) factors for the stand as 1.0.

Therefore the holding capacity of the West Stand is: $1848 \times 1.0 = \mathbf{1848}$

For more guidance on (P) and (S) factors see online Annexes A and B.

c. Step 3 – calculate the entry capacity

This step is explained in Sections 2.11, 7.5 and **Figure 1** of the *Guide*.

From observation and experience it is apparent that all four automated turnstiles serving the Main Tier and the two ticket check points serving the Executive area can process the recommended maximum rate of entry, that is, 660 persons per entry point per hour.

Therefore the entry capacity of the West Stand is: $660 \times 6 = \mathbf{3960}$

d. Step 4 – calculate the exit capacity

This step is explained in Sections 10.10 – 10.11 and **Figures 1 and 13** of the *Guide*.

For calculation purposes, the egress time under normal conditions from the seated accommodation to the start of the exit system – referred to in the *Guide* as the Zone 2 travel time – is set at a maximum of **eight minutes**. (As explained in **Figure 13**, under normal conditions there is no need to measure how long it might take spectators to negotiate the entire exit route.)

Main tier: the start of the exit system consists of four vomitories at ground level, each measuring 1.5 wide. These vomitories lead through the concourse to four final exit gates, each of which measure 3m wide. For the purposes of calculation, the *narrower* width of the vomitory (1.5m) should be used, rather than that of the final exit gates (3m).

All spectators other than those in the front row must step down the radial gangways in order to exit via the vomitories. On a stepped surface, the *maximum* flow rate used for calculation is 66 persons per metre width per minute.

Therefore the exit capacity of the West Stand's main tier is: $(4 \times 1.5) \times 8 \times 66 = \mathbf{3168}$

Executive area: normal egress is via four exits at the rear of the executive seating area, each 1.2m wide, leading into a hospitality lounge and from there down stairs to two exit gates, each measuring 3.0m wide. These factors, combined with observation of crowd flow and spectator behaviour, lead the ground management to apply the maximum flow rate 66 people per metre width per minute for the purposes of calculation.

The Zone 2 travel time for the Executive area (that is the time set for spectators to reach the start of the exit system under normal conditions) is eight minutes. (As explained in **Figure 13**, under normal conditions there is no need to measure how long it might take spectators to negotiate the entire exit route.)

Therefore the exit capacity of the Executive area is: $(4 \times 1.2) \times 8 \times 66 = 2534$

Therefore the total exit capacity of the West Stand is: $3168 + 2534 = 5702$

e. Step 5 – calculate the emergency exit capacity

This step is explained in Sections 2.13, 10.12–10.18, 15.8–15.12 and **Figures 1 and 13** in the *Guide*.

Main tier: all emergency exit routes pass through concourse areas with a low risk of fire. The condition and the management of the emergency exit routes are considered to be good, and it is not considered necessary to discount one emergency exit for the purpose of calculation. Therefore a maximum emergency egress time of **eight minutes** – the same as the exit time under normal conditions – is considered to be applicable.

Therefore the emergency exit capacity for the Main tier = **3168**

Executive area: all emergency exit routes pass through areas, parts of which are high risk, others of which are medium risk. As stated in Section 15.12, the emergency egress time for all parts of the route should therefore be set as if the whole route were subject to high risk, that is, a maximum **two and a half minutes**. It is not considered necessary to discount one emergency exit for the purpose of calculation. The condition and the management of the exit routes are also considered to be good.

Therefore the emergency exit capacity of the executive area is: $(4 \times 1.2) \times 2.5 \times 66 = 792$

Therefore the total emergency exit capacity of the West Stand is: $3168 + 792 = 3960$

As stated in Section 2.13, the emergency exit capacity must include not only spectators but *all* people present. In this stand, however, the emergency exit capacity comfortably exceeds the total number of spectators, staff and other personnel likely to be on duty in the stand, and therefore the emergency exit capacity does not need to be re-calculated.

f. Step 6 – calculate the final capacity of the West Stand

This step is explained in Sections 2.11 and **Figure 1** of the *Guide*.

The final capacity of the West Stand is lowest figure of those calculated, as follows:

Step 2: holding capacity:	1848
Step 3: entry capacity:	3960
Step 4: exit capacity:	5702
Step 5: emergency exit capacity:	3960

Step 6: final capacity of **West Stand** = **1848**

WEA.3 East Stand

a. Step 1 – calculate the number of usable seats

This step is explained in Sections 2.6, 12.15 and **Figure 1** of the *Guide*.

The East Stand consists of one tier of 1536 seats. No seats are damaged and none has restricted views. There are no rows with seats in excess of the recommended number between radial gangways. There are spaces for 4 wheelchair users and 4 seats for helpers.

Therefore the number of usable seats in the East Stand is: $1536 + 8 = 1544$

b. Step 2 – calculate the holding capacity

This step is explained in Section 2.6 and **Figure 1** of the *Guide*.

The East stand is well maintained and in good order. All seats are covered and offer reasonable sightlines. There are no unreserved seats on sale. The management have assessed both the (P) and (S) factors for the stand as 1.0.

Therefore the holding capacity is: $1544 \times 1.0 = 1544$

c. Step 3 – calculate the entry capacity

This step is explained in Sections 2.11, 7.5 and **Figure 1** of the *Guide*.

From observation and experience it is apparent that all four of the East Stand's turnstiles in the south east corner can process the recommended rate of entry, that is, 660 persons per entry point per hour.

Therefore the entry capacity of the East Stand is: $660 \times 4 = 2640$

d. Step 4 – calculate the exit capacity

This step is explained in Sections 10.10 – 10.11 and **Figures 1 and 13** of the *Guide*.

For calculation purposes, the egress time under normal conditions from the seated accommodation to the start of the exit system – referred to in the *Guide* as the Zone 2 travel time – is set at a maximum of **eight minutes**. (As explained in **Figure 13**, under normal conditions there is no need to measure how long it might take spectators to negotiate the entire exit route.)

At the front of the East Stand is a 3m wide lateral gangway. This leads to two final exit gates at the south end of the stand, each also measuring 3m in width. The exit route is on a level surface and with few changes of direction. On a level surface, the *maximum* flow rate used for calculation is 82 persons per metre width per minute.

Therefore the exit capacity of the East Stand is: $(2 \times 3) \times 8 \times 82 = 3936$

e. Step 5 – calculate the emergency exit capacity

This step is explained in Sections 2.13, 10.12–10.18, 15.8–15.12 and **Figures 1 and 13** in the *Guide*.

All exit routes pass through areas with a low risk of fire. It is not considered necessary to discount one emergency exit for the purpose of calculation. The condition and the management of the exit routes are also both considered to be good. Therefore a maximum emergency egress time of **eight minutes** – the same as the exit time under normal conditions – is considered to be applicable.

Therefore the emergency exit capacity of the East Stand = **3936**

As stated in Section 2.13, the emergency exit capacity of the stand must include not only spectators but *all* people present. In this stand, however, the emergency exit capacity comfortably exceeds the total number of spectators, staff and other personnel likely to be on duty in the stand, and therefore the emergency exit capacity does not need to be re-calculated.

f. Step 6 – calculate the final capacity of the East Stand

This step is explained in Section 2.11 and **Figure 1** of the *Guide*.

The final capacity of the East Stand is lowest figure of those calculated:

Step 2: holding capacity:	1544
Step 3: entry capacity:	2640
Step 4: exit capacity:	3936
Step 5: emergency exit capacity:	3936
Step 6: final capacity of East Stand =	1544

WEA.4 North Terrace

a. Step 1 – calculate the available viewing area

This step is explained in Section 2.8 and **Figures 2** and **15** in the *Guide*.

The North Terrace has two rows of crush barriers, each configured continuously between radial gangways measuring 1.2m wide. The crush barriers at each end of the front row measure 5.0m in length. The four other crush barriers in the front row each measure 14.5m in length. All crush barriers have been tested to 3.0 kN/m.

The risers and goings of the terrace steps measure 180mm and 380mm respectively, forming an angle of 25 degrees. Between the first row of crush barriers and the pitch perimeter barrier is a lateral gangway, 2.4m in depth. There are no restricted views.

First row of crush barriers: the depth of terracing between the first row of crush barriers and the second (or rearmost) row is 1.9m. However, as stated in **Figure 15**, for barriers of 3.0 kN/m on a terrace with a slope of 25 degrees the maximum distance between barriers should be 1.8m.

For the purpose of calculation therefore the available viewing area for this row of barriers is 1.8m rather than 1.9m.

Therefore the available viewing area for the terracing behind the first row of crush barriers is: $(2 \times 5) + (4 \times 14.5) = 68.0 \times 1.8 =$ **122.4 square metres**

Second row of crush barriers: the depth of terracing behind the second row of barriers (at the rear) is 3.1m. Again, however, as stated in **Figure 15**, the maximum distance for calculation purposes should be 1.8m.

Therefore the available viewing area for the terracing behind the second row of crush barriers is also: $(2 \times 5) + (4 \times 14.5) = 68.0 \times 1.8 =$ **122.4 square metres**

Therefore the total available viewing area for the North Terrace = **244.8 square metres**

b. Step 2 – calculate the appropriate density

This step is explained in Section 2.9 and **Figure 2** in the *Guide*.

The North Terrace is fully covered, in good condition and there no sightline problems. The management considers an appropriate density for the terrace is 4.7 spectators per square metre and has assessed both the (P) and (S) factors for this area of the ground as 1.0.

Therefore the appropriate density for the North Terrace is: $4.7 \times 1.0 = 4.7$ **spectators per square metre.**

c. Step 3 – calculate the holding capacity

This step is explained in Section 2.10 and **Figure 2** in the *Guide*.

The holding capacity of the North Terrace is: $244.8 \times 4.7 = 1150$

d. Step 4 – calculate the entry capacity

This step is explained in Sections 2.11, 7.5 and **Figure 2** in the *Guide*.

From observation and experience it is apparent that all three of the turnstiles serving the North Terrace can process the recommended maximum rate of entry, that is, 660 persons per entry point per hour.

Therefore the entry capacity for the North Terrace is: $660 \times 3 = 1980$

e. Step 5 – calculate the exit capacity

This step is explained in Section 10.9 – 10.11 and **Figures 2 and 13** in the *Guide*.

The North Terrace has two exit points, each 2.4m wide, at each end of the front lateral gangway, leading to one final exit gate 4.8m wide. The exit routes are on a level surface and with few changes of direction.

The Zone 2 travel time for the terrace under normal conditions is **eight minutes**. (As explained in **Figure 13**, under normal conditions there is no need to measure how long it might take spectators to negotiate the entire exit route.)

Combined with observation of crowd flow and spectator behaviour, the ground management has decided to apply the maximum flow rate for a level surface of 82 people per metre width per minute for the purposes of calculation.

Therefore the North Terrace's exit capacity is: $(2.4 \times 2) \times 8 \times 82 = 3148$

f. Step 6 – calculate the emergency exit capacity

This step is explained in Sections 2.13, 10.12 – 10.18, 15.9 and **Figures 2 and 13** in the *Guide*.

The emergency exit routes for the terrace pass through areas with a low risk of fire. It is not considered necessary to discount one emergency exit for the purpose of calculation. The condition and the management of the exit routes are considered to be good. Therefore a maximum emergency exit time of **eight minutes** – the same as the normal exit time – is considered to be applicable.

Therefore the emergency exit capacity of the North Terrace = **3148**

As stated in Section 2.13 the emergency exit capacity of the terrace must include not only spectators but *all* people present. In this terrace, however, the emergency exit capacity comfortably exceeds the number of spectators, staff and personnel likely to be on duty, and therefore the emergency exit capacity does not need to be re-calculated.

g. Step 7 – calculate the final capacity of the North Terrace

This step is explained in Section 2.11 and **Figure 2** in the *Guide*.

The final capacity of the North Terrace is lowest figure of those calculated:

Step 3: holding capacity:	1150
Step 4: entry capacity:	1980
Step 5: exit capacity:	3148
Step 6: emergency exit capacity:	3148
Step 7: final capacity of North Terrace =	1150

WEA.6 South Terrace

a. Step 1 – calculate the available viewing area

This step is explained in Section 2.8 and **Figures 2** and **15** in the *Guide*.

The South Terrace has two rows of crush barriers, both configured continuously between gangways measuring 1.2m wide. The crush barriers in both rows are in three different lengths: 2 x 6.3m, 2 x 11.7m, and in the centre, 1 x 24m. Between the first row of crush barriers and the pitch is a lateral gangway, 1.2m in depth, for circulation, fronted by a perimeter barrier. The crush barriers have all been tested to 5.0 kN/m.

The risers and goings of the terrace steps measure 95mm and 280mm respectively, forming an angle of 20 degrees. There are no restricted views.

First row of crush barriers: the depth of terracing between the first row of crush barriers and second row is 3.4m, exactly as required in **Figure 15** for barriers of 5.0 kN/m on a terrace with a slope of 20 degrees.

For the purpose of calculation therefore the available viewing area for this row of barriers is: $(2 \times 6.3) + (2 \times 11.7) + (1 \times 24) = 60 \times 3.4 =$ **204 square metres**

Second row of crush barriers: the dimensions of the terracing behind the second row of crush barriers is the same as for the first row: **204 square metres**

Therefore the total available viewing area for the South Terrace = **408 square metres**

b. Step 2 – calculate the appropriate density

This step is explained in Section 2.9 and **Figure 2** in the *Guide*.

The South terrace is fully covered, in good condition and there no sightline problems. The management considers an appropriate density for the terrace is 4.7 spectators per square metre, and has assessed both the (P) and (S) factors for this area as 1.0.

Therefore the appropriate density for the South Terrace is: $4.7 \times 1.0 =$ **4.7 spectators per square metre.**

c. Step 3 – calculate the holding capacity

This step is explained in Section 2.10 and **Figure 2** in the *Guide*.

The holding capacity of the South Terrace is: $408 \times 4.7 =$ **1917**

d. Step 4 – calculate the entry capacity

This step is explained in Sections 2.11, 7.5 and **Figure 2** in the *Guide*.

From observation and experience it is apparent that both turnstiles serving the South Terrace can deliver the recommended maximum rate of entry, that is, 660 persons per entry point per hour.

Therefore the entry capacity for the South Terrace is: $660 \times 2 = 1320$

e. Step 5 – calculate the exit capacity

This step is explained in Section 10.9 – 10.11 and **Figures 2** and **13** in the *Guide*.

The South Terrace has four vomitories at the rear, each 1.2m wide, leading into a concourse. From the concourse there are two exit gates at the rear, each 1.5m wide. The exit routes are on stepped surface and with few changes of direction.

The Zone 2 travel time for the terrace under normal conditions is **eight minutes**. (As explained in **Figure 13**, under normal conditions there is no need to measure how long it might take spectators to negotiate the entire exit route.)

Combined with observation of crowd flow and spectator behaviour, the ground management has decided to apply the maximum flow rate of 66 people per metre width per minute for the purposes of calculation.

The four vomitories at the rear of the terrace offer a total exit width of 4.8m. However the two exits at the rear of the concourse offer a narrower total width of 3.0m. Therefore for the purpose of calculations, the narrower total width should be used for calculation.

Therefore the South Terrace's exit capacity is: $(2 \times 1.5) \times 8 \times 66 = 1584$

f. Step 6 – calculate the emergency exit capacity

This step is explained in Sections 2.13, 10.12 – 10.18, 15.10 and **Figures 2** and **13** in the *Guide*.

The emergency exit routes for the South Terrace pass through areas with a medium risk of fire (owing to catering outlets in the concourse). It is not considered necessary to discount one emergency exit for the purpose of calculation. The condition and the management of the exit routes are considered to be good. Therefore a maximum emergency exit time of six minutes is considered to be applicable.

The emergency exit capacity is therefore $(2 \times 1.5) \times 6 \times 66 = 1188$

As stated in Section 2.13 the emergency exit capacity of the terrace must include not only spectators but *all* people present. In this terrace, however, the emergency exit capacity comfortably exceeds the number of spectators, staff and personnel likely to be on duty, and therefore the emergency exit capacity does not need to be re-calculated.

g. Step 7 – calculate the final capacity of the South Terrace

This step is explained in Section 2.11 and **Figure 2** in the *Guide*.

The final capacity of the South Terrace is lowest figure of those calculated:

Step 3: holding capacity:	1917
Step 4: entry capacity:	1320
Step 5: exit capacity:	1584
Step 6: emergency exit capacity:	1188
Step 7: final capacity of South Terrace =	1188

WEA.7 Calculate the final capacity of the ground

This step is explained in Sections 2.11 in the *Guide*.

The final capacity of the ground is:

West Stand:	1848
East Stand:	1544
North Terrace:	1150
South Terrace:	1188
Final capacity:	5730

WEA.8 Applying the capacity calculation

Under no circumstances should more than 5730 spectators be admitted to the ground, unless remedial work and any other necessary steps have been undertaken, and the capacity calculation then re-assessed.

For example, the capacity of the South Terrace could be raised if fire safety measures were introduced to the concourse area, thereby reducing the level of risk from medium to low, and if the final exit gates were widened.

WEA.9 Planning for a heightened security alert

This step is explained in Sections 3.18, 7.5 –7.6 and Figure 7 in the *Guide*.

Owing to a heightened security alert the management are advised to conduct manual searches of all spectators entering the ground for a particular event. This procedure is expected to reduce the rates of entry.

Experience from previous occasions when similar searches have been undertaken suggest that the rate of entry will decrease to approximately 350 persons per entry point per hour.

The ground management must therefore decide what is the preferred outcome and then implement the appropriate contingency plans. The options are:

- a. to maintain the ground's full capacity** – this will require additional, trained stewards to be deployed, for spectators to be advised in advance to arrive early (for example using advertisements, press notices and social media), and for all entry points to be opened early, or
- b. to delay the event's starting time** – this is to allow sufficient time for all spectators to be searched, or
- c. to accept a lowering of the capacity** – based on the anticipated reduced rates of entry.