Sample Chapter

StadiumATLAS - Technical Recommendations for Grandstands in Modern Stadia

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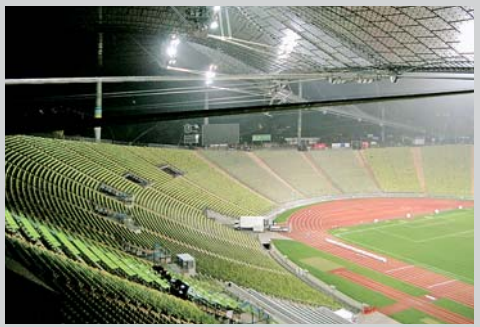
Chapter 11



216 **Main stand west (below tent roof)**
Olympic Stadium, Berlin
217 **Reverse stand – (Estadio Azteca)**
Guillermo Cañedo, Mexico City
Capacity 105,060

Pre-dimensioning and circulation

Shedding light on the relationship between circulation systems and holding capacity

External circulation systems

A fundamental planning principle for all circulation systems is to provide easy orientation to visitors of the stadium. This should preferably be achieved through structural provisions, i. e. visibility of routing through decreasing hierarchy of space proportions, rather than through additional visual measures such as signage, etc. Entrances should ideally be visible from afar and directly from the general circulation routes around the stadium. Colour coding on tickets designating each sector (blue, green, yellow, red) should also be clearly reproduced at the relevant entrances. Segregation of spectator streams is part of the safety concept of guiding different groups to their sectors along intersection-free routes:

– Home fans / Visitors
– Regular spectators / VIPs
– Press / VIPs
– Players / Service personnel.

Zone 1 – Playing field	central area
Zone 2 – Spectator stand	auditorium
Zone 3 – Stadium	circulation area
Zone 4 – Sports complex	external area

1st check	at the outer safety ring
2nd check	at the stadium entrances
3rd check	at the concourse access to the stand
4th check	at the stand vomitories

Corresponding to the above mentioned areas, *external* and *internal* circulation are distinguished. All routes beyond or below the stand belong to the external group. All routes to seating / standing places on the stand (from access / vomitory) belong to the internal group.

Number of tiers

Depending on the concept and capacity, the stand structure is divided into *tiers*. The classical earth stadium with just one lower tier is either created by lowering of the pitch into the ground (or topographical trough / hillside) or by constructing a circulating embankment.

The concept of the built stadium either replaces the terrain elevation of the Greek or Roman theatre, or complements the spectator embankment by a further structural upper tier (as in Müngersdorfer Stadion, Cologne, 1975). The number of consecutive tiers depends on the required capacity and the utilizations designated to the ancillary rooms beneath the terrace.

World Cup Stadium Stuttgart: one-tier stadium
World Cup Stadium Cologne: two-tier stadium
World Cup Stadium Munich: three-tier stadium

Note: Mistakes may occur when determining the number of tiers of a grandstand. For example, a two-tier stadium from a visual or structural viewpoint, the Aztec Stadium in Mexico City (Guillermo Cañedo) is a three-tier stadium with regards to circulation. Ingress and egress at the upper tier of World Cup Stadium Hamburg, takes place on two access levels. Technically a two-tier stadium, the size of the spectator blocks at the upper tier forms two tiers (middle and upper tier) which are fed from a lateral gangway. To avoid confusion, terraces should be distinguished by clear visual separations such as 'box tiers' (one joint = two tiers).

To reach their seats, spectators follow two directions of movement: *vertical* and *horizontal*.

A stadium with more than one tier should guide spectator streams vertically to the different lateral gangways / concourses.

Generally, the routes leading there and back are the same. Determination of necessary exit widths applies only to emergency evacuation. Regular routing may be complemented by additional escape routes (e.g. additional evacuation gates). The following vertical systems of circulation are distinguished:

Stairs

This is the main and most frequently implemented option of leading spectators to the respective circulation areas. For the external area, a design value of 1.20 m per 600 persons and max. 2.40 m clear flight width applies.[1]

Split/staggered stairs seem especially suitable for confined spaces; straight-line stairs, however, are better as short stairs for terrace access along the vomitory axis (compare to middle tier Allianz Arena, Munich, or Stade de Suisse, Berne/Switzerland)

Cascading stairs covering several storeys are relatively long and are located as near the façade (as in Köln-Arena, architects G. Böhm). If necessary, they intersect under-terrace utilizations (as in Allianz Arena).

Ramps

This circulation type is becoming increasingly rare. There are, however, prominent examples, such as the Estadio Santiago de Bernabeu in Madrid, Spain, or the Guiseppe Meazza Stadio (San Siro) in Milan, Italy.

Since the shape of such systems tends to be prominent, they possess a significant recognition value. The relevant DIN standard describes the structural requirements for ramps as follows:[2]

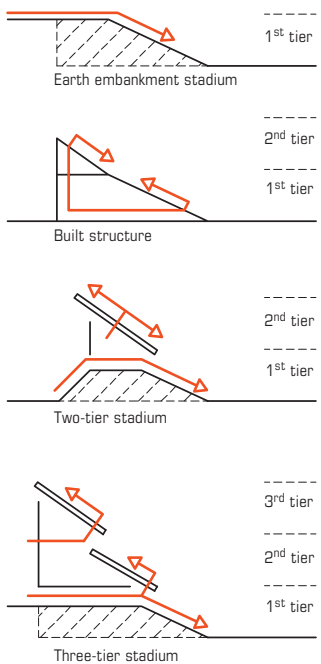
'Circulation areas for buildings with a longitudinal gradient of more than 3% are to be realized as ramps, the rake of which may be 6% maximum. A transverse slope is inadmissible. The length of each ramp flight is limited to 600 cm maximum. Platforms are to be installed between the flights. No descending stairs may be placed at the prolongation of a ramp.'

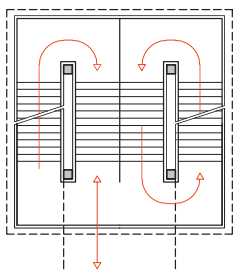
Lifts and escalators

Passenger and goods lifts are planned for almost every large sports or event venue. Goods lifts connect the low-lying storage rooms with the kitchens and kiosks in the higher storeys. In case of vertical stacking of catering service units, such as production kitchen, dishwashing facility or storage space, at least one lift system is obligatory. Provision of further goods lifts depends on the catering concept or stadium operation.

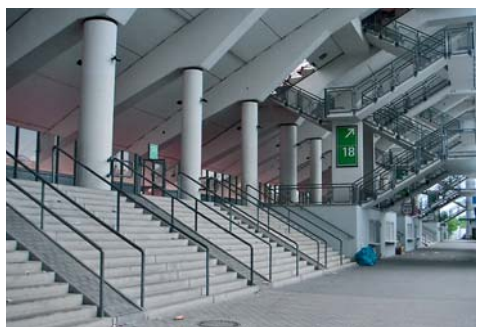
Passenger lifts in the VIP area facilitate convenient access to VIP suites as these are mostly located on the higher levels of the box tier, at the separation between upper and lower tier. Their number and outfit depends on the wishes of the stadium operator, or rather on the number of people intended to be transported up or down per hour.

Escalators, as in Gelsenkirchen or Munich, are employed less frequently.



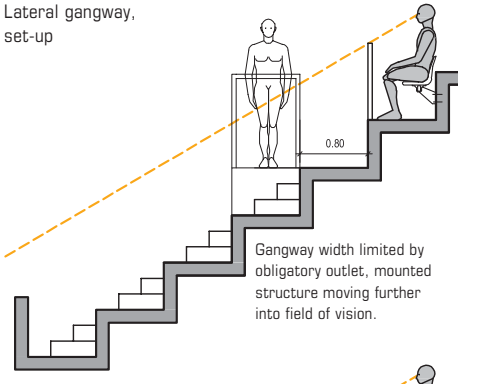


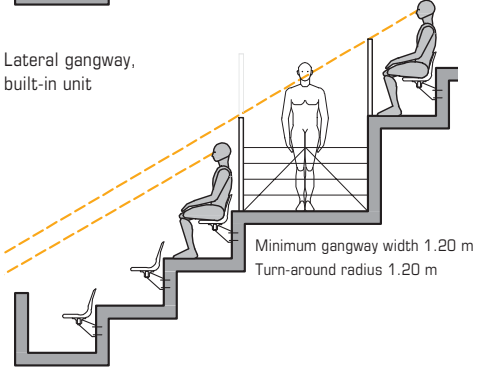
218 **Principles of circulation/tier sections**
(4 system drawings)
219 **Staggered stairs (drawing ca. 10 x 10 cm)**
Type RheinEnergieStadion, Cologne

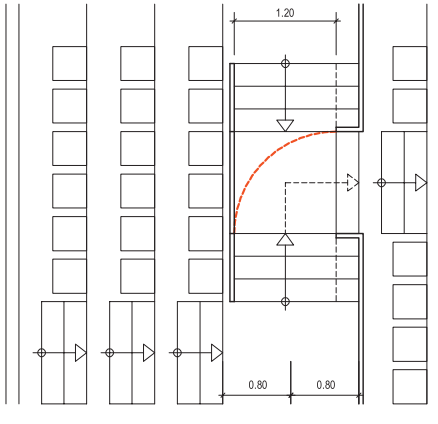


220 **Circular ramp tower**
Stadium Faro, Portugal, EURO 2004
221 **Short stairs between twin joggle beams**
Stadium Stade de Suisse, Berne, EURO 2008
222 **Wall stairs**
World Cup Stadium Nuremberg 2006

Internal circulation systems







223 **Vomitory circulation**
Stade de France, Paris
Capacity 80,000

224 **Access situation through vomitory**
Olympic Stadium, Berlin

225 **Gangway landing with turn-around radius 1.20 m**
System drawing with change of direction
horizontal on vertical

First: Terrace access

Two options of internal terrace access are common:
a) from a vomitory (at the terrace), same-level or with short stairs
b) from the concourse (behind the tier)

A concourse or tier access is the most efficient option, as the terrace is accessed directly from the rear without loss of seating caused by vomitories. This type of access is normally integrated into the gap between lower and upper tier (as in World Cup Stadium Nuremberg).

In some cases though, this joint is already taken up by high-quality hospitality suites, mostly with a large VIP area adjoining at the rear. An exception would be the Olympic Stadium in Berlin which has corridors from the lower circulation levels passing through between individual groups of boxes.

Access to the upper tier accommodation is mostly via vomitories, as it seems rather unpractical to bring spectators to the height of the upper edge / upper tier in order to then access the tier from the rear. (Exception: AWD Arena, Hanover, where the upper tier of the west stand is accessed via the wall system and the lower tier via a lateral gangway called 'Avus').

Second: Radial gangway system

As MVStättV 2005 limits block width to a maximum of 2 x 20 places, the distribution of gangways becomes essential:
Maximum block size: 30 rows x 40 persons
Maximum gangway grid: 22.40 m
30 rows x 40 places = 1,200 persons
per 600 pers. = 1.20 m escape route width
40 x 0.50 seating grid = 20 m + 2.40 m

Regular distance

The intervals at which vomitories are installed vary significantly in all German World Cup stadia (from 13.5 m to 37.0 m) and are reliant on the structural and circulation grid. The number of vomitories is essentially based on the underlying circulation principle, i. e. the way spectators reach the gangway:
a) vertical circulation (radial gangways)
b) horizontal circulation (lateral gangways)

Either the vertical circulation is directly adjoined to the terrace circulation (a) or the spectators are distributed horizontally up to the respective gangway.

Two different principles are distinguished: *one vomitory – one gangway* or *one vomitory – two gangways*. In the latter case, the gangways are located along the field axis, i. e. one vomitory for every other planning grid.

In the case of horizontal distribution of spectators (as for the upper tier of World Cup Stadium Hamburg), the gangway width should be integrated into the terrace elevation to keep it from affecting the sightline profile of people sitting behind. Depending on the number of people it has to accommodate, a larger width requires a short-stair gangway leading the evacuation route from the vertical to the horizontal, without diminution. The stairway itself may cause viewing restrictions.

Radial gangway types

There are three principal systems for a vomitory circulation:
a) axial gangway
b) single-plan gangway
c) double-plan gangway

The rampant gangway represents a very efficient type of circulation as it circumnavigates the problem of joining the double-plan gangway to the right and the left of the vomitory into an axial gangway. The axial route to the vomitory requires a safety barrier (to prevent people from falling) of 1.10 m at the turn-around platform of the vomitory lintel. This railing (also called 'cow catcher') often results in viewing restrictions towards the corner flag. Depending on the visual angle zone, the number of affected spectators may be excessively high.

Note: Glass railings or fillings are urgently advised for all components of the stand which might be located within the sightline profile of spectators (barriers, etc.).

Escape routes are not to be tapered along their course. Their exit width may be combined and added in the direction of flight, but under no circumstances may the width be reduced.

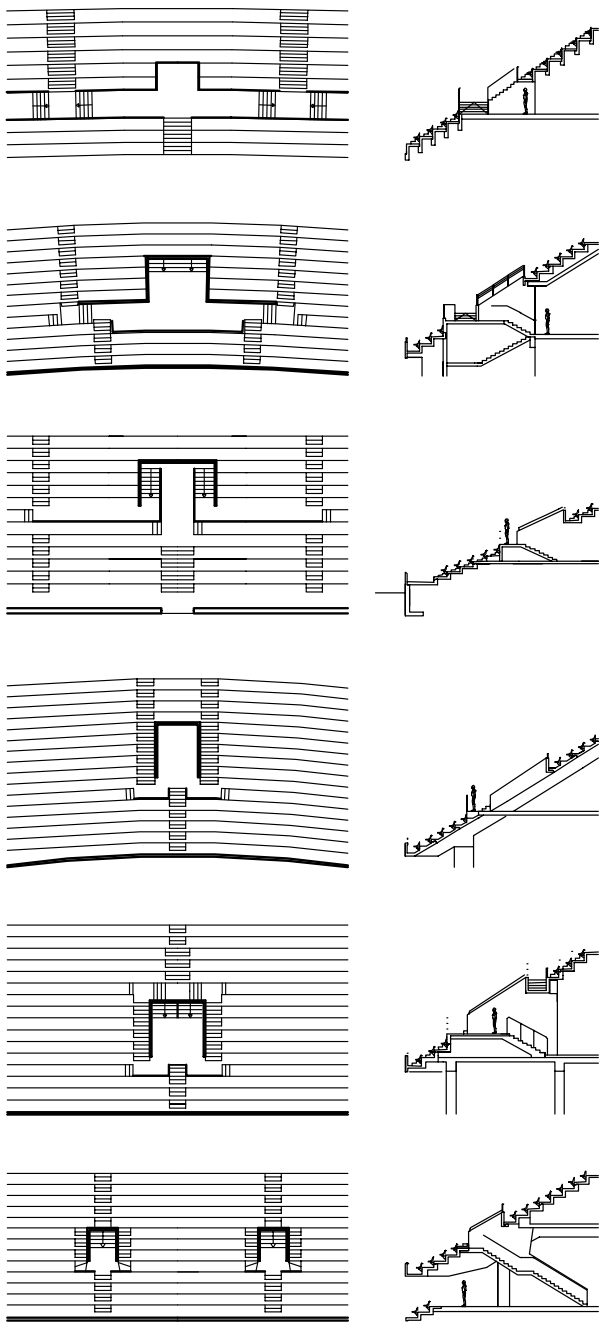
This precondition creates an additional problem for the stands: a seating row must be at least 40 cm wide (clearance); but exit width is calculated only for the gangway. Here, the number of people reliant on this particular gangway becomes crucial. Minimum width is 1.20 m, which is 30 % wider than the recommended tread depth of 80 cm.

Therefore, more than one riser is needed for the horizontal distribution of spectators and the evacuation route (width) frequently leads directly around the vomitory and upward.

Viewing obstructions

Lateral gangway
A horizontal distribution of spectators may result in sight restrictions for occupants on the stand and on the turn-around platform to the gangway. Planning should ensure that the number of people allocated to it and the resulting sight restrictions are kept to a minimum (compare to *Green Guide*, B028, p. 110).

226 – 231 **Vomitory typologies with section sketch**
System drawings of built examples for World Cup 2006



226 **Upper tier, Hamburg**
Vomitory = 3.0 m Gangway = 1.2 m
Horizontal
w = 2.0 m *l* = 2 x 7.5 m

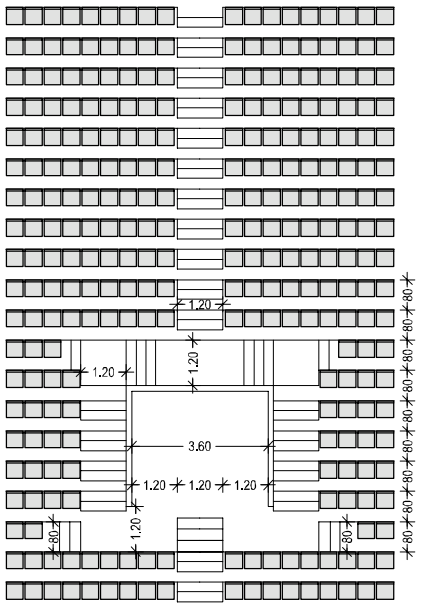
227 **Upper tier, Frankfurt**
Vomitory = 4.25 m Gangway = 1.2 m
Horizontal
w = 2.1/1.6 m *l* = 2 x 7.5 m

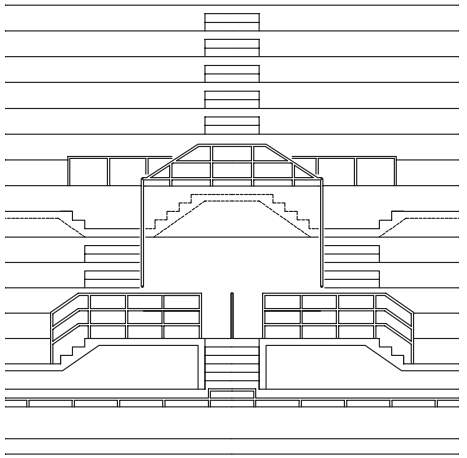
228 **Lower tier, Cologne**
Vomitory = 5.4 m Gangway = 1.2 m
Horizontal (3 accesses = 1 vomitory)
w = 1.6 m *l* = 2 x 9.4 m

229 **Upper tier, Hanover**
Vomitory = 3.0 m Gangway = 1.3 m
Double / single-plan

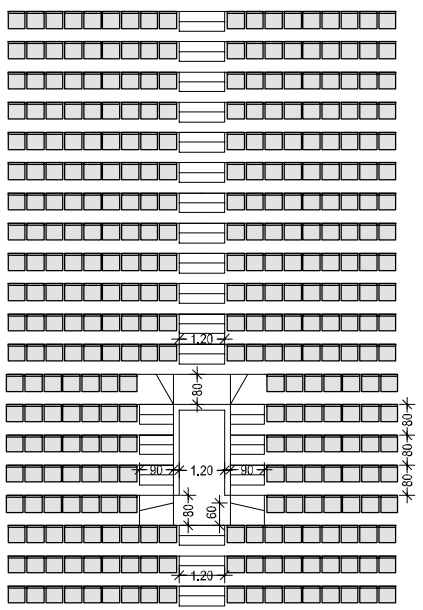
230 **Upper tier, Cologne**
Vomitory = 3.6 m Gangway = 1.2 m
Axial (vomitory grid 20.0 m)

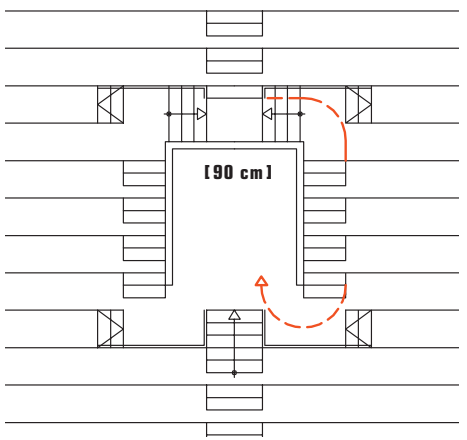
231 **Upper tier, Munich**
Vomitory = 5.4 m Upper tier = 1.35 m
Gangway = 0.9/1.2 m
Axial (vomitory grid 12.5 m)





RheinEnergieStadion, Cologne
232 **Vomitory type (system 3.60 m)** (left)
233 **Vomitory type (elevation)** (right)





Allianz Arena, Munich
234 **Vomitory type (system 1.20 m)** (left)
(scale of execution, clear width = 1.35 m)
235 **Turn-around radius 90 cm** (right)

The vomitory type at the upper tier in World Cup stadium *Cologne* shows that the necessary radius of the escape route can only be achieved by placing a double riser at the vomitory exit.

The vomitory type in *Munich* has a gangway of just 0.90 m to the left and right which is joined up axially above the vomitory into a 1.20-m gangway.

According to the relevant regulation for places of assembly, a clearway of 0.90 m is permissible for a limited number of people (interior areas < 200 persons).[3]

There are around 20 seating rows above the vomitory at the middle tier of World Cup Stadium Munich. The axial spacing of vomitories is circa 12.5 m, so with a seating grid of 50 cm each area to the side of the gangway has to accommodate around 200 people. The 90-cm platform on both sides of the vomitory is executed as a 'spiral stair'; the advantage being that no second double riser (see above) is necessary for the 180° change of direction at the vomitory.[4] Before the entire stand geometry is based on this principle, clarification with the respective approval body prior to planning should be sought.

Note: The low number of two risers surely suggests a deviation from the planning regulations, especially since the upper riser (external w = 40 cm) is covered completely by the next seat. (To the author, the double riser at the spiral point appears problematic.)

The axial gangway, which separates (descending) to the left and right above the vomitory, promotes the flow of spectators in flight. Therefore, the 1.20 m axial gangway could be replaced, if need be and in coordination with approving authorities, by two 90-cm vomitory passageways. If more than 600 people are sitting above the vomitory (example: 1.80 m gangway = max. 900 people), and are not evenly distributed to the left and right, the vomitory passageways should not be reduced to 90 cm.

In this case, the number of people positioned above the vomitory may be balanced by the vomitory height in the terrace elevation, in order to adjust numbers in this gangway section to below 600 persons.

Note: The 90-cm rule is not yet represented in the official regulations (MVStättV 2005).

Reduction factor

The effects a chosen vomitory type might have in terms of seat loss will be systematically clarified for four typical angles of slope (20°/25°/30°/35°) without taking into account horizontal distribution.

By means of preliminary dimensioning, capacities may be approximately calculated in the early planning stages and verified during the ensuing design process. The principle of capacity determination in relation to space is based on tier access, that is, without vomitories.

Variant A represents the classic radial gangway as axial continuation of the vomitory. Regarding the ground-plan graphics, this is a very 'clean' type as the symmetry of the supporting and circulation grid may overlap. Seat loss is relatively high at minimum evacuation route widths of 1.20 m.[5] Efforts to reduce the vomitory width, or rather the loss of seats, of around 6.0 m seem reasonable enough.

Proposal D works, for this reason, with a 2 x 90 cm division of the axial 1.20-m gangway, reducing the number of reliant persons to 2 x 300.[6] For the vomitory grid this means: for 30 rows (block size) and a maximum of 600 people on 1.20 m gangway width = 2 x 10 people to each side of the gangway. This roughly corresponds to the 12.50 grid implemented at World Cup Stadium Munich. Variant D thus produces a denser vomitory grid than variants A – C because no further restrictions on the number of people, other than 600/1.20 m, are necessary.

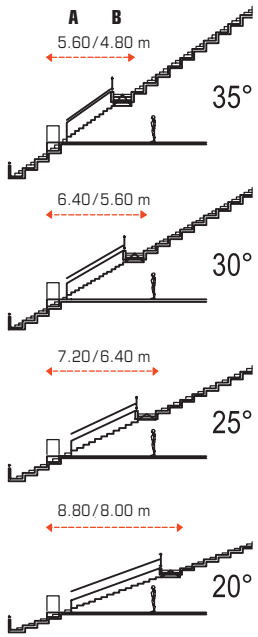
Interpolation of both limit values should be possible; the other extreme would be to exploit the capacity of 2 x 20 persons for each side of the gangway. The maximum vomitory grid (22.40 m) can be exhausted, but the number of rows is reduced by the 90-cm limit to the left and right of the vomitory to a total of 600 people. Check calculation: 600/(2 x 20 people) = 15 rows.

In exceptional cases the required minimum width of 1.20 m may be reduced by around 5%; a request for deviation would have to be submitted as part of a fire protection survey.

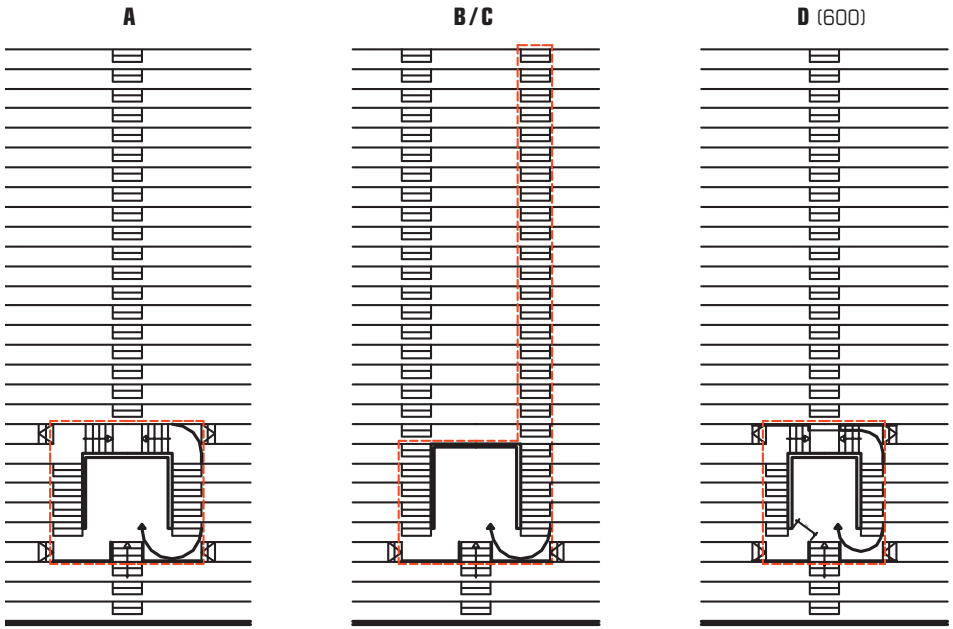
Possible reasons as given in a relevant fire-protection survey: '… since the minimum value, according to VStättVO, from the upper edge of the concrete barrier or above the safety barrier is observed and the increased space demand for a person's upper body is taken into account.'[7]

	A	B	C	D
Width	6.05 m	6.05 m	6.05 m	4.75 m
	12 seats	12 seats	12 seats	10 seats
Gradient				
20°	132 seats	120 seats	120 + 34 = 154 seats	110 seats
25°	108 seats	96 seats	96 + 38 = 134 seats	90 seats
30°	96 seats	84 seats	84 + 40 = 124 seats	80 seats
35°	84 seats	72 seats	72 + 42 = 114 seats	70 seats

236a.

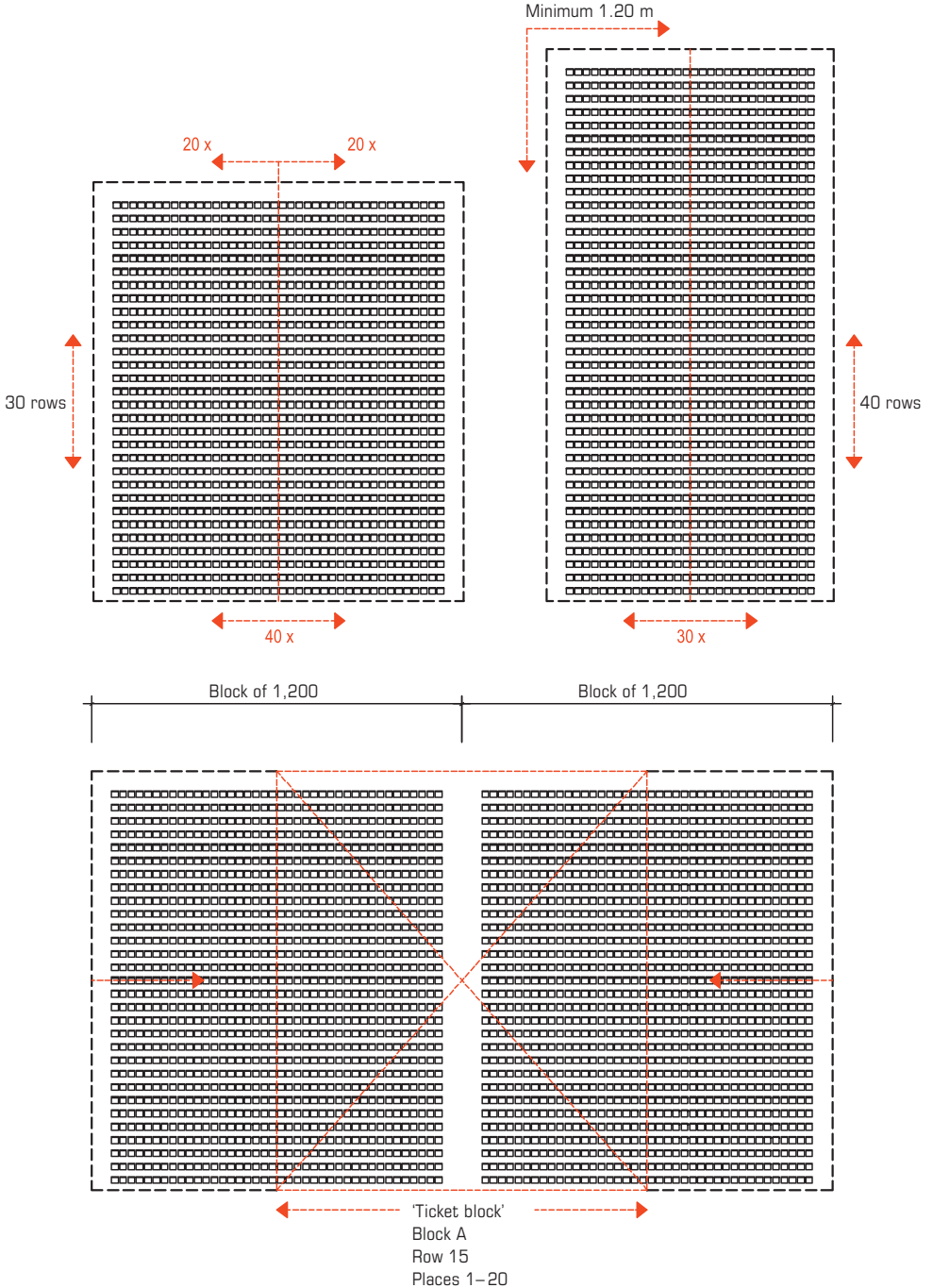


236b.



236c. Stand inclined by 35° Stand inclined by 35° Stand inclined by 35°

236 **System sketch to calculate a reduction coefficient for seats loss due to vomitory instead of open circulation via radial gangway**
a. Estimation table (reduction)
b. Sectional sketch of the tier 20°/25°/30°/35°
c. Ground-plan system types A – D



Block definition for seating accommodation

The following block definition is stated in the relevant German regulation: 'Seating accommodation must be arranged in blocks of 30 seating rows maximum. Behind and between the blocks gangways of at least 1.20 m length have to be arranged, leading at the shortest distance to the next exit.'[8]

The new '60-cm staggering' method requires a three-fold exit width for modern event arenas with convertible roofs as compared to open-air stadia. This far-reaching regulation for covered stadia also applies to theatres and cinemas.

In former legal regulations, between two gangways up to 32 people (2 x 16) are allowed to sit in rows without steep slopes.[9] For steeply inclined rows the number is reduced to 24 persons (2 x 12) and a maximum of 50 if flight doors at least 1.50 m wide are provided for every four rows.

Today, MVStättV 2005 states a maximum of 20 seats to each side of a gangway in uncovered areas, i.e. a maximum of 40 seats between two gangways. The values are reduced to 10/20 for indoor venues. A maximum of 50 successive seats is the exception, and only if a door of 1.20 m width is provided for every four rows.

Note: Deviating from this, EN/DIN 13200-1 states: seating between two radial or parallel passageways indoors 2 x 14 = max. 28 places.[10] Thus, the European standard follows the guidelines of *Green Guide* 1997 (chapter 11.14).

In Germany (status as of 2004), the project group 'Muster-Versammlungsstätten-Verordnung' is looking into defusing the regulation 1.20 m/200 persons for indoor assembly places (theatres, cinemas, etc.). Alterations would be conceivable if fire-protection aspects are considered (fire load, room height and smoke exhaust systems).

Revision to block definition[11]

The maximum size of a seating accommodation block is set at 1,200 people. The combination of row/place can be interpolated, inasmuch as the maximum length of emergency evacuation routes is not exceeded:
30 rows x 40 persons = 1,200 persons
40 rows x 30 persons = 1,200 persons

Note: This new definition of the term 'block' has so far not been entered into MVStättV 2005. However, it is deemed a viable planning base among experts.

Two definitions of blocks are distinguished. Depending on the dimensioning of spectator blocks, the block boundaries are shifted toward the centre of the block or field:
a) spectator blocks, i.e. standing/seating accommodation between two gangways, and
b) ticket blocks, i.e. the definition and numbering of single seats, generally complying with the circulation system. In this case, the term block applies to the gangway and the adjoining seating to the left and right. Hence, only spectators reliant on this gangway are counted.

237 **Block definition**
a. Sketch according to MVStättV 2005 (top)
b. Definition 'ticket block', according to *Stadium Atlas* (dissertation)

Chapter 24

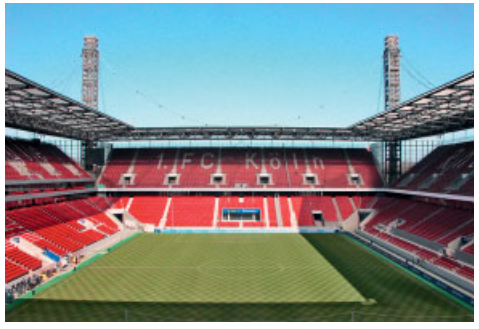
Grandstand profiles of built examples

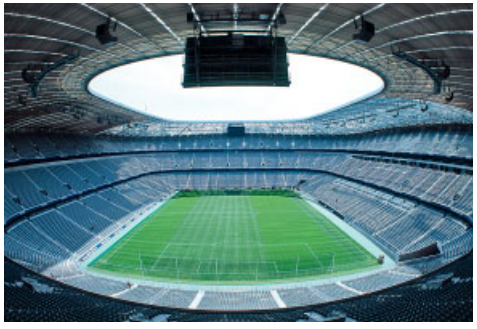
A comparison of the stadia for
FIFA World Cup 2006™ in Germany

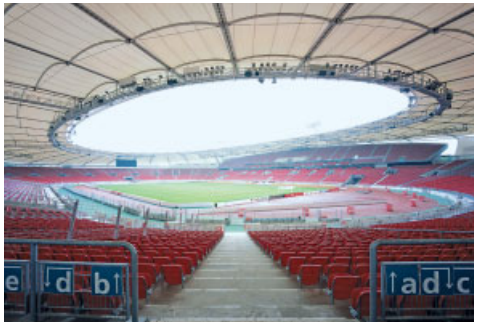




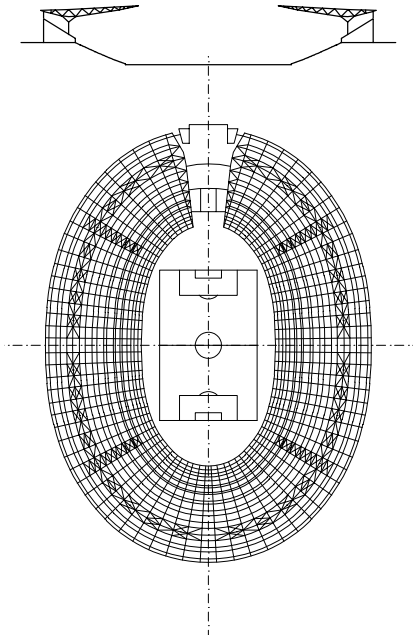


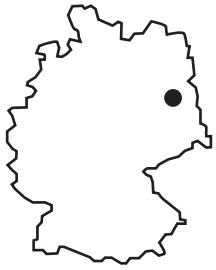




517–519 **Views of stadium interior areas**
from left to right:
World Cup Stadium **Berlin**
World Cup Stadium **Dortmund**
World Cup Stadium **Frankfurt**
World Cup Stadium **Gelsenkirchen**
World Cup Stadium **Hamburg**
World Cup Stadium **Hanover**
World Cup Stadium **Kaiserslautern**
World Cup Stadium **Cologne**
World Cup Stadium **Leipzig**
World Cup Stadium **Munich**
World Cup Stadium **Nuremberg**
World Cup Stadium **Stuttgart**





520 **Roof framework** (sectional view)
Olympic Stadium Berlin
521 **Roof framework (top view)**
Olympic Stadium Berlin
522 **Historic aerial view**
Olympic Stadium Berlin
523 **Geographic location** of the city of Berlin

page 261:
524 **Aerial view** (2006)

World Cup Stadium Berlin

In 1913, Otto March started planning for the 'German Stadium' as multifunctional stadium accommodating almost all sports in one single edifice. Because of the First World War, the 1916 Olympics were cancelled.

For the XI Olympic Summer Games, the former 'German Stadium' at the Reichssportfeld was converted and in part newly erected by the architect's sons Walter and Werner March.

A second phase of conversion followed for the Football World Cup in 1974. A MERO-system roofing of the main and opposite stand plus floodlighting system were supplemented.

In 1998, gmp architects were awarded the 1st prize in an international competition with 10 participants. The Berlin senate allocated a construction and utilization concession for 13 to 21 years to Walter Bau AG. In the summer of 2000, the complete renovation and modernization of the Berlin Olympic Stadium began.

Based on the protection requirements for historical monuments, the construction was marked by cautious renovation with only gentle interventions into the general appearance. Roofing for spectator seats was provided and modern service facilities installed. Conversion took place with 48 months from 07/2000 to 12/2004 during the regular season (minimum capacity 55,000 seats, DFB Cup Final 70,000 seats).

The two-tier multipurpose stadium is used for athletics, football and open-air concerts and has a total capacity of around 74,200 seats, with around 5,000 executive seats. It is the largest of all twelve World Cup stadia. Clockwise, beginning at the marathon gate, in three construction phases (14 substages), lower and upper tier were dismantled and newly erected. Next, the integration of the load-bearing structure was carried out for the upper-tier roofing. No documents were available on the original structure from 1936. The framework, steppings and natural stone façades were restored. The lowering of the playing field by 2.65 m created two extra seating rows, improved the sightline and enabled the set-up of a new reporters' moat (1,600 additional places).

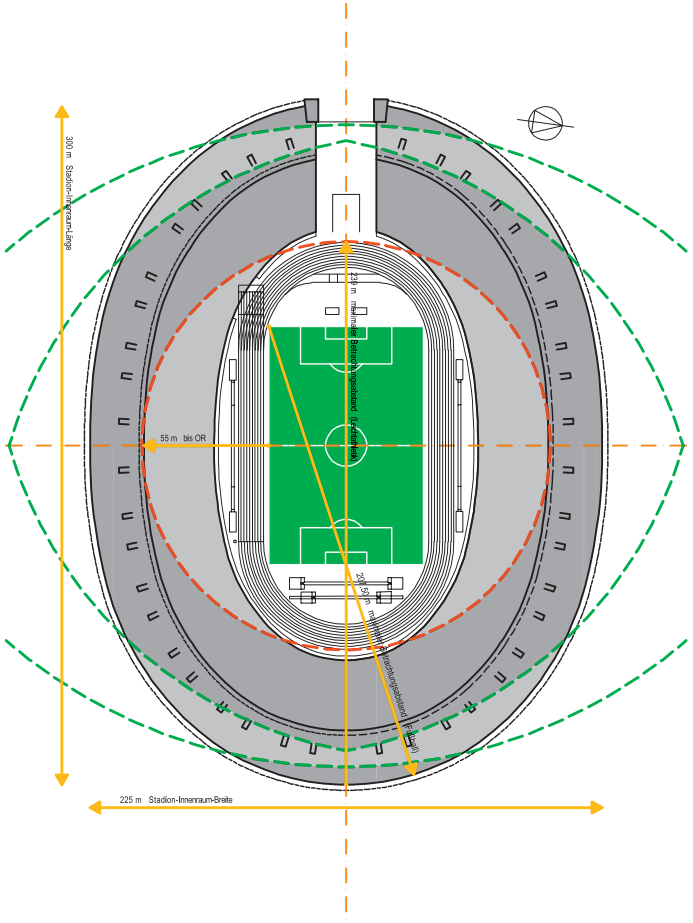
First, the outer columns and tree-like supports were erected to form the new roof structure, then binders and tangentials, followed by the membrane structure (06/2002 – 05/2004). Next, the VIP area and the catering/merchandise points were inserted into the grandstand structure as well as the underground car parks south and north.

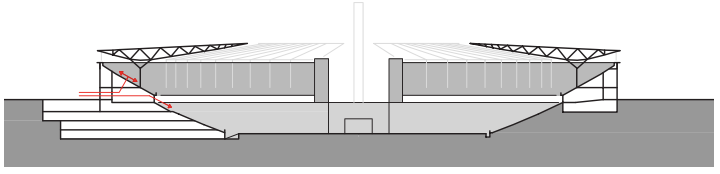
Quite exceptionally, the new tartan tracks are blue, the colour of home club Hertha BSC.

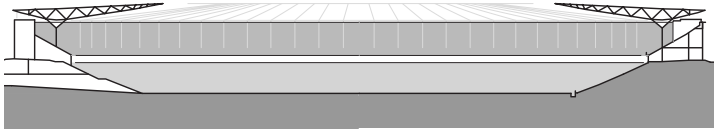
60% of spectators (around 44,500 places) are situated within an optimum viewing circle for athletics and only 22.5% of spectators (around 16,700 places) are seated within the best viewing radius of 90 m for football.

Due to the oval geometry, the circulating hospitality box tier is located near the halfway line at best viewing radius. Yet, around 3,000 spectators sit beyond the maximum admissible athletics distance of 230 m.

The large distance of the first row is typical for sports stadia with integrated athletics tracks. Football enthusiasts tend to assess more critically the rather 'expansive' atmosphere of an athletics stadium, a fact that certainly does not apply to the historic grandstand of the Berlin Olympic Stadium.







Olympic Stadium Berlin – Two-tier stadium (athletics)

Open oval geometry with circulating private box tier

Capacities

Gross capacity (international)	74,200 places [1]	100 %
Gross capacity (national)	74,200 places [2]	
Standing places	–	
Seats available for World Cup 2006 (net)	63,400 places [1]	
Within opt. 90-m viewing circle (football)	16,700 places	22.5 %
Within opt. 130-m viewing circle (athletics)	+44,500 places	60.0 %
Up to the max. recomm. 230-m distance	+10,000 places	3.5 %
Beyond 230-m distance	+ 3,000 places	4.0 %
Lower tier	approx. 37,800 places	
Upper tier	approx. 36,400 places	
VIP guests (total)	5,653 places [1]	approx. 9,750 m^2
Executive seats (World Cup 2006)	4,758 seats [1]	
Number of private boxes (total)	74 private boxes (+ 13 Sky-Boxes)	
Box seats, honorary tribune	895 box seats	
Media representatives (World Cup 2006)	200 commentators' positions (south) 400 television observers 1,000 press seats (with desk) 1,000 press seats (without desk)	
Wheelchair places	130 places [1]	
Dimensions (approx.)	225 x 300 m (total)	
Stadium interior	116 x 189 m = 22,000 m^2	
Width of roof	b = 68 m max.	
Height above pitch	h = 40 m	
Height above terrain (eaves)	h = 21 m	
Roof area	A = 42,000 m^2	
Spans	77 spans (6 – 11 m)	
Membrane roof	= 27,000 m^2	
Glass roof edge	= 6,000 m^2	
Concrete roof edge	= 9,000 m^2	
Drainage	Slope toward exterior = 3 ° or 5 %	

1) according to LOC World Cup 2006, Frankfurt (status: October 2005)
2) according to *www.stadionwelt.de* (status: October 2005)

525 **Viewing circle and dimensions** (plan)
Olympic Stadium Berlin, Scale 1 : 3,000
526 **Structure and circulation**
(transverse / longitudinal section)

page 265:
527 **Picture of the stadium interior** (2006)

01. PTFE membrane roof
02. Glass roof (interior ring)
03. Reinf.-conc. compression ring (exterior)
04. Tree-like support
05. Three-boom girder (radial)
06. Trussed girder (tangential)
07. Hinged pillar

Upper tier

Row number	31 rows
Tread depth	75 cm
Rise	39.6 – 51.0 cm
Stand inclination (average)	25 °
Sightline elevation *C*	17.1 – 19.8 cm

Distance of stand (front edge)

Distance to field	24.20 m

Lower tier

Row number	42 rows
Tread depth	78 cm
Rise	25.5 – 37.0 cm
Stand inclination (average)	23 °
Sightline elevation *C*	19.7 – 15.0 cm

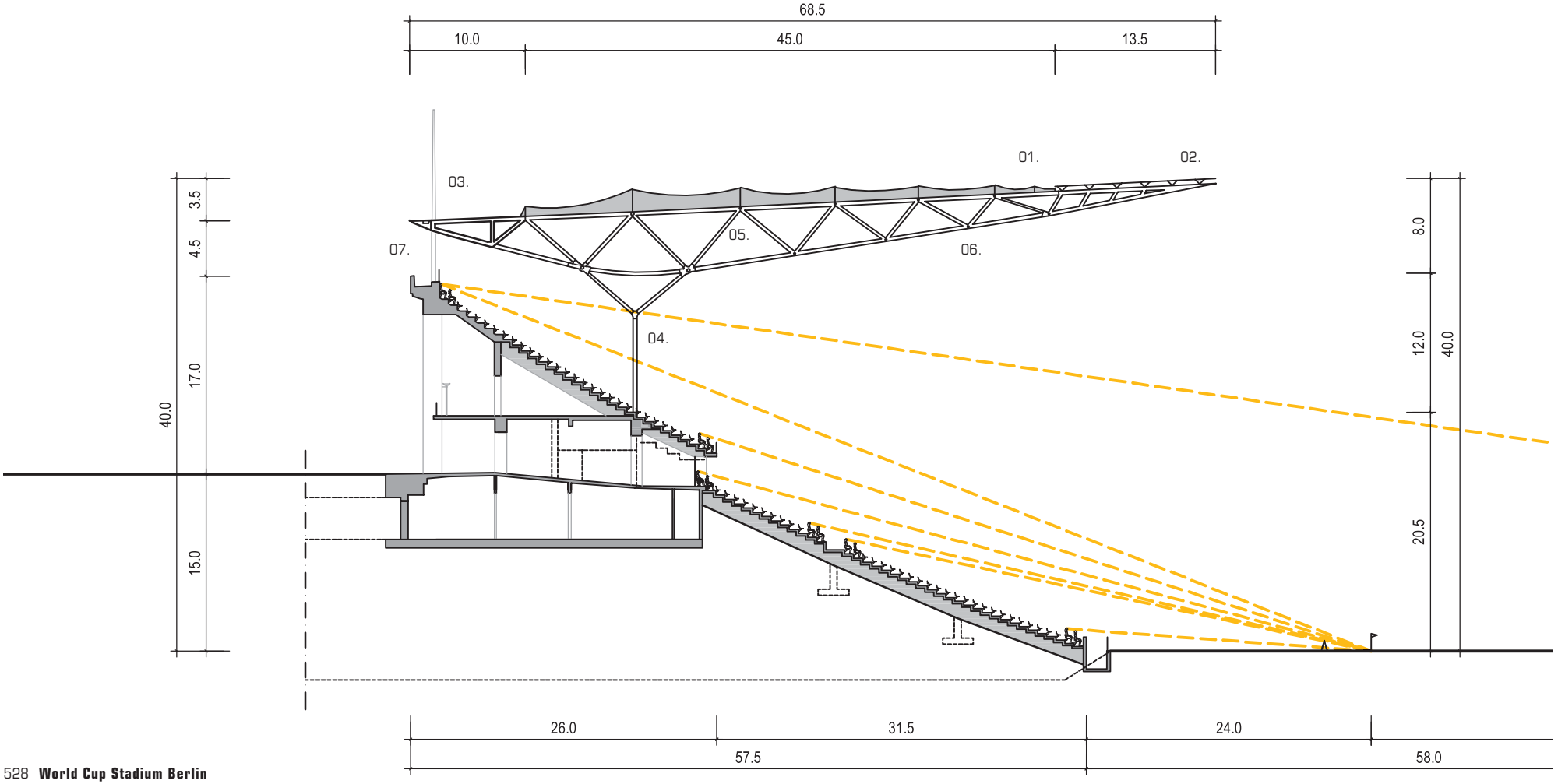
Viewing distance (to the point of focus)

Maximum horizontal distance	78.90 m
Maximum vertical distance	31.00 m

Distance of hosp. boxes (touch line) 55.00 m

Viewing angle (front touch line)

Upper tier	4.5 ° – 15.0 °
Lower tier	18.0 ° – 21.5 °



528 **World Cup Stadium Berlin**
Cross section of north stand
Scale 1 : 500

Lower tier

Row number	42 rows
Tread depth	78 cm
Rise	22.1–23.3 cm
Stand inclination (average)	16°
Sightline elevation *C*	22.1–23.3 cm

Upper tier

Row number	31 rows
Tread depth	75 cm
Rise	29.5–50.1 cm
Stand inclination (average)	25°
Sightline elevation *C*	11.7–24.8 cm

Distance of stand (front edge)

Distance to field	42.0 m (west)
	44.0 m (east)

Viewing distance (to the point of focus)

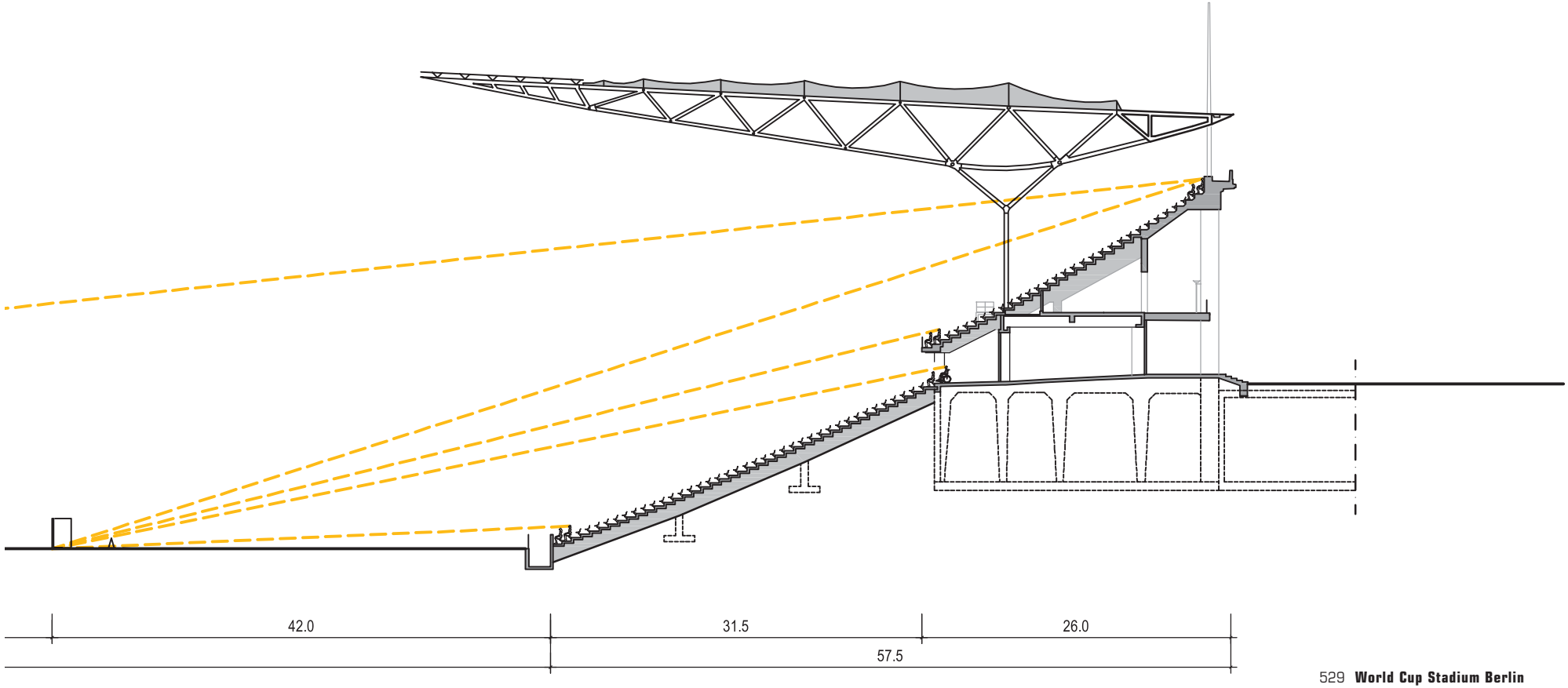
Maximum horizontal distance	96.75 m
Maximum vertical distance	31.00 m

Viewing distance (maximum)

Football	207.50 m
Athletics	239.00 m

Viewing angle (front goal line)

Lower tier	2.5°–11.5°
Upper tier	14.0°–17.0°



529 **World Cup Stadium Berlin**
Longitudinal section of east stand
Scale 1 : 500

Book Recommendation

Nixdorf, S.

Stadium Atlas

Technical Recommendations for Grandstands in Modern Stadia

This Stadium ATLAS is a building-type planning guide for the construction of spectator stands in modern sports and event complexes. A methodological comparison of the venues of the FIFA World Cup 2006 in Germany continues into a catalogue of "Technical recommendations and requirements" for the new erection or the modernization of multi-functional sports arenas on the basis of current European building regulations. The main focus lies on all essential and relevant aspects of planning and developing future concepts for the construction of grandstands.
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