

# REPORT

## **Structural Design Manual for Stage, Grandstand and Multi-level Stand construction**

Client: RAI Amsterdam

Reference: BG1975-RHD-ZZ-XX-RP-Z-0001

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## 1 Introduction

RHDHV applies the minimum requirements specified in the Netherlands Building Decree 2012 for constructing a stage, VIP deck, grandstand, multi-level stand, stairs or scaffold in the Amsterdam RAI Exhibition and Convention Centre. This Stage, Grandstand and Multi-level Stand Construction Manual highlights the key elements that apply at the RAI (including the Netherlands Building Decree and RHDHV's advice).

## 2 General

In general, the condition applies that the application must be submitted to the RAI Permit Desk at least **6 weeks** prior to the start of the event for Dutch exhibitors and **8 weeks** for non-Dutch exhibitors. This time is required for the application to be assessed by an independent engineer and architect. This also includes time for responding to any questions.

Stands are temporary structures and therefore are not considered full-fledged buildings. The Netherlands Building Decree 2012 in this case specifies different requirements than those that apply to new or existing buildings.

Aside from the Buildings Decree, the following standards apply to stands, grandstands and stages:

- NPR 8020-50 Netherlands Code of Practice Events - Stage structures - Responsibilities
- NPR 8020-51 Netherlands Code of Practice Events - Stage structures - Loads and structural keynotes

## 3 Stages, VIP Decks and Grandstands

Stages are elevated floors (equal to or higher than 0.6 m) that are only accessed by instructed personnel and/or several invited guests. For this reason, stages do not need to be equipped with a railing or balustrade (except for the access stairway), because it may reasonably be assumed that its users have been informed of the dangers.

VIP decks are elevated floors (equal to or higher than 0.6 m) that are open to the public. They must always be equipped with railings and balustrades.

Grandstands are inclined ascending rows of seats for spectators.

Standards and Guidelines

- Eurocodes; including Dutch appendices
- NEN-EN 13200-6:2020.
- IStructE, Temporary demountable structures; 2017, 4th edition

As soon as a stage, VIP deck or a grandstand is to be built that is higher than 0.6 m, the RAI must be asked for permission. There are two possibilities:

1. A stage, VIP deck or grandstand built using a TÜV construction:
  - In addition to the application, it is sufficient to provide a construction drawing (including the location of the bracing elements) of the specific stage with the dimensions of the construction and the applicable TÜV inspection certificates.
2. A custom-built stage, VIP deck or grandstand:
  - In this case, the application must include the construction drawing, as well as a structural/static calculation.

- The structural calculations for VIP decks, grandstands, etc, with spectators (not meant to be used as stages for performers) must be made in accordance with the NEN-EN 13200-6:2020.
- Stages meant for performances and (instructed) implementing personnel do not need to have railings. This is in accordance with the NPR 8020-50:2011, which makes a distinction between spaces where implementing personnel or the public is present.

- The railings or balustrades must be fitted with solid panels or vertical bars (see drawing).
- Separation structures should not contain openings that are wider than 0,10 m<sup>1</sup>.
- The opening below or above panels or vertical bars should not exceed a maximum of 0,10 m<sup>1</sup>.



## 4 Multi-level stands

In addition to the building regulations applicable in the Netherlands, the organisation can also impose additional requirements, for example on the design of the stands. The specific conditions for the construction of stands are made available by the trade fair organiser (there may be a surcharge on the m<sup>2</sup> price).

The applications are verified by the Amsterdam RAI and potentially an external engineering firm based on the structural and architectural regulations.

### 4.1 Construction of Upper level

Applicable Standards and Guidelines

- Eurocodes; including Dutch appendices
- NEN-EN 13200-6:2020
- IStructE, Temporary demountable structures; 2017, 4th edition

To ensure quick and proper handling of your application, we ask you to submit the following, with due consideration to the building regulations applicable within the RAI (also see checklist in Appendix).

- Working drawing(s).
- Stand floor plan, cross sections, elevation drawings together with clearly visible dimensions.
- Dimensions/section types to be used for columns, beams, cross-braces, etc.
- Connections detailed principle(s).

Including the corresponding calculation(s) made in accordance with the Eurocode regulations applicable in the Netherlands, including:

- The loads on the structure must be clearly indicated and substantiated.
- Static calculations of the load-bearing structural components.
- Quality of materials (e.g. steel grade and quality, timber quality).

In designing the stability system, please consider the fact that it is not possible to anchor the stand in the floor. In other words, no tensile forces should be the result of bracing elements used for stability reasons.

## 4.2 Structural information

The design is structurally tested to confirm compliance to the Netherlands Building Decree 2012. The following components are reviewed to confirm compliance (see checklist in Appendix A1):

### Stairway(s)

- Minimum one stairway for every 50 m<sup>2</sup> of upper level floor space.
- Stairway minimum width 0.7 m.
- Minimum run 0.13 m.
- Maximum rise 0.22 m.
- Minimum free height at top of stairway 1.9 m.
- Minimum distance from climbing line to the sides of the stairway 0.2 m.
- Maximum number of persons allowed to enter the stand: 45 person / meter of staircase width.

### Stairway Platform

- Minimum 0.7 m x 0.7 m surface area with a free height of at least 1.9 m.

### Stairway Railing

- Stairways used to bridge a difference in height of more than 1.5 m must be equipped with a stair rail on at least one side.
- The top of the stair rail, measured from the top of the stairway step's surface, must be at least at a height of 1 m.
- The lower 0.7 m of a stairway does not need to have a railing.

### Balustrades

- A balustrade offers protection against falling from a floor. This separation can consist of a balcony's railing, as well as the wall of a building.
- A balustrade must be installed when the difference in height is at least 1.2 m.
- The height of a balustrade must be at a height of no less than 1 m.

### Parapet for Window Frame

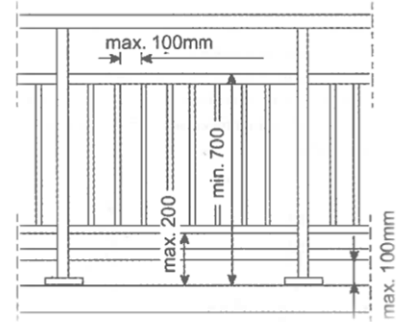
The parapet for window frames must be at least 0.85 m high, or safety glass (in accordance with the NEN 3569 2011) must be used. If continuous glass (not being safety glass) is used, a railing must be installed at a height of 0.85 m.

### Stair Railing and Balustrade Fillings

- Railings or balustrades must be fitted with solid panels, vertical bars (see drawing) or steel wire (horizontal wire).
- If glass panels are used as filling, they must be made of safety glass. This is to prevent the glass from shattering and falling on the passing public, in case of damage.
- Non-transparent filling must be requested in the stand's design.



- The separations are not allowed to have any openings wider than 0.10 m, both horizontally and vertically.
- Openings below the panels (glass) or the bars (steel wire) shall not exceed 0.10 m when there is the possibility of having children present at the stand. In the absence of children, openings shall not exceed 0.20 m.
- The openings can also be closed off using hardened or laminated glass, etc
- Stands at public trade fairs are not permitted to have step-on structures between 0.2 and 0.7 m in height. Openings wider than 0.1 m are not permitted up to a height of 0.7 m.



#### Kick Plate

- To prevent something from falling from a multi-level floor, the edges must be fitted with a kick plate at least 0.03 m<sup>1</sup> in height.

In addition, the following conditions apply in relation to (door) openings, continuous glass and raised floors.

## 5 Single level stands

The approval of the exhibition team is required for the construction of a single level stand. They will check the design in relation to the applicable requirements. For a single level stand, it is not necessary to submit an application to the Amsterdam RAI Permit Desk.

However, a number of building provisions must be respected:

#### (Door) Openings

- In rooms that are not permitted to hold more than 20 persons, the (door) opening (clear width) must be a minimum of 0.80 m<sup>1</sup> x 2.015 m<sup>1</sup>.
- In rooms that are permitted to hold more than 20 persons, one or more doors of sufficient width must be installed in accordance with the Building Decree.
- Doors must open in the direction of the escape route.

#### Continuous Glass

- If continuous glass (not being safety glass in accordance with NEN 3569 2011) is used, a railing must be installed at a height of 0.85 m.

#### Raised Floor

- In case of a raised floor (higher than 20 mm), at least one feature, with a width of 0.8 m and an incline of 1 to 12, for allowing a wheelchair to drive up must be installed within the boundaries of the stand.
- The raised floor must have a clear separation (termination). For example, by applying a difference in colour to the floor finish or a caution marking using an aluminium angle section.
- The maximum difference in height is 0.1 m, measured from the (exhibition/hall) floor to the top of the raised floor.

- The sides of the raised floor must be closed and neatly finished.
- The raised floor must be installed within the stand's alignment.

## **6 Scaffolds and stairways with a limited height**

A simplified application submitted via the HISWA web shop is sufficient for using scaffolds, stairways, etc up to a maximum height of 1.2 m<sup>1</sup>, for example for viewing boats during the HISWA Amsterdam Boat Show. The following regulations apply to these scaffolds, etc:

- Minimum width of scaffold and/or stairway 0.7 m<sup>1</sup>.
- Minimum run 0.13 m<sup>1</sup>.
- Maximum rise 0.22 m<sup>1</sup>.
- The construction of stairways and scaffolds must be sufficiently sturdy and will be checked accordingly by the RAI.
- If standard scaffolds and/or stairways are used, they must be accompanied by a quality mark and the applicable certificates.
- Protection against falling hazards in parallel to the direction of the pedestrian flow must be provided by means of a sturdy railing or by means of a temporary partition. For example, another boat (see drawings).
- Stairways/scaffolds that can only be entered on one side must be fitted with a railing or partition on the side that cannot be entered to prevent falling danger for visitors (see drawings).

Scaffolds or stairways higher than 1.2 m<sup>1</sup> are considered stages or multi-level stands and an application for approval must be submitted in advance to the RAI Permit Desk (if applicable via the HISWA web shop, for instance).

## **7 Fire safety regulations**

The RAI Fire Safety Regulations apply to the construction of all stands, stages, VIP decks and/or grandstands. These regulations are contained in the RAI Accommodation Regulations.

## **8 Safety regulations**

The regulations contained in the Safe Working Practices Manual apply to all work performed within the RAI. This manual is available at <http://www.rai.nl/nl/rai/organisatie/Paginas/Veiligheid.aspx>

## **9 Other regulations**

All other rules and regulations that apply to the RAI are included in the Amsterdam RAI Accommodation Regulations.



## A1 Structural information checklist

Checklist	RAI multi level stands	2017-12-04	
	Architecural issues		
			Present: Yes/No
<b>General</b>	Drawings	Plan (ground floor and 1st level)	<input type="radio"/>
		Cross sections	<input type="radio"/>
		Façade	<input type="radio"/>
	Impression	Artist impressions / pictures of the stand	<input type="radio"/>
<b>Stairs</b>	Dimensions and details	riser max. 220mm and tread min.130mm	<input type="radio"/>
		Stairs width minimum 700mm	<input type="radio"/>
		Handrails of the stairs minimum height 1000mm.	<input type="radio"/>
		If glass-filling is applied for the balustrade (first floor level and stairs) safety glass is required.	<input type="radio"/>
		Dimensions of the stair landing	<input type="radio"/>
<b>Railing</b>	Dimensions and details	Handrails of the stairs minimum height 1000mm.	<input type="radio"/>
		If glass-filling is applied for the balustrade (first floor level and stairs) safety glass is required.	<input type="radio"/>
<b>Doors</b>	Dimensions and details	Doors of public use (meeting rooms), have a minimum door width of 850mm and minimum height of 2015mm	<input type="radio"/>
		If entire glazed walls or doors are applied safety glass is required	<input type="radio"/>
			<input type="radio"/>
			<input type="radio"/>

## A2 Structural engineering checklist

Checklist	RAI multi level stands	2017-12-04	
	Structural issues		
			Present: Yes/No
<b>General</b>			
	Structural Report		<input type="radio"/>
		First floor accessible for public?	<input type="radio"/>
		Floor loads	<input type="radio"/>
		Staircase loads	<input type="radio"/>
	Stability Calculation		<input type="radio"/>
		>= 6% Live Load for spectator movement, 10% of live load for synchronised and periodic crowd movement	<input type="radio"/>
		Location bracings indicated on drawing	<input type="radio"/>
		Deflection check	<input type="radio"/>
		there will be no tension on the supports using load combination: 0,9xDL+0,5x1,35xLL+1,35xHL (HL=horizontal load)	<input type="radio"/>
<b>Stairs</b>	Calculation		<input type="radio"/>
	Drawings		<input type="radio"/>
	Railing	Calculation	<input type="radio"/>
		Drawings	<input type="radio"/>
	Details	Detail connections drawings	<input type="radio"/>
		Detail calculations	<input type="radio"/>
<b>Railing</b>	Calculation		<input type="radio"/>
	Drawings		<input type="radio"/>
	Details	Detail connections drawings	<input type="radio"/>
		Detail calculations	<input type="radio"/>
<b>Details</b>	Connections	Drawings	<input type="radio"/>
		calculations	<input type="radio"/>
<b>Drawings</b>	Structural floorplans		<input type="radio"/>
	Structural sections		<input type="radio"/>

## A3 Example of assessment form

### Note/Memo

HASKONINGDHV NEDERLAND B.V.  
INDUSTRY & BUILDINGS

To: RAI Amsterdam  
From: Royal HaskoningDHV  
Date: xx-xx-xxxx  
Copy:  
Our reference: BG1975-xxx-xxx "Name of event"  
Classification: Project related

### Review stands, Architectural + Structural

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Architectural: "Status if approved" "Status if not approved"

#### General remarks:

- According to the guideline for the maximum number of persons allowed to enter the stand: **45 person / meter** of staircase width.
- In case of a single door, minimum width 850 mm, the guideline remains the same: **45 person / meter** width escape route =  $45 / 1000 = 0.045 \times 850 = 38p$

#### Checked:

- Dimensions riser and tread? According to The Dutch Building Regulations 2012 riser max. 220 mm and tread min.130 mm
- Stair width minimum 700 mm (according to The Dutch Building Regulations 2012)
- Landing width minimum 700 x 700 mm (according to The Dutch Building Regulations 2012)
- Handrails of the stairs minimum height 1.000 mm
- Handrails of the balustrade minimum height 1.000 mm
- If the height difference between the ground floor of the stand and the ground floor of the hall exceeds 20 mm (20 mm is maximum) it is required to place a ramp for a wheelchair user
- If entire glazed walls, doors and balustrade are applied safety glass is **required**
- Doors of public use (meeting rooms), have a minimum door width of 850 mm and minimum height of 2.015 mm

**Structural Status: “Status if approved” “Status if not approved”**

- **General**
  - Structural calculation report is present:
  - Starting points
    - Live load (5,0 kN/m<sup>2</sup>)
      - 3,0 kN/m<sup>2</sup> only acceptable if public access is limited
      - 1,5 kN/m<sup>2</sup> only acceptable if the area is not accessible for public
    - Horizontal load = 6% of LL for spectator movement, 10% of LL for synchronised and periodic crowd movement.
    - Stair Live Load minimal 5 kN/m<sup>2</sup>
- **Stability:**
  - Resistance by:
    - Cross bracings
    - Moment Resisting Frames
  - Calculation is present
    - Horizontal load= (minimum of 6% or 10% of LL)
    - Horizontal deflection check, max 1/300xh
    - There will be no tension in the vertical direction (z-direction) on the supports by using the load combination.
      - $0,9 \times DL + 0,5 \times 1,35 \times LL + 1,35 \times HL$  (HL=horizontal load)
  - Anchors fixing supports and floorplates should not be anchored to hall floor
- **Stair**
  - Calculation is present;
    - Stair loads
  - Drawings/sketches are present
  - Railing & Balustrade\*
    - Drawings/Sketches are present
    - Detail connection drawings/sketches are present
    - Railing/balustrade details, calculation is present
- **Railing & Balustrade\***
  - Calculation is present
    - Horizontal load
  - Drawings/Sketches are present
  - Detail connections
    - Drawings/Sketches are present
    - Calculation is present
- **Connections details**
  - Calculation is present
  - Drawings/sketches are present
- **Structural Drawings**
  - **Structural** Drawings are present

\*Note, the railings and balustrades will be tested manually on site by the RAI stand manager