

## **Technical Requirements**

Project: PF45DL

Section: A. Building Requirements

Architect:  
Lead design engineer:

## Project scope

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2	Wind tunnel equipment location *	T
3	Equipment loads *	E
4	Equipment bases tolerance requirements *	H
5	Cooling System *	C
6	Cable networks *	P
7	Service floors and ladders *	K
8	Building Markup and Inspection *	M
9	Site work execution program *	X

\* - Full versions of all documents are available in the TunnelTech customer portal.

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PROJECT, SECTION


PF45DL  
Building Requirements



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Revision Schedule
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No.	Index	Description	Date
1	0	Release of technical requirements.	01.09.2022


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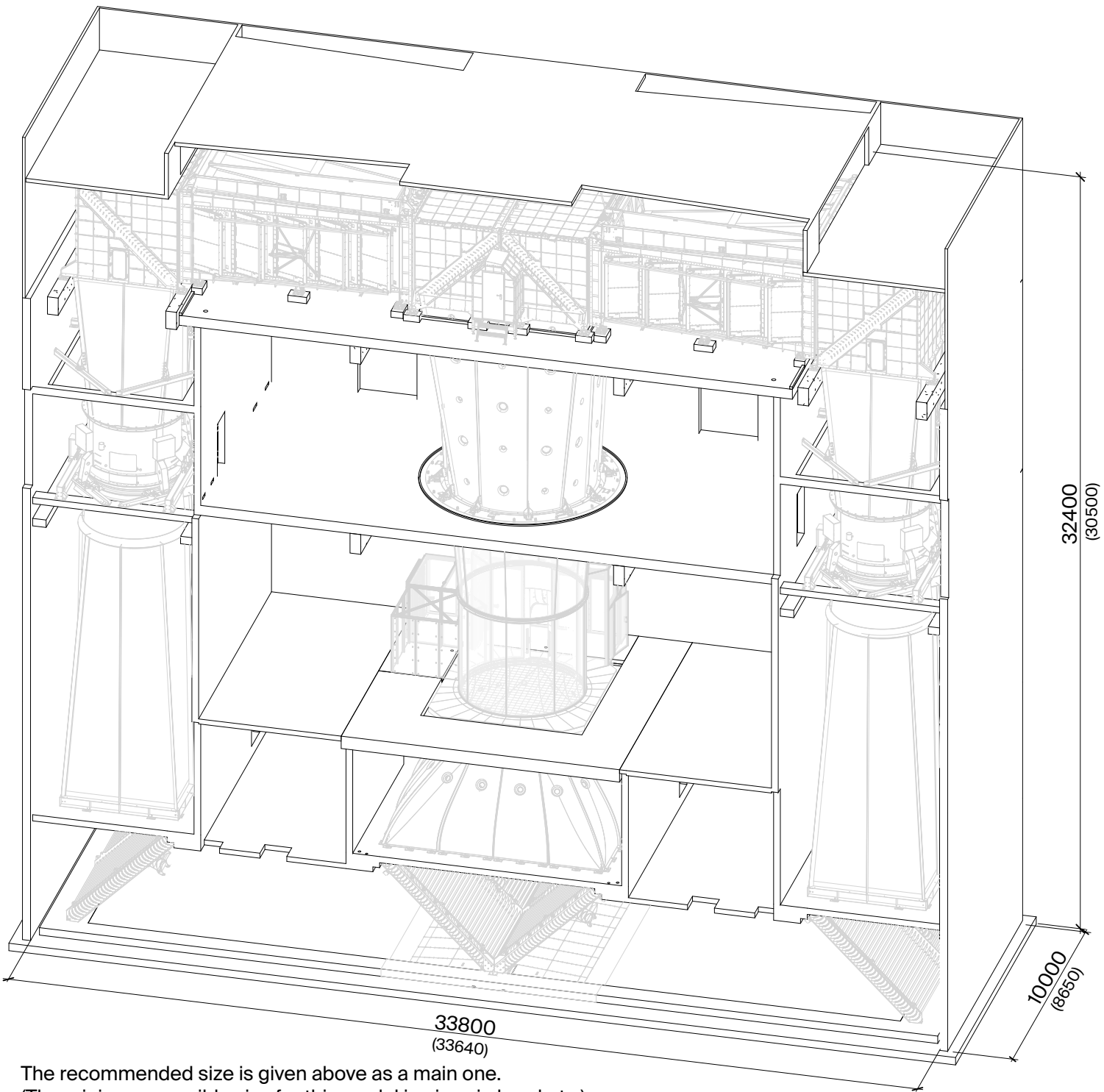
\* - All drawings are available in the full version of the document.

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Introduction

- This section of the technical requirements documentation contains explanations on the following:
- Architectural restrictions for the technological space of the wind tunnel in the building;
  - Requirements and recommendations for the technological space of the wind tunnel and ways of access there;
  - Specifics of the building design in order to provide the installation, commissioning and maintenance of the wind tunnel.



The recommended size is given above as a main one.  
(The minimum possible size for this model is given in brackets.)

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## Technological space of the wind tunnel

The technological volumes of the wind tunnel are aligned and described in relation to 4 main axes and 8 levels. See the following drawings for the necessary axes positioning and the relative elevations of the levels.

The intersections of the 4 principal axes of the wind tunnel mark the centers of the 3 vertical shafts of the technological volumes:

- The central shaft (where the Flight Chamber is located);
- The two side shafts, each has two Axial Fans that create the air flow;
- Centers of the two side shafts are equidistant by 13900 mm from the center of the Flight Chamber shaft.

The following levels and their relative elevations are crucial for the wind tunnel equipment:

1. **Lower Duct base level.** The base face for the Lower Turning Vanes Blocks;
2. **Airjet and Axial Fans Outlet Duct base level** The base face of the Airjet and of the Axial Fans Outlet Duct;
3. **Waiting Zone base level.** The base surface of the Lower Ring with the Safety Net, the base face of the Waiting Zone frame, finish floor thickness;
4. **Axial Fans base level.** The base face (or faces) of the Fans Suspension in both side shafts;
5. **Flight Chamber Diffuser base level.** The base face of the Flight Chamber Diffuser, Upper Ring in central shaft;
6. **Axial Fans Inlet Duct base level.** The base face of the Axial Fans Inlet Duct suspension in both side shafts;
7. **Upper Duct base level.** The base faces of the Upper Axial Fans Turning Vanes Blocks above the both side shafts (see below, the requirements for the beams serving as the base to the containers). The 250 mm high bases for the Upper Flight Chamber Turning Vanes Block and the Air Exchange Diffusers.
8. **Intake/Exhaust level.** The level at which the inlet and outlet air exchange openings are located.

## Dimensions of the technological space of the wind tunnel

The internal dimensions of the technological space of the wind tunnel are shown in the following architectural drawings.


All dimensions (linear, radial and elev. marks) that are shown in the architectural drawings are dictated by the wind tunnel technology. The dimensions must be respected in order to provide the wind tunnel equipment installation, functioning and maintenance.

Dimensions marked with '#' and '\*' are shown only as a reference and are not dictated by TunnelTech.

Prior to the wind tunnel equipment installation the measurements of the technological space must be conducted by the contractor. The measured data must be provided by the contractor to TunnelTech in accordance to "Building Markup and Inspection" section of the technical requirements documentation.

If, according to the measurements' report, the precision of the structure is not sufficient for the equipment installation purposes, after careful consideration TunnelTech might request the contractor to fix. The process of installing wind tunnel equipment in a building can't begin until all changes and control measurements have been made.

See the "Building Markup and Inspection" section of the technical requirements documentation for further information.

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The specifics of installation, commissioning and maintenance  
of the wind tunnel by levels of the building.

**Lower Duct base level.**

Two pits for collecting water and draining must be provided on the foundation slab.

A drain tray must be provided along the perimeter of the technological space.

A slope between the base faces of the Lower Turning Vane Blocks organized on the foundation slab to direct the water to the draining pits.

The Lower Duct base level can be accessed via a door from the other volumes on the level or via two manholes in the slab above the level. The general requirement for the door or the manhole cover is that it must be airtight to withstand the pressure up to 2000Pa. The final position of the door/manhole must be confirmed with TunnelTech.

All concrete Lower Duct's surfaces must be treated with a dedusting compound.

**Airjet and Axial Fans Outlet Duct base level.**

To provide access to the side shafts during the installation and commissioning of the wind tunnel equipment technical openings must be provided. After the wind tunnel equipment is installed, it is possible to install doors in the opening. The dimensions of the three openings in the floor slab must be respected in relation to the principal axes of the wind tunnel equipment with the tolerance of -20mm .. +20mm.

Two manholes to provide an access to the basement level during installation and maintenance of the wind tunnel must be provided. The dimensions and position of the manholes must be clarified later in course of the project.

The doors to the central technological volume on the level must be provided for installation, commissioning and maintenance of the wind tunnel.

Four openings for cooling system manifolds must be provided. The dimensions and position of the manholes must be clarified later in course of the project. The openings must be plugged after mounting and connecting the manifolds to the mains.

Four openings for cable networks must be organized. The diameter of each opening is 100 mm. The dimensions and position of the openings must be clarified later in course of the project.

**Waiting Zone base level.**

The final position of the Waiting Zone, the Airlock, the Control room and their attachment to the building structure must be clarified in course of the project. The slab elevation and the thickness of the finish floor under the Airlock, Control room and the Waiting Zone must be implemented in accordance with the technical requirements.

The tolerance for the position of the center of the central round opening in plan view in relation to the project values is 15mm;

The tolerance for the actual radius of the central round opening (or the shape of the opening, its' "roundness") is 10mm.

The stability requirement for the slab around the central opening (Lower Ring base slab) is that the slab must not bend or shift more than 5mm. That includes the shifts of the structure (if any) during the first years after the construction.

Three openings for Control room, Airlock and Waiting Zone equipment cables from Airjet and Axial Fans' Outlet Duct level to Waiting Zone level must be provided. The dimensions and position of the openings must be clarified later in course of the project.

Areas for storage and installation of Flight Chamber equipment must be provided. Spider crane access must be provided in these areas. The finish floor in these areas is installed after the installation of the Flight Chamber and Waiting Zone equipment.

**Axial Fans base level.**

To provide the possibility of extracting the Axial Fans for maintenance after the equipment is installed, the technological openings must be created in the external wall of each side shaft. The openings must have demountable filling. The position and dimensions of the openings must be clarified in course of the project and confirmed with TunnelTech.


The additional beams needed for the Axial Fans extraction are supplied by TunnelTech.

After an Axial Fan is rolled out of a side shaft volume on the additional beams, it is the customer's responsibility to provide a way of replacing the Axial Fan.

It is necessary to provide access to the axial fans in the side shafts.

An access to the Axial Fans base level must be provided for the installation, commissioning and maintenance.

The Machine Rooms in the side shafts, where the Axial Fans are located, must be accessible.

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## The specifics of installation, commissioning and maintenance of the wind tunnel by levels of the building.

### Flight Chamber Diffuser base level.

The stability requirement for the slab around the central opening (Flight Chamber Diffuser base slab) is that the slab must not bend or shift more than 5mm. That includes the shifts of the structure (if any) during the first years after the construction.

External wide doors are required on the Flight Chamber Diffuser base level for loading in and out the Variable Frequency Drives (VFDs).

A ledge must be constructed around the central opening to exclude the possibility of water leakage down from the floor to the shaft during installation. The ledge dimensions are 50\*50 mm

An access to the Flight Chamber Diffuser base level must be provided for the installation, commissioning and maintenance.

Two technical openings to provide the access to the side shafts of the wind tunnel must be provided for installation, commissioning and maintenance of the wind tunnel.

Three openings in each partition wall from Technological room to Machine rooms must be provided. Openings 350x100mm are for the main power cables (VFD to Axial Fans). Openings 200x100mm are for the control system cabling.

It is necessary to ensure the removal of heat generated by VDF's in the central shaft room. Detailed heat dissipation values will be specified in the technical requirements section "P - Cable networks".

### Upper Duct base level.

Two beams above each of the side shafts are the base of the Upper Axial Fans Turning Vane Blocks.

The installation sequence for the beams is the following:

1. All the wind tunnel equipment for the side shaft below the Upper Duct base level is installed;
2. The beams are installed on the Upper Duct base level;
3. The Upper Axial Fans Turning Vane Block is installed onto these beams.

These beams are contractor's responsibility. Their design, position and installation method must be confirmed with TunnelTech.

An access to the Upper Duct base level must be provided for the installation, commissioning and maintenance.

A ledge must be constructed to exclude the possibility of water leakage down from the floor into the shaft during installation.

A draining openings must be organized on the level for cooling system's drainage water removal. Minimum openings diameter is 150 mm.


### Intake/Exhaust level

Wide openings for air intake and exhaust must be implemented above the Upper Duct base level. See the drawings below for positioning of the openings. The minimum free areas for these openings are:

- For each of four air intake openings minimum required free area is 6 m<sup>2</sup>, recommended free area is 9-12 m<sup>2</sup>. Volumetric flow rate is 70 m<sup>3</sup>/s.
- For each of two air exhaust openings minimum required free area is 9 m<sup>2</sup>, recommended free area is 12-14 m<sup>2</sup>. Volumetric flow rate is 140 m<sup>3</sup>/s.

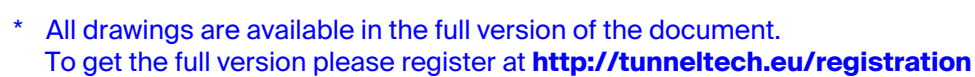
The volumetric flow rates numbers are given for the case when the wind tunnel is running on 100% capacity and the ventilation flaps are open 100%.

The structure of the walls on the Upper Duct base level and of the roof must have several openings for air intake and exhaust. Their dimensions and position must be clarified and confirmed by TunnelTech in course of the project to eliminate possible intersections with the wind tunnel equipment and interference to the air flow.

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LEGEND

[ \_ \_ ] - Annotative frame

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Dimensions marked '"' are shown only as a reference and must be specified and confirmed with the local engineer.

NOTES

**Lower Duct base level**


Access to Lower Duct base level must be provided through two manholes in Airjet and Axial Fans Outlet Duct level slab. A drain tray must be provided along the perimeter of the technological space. All concrete Lower Duct's surfaces must be treated with a dedusting compound.

\*1 - A draining pit must be organized on the level for draining water removal

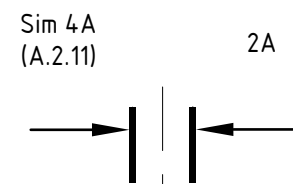
\*2 - Slope for collecting water (300 mm).

## REVISIONS

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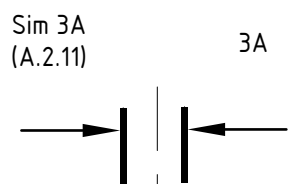
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<p style="text-align: center;"><b>Lower Duct base level plan view</b></p>		
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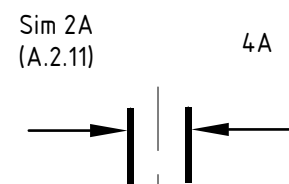
Sim 4A  
(A.2.11)

2A



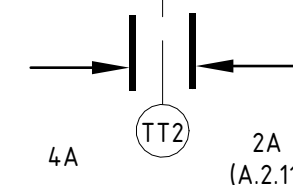
Sim 3A  
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3A

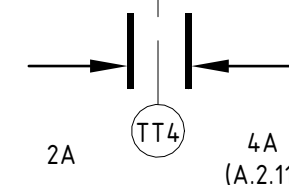
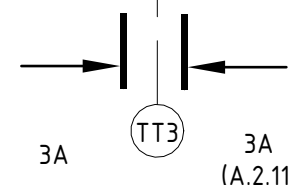


Sim 2A  
(A.2.11)

4A



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Intake/Exhaust level  $\downarrow$  +18.300

Upper Duct base level  $\downarrow$  +13.500

+9.800  
Axial Fans Inlet  
Duct base level

Flight Chamber Diffuser base level +5.800  
Axial Fans base level +4.450

Waiting Zone base level  $\downarrow$  -2.850

-7.550

Airjet and Axial Fans      -

Outlet Ducts base level      -

-12.200

Lower Duct base level.

#### LEGEND

[ ] - Annotative frame

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NOTES

1A-1A section

\*1 - Technological openings with demountable filling is required to provide the possibility of removing the fans.

\*2 - Four precast concrete or steel beams.  
Installation sequence: The beams can be installed in the design positions strictly after all equipment on lower levels has been loaded.

\*3 - Wide doors for taking in/out Variable Frequency Drives (VFDs) are required.

\*4 - Area for the exhaust opening (2 openings in total).  
For each of two air exhaust openings minimum required free area is 9 m<sup>2</sup>, recommended free area is 12-14 m<sup>2</sup>.  
Volumetric flow rate is 140 m<sup>3</sup>/s.

\*5 - A ledge must be constructed around the central opening to exclude the possibility of water leakage down from the floor unto the shaft during installation.  
The ledge dimensions - 50\*50 mm

\*6 - A ledge must be constructed a to exclude the possibility of water leakage down from the floor unto the shaft during installation.

## REVISIONS

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## PF45DL

### Building Requirements

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1A-1A Section view (longitudinal section)

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