Tender No. 2016/070/0013/00

for the Design, Supply, Installation, Commissioning and Support of Passenger Boarding Bridges (PBB) for the Israel Airport Authority

Annex A - Technical Specifications

March 2016
Aircraft Passenger Boarding Bridges

The following Work specified herein are items and associated work concerning the Aircraft Passenger Boarding Bridges for the Concourse E of Ben Gurion Airport, Tel Aviv, Israel.

Contractor shall provide all labor, Materials, Contractor’s Equipment and Plant to fully execute the requirements to furnish, deliver, and install the Works as expressly described in the Drawings and Specification, or implied there from, and in accordance with the Contract. It is the intent of this Specification section that the work performed pursuant hereto be complete and acceptable in every respect for its intended purpose. It is further required that the provisions of this Specification section shall be complementary to, and shall be correlated with, the requirements of the Contract. Nothing in this Specification section shall limit the scope of work as required by the Contract.

Content
Aircraft Passenger Boarding Bridges ........................................................................................................ 1
Part 1. General ........................................................................................................................................ 3
   1. Introduction ................................................................................................................................... 3
   2. Procurement, requirements and data .............................................................................................. 4
   3. Summary ........................................................................................................................................ 5
   4. Additional options ........................................................................................................................... 7
   5. Standards and References .............................................................................................................. 7
   6. Design Requirements .................................................................................................................... 9
   7. Quality Assurance .......................................................................................................................... 13
   8. Failures ......................................................................................................................................... 14
   9. Co-ordination ............................................................................................................................... 15
  10. Design Criteria ............................................................................................................................. 16
  11. Warranty ...................................................................................................................................... 19
  12. Safety requirements ...................................................................................................................... 20
  13. Availability .................................................................................................................................... 22
  14. Maintenance Process and Requirements ...................................................................................... 22
  15. Calamities process ......................................................................................................................... 23

Part 2. Products ........................................................................................................................................ 23
   1. Rotunda Assembly ......................................................................................................................... 23
   2. Telescoping Tunnels and Fixed Bridge Tunnels .......................................................................... 25
   3. Ground stairs ............................................................................................................................... 29
   4. Drive Column ............................................................................................................................... 30
   5. Boarding Bridge Cab .................................................................................................................... 31
   6. Aircraft Closure ............................................................................................................................ 32
   7. Services Access ............................................................................................................................ 33
   8. Control Station and Control Systems ......................................................................................... 34
   9. Electrical and Communications ................................................................................................ 41
  10. Control Features and Interlocks .................................................................................................. 43
  11. Automatic Leveling ...................................................................................................................... 44
  12. Safety shoe .................................................................................................................................. 44
  13. PBB System Cooling, Ventilation and Pressurization ................................................................. 45
  14. Building Management System ................................................................................................... 46
  15. Interior Finishes and Lighting ....................................................................................................... 46
  16. Exterior Finishes and Lighting ...................................................................................................... 48
  17. Electro Technical Facilities .......................................................................................................... 48
  18. Safety Features ............................................................................................................................ 54
  19. Operation and functions Apron Drive PBB ................................................................................ 55
  20. Operation of main PBB sub-assemblies ...................................................................................... 60
21. PCA System interface ........................................................................................................................................ 64
22. Additional Interfaces ......................................................................................................................................... 65
23. Additional Items ............................................................................................................................................... 66
24. Name and Instruction Plates .......................................................................................................................... 66

Part 3. Execution .................................................................................................................................................... 67
1. Delivery, Storage, Handling and Installation .................................................................................................... 67
2. Examination ...................................................................................................................................................... 67
3. Site Erection .................................................................................................................................................... 68
4. Progress of Manufacture and Equipment Delivery .......................................................................................... 68
5. Storage and Protection of Material and Equipment ....................................................................................... 68
6. Parts Supply, Purchase Contract and Inventory .............................................................................................. 69
7. Manuals and Training ...................................................................................................................................... 69
8. Documentation .................................................................................................................................................. 71
9. Testing and Commissioning ............................................................................................................................ 74

Appendix 1.

a. List of Drawings for PBB Tender .................................................................................................................. 77
b. Table of Compliance for PBB tender ............................................................................................................... 79
c. Milestones schedule for PBB tender ............................................................................................................. 80
d. Schedules of passenger boarding bridge service requirements ................................................................. 81
- Drawings and layouts, see PBB tender drawing list below.
- Table of Compliance for PBB tender
- Milestones schedule for PBB tender
- Schedules of passenger boarding bridge service requirements,

Part 1. General

1. Introduction
   a. Purpose of the Passenger Boarding Bridge
   The general purpose of Passenger Boarding Bridge (PBB) is as follows:

   To guide:
   - able and disabled passengers with or without baggage or hand baggage who do not use baggage trolleys
   - aircraft crew members
   - ground handling staff
   - maintenance staff
to and from the aircraft in a comfortable and safe manner.

   ‘Comfortable’ is understood to mean protected against external weather-related influences (wind and water-proof).
In addition, the PBB bridge will also, occasionally, be used for transporting passengers in wheelchairs or on stretchers.

   Also the contribution of the PBB is:
   - To minimize and to quantify the turnaround of the aircraft handling process.

b. Description of the PBB
   General description
   The connection between the terminal building and the aircraft consists of the following most general components:
   - Fixed bridge (if applicable);
   - The actual PBB, which consists of the following elements:
     o Rotunda;
     o 2 or 3 Tunnels;
     o Bridgehead;
     o Canopy between the aircraft and the PBB;
     o Carriage;
     o Lifting system;
   - Service staircase;
   - The connection with the terminal building;
   - The column(s) (if applicable);
   - Ground stairs (gate E5 and E9).

   Drawing F-A75.01 shows the bridge and its various components.

c. Fixed bridge
   The fixed bridge connects the terminal building to the rotunda, except at gate E3 and E4, where the rotunda immediately connects with the terminal building.

d. Passenger Boarding Bridge (PBB)
   The PBB shall be able to rotate and extend and its height shall be adjustable to allow handling activities for all types of aircraft linked via the bridge to the terminal building. These features make it possible for the PBB to be moved in the desired door position(s) of the parked aircraft.
e. Rotunda
The rotunda connects the fixed section to the telescopic tunnel. The rotunda is provided with a column and allows for rotation of the PBB.

f. Telescopic tunnel
The telescopic tunnel is the connection between the rotunda and the bridgehead. The tunnel(s) shall be telescopic in order to connect the bridgehead to the desired door position(s) of the parked aircraft.

g. Bridgehead
A revolving bridgehead connects the PBB to the aircraft and provides for leveling of the cab floor at its intersection with the aircraft. The bridgehead is the element that comes into direct contact with the aircraft. Therefore the bridgehead can be turning. If the PBB is not used, the bridgehead is closed with a double swing door.

In the bridgehead the control panel for the operation of the PBB is located.

h. Canopy
The bridgehead contains several features, including the canopying element that provides a flexible connection between the bridgehead and the aircraft. The canopy protects the passengers against external influences (wind, rain etc.).

i. Carriage and lifting system
The carriage and the lifting system are used to move the PBB into the right position and raise it to the level required for the aircraft in question.

j. Service stair
The service stair connects the PBBs service platform, next to the bridgehead, with the apron. The service stair is arranged paralleling with the platform at all-time regardless of the variation of PBB height and is used for the following purpose:
- Handling staff, during aircraft handling operations;
- Aircraft crew (especially the pilot and co-pilot) to inspect the aircraft;
- Maintenance staff.

k. Luggage slide (chute)
A sloping channel or slide for conveying baggage, buggies and a like to a lower level (this will be optional).

l. Ground stairs
Self-supporting ground stairs for bus operations are located at gates E5 and E9. The stairs connect to the fixed bridges of the gates.

2. Procurement, requirements and data
To qualify for the work of the commission, the contractor shall submit the following information to the Israeli Airport Authority (IAA) for the purpose of the passenger boarding bridge:

a. The maintenance policy and operational deployment shall be matched to each other, making a technical availability of 99.9% is realized during 24 hours a day, 365 days per year;

b. The maintenance of the PBBs and fixed bridges will be carried out by the IAA.

c. List of the parts whereof the MTTR (Mean Time To Repair) is longer than 2 hours an overview with an expected MTTR and frequencies (Part 1, paragraph 12).

d. Way of start-up the installation and the associated start-up and nominal flow.

e. Energy consumption, cos φ and harmonic values to provide insight into the energy consumption (in kWh), cos φ and harmonic values.

Guaranteed statements overall passenger bridge installation:
f. Written statement in which the Life Cycle Costs (LCC) insightful should be made on the basis of expected lifetime of 25 years or 90,000 connections and by the manufacturers indicated revision period;
g. Written statement indicating that the entire electrical installation has a technical lifetime of 5,000,000 circuits, during the use as described in this specification and the meaning of it, without intermediate overhaul. After 5,000,000 circuits an intermediate overhaul is permitted whereby the goal shall be a lifetime extension of 5,000,000 circuits.
h. Written statement indicating that the complete installation has a technical service life of 90,000 connections (25 years), during the use as described in this specifications and the meaning of it, without intermediate overhaul.
i. Written statement indicating that the monitors have a service life of at least 20,000 hours.
j. Written guarantee that the lifetime of the control buttons and / or on-display or screen control (touch screen) are tuned to an operational or technical service life of 25 years or 5,000,000 circuits;
k. Written guarantee that the lifetime of the to use flexible cables at least 5 years or 18,000 connections;
l. A written statement that when maintenance is carried out by an independent maintenance / service party which will be selected by the IAA or if maintenance is carried out by the IAA maintenance staff itself, the delivery of spare parts or service takes place in such a way as if the contractor is the maintenance / service party. This refers in particular to the delivery times of spare- and service parts and the obligation on warehouse management by the contractor because of the in time supply of spare- and service parts can.
m. A written statement that in these specification requested guarantees are fully covered when maintenance is carried out by an independent maintenance / service party which will be selected by the IAA or the maintenance is carried out by IAA maintenance / service staff itself.
n. A written statement that the contractor is prepared to give any necessary instructions or training to the independent maintenance / service party which will be selected by the IAA or if the maintenance is carried out by IAA maintenance / service staff itself.
o. A written statement that the contractor is prepared to provide any necessary special tools to the independent maintenance / service party which will be selected by the IAA or to the IAA maintenance / service staff itself.
p. A written statement that the contractor, in accordance with the specifications, at the same time with the completion of the passenger boarding bridge installation to supply a user manual.
q. The user manual should contain no contradictions with the requirements as specified in the specifications or contract. This service is necessary to, the independent maintenance / service party which will be selected by the IAA or the IAA maintenance / service party be able to maintain in a responsible manner.
r. If the maintenance is carried out by an independent maintenance / service party which will be selected by the IAA or if maintenance is carried out by the IAA maintenance / service staff itself, what are the activities that are necessary to be carried out by the contractor themselves? If this is so, then this needs to be substantiated with arguments.
s. A statement by the contractor shall be made if in the above paragraphs leads to additional costs which should be passed on to the IAA. Specify this task per installation and per item in relation to the lifetime of the passenger boarding bridge as mentioned in these specifications.
t. Operational costs, per year, based on the number of connections as mentioned in these specifications.
u. The operating costs shall be calculated on the variable charges:
   • maintenance (hours and materials used);
   • the energy consumption;
   • the number of connections according to specifications or use per 24 hours.
v. In the offer a statement shall be submitted showing what the contractor means by 'Guaranteed costs', if there are and what the works are what has to be carried out by the contractor on the purpose for these costs.
w. A written statement, together with drawings, explaining what the contractor understands on the indication in the specifications "... appropriate for extremely heavy use in industrial environments and designed for reliability and ease of maintenance".

3. **Summary**
   
   a. Work Included:
The new contact stands of concourse E are going to be equipped with eleven (11) Passenger Boarding Bridges and fixed links. The PBB connects with all types of aircraft at the gate (ICAO-categories C, D, E and F). There are two types of stands envisaged in the design, namely:

- three (3) Double Apron Drive (DAD) stands carried out with two (2) apron drive PBBs per stand;
- five (5) Single Apron Drive (SAD) stands carried out with one (1) apron drive PBB per stand.

The bridges exist of self-propelled, two and three tunnel apron drive Passenger Boarding Bridges and Fixed Bridge Extensions of the sizes and types required to board and disembark passengers from the designated doors of the terminal to the designated types and sizes of docked aircraft intended to be served by each of the respective aircraft passenger boarding bridges.

Lift columns shall be provided with a hydraulic lifting system, per the manufacturer’s proven design, providing full extension to accommodate all required aircraft door heights. Horizontal drive assemblies shall be proven electro-mechanical variable-speed drives with solid rubber tires.

PBB’s and Fixed Bridges shall be supplied with comfort cooling, ventilation and life-safety pressurization as part of the work of this Specification.

The Contractor shall install the PBB’s and Fixed Bridges including the supply the lifting cranes and crane operators for the movement of the PBB’s from their on-site staging location to their final installed locations and will have full responsibility for the Work and hold the IAA harmless from any and all direct and third party damages and/or liabilities associated with the Work.

b. Exclusions from the work of this Specification:

- The design and construction of rotunda and fixed bridge supporting column foundations and installation of the anchor bolts will be performed by other contractors. Anchor bolts and installation supervision shall be provided by the PBB manufacturer.
- The Visual Docking Guidance System (VDGS) shall be furnished and installed by others, except that the work of this Specification shall install the agreed length of VDGS control cabling furnished by others within the PBB’s during the PBB manufacturing phase (with slack cable sufficient to reach the electrical room junction box). The Contractor shall also provide a universal mounting bracket at the PBB wheel bogie for the VDGS control panel.
- Dedicated power supply and communication cabling connections for PBB’s operations will be terminated by others, into power and junction boxes furnished and installed under this Specification. The assumption of the required power to the PBB is 3x100 Amp.
- Gate numbering signs to be mounted on the side of the fixed bridges at gate E2 and E5 will be furnished by others.
- There will be no aircraft potable water supply unit or water supply lines in the PBB’s.
- Aircraft Ground Power will not be supplied via the PBB’s.
- The design of the PBBs shall also accommodate mounting of aircraft PCA equipment, including duct retriever and storage systems. The PBB shall be designed for telescopic PCA ducts with hose retrievers. The PCA-ducting and hose retrievers shall be furnished and installed by others, except that the work of this equipment shall install the agreed length of retriever control cabling furnished by others within the PBBs during the PBB manufacturing phase. The Contractor shall also provide a universal mounting bracket outside the PBB for the retriever control panel. The delivery of the PCA equipment will be a third party delivery, however the coordination for mounting and adjustment of the various installations is for the responsibility of the contractor of the PBB installations.
4. **Additional options**

The options given below shall be separately priced in the offer by the manufacturer.

a. **Option 1: Glass wall tunnels of PBB and fixed bridge**
   
   Both walls of the tunnels of the PBB and the fixed bridge will be made of glass. The glass shall have an insulation factor (U-value) of 1.1 W/Km² or better. The solar factor (g-value) shall be 0.2. The color of the glass shall be coordinated with the IAA to match the glass of the building.
   
   As a result, the cooling demand of the HVAC system will increase accordingly.
   
   The used glass shall comply with NFPA 415.

b. **Option 2: One side glass wall tunnels of PBB and fixed bridge**
   
   One wall of the tunnels of the PBB and the fixed bridge will be made of glass. Which side shall be the glass side will be determined by the IAA. The glass shall have an insulation factor (U-value) of 1.1 W/Km² or better. The solar factor (g-value) shall be 0.2. The color of the glass shall be coordinated with the IAA to match the glass of the building.
   
   As a result, the cooling demand of the HVAC system will increase accordingly.
   
   The used glass shall comply with NFPA 415.

c. **Option 3: Luggage slide**
   
   As an option, a covered oversize luggage slide (chute) and integrated wheelchair winch with a complete transparent weather hood shall be provided. The slide shall be all fiberglass with a stainless steel slider bed with a minimum bed width of 700mm. The slide shall have a mechanism to slow and stop luggage at the bottom to prevent damage to equipment or luggage. The top of the slide shall be at the level of the stair landing. Provide a removable break in the landing guardrail at the point where luggage is be place on the slide. It shall be possible to place luggage on the slide without lifting. Also provide a similar break in the stair handrail at midpoint of the stair and an opening in the weather hood to allow for clearing of luggage jams. An integral winch shall be capable of raising and lowering a wheelchair weighing 230kg on the slide.
   
   The complete assembly shall be custom colored to match the PBB. Fiberglass shall be integral color. All surfaces shall be scratch and UV resistant.

d. **Option 4: Handrails on both sides of tunnels**
   
   As an option, full length handrails shall be provided at both sides of the fixed bridges and tunnels of the PBB system. The clearance between tunnel sections shall be designed to accommodate the full length handrails. Handrails shall be of brushed stainless steel and be compliant with Israeli standards number 1918 and 1142.

5. **Standards and References**

   a. **General Considerations**
Design, manufacture and installation shall comply with all applicable Israeli Laws, Regulations and Standards, as well as applicable International and United States Codes and Standards as further defined below:

b. Israeli Laws, Regulations and Standards:
- Israeli Rules and Regulations for Electrical Installations (IRREI)
- Israeli Planning and Building Law
- Safety Regulations (Ministry of Labor)
- Israel Electric Corporation (IEC) (including but not limited to IEC-60489, IEC-70 and IEC-592)
- General Specifications for Building Works (issued by the Ministries of Housing and Defense)
- Israeli Airports Authority (IAA)
- The Standard Installation of Israeli (SII) Standards (including but not limited to Israeli Standard 1419)

c. International and United States Codes and Standards:
- US Department of Transportation, Federal Aviation Administration (FAA) Advisory Circulars (including but not limited to AC 150/5220-21C, Aircraft Boarding Equipment)
- International Civil Aviation Organization (ICAO) (including but not limited to ICAO Annex 14 Aerodromes)
- International Air Transport Association (IATA) (including but not limited to AHM922, Airport Handling Manual, Basic Requirements for Passenger Boarding Bridge Aircraft Interface)
- European Standards (including but not limited to EN 12312-4 (2014), Aircraft ground support equipment - Specific requirements – Part 4: Passenger boarding bridges)
- European Standards (including but not limited to NEN-EN 1915-2013, Aircraft ground support equipment - General requirements – Part 1: Basic safety requirements)
- International Electro technical Commission (IEC)
- American National Standards Institute (ANSI)
- American Society of Mechanical Engineers (ASME)
- American Society for Testing and Materials (ASTM)
- Institute of Electrical Electronic Engineers (IEEE)
- VDE, DIN German Standards
- National Electrical Manufactures Association (NEMA)
- Underwriter’s Laboratories (UL), or European Conformity (CE)
- Society for Protective Coatings (SSPC)

Where a reference standard is cited in these specifications, the subject to which it applies (equipment, material or work) shall be in compliance with the most recent edition of that standard.
None of the above, however, shall be construed as relieving from any requirement that may be in excess of, but not contrary to, the referenced standard.

d. CE marking
Based on the European legislation every manufacturer is obligated to deliver the PBB with CE-marking. Reason is that one or multiple EU product directives apply to the product. These European Directives apply to all machines which are sold in Europe after 1st January 1995.
Remark: If second hand machines are sold on the European market for the first time; the same obligations apply.
New machines which meet the European legislation are provided with a CE-marking.
Examples of EU product directives for the PBB (not limited):
- Machine Directive (2006/42/EG);
- Low Voltage Directive (2006/95/EG);
- Etcetera.
The European Directive(s) contain fundamental requirements with regard to safety and health. Several (technical) subjects are drawn up more detailed in the Standards and offer possible solutions for the manufacturer of the machine or system.
6. Design Requirements

a. General
The Passenger Boarding Bridges and Fixed Bridges (hereafter referred to as PBB) covered by this specification are designed to extend from the gate node doorway to the aircraft boarding door. This design enables passengers to enplane and deplane during normal or emergency operations while providing a safe environment which is protected from hazardous and atmospheric conditions. The bridge provides a simple, safe, convenient and controlled method for boarding passengers. The complete assembly is protected against inclement weather conditions, both when sealed against an aircraft and when parked with the weather door closed.

The PBB allows for movement in the following manner: The PBB shall extend / retract, swing laterally, move vertically, and be equipped with a rotating cab. The PBB extend/retract and lateral swing motion shall be accomplished by use of a wheel bogie device. The tunnel sections shall be sectioned, with the largest tunnel section being closest to the aircraft. The PBB shall be capable of moving in two axes simultaneously.

Bridge horizontal movement shall be smooth and continuously variable for speed in both rotation and extension/retraction. Movement shall be controlled by an operator control stick. Horizontal drive shall be through the use of A/C drive motors controlled by VFDs (Variable Frequency Drives). The bridge shall automatically enter a slowdown mode of approximately 3 inches (75 mm/s) per second when the PBB approaches the aircraft. Slow down and stop, including forward motion and cab tilt, shall be activated via sensors in the bumper upon contact with the aircraft.

Boarding bridges shall be of the telescopic apron drive type and shall meet the operational criteria and other conditions described in these specifications and in the drawings. The aesthetic aspects of the integrated design are paramount, particularly with regard to equipment, ductwork and cables.

In the design the contractor shall take into account the existing environment (Mediterranean climate, high humidity and exhaust from aircraft and other transport equipment). It is obvious that all materials of the new passenger boarding bridges (tunnel sections / structures) that are used shall be resistant (to be specified by the contractor in the tender documents). All equipment shall be designed for continuous and trouble free service under dust and sunny atmospheric conditions and has a minimal IP54 class of protection.

Tel Aviv climate & temperature
Koppen-Geiger classification: Csa
Annual average temperature: 21 Degrees
Annual average hot season temperature: 27 Degrees
Maximum temperature: 53 Degrees
Annual average cold season temperature: 16 Degrees
Minimum temperature: 8 Degrees
Annual average rain precipitation: 655 mm
Annual average wind speed: 10 km/h
Annual average hours of sunshine: 3300 hours
Annual highest humidity: 94 %
Annual lowest humidity: 37 %
b. Aircraft to be served
The range of minimum and maximum lengths and other operation criteria of the PBB’s shall be necessary to satisfy multiple requirements for the aircraft types and door positions at each gate as identified in the drawings and the Schedule in Appendix 1. The aircraft are defined on specific lead-in lines and multiple nose-wheel stop lines for each Gate. Factors taken into account in setting the positions include:

- Required clearances on all sides of the aircraft per ICAO Annex 14
- Heights of terminal and ramp
- Allowable slope in the bridge components and desire to minimize slopes for passenger safety and convenience.
- Space for efficient Ramp Operations while accommodating maximum aircraft sizes.
- Locations of aircraft service points and service radii in relation to 400 Hz, PCA and Fueling Pits
- Commonly available models two and three tunnel apron drive type PBB’s

The resulting Gates, Layouts and Basis of Design PBB’s Schedule, as shown in the drawings, represent an optimization of these factors. The PBB manufacturer may propose adjustments as part of the submittal process for the IAA’s review and possible approval.

The PBB manufacturer shall note that it is the IAA’s intent to serve several aircraft that can be problematic for efficient mating to a PBB and service pits. These aircraft include:

- BAE 146 100-300 (bumper and canopy)
- Embraer 170-175 (fuel service point)
- MD 80-series (pre-conditioned air service point)
- TU 154 (general)
- A380 Main Level (needed space for opening the door)
- B787-8 door L1 (pitot tube proximity) and L2 (engine proximity)

c. Boarding Bridge Length:
The number and length of bridge sections will be determined as a function of the maximum (extended) and minimum (retracted) lengths required for each bridge. These lengths will be determined as a function of the
height of the boarding gate above finished apron level, apron grade and the final parked position of all aircraft assigned to each gate. The bridge slope shall not be greater than 1 in 12 (8.33%), up or down, in serving all the required aircraft and door positions in all conditions of load and mispark, and wherever possible shall be less than 8%.

d. Boarding Bridge Normal Operation
On parking the aircraft, the bridge should already have been pre-positioned in the waiting position adjacent to and at a height to suit the incoming aircraft door(s). The bridge will then be driven from its waiting position to the docking preposition near the aircraft door using the semi-automatic pre-positioning system, rotation of the cab ensuring a "square-on" approach.
At this stage, minor height adjustments can be made manually to compensate for any difference between the pre-selected height and the actual height of the door sill.
Slow speed final approach shall be made by the operator using the infinitely variable speed control and the forward movement can be arrested by activation of switches within the bumper upon contact with the aircraft.

When docking has been satisfactorily achieved, the auto leveler and canopy shall be deployed, where upon the "auto" mode can then be selected.

e. Boarding Bridge Emergency Operation
Depending on the prevailing circumstances, there shall be several options available for the Emergency Back-off of a bridge from an aircraft:

- Emergency back-off
The Emergency Back-off feature shall allow the bridge to be retracted from an Aircraft rapidly during an emergency - such as fire, while the bridge is still in "Auto" mode.

- Towing Facility
Tow-bar attachment lugs shall be located on the bogie frame. Under conditions of power failure or control equipment problems, the brakes on the main drives can be manually released to allow a bridge to be towed back from an aircraft.

- Manual Battery back-off
Facilities shall be provided that allow a bridge to be manually moved back under conditions of power failure or control equipment problems and when towing is not convenient. A separate portable set (1) of batteries shall be provided on a towable vehicle to provide the PBB with power for emergency back-off. The facility will be equipped with minimal a control panel and battery charging device. The control panel enables releasing the brakes and moving the bridge away from the aircraft using the set of batteries.

f. Equipment
- Drive and Controls
The control system shall be capable of achieving all specified duties and have a high level of reliability and status indication.
   The system shall:
   o Maintain preset heights
   o Diagnose faults, with local report and links to SCADA
   o Log usage to assist maintenance

- Back-Up Switches
All main control functions shall be provided with secondary back-up switches, designed to operate if the first switch fails. Furthermore, an ultimate mechanical stop shall be included, which would physically prevent movement, even if both switches fail.

- Duty
The passenger boarding bridge shall have a minimum technical life of 25 years without major overhauls. During this period the passenger boarding bridge shall be expected to be used for 90,000 connections in all
(3.600 per year). During those 25 years and 90.000 connection operations, the passenger boarding bridge should continue to meet the reliability requirement as formulated in Part 1, paragraph 13 (Availability). The design life of 25 years is required and shall be based upon a 24-hour working day availability, seven days per week. An operational cycle shall be regarded as the servicing of an aircraft, including docking, all auto leveling movements and retracting to a parked position. Design of component parts shall take into account the number of stop / starts required and also the idle time both during and between operational cycles. The supplier shall submit LCC calculations to demonstrate that it will be able to meet this requirement.

- Detailed Scope
  The bridge manufacturer shall furnish the labor, materials, hoisting, scaffolding, equipment, engineering testing and supervision for the design, furnishing, installation and commissioning of all of the installation works and all related work in accordance with the Contract Documents.
  The works shall comprise, but not be limited to, the following complete installations and systems:
  
  o Fixed bridge
  o Rotunda and columns
  o Telescopic tunnels
  o Elevation frame
  o Powered axle
  o Bridgehead/cabin
  o Traction drive system
  o Electrical distribution system
  o Boarding bridge control system
  o Lighting system
  o Telephone installation
  o Various ancillary equipment
  o Closed circuit TV
  o Communication
  o Fire Alarm
  o Public Address
  o Air Conditioning and ventilation
  o Other system interfaces
  o Maintenance Equipment
  o Staff training
  o Manuals and documentation
  o Design, fabrication, inspection and testing
  o Warranty
  o Spare parts

- Activities in preparation for production work
  Based on the Functional and Technical specifications, the supplier of the PBBs shall perform the following activities prior to production:
  
  - Physical on-site measurement of the final dimensions, in the presence of representatives from IAA.
  - Prior to construction of the PBBs it will be necessary to reach agreement with the third-party suppliers of those elements on the structural connection to the terminal building, the foundations on or near the apron, the PCA duct and retriever system and other elements that are important to the PBBs. If it appears upon completion that no such agreement has been reached, the supplier of the PBB will be held accountable (if third-parties are involved)

- Transport-related activities
  The supplier is responsible for the transport of the PBBs between the production site and the relevant aircraft stand at Ben Gurion Airport, Tel Aviv.

- Activities in connection with assembly and commissioning
The supplier is responsible for all activities at the relevant aircraft stand that relate to the assembly and commissioning of the PBB. This includes:

- All lifting activities
- All transport activities.

h. Objectives as formulated by Ben Gurion Airport, Tel Aviv.

- Environment
  Ben Gurion Airport, Tel Aviv strive to take a responsible approach to environmental issues. As a result, the PBB and the fixed section shall be constructed in accordance with the applicable environmental legislation. This means that permanent measures shall be taken to prevent harmful substances (oils, hydraulic liquids and the like) from ending up on the apron or in the rainwater discharge system as a result of spills, leaks or maintenance work.

- Energy
  Ben Gurion Airport, Tel Aviv strive to take a responsible approach to energy and to operate in an energy-efficient manner. Suppliers are challenged, therefore, to incorporate energy-efficient components into the PBB (energy label A or B or an equivalent industry standard).

- Raw materials
  Ben Gurion Airport, Tel Aviv strive to take a responsible approach to raw materials and to ensure they are used efficiently. PBB suppliers are challenged, therefore, to only use materials for the PBB that are at least 95% recyclable at the end of the service life of the bridge and fixed section.

- Innovation
  The requirements set forth in this document are essential requirements. In the interest of innovation, the candidate may suggest deviations from some of these general or detailed requirements if he provides justifications that these deviations improve the overall quality (including TCO) of the product or service.

7. Quality Assurance

a. Manufacturer Qualifications:
   Manufacturer shall fulfill the threshold requirements as stated in the tender documents.

b. Installer Qualifications:
   Engage an experienced Installer who shall be the manufacturer’s authorized representative, who is trained and approved for supervision and installation of each type of products specified in this section and whose installation have resulted in construction with a record of successful in-service performance. Contractor is to submit Curriculum Vitae and certificates of the installers and the welders.

   Installation: Provide installation by the manufacturer, or by an installer certified by the manufacturer as qualified for the installation work, and with a manufacturer’s representative at the site to supervise the installation.

   Training: Provide qualified manufacturer’s representatives to provide training to the IAA’s personnel in the operations and maintenance of the PBB equipment.

c. IAA’s Factory Inspection:
   The IAA representatives shall have the right to visit the manufacturer’s production facilities to inspect the built quality of the products. Upon request the manufacturer shall inform the IAA where and when which products are manufactured. The IAA shall be notified 4 weeks in advance when completion of the first product is expected.

d. Quality Assurance:
   Program documentation: The PBB manufacturer shall provide documentary evidence of his Quality Assurance System and the Quality Plan for this Project (see Coordination and Submittal requirements).
e. **Quality Control Manual:**
   Prepare a quality control manual that meets the requirements of ISO 9001 and acceptable for the IAA. Draft inspection list and methods that will be applied for quality control inspections and testing to confirm compliance with Contract documents and all relevant codes, standards and regulations.

f. **Welding Qualifications:**
   All welds shall exhibit adequate penetration and shall be clean and free of slag. Welds shall not be ground to improve appearance except as required for flush surfaces or where non-structural parts are involved. Qualify welding procedures and personnel according to American Welding Society (AWS) Standards:
   - AWS D1.3: Structural Welding Code - Sheet Steel.
   - AWS D1.4: Structural Welding Code - Reinforcing Steel.

g. **Bolts and screws:**
   - Shall be made of stainless steel.
   - Shall have hex cap or hex socket head.

h. **Electrical components**
   Electrical components, work and materials shall comply with the latest IEEE regulations and in accordance with IAA requirements. Examination by a qualified testing agency and marked for intended location and application.

8. **Failures**
   a. **Definitions:**
      - The functional uptime of a system is determined by the number of breakdowns and the required repair times in comparison with the time of operation (not standby).
      - A breakdown is the malfunctioning of a system element or component which interrupts normal operational procedures, i.e. a technical fault/malfunction occurs resulting in a message requiring technical personnel to go to the location of the fault to check or remedy the problem.
      - The following malfunctions will not be considered to be breakdowns:
        1) Malfunctions caused by external persons or incidents
        2) Incorrect system operation caused by inattention or negligence
        3) Activation of E-Stop by operator. As subsequent system failures (e.g. motor trip) however shall not occur in conjunction with E-Stop activation, those occurrences will be deemed as breakdowns and count, even though the E-Stop was activated.
      - The repair time is the period of time between the beginning of a breakdown and the resumption of normal operations.
   b. **Handling epidemic malfunctions**
      - The contractor acknowledges that the multiple occurrence of identical malfunctions in general describe the situation of an epidemic malfunction.
      - An epidemic malfunction/failure is been identified if:
        1) The same malfunction/failure occurs within one day of operation for more than three (3) times at the same PBB/equipment, periodically within one (1) month.
        2) The same malfunction/failure occurs within one day of operation for more than three (3) times at different PBB s/equipment, periodically within one (1) week.
3) The same malfunction/failure occurs for more than three (3) times at the same PBB/equipment, periodically, whenever the area/equipment operates under special conditions (e.g. load, type of aircraft, weather conditions, etc.)

- Safety failures always shall be handled as epidemic ones.
- In case a malfunction/failure is defined as an epidemic failure, the following preventive steps shall be taken by the contractor immediately:
  1) Carrying out “failure research” in order to locate the reason and the source causing this epidemic failure (such as design, production, workmanship problem etc.) and the method to repair and prevent re-occurrence in the future.
  2) Prepare a detailed “failure analysis” report and submit this to the IAA for reviewing and approval.
  3) Carry out the approved countermeasures and monitor up to one month from the date of finishing the (countermeasure) works.

- The contractor shall indicate in the aforesaid report the time table for implementing the results of the “failure analysis”. The IAA preserves its right to discuss the time table for implementation with the contractor, in order to shorten / compress the time table.
- The contractor pledges to apply all the results and necessary repairs / modifications / improvements, as concluded through the failure analysis report, in all the equipment that has been installed under this Contract and within the time table finalized with him.
- This process shall be accomplished by the contractor immediately after the failure was discovered and the contractor had been notified regarding it.
- It is clarified that in the event of an epidemic malfunction all efforts and coordination for service and repair, including all spare parts and consumables have to be provided by the contractor free of charge, until the epidemic malfunction has been proven rectified.

9. Co-ordination

Certain materials will be furnished, installed, or furnished and installed, under this Contract. Examine the Contract Documents to ascertain these requirements.

Carefully check space requirements with other Contractors to ensure that all material can be installed in the spaces allotted thereto.

Wherever work of this Specification interconnects with work of other Trade Contracts, coordinate this work to ensure that all Trade Contractors have the information necessary so that they may properly install all the necessary connections and equipment.

Provide required supports and hangers for the distributed services and equipment, so that loading will not exceed allowable loadings of structure while retaining the frequency of supports as dictated by this Specification.

It shall be the responsibility of the Bridge Manufacturer to schedule this work with other Trade Contractors in accordance with the construction sequence.

The Bridge Manufacturer shall provide structural load calculations, anchor bolts and installation supervision for concrete foundations provided by others. Any other field drilling, cutting and/or reinforcing of holes in structural slab required for work under this Specification shall be coordinated through the Construction Manager. All such drilling, cutting and reinforcing costs shall be borne by the Bridge Manufacturer.

The mechanical services shall be fully coordinated with all other Trade Contractors.

It is the responsibility of the Bridge Manufacturer to coordinate the supply, installation, commissioning, testing and programming of all the works described in the contract documents, whether it is supplied or modified.
under this Contract or is a free issue for his installation.

The Bridge Manufacturer shall accept responsibility for coordination and liaison with other trade contracts to ensure that the installation as detailed does not conflict with other services or the building fabric, either during the construction or within the finished assembly.

The Bridge Manufacturer shall ensure that coordination with all related elements of work has been fully coordinated and planned prior to submitting information for acceptance or commencing the installation. The locations of other permanent facilities, including fuel hydrants, 400 Hz configurations and the like that affect the freedom of movement of the passenger boarding bridge shall be taken into account. No instructions shall be issued in respect to additional cost due to modifications being necessary as a result of failure to properly coordinate drawings or the installation.

The Bridge Manufacturer shall allow for the position of any service run to be adjusted from the positions shown on the Tender drawings, during the production of coordinated Installation Drawings.

The Bridge Manufacturer shall take site dimensions during the preparation of the Installation or Shop Drawings and shall be responsible for their accuracy. Setting out of the works on site shall be carried out by the Bridge Manufacturer who shall be responsible for the accuracy of such setting out.

The Bridge Manufacturer shall liaise with the suppliers of the PCA, 400Hz, Visual Docking Guidance System and Fueling installations adjacent to the PBB installations, and with power, communications, public address, fire alarm, telephone, emergency lighting, intercom and other systems installed within the PBB and shall ensure these systems are adequately coordinated.

10. Design Criteria

The bridge shall be designed in accordance with good engineering practices and the standards developed and adopted by the PBB industry. Particular attention shall be given to keeping components simple, rugged and easily accessible for routine maintenance, including lubrication, component exchange and ease of adjustment. All fixed limit stops shall be adjustable. All access panels and openings shall be sized to accommodate the component being changed or adjusted, as well as the equipment and personnel necessary to accomplish the work.

a. Structural Loads

The PBB shall be designed for a structural working life of 25 years or 90,000 connections and adequate protection of the structure against corrosion shall be provided, consistent with the implementation of good planned preventative maintenance policies to be defined by the PBB manufacturer.

- The PBB will support the following loads. These loads may be applied in total or in part, singularly or simultaneously. The design shall be based on the combination which imposes the most adverse loading. In addition to the dead loads and strain caused by movement, the entire PBB shall support:
  - Nominal 320 kg/m², According to UNI EN 1915-2;
  - Dynamic test (320x1.2) kg/m²;
  - Static test (320x1.5) kg/m².
  - A roof load of 100 kg/m²
  - Wind velocity of 100 km/h (operational)
  - Wind velocity of 150 km/h (retracted and stowed)

- The structural design shall provide sufficient torsion rigidity to avoid sway when the boarding bridge is brought to a stop.

- All mechanisms for actuating, guiding and restraining the loading bridge and its components shall be designed so that no noise, sway or sense of insecurity is apparent to passengers. No operating
vibrations or loads shall be transmitted to the terminal building.

- With winds above 100km/h the boarding bridge should be retracted, depressed and moved to a parked position as close to the Terminal as practical.

b. Environmental Considerations

- The boarding bridge shall operate satisfactorily under exterior ambient temperature conditions of -20°C to +53°C, with winds up to 100 km/h. The equipment is not expected to operate in higher winds, but shall withstand them without damage.

- The design of the tunnels will incorporate measures to provide adequate insulation to maintain design temperatures and to ensure that storm water is effectively collected and discharged to apron level. Flexible seals will prevent ingress at gallery ends and stainless steel gutters and drainage points to be fitted. Structural flat floor, wall and roof panels with a minimum of R12 thermal insulation shall be utilized to save energy, promote prompt drainage, reduce inner condensation, and insure the best resistance to corrosion.

- The PBB System Cooling shall maintain temperature in the fixed and telescoping PBB’s at 22°C +/- 2°C, 50% rh.

- All external equipment shall be suitable for outdoor operation and shall provide a minimum level of protection to NEMA IC SE-110, EEMAC E 14-2 enclosure type S (or equivalent EN standards), dust tight, rain tight, resistant to hail and ice (IP65).

- The noise level produced by any piece of equipment supplied under this contract shall not exceed 75dBA at a distance of one meter in any direction.

- The following requirements apply to all stainless steel components:
  - Outdoor use: 1.4404 (AISI 316L)
  - Visible stainless steel components shall be treated with silicon carbide, grain size K320.

c. Power Characteristics

- Each PBB System shall operate on 400V 3 phase 50Hz 4 wire, 100 Amp service for the PBB main supply, motors activators. Lighting, air-conditioning system and controls shall be by transformation by PBB equipment.

- A local TCP communicated UPS shall be provided for the PLC and HMI units.

- Interlocks shall be provided to prevent operation of PCA until the boarding bridge has docked with the aircraft, except for the boarding bridge and fixed bridge pre-conditioning. Interlocks shall be provided to prevent the bridge from moving while the PCA is connected to the aircraft. Key operated override switches shall be provided.

- Electrical equipment shall be mounted a minimum of 500mm above apron surface.

d. Boarding Bridge Operational Speeds and Range

Design speeds will be as follows:

- Horizontal travel (Extension Retraction): 0 - 0.5 m/s (infinitely variable)
- Vertical movement of cab (Automatic & Manual): 0.05 m/s (Adjustable)
- Automatic leveling: 0.05 m/s (Adjustable)
- Safety shoe initiated lowering: 0.1 – 0.2 m/s (for one second)
- Cab Rotation: 3.0°/sec
- Bogie Wheel Rotation: 8.0°/sec
The boarding bridges shall provide the following minimum range of principal movements.

- **Cab rotation**: 90° left  
  35° right
- **Bridge (rotunda) rotation**: 83° left  
  83° right
- **Elevation**: Adequate to serve all aircraft doors per Appendix 1 in full to empty and mispark conditions
- **Clearances**: 7,5m to aircraft with PBB in parked position and 3,0m to aircraft engine at any point of PBB operational travel

e. **Maintenance**

Boarding bridges will be designed for ease of maintenance. Self-lubricating or pre-lubricating parts will be provided where possible.

- The following items will be specified as requiring sealed for life components:
  - Elevation legs
  - Drive shaft hydraulic cylinder
  - Tunnels
    - Lower horizontal rollers (pre-greased)
    - Upper auxiliary rollers (pre-greased)
    - Large cable sheathes

- **Main Drives**
  Each bogie wheel will be powered by an easily maintained variable-speed AC drive giving inherent high reliability.

- **Modification process**
  - **Modifiability**
    The components of the installation that form part of the PBB shall be positioned, placed, connected and attached in such a way that they can easily be replaced. Cable ducts shall be accessible to ensure that the number of cables for the PBB can be changed / increased in the future without structural changes to the installation.
  
  - **Practicability**
    It shall be easy to replace individual installation components and they shall be mutually exchangeable. In addition, the installation shall offer safe access to its constituent components.

  - **Configurability**
    All the configurability possibilities shall be able to be configured by the HMI. Also all functions mentioned in the specifications shall be activated / de-activated.
- Control Equipment
  All control equipment and panels will be located within the boarding bridge, this ensuring a weather-proof enclosure and a good working environment for maintenance. In addition, there shall be a provision for maintenance personnel to operate the PBB from below by hand-held remote.

- Wheels
  Wheels will be solid rubber in order to eliminate inflation problem and increase service life. Provide tires with at least a seven (7) year duty cycle or 18,000 cycles/connections with the expected field conditions and nature of the activity at the airport.

f. Corrosion Protection
All structural panels shall be hot-dip galvanized after fabrication and before painting.

11. Warranty
The Bridge Manufacturer shall provide an unconditional warranty for a minimum of 24 months (after successful finishing of the OMP) for the total PBB installation including fixed bridge sections. Full details of extended warranties shall be provided for review and approval.

In addition a ten year warranty is required for all exterior metal paint finishes.

Maintenance / warranty period must, together with the bid, given by the manufacturer / contractor. The length of this period and the shape of the maintenance / warranty conditions help to determine the choice.

a. Products
  • A fifteen (15) year or 54,000 connections warranty shall be provided for correction of defects attributed to deficient structure.
• Guarantee all PBB electronic components and equipment for 5 years or 18.000 connections against defects.
• Guarantee all other PBB and ancillaries equipment for 10 years or 36.000 connections against defects.
• Guarantee all software, high level and low level controls as required. Software has to be build modular.
• Allow for the assignment of all guarantees provided or received from Subcontractors and suppliers as required by the specification.

Note: the Warranty demands as described in this chapter also counts for the specific warranty requirements as mentioned in other specific chapters in this specifications.

12. Safety requirements

a. Safety requirements - general
The following general safety requirements apply to the PBB:
• Facilities should be in place to prevent damage to the PBB and to objects on the apron (including the aircraft) during the operational use of the PBB. When no light lit indicates that the PBB is in the correct parking position and the horizontal distance between the PBB and the incoming aircraft and the nearest part of the parked PBB is, recommended, at least 7,5 meters. If the distance between an incoming aircraft and the nearest part of the parked PBB is less than 7,5 meters the contractor will, during the design stage, inform to the IAA which PBBs this concerns and also what the distance will be.

b. Life Safety and fire protection Requirements
• The Passenger Boarding Bridges and Fixed Bridges shall be designed to meet all requirements of NFPA 415.
• Corridor/Fixed Bridge
  The PBB Fixed Bridge and Tunnel components will be double skinned construction and filled with an insulating, fire resistant material. All floor and ceiling cavities will be similarly insulated. Canopy bumper and seals will be produced in fire resistant materials and heat resistant glass fitted to control cab windows.

c. Safety requirements related to the aircraft
The following aircraft-related safety requirements apply to the PBB:
• PBBs must be provided with a so-called "automatic levelling installation" which follows the changes in height of the aircraft. The horizontal distance between the parked aircraft and in lengthwise along the aircraft moving PBB shall be at least 3 m, with the exception of the connection procedure, where the distance between PBB and aircraft decreases to zero (0). This rule does not apply to that part of the process when the PBB is actually connected to the aircraft.
• Opening of the aircraft door should never incur damage from a properly connected bridgehead, with respect to the following guidelines:
  • There should be sufficient turning space for the aircraft door. The underside of the aircraft door may not touch the floor of the bridgehead, even if the PBB is in a sloped position
  • Incorrect Parking Tolerances: stop position of the nose wheel of the aircraft is within plus or minus 0.5 m at both the lead-in line and perpendicular to it. Deviation centerline aircraft up to 5° left or right of the center of the lead-in line, with nose wheel centered on lead-in line
  • The PBB (except the bridgehead, canopy and levelling tool) never touch the aircraft.
  • The PBB has a safety zone: Relative to engine of the aircraft. Relative to a second PBB (at DAD-stands) Relative to other aircraft components.
  • The bridgehead and the canopy between the bridgehead and the aircraft should never cause any damage during the connection process and when the aircraft moves.

d. Safety requirements related to individuals
The following personal safety requirements apply to the PBB:
• The bridgehead shall be equipped with a facility that prevents operators or maintenance staff from being injured by a PBB while it’s moved or when it’s in parked position.
• The open part of the bridgehead shall be protected against a slippery floor to prevent the risk of people slipping.
• Both visual and acoustic signals should warn people on the platform that the PBB is moving.
• Safety Hoop
  Ultimate protection during the movement of the boarding bridge will be provided by a safety hoop around the drive bogie using laser, ultra-sonic and/or mechanical sensors. Contact with any obstruction, including personnel, will activate a limit switch bringing the boarding bridge to an immediate halt. The safety hoop will meet the European standard: EN 12312-4 (2014), Aircraft ground support equipment - Specific requirements - Part 4: Passenger boarding bridges (Supersedes EN 12312-4:2003+A1:2009)
• For the benefit of staff working on the apron, the carriage shall be fitted with emergency stops on either side (4 stops mounted on the carriage) which, when activated, will stop the movement of passenger boarding bridge immediately. Only expert staff should be able to reset the emergency stop.

The diagram below shows the areas to be covered by the camera system showing the drive-wheel assembly.

- All functions on the control panel shall be disabled when the PBB is connected and ready for boarding / deboarding. The operator of the PBB can enable all functions using the badge reader or key or by selecting the MANUAL mode.
• If an aircraft stand (DAD) is equipped with multiple PBBs, measures shall be taken to prevent the PBBs or parts thereof from interfering with each other or from entering each other’s operational zones.
• The PBB shall not be able to leave the operational area.
• Each bridge cabin has to be designed in such a way that there is allowance, both structurally and availability of space, for the installation of:
  o A VDGS emergency stop button, to be provided and connected by supplier VDGS and in coordination to be installed by supplier PBB.
  o A Manual fire-alarm box and System smoke detector complying with NFPA 72 code, to be provided and connected by supplier Fire alarm systems and in coordination to be installed by supplier PBB.
  o A portable thermostat with cable and bracket for the Pre-Conditioned Air system, to be provided and connected by supplier Pre-Conditioned Air system and in coordination to be installed by supplier PBB.
  o A telephone set, to be provided and connected by the supplier of Telephone system and in coordination to be installed by supplier PBB.
  o Cabling for the badge reader, to be provided and connected by IAA.
• If the PBB is outside the parking zone during the connection process and no control is activated within 30 seconds, this shall automatically trigger acoustic and visual signals. These signals shall stop as soon as one of the controls is activated.
• If the PBB is outside its parking position after the connection process, this shall automatically trigger acoustic and visual signals after 5 seconds. To end these signals, the parking function shall be reactivated.

13. Availability

PBBs shall have an operational availability of at least 99.9%. Regular scheduled maintenance need to be taken into account in operational availability calculations. Note, however, that no more than 24 hours is available for this type of maintenance per year.

The availability requirements are clarified below:

\[
\text{Total time} = 8760 \text{ hours (365 days x 24 hours)}
\]

\[
\text{Effective time} = 8736 \text{ hours (365 days x 24 hours) - 24 hours}
\]

\[
\text{Productive time} = 8727 \text{ hours}
\]

\[
\text{Availability} = \frac{\text{Total time} - \text{losses}}{\text{Total time}} \times 100\%
\]

\[
\text{Availability target} = 99.9\%
\]

\[
\Rightarrow 99.9\% = \frac{8760 - \text{losses}}{8760} \times 100\%
\]

\[
\Rightarrow \text{losses} = \text{availability loss + productivity loss}
\]

14. Maintenance Process and Requirements

a. Maintenance strategy
The central purpose of PBB maintenance is to safeguard the availability and reliability targets at all times. To that end, an Installation Management Concept is used that generates recommended maintenance policies based on risk analyses, failure frequency data, etc.

b. Maintainability
The Mean Time To Repair (MTTR) of the PBB is two hours. This means that components shall be able to be replaced within two hours. In order to safeguard the MTTR, the supplier shall provide a list indicating which components will need to be kept in stock and quantities. The supplier shall provide a separate list with exceptions to the MTTR if there are.

The PBB installation shall be low-maintenance in design and be as maintenance-friendly and environmentally friendly as possible. With respect to the PBB, two types of maintenance will be distinguished:

- Keeping the electrical, hydraulic and mechanical installations of the PBB in a good state of repair and carrying out repairs to such equipment.
- Cleaning the interior and exterior of the PBB.

Situations that call for special maintenance tools shall generally be avoided. If the maintenance work cannot be performed without special tools, it is up to the supplier of the PBB to provide such tools.

In addition, the supplier shall submit for approval in Hebrew and English language, a list of:

- Essential components required to meet the availability targets for the PBB
- Non-wear resistant components with a service life of less than 24 months (in normal use)

**c. Inspections**

Throughout its service life the PBB will be inspected at regular intervals. The design of the PBB shall allow for an effective inspection without too much preparatory work.

**d. Service request**

The PBB shall give a signal to the PBB Control station (future) when maintenance is required.

### 15. Calamities process

**a. Performance requirements**

The PBB and fixed bridge (if applicable) will also be used as an egress route for:

- Passengers and crew from the connected aircraft, enabling them to egress via the PBB and the fixed section (if available) to the terminal building in the event of a calamity inside the aircraft or on the aircraft platform (e.g. fuel fire)

**b. Safety requirements**

Given that it is used as an egress route in the event of a calamity, the PBB shall be equipped with an emergency system that includes:

- Anti-panic lighting
- Exit signs
- Safety push bar in service door of the PBB
- Fire alarm system (smoke detection)
- Public address system
- Fire resistive construction and materials per NFPA 415
- Air pressurization per NFPA 415, NFPA 92A and other standards

The requirements shall be approved by the IAA.

### Part 2. Products

#### 1. Rotunda Assembly

The rotunda assembly is made up of a corridor, rotunda and support column. The assembly shall be designed so that no loads or vibrations are transmitted to the building, including the fixed bridge where applicable.
The rotunda assembly shall be designed as the terminal end pivot for PBBs vertical and horizontal motion. As the main pivot for the PBB, the rotunda assembly shall allow the bridge to swing clockwise and counterclockwise from the corridor centerline (required range of motion as shown and specified).

Slope, over-travel and operational swing limits are to be located on the rotunda assembly. Slope limits shall be capable of adjustment up to 10% (5.71°) for both up and down slopes (slope for passenger use is limited to 8.33 % (4.76°) up or down). This limit is to be adjustable to meet local operating conditions and requirements.

Limits to PBB movement will be staged. Limits to PBB travel will be set / activated using software and / or electrical limit devices followed by mechanically activated limit switches. Activation of limits will prevent PBB motion in the direction of the activated limit. The field adjustable, over-travel swing limit switches are located on the rotunda (these switches are adjustable to meet local conditions). When the limit is actuated, PBB drive in that direction is disabled with the PBB still being able to move in the opposite direction. Activation of the ultimate or mechanical swing limit switch will disable all control power. Maintenance personnel will be required to enable control power and move the PBB away from the swing limit.

a. Foundation:
The PBB manufacturer shall supply the necessary anchor bolts and flange connections details and drawings for the rotunda column foundations which are to be provided under other Sections of these Specifications. The anchor bolts shall be supplied by the PBB manufacturer and the placing, the adjustment and the casting of these anchor bolts is done by others but shall be supervised by the PBB supplier.

b. Support Column
The support column is the structural support for the bridge and shall be manufactured from a steel tube, flanged at the base for connection to the foundations and flanged at the top for location of the rotunda, and shall be designed to absorb all loads and vibrations from the PBB and supported portion of the fixed bridge and transfer them to the foundation.
The support column rests on the foundation. The PBB Manufacturer shall provide the base grout at the support column. The PBB Manufacturer shall provide the structural reactions and attachment requirements so that they may be incorporated into the foundation/ pavement design detailing. The intended floor elevations are as shown on the drawings.
Mechanical supports to be supplied and installed on the column for the fixation of:
- Additional video safety cameras;
- Hydrant system emergency stop box (E.S. box, out of scope),
- Other equipment.

c. Rotunda
The rotunda, together with the connection between the bridge and the terminal, constitutes the horizontal and vertical articulation of the bridge. It shall be formed by two differentiated parts: a fixed chassis and another mobile part or rotating chassis. The fixed chassis shall be directly connected to the terminal or fixed bridge. Colors to match the PBB.

The rotating chassis is the structure that supports the tunnel and transmits its loads to the column. It is formed by a structure that surrounds the fixed chassis. It shall be connected to the column via a rotating crown with bearings and permanent lubrication that does not need re-greasing. The connection to the tunnel shall be done using two articulations each made up of their hinges with their respective screws. This connection shall prevent the entry of water and dust by using the same material as used in the canopy. The rotating crown allows the horizontal rotation of the tunnel and the articulations allow its inclination. This device shall provide smooth and continuous rotation of the bridge around the axis of the rotunda. It is provided with long-duration lubrication and equipped to enable later lubrication. The design of the floor is the same as specified for the tunnels.

d. Connection of the Rotunda to Terminal or Fixed Bridge and the Fixed Bridge to the Terminal
The corridor is the interface between the rotunda and the terminal building or fixed bridge. It shall be
directly connected to the terminal building or fixed bridge via a series of flexible closures that allow perfect adjustment to the gap in the building and, in turn, prevents the entry of water and dust together with a terminal threshold plate. The roof shall be flat plate (not corrugated). The minimum internal sizes shall be 244cm clear height and 140cm clear width. The connection of the Fixed Bridge to the Terminal is similar, except that the clear height is 239cm and the clear width is 189cm. Flexible seals and brushes shall be hermetically fitted at all interfaces to ensure weather sealing, including heat and UV resistance of the bridge and rotunda interiors with a seal duty-cycle of ten years.

e. Rotunda floor
The floor of the rotunda shall be a welded steel construction. It shall be mounted onto a precision ball bearing slewing ring which allows horizontal rotation through the prescribed angle of bridge movement. The slewing ring shall be able to absorb both the vertical load and the torque due to the eccentricity of this load. Hinge assemblies shall also be fitted for connection of the tunnels.

f. Rotunda ceiling
The enclosure at the front of the rotunda shall be formed by the combined ceiling and side casing which protects the end of the tunnel at its connection to the rotunda. The construction shall be from welded steel sections and sheet. 70mm fiberglass ceiling panels shall be provided as acoustic and thermal insulation.

g. Shutter walls
Each side of the rotunda shall be equipped with vertical corrosion-proof shutter walls. Double galvanized steel flexible curtain walls shall provide a seal between the static tunnel and the first telescopic tunnel section, throughout the rotational movement of the rotunda. The flexible curtain walls shall be self-winding and self-unwinding onto self-coiling drums, leaving continuously 2 free passages on either side of the rotunda. Shutter walls shall meet the fire resistive requirements of NFPA 415.

h. Fold-back barrier
A lockable by padlock barrier at the rotunda entry, with storage box, is to be scheduled to prohibit access to the PBB during maintenance operations.

i. Electrical support requirements
The PBB manufacturers shall make provisions for the rotunda disconnect panel to be mounted on the rotunda support column; this provides the electrical connections and transformers needed to adapt the specified terminal power to the PBB’s electrical requirements.

2. Telescoping Tunnels and Fixed Bridge Tunnels
   a. General
The PBB telescoping tunnels shall be comprised of rectangular two or three tunnel sections, one sliding inside the other, with the largest section toward the aircraft. The proposed two or three tunnel PBBs are shown at the drawings in Appendix 1. NFPA 415 (2016) and EN 12312-4 (2014) are required.

Tunnel sections shall be constructed to prevent water, wind or dust from entering any part of the PBB at joints between sections or at the connections with the rotunda and cabin.

Tunnel sections shall be provided with internal and external gutters to drain water from collection points in any operating attitude, sized to prevent blockage by accumulated debris.

All structure elements shall be designed to resist the accumulation of water in the structure.

The floor, side walls and ceiling of the tunnels shall be built with a structure made from structural angles of high quality galvanized steel and galvanized steel plate and providing a smooth exterior surface (not corrugated). The angles shall be used as guiding rails for the rollers of the telescopic system of the bridge.
Is not allowed any corrugated steel as a tunnel external finishing. The structural welding shall be done according DIN 18800-7 and DIN EN ISO 3834-2 standards assuring minimum tolerances. Alternative tunnel design incorporating structural tubes in a truss design and using non-load bearing steel sheet side panels will be acceptable when consistent with an approved manufacturers established approach. The use of wood for the floor structure will not be allowed.

The tunnels shall be designed in a way (structural, electrical, operational and other aspects) which makes it possible to install under them 2 (two) 400 Hz converters with cable retrievers and 1 (one) PCA unit for Jumbo (type E) aircraft with hose retrievers in case they may be required in the future.

The tunnels shall be guided horizontally and vertically by roller units on the tunnel corner profiles (guidance rails) and provided for smooth operation. For ease of servicing all roller units shall be readily accessible from inside or outside the tunnel. The rollers shall be maintenance free. Rollers and roller paths shall be designed for PBB service life before any major overhaul is required. Roller tracks or rails and all other surfaces which cannot be painted due to moving parts shall be protected against corrosion.

Clearance between telescopic tunnel sections shall be preserved that no wear of interior surfaces will occur as the result of movements. Rainwater dripping from the inboard tunnel (and from the middle tunnel for three-tunnel bridges) shall be collected in the water ducts of the outboard tunnel and discharged at the bridgehead end of the PBB. The rainwater shall not wet the floor. The duct will not create a safety hazard. The duct will be made of stainless steel.

The flooring material of the PBB shall have a slip-resistant surface, with a slip-resistance classification of at least R11, as stated in EN 12312-4 (2014).

PBB floor, roof and wall panels shall be insulated in line with NFPA 415 with a product recommended by the PBB manufacturer. The heat transfer coefficient (U-value) of the closed panels shall be in the order of 0.5 W/Km². For the glass walled option, this value is different.

The inboard tunnel shall be flexibly linked to the rotunda support frame by a hinged connection. The link support shall be smooth in operation and maintenance free and shall incorporate a ball joint assembly.

The Contractor shall install a proper weather tight seal between the Rotunda and the first telescopic tunnel section and the telescopic tunnel transitions, as per principle detail indicated on the drawings.

b. Tunnel Slope and Handrails:
The PBBs are to be based on approved airport ramp planning procedures, and accommodate the aircraft parking arrangements and terminal floor heights as shown on the drawings. The operational tunnel floor slope is to be 8.33% maximum, up or down. Handrails are to be provided at both sides at transitions and on one side for the full length of the fixed bridge and tunnels of the PBB system. The clearance between tunnel sections shall be designed to accommodate the full length handrails. Handrails shall be of brushed stainless steel and be compliant with Israeli standards number 1918 and 1142.

Option:
As an option, full length handrails shall be provided at both sides of the fixed bridges and tunnels of the PBB system. The clearance between tunnel sections shall be designed to accommodate the full length handrails. Handrails shall be of brushed stainless steel and be compliant with Israeli standards number 1918 and 1142. This situation is shown at the drawings in Appendix 1.
c. **Tunnel Floor Transitions:**

The floor transitions between tunnels shall accommodate the difference in elevation where telescoping tunnel sections overlap. This area will consist of a section of floor that is sloped with respect to the tunnel centerline; and a hinged transition ramp. The difference in level between two adjoining sections shall not be more than 150 mm. The tunnel floor of the PBB shall slope as it approaches the transition ramp to minimize transition ramp slope. The slope of all components of the floor transition shall not exceed 5% (1:20) when measured with respect to the tunnel in a level position, per NFPA 415. The transitions shall have a visual and tactile surface that provides a warning to passengers about the hazard, which has to be approved by the IAA.

To protect the floor covering from damage through retracted and extracted movements of tunnel sections the floor of tunnel 2 and 3 (if present) shall be covered with guidance plates as shown a picture below. Alternative suggestions to prevent the tunnel floors will need approval of the IAA.
d. Roof of Tunnel and Fixed Bridge:
The roof of each tunnel section shall be designed to provide a flat, smooth, profile that is slightly crowned
in the center to facilitate water run-off. The crown shall be not less than 19mm.
Stagnant water on the roof should be prevented.
At the location of the lifting column, a non-slip surface shall be painted at the roof. Guardrails (optional)
and anchoring points (mandatory) for working personnel shall be provided at this location as well.
The possibility for more anchoring points for personnel shall be discussed with IAA.

e. Fixed bridge:
The fixed bridge shall consist of:
• The fixed bridge shall be installed between the Rotunda and the Pier façade.
• The fixed bridge shall resemble the telescopic tunnels in appearance and technical characteristics.
• The fixed bridge shall impose neither loads nor forces on the Pier façade.
• The contractor of the PBB shall provide the building contractor and / or the engineer with the
  particular loads and forces, needed to provide the appropriate concrete foundations and bearings for
  the fixed bridge supports.
• The contractor shall install a proper weather tight seal between the Pier façade and fixed bridge
  according to the architect drawings and between the fixed bridge and Rotunda, as per principle detail
  indicated on the drawings.
• The fixed bridge shall be equipped with handrails on one side of the tunnel.
• At the gates E2 and E5, it is necessary to mount gate indication signs on the side of the fixed bridge.

Across the entire width of the service road and parking strip, the clear height under the fixed sections shall be at least 4000mm, unless specified otherwise on the drawings in Appendix 1.

f. Minimum clear widths/heights of tunnel elements are to be as follows:
• Internal width Fixed Bridge: 189cm
• Internal heights Fixed Bridge: 239cm
• Internal width Tunnels: 147cm
• Internal heights Tunnels: 210cm

g. Door in fixed bridge
In the fixed bridges of gates E5 and E9, an outward swinging door shall be positioned as indicated at the drawings in Appendix 1. The door will lead to the staircase of the ground stairs.

The door from the fixed bridge to the staircase shall be:

- The service door shall be steel, hollow core, with an NFPA approved window. The door shall be 1500mm in effective width and be equipped with heavy-duty commercial-type hardware and automatic door closure. The closure shall be appropriate for extremely heavy use in industrial environments and designed for reliability and ease of maintenance-free operation. The door opens outward onto the landing. Submittals shall be made prior to fabrication for IAA approval. The life time of the door shall be at least ten years.

- The following requirements apply to the frame of the outside door to the staircase:
  - Standard profile section.
  - Made of stainless steel, 3-4 mm thick.
  - Stainless steel frames shall be made of bright-rolled steel. The frames and fronts shall be dimensioned per access point and made to measure separately. The profiles shall not warp either, nor be dented, become loose etc.

- The following requirements apply to the outside door to the staircase:
  - Type: double leaf.
  - The door’s direction of rotation is outward.
  - Headroom (effective width x height in mm): 1200 x 2084.
  - Made of steel or aluminum, minimum thickness 4 mm.
  - Preservation in accordance with Part 2, paragraph 15 (Exterior Finish and Lighting).
  - The door shall be equipped with a door-spring that works on the basis of a graded braking system.
  - A kick plate at the lower part of the door shall be mounted on the inside.
  - ‘Locking device’ to keep the door open.
  - Push bar for opening in case of emergency.
  - The door shall have an option of electrical locking device.
  - Door accessories shall be made by a well-known international brand.

h. Cable conveyance system:

The telescoping tunnels are to be equipped with an exterior under-the-bridge-mounted electrical cable conveyance system. This system is to be fully accessible to maintenance personnel for inspection or cable addition when the PBB is at a minimum of one-half extension. Access to the cable conveyance system shall not impede passenger traffic or bridge operation. The cable conveyance system is to be capable of supporting all necessary data, power, signal cables and additional loads to be applied by the environmental conditions (wind, rain, etc.) on the system. This cable system shall serve the main power supply for PBB and PCA hose retrieving system, as well as signal, control and telephone lines. The use of pantographs shall be avoided. All cables shall be rated for flexibility and be suitable for PBB travel.

The cable conveyance system shall have a minimum spare capacity of 40%.

The cable conveyance system shall be suited for draining of water without stagnation.

The mounting and location of the cable conveyance system shall be coordinated with the telescopic tube of the PCA system.

3. Ground stairs

At gates E5 and E9b, the contractor shall design, manufacture and install additional self-supporting ground stairs as part of the works, in order to use them as ‘Bus-gates’. The locations and dimensions of the stairs are indicated at the drawings in appendix 1 and shall be matched with the doors in the fixed bridges of these gates. The ground stairs shall meet the requirements of EN 1915-1:2013, 5.13.1 and 5.13.2. Design of the staircase shall be approved by IAA.

The staircase shall meet the following requirements:
- The staircase shall be allocated on the right side of the Fixed Bridge, close to the Rotunda.
- The effective width of this staircase will be at least 1.5m.
- The construction of the staircase will be made of galvanized and painted steel.
- The staircase will be equipped with proper lighting.
- The steps, stairs landing and all other treading surfaces will have a non-slip (at least R11) surface (Tramex stair treads or similar) and tactile strips on the edge of the stair treads.
- The staircase will be installed in compliance with all relevant Israeli standards and regulations, an emphasis (but not exclusively) for safety and accessibility.
- The staircase shall be covered by using Aluminum/Alucobond coated roofing.
- The staircase surfaces shall be designed with 1% minimum drainage slopes to avoid water accumulation.
- The staircase structure should be steel, painted with fire resistance paint (RAL 9006).
- The staircase should meet the requirement of Israeli codes for structure, safety and accessibility.
- The staircase handrail should meet the requirements of Israeli code 1918.
- For the staircase architectural design, please find architectural drawings X-A60.18-19 and the referenced details.
- The precise location of the staircase will be determined within the framework of detailed design.
- The detailed design of the discussed staircases will require IAA's approval.

4. Drive Column

The drive column will provide the vertical and horizontal motion for the PBB. The drive column and control systems are to be designed for smooth, quiet operation. The vertical and horizontal movements shall both be operable at the same time.

The drive column is divided into two major components: Vertical Drive and Horizontal Drive:

a. Vertical Drive: The vertical drive shall be hydraulic.
   - Vertical travel shall be achieved by means of two hydraulic cylinders equipped with solenoid operated valves. The cylinder rods shall be chrome plated. Each assembly shall be independent of the other and capable of supporting the PBB under the full design load.
   - The hydraulic cylinders shall be equipped with a suitable automatic vertical drive pump brake actuated from the operator’s console or by the auto level circuit.
   - The lift cylinders shall be equipped with integrally mounted pilot operated check valves that prevent the PBB from descending in event of fluid loss or other system failure. The hydraulic circuit shall be designed so that the PBB cab can be lowered manually in case of a power failure.
   - Mechanical stops in the cylinders shall be provided to prevent over-travel of the lift column. The system shall not be damaged if the PBB is raised or lowered into the cylinder stops.
   - See ‘Design Criteria’ for required Vertical drive travel rate.
   - The hydraulic pump and motor shall be an integral part of the wheel bogie assembly, accommodate the size and weight of the PBB, and operate smoothly and quietly.
   - All hydraulic components shall be designed for maximum corrosion resistance and compatibility with the hydraulic fluid used.
   - All hydraulic pipes shall be covered with protective spiral tubes to protect against environmental conditions. The protection shall be approved by the IAA.
   - Drip pans shall be provided under all hydraulic components to prevent the dripping of hydraulic fluid on the ramp.
   - The hydraulic system, including all its components, shall be designed for Israeli environmental conditions.
   - The hydraulic system will have the option of connecting an external pump
   - The hydraulic power unit, including all its components, should be covered and environmental conditions protected.

b. Horizontal Drive:
   A variable speed, electro-mechanical drive system shall be provided for horizontal travel.
• High wearing solid rubber tires shall be provided. The used rubber shall the following requirements:
  o Natural rubber.
  o Nominal hardness: 70 shore A at tread surface; 78 shore A at core. Hardness tolerance: ± 5 shore A.
  o Working temperature: -10ºC to +60ºC.
  o The wheels shall be able to carry the bridge load without unrecoverable deflection, even if the wheels have not been operated for a long time.
• The AC horizontal drive system uses AC gear motors with integral brakes. The AC motors shall be driven by solid state, variable frequency motor controllers. The AC drive system shall provide high efficiency, smooth performance, and good component availability. The horizontal drive motors shall be direct drive and allow easy access and servicing.
• The controller provides a variable frequency signal to provide adjustable speeds from 0 – 0,5 m/s as stated in the Design Criteria. The controller can be adjusted to provide optimum responsiveness to the horizontal controls. The controller shall include diagnostics to assist with trouble shooting. The controller shall not be placed on the bogie, but inside the PBB cabin.
• A regenerative braking system shall be used allowing the PBB to come to smooth controlled stops. Integral spring-applied, electrically-released brakes shall be provided with each drive motor. The brakes lock the PBB in place when electrical power is disconnected. This shall occur when the joystick is in the neutral position or when normal operating power shall be discontinued.
• The horizontal drive motors shall be equipped with lockable manual brake releases. These allow the PBB to be towed in the event of power failure. Tow lugs shall be a component of the lower wheel frame.
• The horizontal drive wheel system shall be equipped with mechanical stops to prevent over steer. A wheel position detector monitors rotational alignment with the bridge and provides operational wheel bogie limits. Wheel bogie position shall be indicated on the HMI.
• An anti-collision detector shall be provided with a detector ring to prevent the axle and the PCA hose dispenser unit from collision with objects in the PBB maneuver area. This detector will serve as an emergency stop for the main traction drive.

5. **Boarding Bridge Cab**

• The cab is to be designed to rotate counterclockwise and clockwise from the tunnel centerline within the limits specified herein (see Design Criteria for minimum limits and rotational speed). Limit switches and physical stops control the rotation limits. Rotation of the cab shall be achieved by chain drive.

• The cab shall be equipped with a forward facing control console on the left side so as to provide maximum operator visibility. The console shall be located behind a laminated safety glass window. There shall be sufficient space for the operator on a floor part turning together with the control console. Operation of the PBB shall be accomplished without opening the cab front doors. Additional visibility shall be obtained through glass vision panels in each of the side-coiling double galvanized curtain slats and windows in the cab located to the front, left and right of the operator. At both sides of the cab, mirrors shall be installed at the exterior, to give the operator the possibility to view along the cab from the operating position. Glass types used shall meet NFPA 415 fire resistance requirements. The transparent panels shall be guaranteed by the manufacturer to have at least 90% of the as new visibility after 5 years in use.

• Cab Front Door

  The cab front doors are to be provided to seal and secure the bridge interior when the PBB is not connected to an aircraft. The double doors shall be aluminum/glass, inward swinging, lockable doors. The clear dimensions of the doors when open are minimum 140cm wide by 220cm high. The doors shall act as a safety barrier and shall be provided with a manual override to allow maintenance access from the exterior. The doors in locked position shall form an electrical interlock. The control system shall demand that the doors are closed and locked before the bridge can be backed off from the aircraft.

  The lower third of the door shall be blind and protected from damage. The upper two-thirds of the door shall be of an aluminum frame with clear laminated safety glass (Triplex). The doors including hinges and locks shall be designed and constructed to be appropriate for extremely heavy use in industrial environments and designed for reliability and ease of maintenance.
• A full width spacer is to be located at the aircraft end of the cab floor. The spacer material, which shall meet the fire protection specifications of NFPA-415, is to be flexible and non-abrasive to prevent scratching or other damage to the aircraft fuselage.

• The cab platform will be equipped with an automatic retractable floor, to prevent damage of the aircraft fuselage.

• Self-Leveling cab floor
The aircraft end of the cab shall be equipped with a self-leveling cab floor that adjusts to the level position relative to the tarmac. The floor is actuated and independently adjustable to adapt to the slope of aircraft door sills. It is designed to level automatically to the tarmac and is equipped with a manual override control switch. The floor is capable of providing a level surface adjacent to the aircraft door sill for PBB slopes from -10% to +10%.
The automatic self-leveling system shall be based on AC motor variable speed drive, or hydraulic techniques, resulting in smooth transitions in height. There shall be manual override for final alignment with aircraft door sills.

• A double hinge floor shall be included in the system to provide a smooth transition between the level floor and the tunnel section. The double-hinged cab floor provides a smooth platform. The maximum slope of the floor shall be limited to half that allowable in the adjacent tunnel. There shall be no raised surfaces, which may introduce a tripping hazard to the passenger. Adjacent surfaces shall be at the same level regardless of the position of the cab floor or the PBB. Seams, grating material, slip plates, plate covers, and tripping hazards shall not be permitted in the cab floor. The cab floor shall not have openings through which flame and smoke can pass. The cab floor shall present a smooth, seamless surface from the spacer to the weather doors and to both the left and right side canopy areas. Water drainage channels shall not be exposed.

• Exterior floodlights: Three exterior floodlights are to be provided for night-time operation to illuminate the apron area ahead of the bridge. A weather-proof LED fixture is also to be provided outside the cab door to illuminate the cab-aircraft interface. These floodlights shall be positioned to illuminate the apron for a distance of approximately 10m forward of the PBB, and around the wheel carriage area. The floodlights shall be automatically turned off when the PBB is in auto-leveling option.

• Two red LED beacons shall be provided on top of the cab near the aircraft interface.

• LED flashing light and acoustical warning signals shall be provided below the cab for automatic actuation when the bridge is in movement. The PBB manufacturer shall investigate this issue and propose/incorporate improvements for this Contract.

6. Aircraft Closure
The aircraft end of the cab is to be equipped with a folding bellows aircraft closure. The canopy closure, when fitted against the fuselage, surrounds both the open aircraft door and the doorway to protect passengers from the elements. All materials shall meet requirements of NFPA 415.

• The closure shall ensure a perfect sealing which prevents penetration of rainwater for all aircraft types expected at the stand as shown in appendix 1. The covering shall not absorb water, shall be highly tear-resistant, UV protected and remain flexible from -25°C to 53°C. All metallic parts shall be protected for outdoor conditions.

• Canopy material:
  o Roof fabric: Hypalon® / neoprene
  o Side fabric: grey outside, silver inside
  o Bumper cover: silver cover
- Each side of the aircraft closure shall have independent and dual actuation. The kinematics shall have a smooth performance.
- Pressure sensitive switches are incorporated into the closure mechanisms to prevent excessive pressure on the aircraft.
- The contact sealing is to be a soft material to prevent scratching or damage to the aircraft skin. The seals that contact the aircraft are to be segmented for easy replacement and shall have easy Velcro type attachments.
- The left bottom part of the forward side of the contact sealing shall be connected with Velcro-type attachment, as recommended by Boeing for handling the B787 aircraft type.
- Canopy conflict features of the aircraft fuselage, such as hot light fixtures that may melt the canopy, shall be resolved.
- All components of the canopy shall be able to serve five (5) years.

7. Services Access

A service door, landing and stair leading to the apron shall constitute the service access for all PBBs. The service access is to be located on the right hand side of the cab end of the bridge (except left hand side at Gate E4). It will provide access between the bridge and apron for authorized personnel.

a. Service door
The service door shall be steel, hollow core, with an NFPA approved window. The door shall be 760mm in width and be equipped with heavy-duty commercial-type hardware and automatic door closure. The closure shall be appropriate for extremely heavy use in industrial environments and designed for reliability and ease of maintenance-free operation and shall be able to function at the various PBB angles serving the different aircraft threshold heights. The door opens outward onto the landing. Submittals shall be made prior to fabrication for IAA approval. The life time of the door shall be at least ten years.

The following requirements apply to the frame of the outside door to the service staircase:
- Standard profile section.
- Made of stainless steel, 3-4 mm thick.
- Stainless steel frames shall be made of bright-rolled steel. The frames and fronts shall be dimensioned per access point and made to measure separately. The profiles shall not warp either, nor be dented, become loose etc.

The following requirements apply to the outside door to the service staircase:
- Type: single leaf.
- The door’s direction of rotation is outward, with hinges towards the aircraft connection. Left or right is determined per service stair position (left or right at bridgehead).
- Headroom (width x height in mm): 760 x 2084.
- Made of steel or aluminum, minimum thickness 4 mm.
- Preservation in accordance with Part 2, paragraph 15 (Exterior Finish and Lighting).
- The door shall be equipped with a door-spring that works on the basis of a graded braking system.
- A kick plate at the lower part of the door shall be mounted on the inside.
- ‘Locking device’ to keep the door open.
- Push bar for opening in case of emergency.
- Door accessories shall be made by a well-known international brand.

b. Service stair
Service stairs shall meet the requirements of EN-12312-4.
The service stair landing is to be parallel to the adjacent tunnel floor. The open mesh grating is to be made of hot dipped galvanized steel with a non-slip surface. The landing is to be protected on the open sides by galvanized steel handrails which are designed to meet International standards for industrial platforms. A kick plate will be mounted at the open edges of the landing. All exposed galvanized steel is to be painted.
The service stair is to be equipped with self-adjusting risers and open mesh steel treads with a non-slip (at least R11) surface (Tramex stair treads or similar). All steps shall have an equal rise. The tread width is to be 700mm and the stairway shall be designed to maintain the stair treads in a level position throughout the PBB elevation range with a maximum rise of 240mm. The service stair shall be protected on each side by handrails 1 meter high which are designed to meet International standards. The handrails shall leave sufficient space between them at transitions to prevent trapping of body parts. The entire service stair assembly is to be galvanized steel. The service stair is to be accessible to ramp service personnel at all operational heights and positions of the PBB.

The service stair shall be fitted with rollers at the base which allow the stair to move with the bridge. The rollers shall be polyurethane wheels with metallic rims. The wheels shall not stick out of the platform.

c. Roof ladder
From the landing a galvanized steel ladder with fall protection shall be provided for maintenance access to the PBB roof. The ladder cage shall have a closure and lock to prevent unauthorized access to the roof.

d. Lighting
LED lighting for the service stair, landing and door shall be provided.

8. Control Station and Control Systems
The control station is located in the cab at the aircraft end of the PBB. It provides the operator with a control console and service utilities required to accomplish PBB operation. This station is positioned on the left side of the cab and oriented to position the operator facing forward in full view of the aircraft during PBB maneuvering and docking operations. An operator of average height shall have an unobstructed view of the boarding bridge cab spacer that contacts the aircraft fuselage during bridge operations.

The control console shall be located in the operator compartment and shall be protected from the outside environment. There shall be no gaps between the console and the bridgehead walls to prevent garbage piling up inside this space. The control console shall contain a Human Machine Interface (HMI) consisting of a graphical display providing the operator with control interfaces, bridge set up displays, PBB HVAC system control, maintenance / diagnostic information, CCTV display, wheel position information, and fault / limit / status messages as described in the following sections. The control panel shall be designed in collaboration with the IAA and receive IAA’s approval prior to it being finalized.

a. Control System:
• The PLC shall be designed and installed based on the latest technical developments in control systems.
• The PLC shall be equipped with a back-up lithium battery and an EPROM back-up in order to prevent the PLC memory loss in case of a power failure.
• The PLC shall be made up of a CPU unit which houses the memory card including control program, and a series of input and output modules, with an extra of at least 25% of spare inputs, outputs and free slots (for each type).
• PLC and HMI unit and/or all its remote units shall be based on an Ethernet TCP connectivity, the use of 232, 485, profibus communication, etc. is prohibited.
• PLC shall be of a well-known brand that has an agency/authorized dealer in Israel capable to give support within 24 hours from call. The PLC shall be an “off the shelf” product, a common product, mounted and operating on at least 50 locations in Israel (industrial use).
• PBB shall be equipped with a Human Machine Interface (HMI) of a touch screen, designated for all control and monitoring functions not involving movement of the PBB. The touch screen shall be of a well-known brand name, user friendly, high resolution and equipped with the latest technological features. It shall be at least of protection class IP54 and of industrial quality.
• A separate screen will serve all PBB surveillance and camera needs.
• The PLC shall have sufficient capacity for controlling added options or changes.
b. PLC and HMI, hardware and software

- The PLC shall have sufficient capacity for data collection registers including capability for internal service data saving of no less than 120 movements per PBB.
- It shall be possible to synchronize the time with the timeserver of Ben Gurion Airport.
- The supplier shall integrate the needed software interface for the data collection system with the other control software on the PLC. The interface software will be defined and written by a third party (authorized by IAA).
- The supplier shall upgrade the operating system to the latest version available.
- The supplier shall quote for upgrading of all software, OS, firmware and PLC's hardware every significant update or every five years or upon demand.
- In the case of a power loss the PBBs shall remain in their state and relative position to the connected aircraft, in order to resume functions automatically at power recovery.

- PLC and HMI, hardware and software

- The PLC shall be designed to allow networking of the boarding bridges and the Ben Gurion Airport PBB Control System, Visual Gate Docking System, Fuel Control system and Aircraft Service Data Reporting System, CCTV, SCADA, along with appropriately equipped ancillary equipment, such as pre-conditioned air units and 400 Hertz converters, to a common remote monitoring station using Ethernet protocols and appropriate hardware. This will require coordination with the work of other Sections of these Specifications and with the IAA regarding existing systems.
- The control program shall be written in proper PLC language and be well structured. It shall contain all the links needed to control the output elements, by taking into consideration, at the same time, the specific requirements of the PBB's.
- Software program shall include operative, diagnostic and memory data functions.
- All software shall be open protocol software.
- Full software licensing: all type HMI and PLC software (and OS or any other type if existing) shall be fully licensed, backed-up and recorded on a media and a product key.
- Software updates, related to hardware change, upgrade or update:
  o At the warranty period, to be included,
  o At the service period, according to manufacturer and/or its suppliers updated price list.
- Software changes and adoptions by demands of the IAA:
  o During construction, startup and OMP period to be included in PBB pricing.
  o After construction, startup and OMP period; to be priced with accordance to estimated change size, software module pricing.
- Software price list appendix will be built and will include all relevant suppliers off the shelve software, modules or upgrade modules.
- Software definitions:
  o Standards used:
    o Software engineering, evaluation of software quality ISO/IEC 9126
    o Information technology, software evaluation ISO/IEC 14598
    o Programmable controllers IEC 61131
- Version management.
  Each and every change to the software shall be saved and shall be traceable in the software at all times.
  Each and every implemented change shall result in a new version and / or new release in the case of a system package. The version and release status of the software shall be included in the software program.
- Program structure guideline
  The program shall be based on an object model with the objects representing the functional and available elements of the PBB. Each functional object deals with a specific functionality and may contain multiple underlying (generic) equipment functions. Within the software, functional objects are interconnected using structured interfaces. All objects will be embedded into the software as configurable functions (library). The main program includes the interconnections between the object call functions. Functions calls should not go deeper than five levels (nesting).
• Human Machine Interface (HMI)
  The HMI shall be provided with extensive diagnostic information about the various functions, components and the working of these functions and components; that extensive information should only be available to authorized individuals using a technical login code.
  The primary tool for this is the alarm and event list, with all current failure and status reports listed chronologically. For each failure and status report the list provides a tag code, date and time and active / non-active status.
  The objects that correspond with the failure indicated in the failure reports list light up in red on the graphic display of the HMI. The object can then be selected to provide a screen with more details on the status of the underlying components.

• Maintenance or Administration passwords shall be required to access PBB operations or maintenance activities. Passwords shall be used to control access to bridge functions, set ups, maintenance and diagnostic screens and password maintenance. The PBB shall have three levels of passwords. Level I (Ten (10) Operator passwords), level II (One (1) Maintenance) and level III (one (1) Administrative password).
  o Operator Passwords allow access all Aircraft docking functions.
  o Maintenance Password allows access to all Operator and Maintenance/Setup functions.
  o Administrative Password allows access to all Operator, Maintenance/Setup and to view and edit passwords.

c. Control panel
  • The control panel shall contain all of the push buttons and elements that are required to control the bridge operations. It shall also function as a point of interconnection between all the equipment that has been fitted under the cabin and the main switch cupboard. Heating element shall be included to avoid dampness.

  • The control panel shall have a stainless steel surface with engraved text for the buttons and elements. No stickers are allowed.

  • The control panel shall consist of the following elements;
    o The HMI (touch screen)
    o The emergency back-off push button
    o Translation joystick
    o Push button keys
    o Switch keys
    o Video-monitor (digital display-colored)
    o Horn
    o Preparation for a badge reader shall be taken into account

  • All bridge motion controls shall be momentary, contact-type pushbuttons or joystick. All of the motion controls shall be designed to be relative to the function of the PBB being controlled, i.e., raise and lower functions, the “raise” push button will be located above the “lower” push button.

  • A Log On, Log Off and Auto Level Mode selection shall be used to select “OFF”, “OPERATE” or “AUTO” (automatic leveling). A key and badge shall be used to exit Auto Level Mode.

  • A lever arm or “joystick” controls horizontal motions: extend / retract and left / right. As the control stick is moved progressively from the neutral position, bridge speed increases proportionally with the position of the joystick. The PBB shall be capable of Point-and-Go steering in which the bridge will move in the direction that the joystick is pointed regardless of the rotational position of the cab.

  • An interlock shall prevent the PBB from being driven forward when the aircraft closure is deployed.
• The cab floor of the PBB shall be adjustable allowing the floor to be aligned with the centerline of the aircraft and leveled. HMI shall have automatic functions as well as manual touch buttons for raising and lowering (tilting) the cab floor of the PBB.

• Push button switches for cab rotation, left or right, shall be available at the control panel. The push buttons shall be at least of protection class IP54 and of industrial quality.

• The control panel shall contain HMI touch buttons for adjustment of the bellows-type aircraft closure. The aircraft closure left and right sides shall both be independently activated and articulated or dual activation with the touch of a single touch button, with an option for automatic canopy deployment when in Auto Level Mode. The aircraft closure shall be powered for both extend and retract operations.

• Emergency Stop. The control panel shall be equipped with an emergency push button switch for discontinuing all bridge movement. This button shall be labeled “Stop”. Emergency-stop push-buttons shall be located on the control panel and on each of the drive-column legs at Ramp level and at the VGDS operator position. The ramp level buttons shall be in locations that don’t propose a risk to the person who pushes them.

• Automatic pre-positioning and parking operation. Pre-position and park buttons shall be used to engage the automatic pre-docking and parking operations. “Pre-positioning” means that the bridge can be automatically moved from its parked position to a pre-selected service position. Pre-positioning includes rotation of the PBB to the correct service angle, extension of the PBB to the correct length, raising of the PBB to the correct preselected height and rotation of the cab to a pre-selected rotational position. The system shall be programmed to employ routes that are free of any potential for collision with the aircraft. The aircraft type selection options shall exist as part of the PBB software. “Parking” means automatic return of the PBB to the established park positions. Once again, the system shall be programmed to employ routes that are free of any potential for collision with the aircraft. The PBB manufacturer shall work with the IAA to program and set up this system for operation at the airport.

• PBB Anti-Collision System. The Anti-collision System shall be incorporated in the PBB control systems at Gates E6, E8 and E9 where two boarding bridges are provided. The system shall employ a dedicated processor and dynamically define two areas around each of the PBB’s, a slow speed area and an anti-collision limit area. In the slow-speed area, when another PBB or known existing structure (building or fixed object) is within the area, only slow motion will be allowed by the PBB. In the collision limit area, movement of the PBB will be only allowed away from the potential collision object. The system shall employ sensors for rotunda angle, cab angle, PBB extension and cab height. An Ethernet connection shall be provided between the paired bridges to facilitate the sharing of system information. The PBB manufacturer shall work with the IAA to program and set up this system for operation at the airport.

• HMI touch buttons in conjunction with a key and badge shall control the PBB operating mode. The three modes available from the touch screen shall be “Auto” for Auto Level Mode, “Operate” for manual operation, and “Off” to discontinue bridge operations.

• Auto Level: Touching the “Auto Level Mode” touch button shall initiate the auto level sequence. The auto level arm extends toward the aircraft, and the system performs an automatic check (test nod) of the auto level system to verify that the aircraft sensor has made contact with the aircraft and that the auto level control system is functional. Upon completion of the verification process, a message shall be displayed indicating that the PBB is in “Auto Level Mode”. The auto level arm shall be located on the right side of the PBB cab area, outside the canopy closure area. Make provision so that the PBB Operator can see the auto level arm. When in auto level mode, the PBB shall allow only vertical travel, canopy, cab rotation and horizontal travel become inactive. In auto level mode, the PBB shall automatically follow the vertical movement of the parked aircraft. To exit auto level mode and return to manual mode, the operator shall touch the auto level mode touch button and use the key and / or badge.
• Manual Mode: Logging on using a valid password, or exit auto level mode using a valid password enables all bridge movements – extend/retract, vertical, floor movement, and cab rotation – provided there are no faults or activated limits. In operate mode, all bridge movement shall be initiated by the operator. The appropriate pushbuttons shall be lighted to indicate those functions available, and a message on the HMI panel shall be displayed indicating the PBB is in Operate Mode. Two ultrasonic sensors shall slow the bridge as it approaches the aircraft when in operate mode.

• Off Mode: The operator shall touch the “Logoff” touch button to exit the Main Screen and return to the Log On Screen. All PBB functions except lighting shall be disabled.

• Cab Floor Auto/Manual: Touching the Cab Floor Auto/Manual touch button shall allow control of the cab floor to be toggled between the automatic and manual modes of operation. Text on the touch button shall indicate cab floor mode. Upon selection of cab floor manual mode, two additional pushbuttons become active enabling the manual movement of the cab floor – up or down. Touching the Up button shall move the right side of the cab floor in the up direction. Touching the Down button shall lower the right side of the cab floor. When the PBB is “Auto Level Mode”, all cab floor movement shall be disabled and the touch buttons shall NOT be visible. The Cab Floor mode of operation previously selected when the auto level mode of operation was energized shall be reactivated when the auto level mode is deactivated.

• Canopy Actuation: The aircraft canopy closure shall be capable dual activation of both canopies simultaneous or independent activation of the right or left Canopy Up or Down. Canopy actuation shall be active only in Operate Mode. When the PBB is in Auto Level Mode both canopy touch buttons shall be NOT visible. Therefore, the canopies shall be deployed prior to entering auto level mode. The left and right side canopy actuator motors shall be independently controlled by limit switches that sense both the pressure against the aircraft, and operational range limits to provide positioning of the canopy to the aircraft and prevent over extension or retraction of the canopy closures. The canopy actuation shall assure the full closure to all of the required aircraft as listed in Appendix 1.

• Floodlights: A HMI touch button shall be provided to allow control of the three floodlights that shall be located on the underside of the PBB. Touching the Floodlight touch button will toggle the apron flood lighting on and off. The flood light type, positions and control need to be designed to eliminate the potential for burn damage to aircraft paint. The floodlights shall automatically turn-off after the docking process is completed and the PBB is in automatic leveling mode.

• Emergency back-off: When the PBB is in auto leveling mode, the horizontal movement may only be triggered by an emergency back-off procedure. Activation of the movement joystick in combination with the emergency (covered) button will activate the emergency back-off procedure, where the PBB will drive away from the fuselage of the aircraft.

• Options: An Options button shall be available on the HMI to allow additional PBB features to be selected. These features may include selections such as additional lighting, etc. The PLC of the PBB shall have sufficient capacity for controlling added options.

• Indicators: The following indicators shall be present in both auto level and manual modes and are displayed on the screen including percentages and angles in degrees:
  - Vertical Height: The current vertical height of the PBB cabin platform measured from apron or ground level shall be measured and indicated. The measurement shall be displayed in centimeters or meters depending on customer preference.
  - Bridge Length: Bridge length shall be measured and indicated between the rotunda center line and the outer edge of the cab spacer. The status panel shall display the linear distance accurately regardless of the rotational position of the cab. The measurement shall be displayed in centimeters or meters depending on customer preference. Changing the display from centimeters to meters shall be accomplished by using a toggle touch switch located in the Options screen under the Maintenance/Set Up program.
• Rotational Angle: The rotational angle of the bridge shall be displayed. The zero data point shall be identified when the tunnel centerline shall be positioned parallel to the rotunda corridor centerline. The display identifies angular counterclockwise (left) rotation in positive (+) degrees, and clockwise (right) rotation in negative (-) degrees from the centerline axis.

• Cab Rotation Angle: The cab rotation angle shall be measured and indicated. The zero data point shall be identified when the aircraft spacer shall be positioned perpendicular to the telescoping tunnel centerline. The display shall indicate counterclockwise (left) rotation in positive (+) degrees and clockwise (right) rotation in negative degrees from the centerline axis.

• Wheel Position Angle: The wheel position angle shall be measured and indicated. Zero degrees shall be identified when wheel carriage drive wheels shall be positioned parallel to bridge telescoping tunnel centerline axis. The display will indicate counterclockwise (left) rotation in positive (+) degrees and clockwise (right) rotation in negative degrees from the centerline axis.

• Other Control panel indicators shall include:
  o An amber light and a text message on the HMI indicate the auto-leveling system shall be energized and functioning.
  o A red light and a text message on the HMI and an audible warning indicate the auto leveler sustained travel timer has activated.
  o A red light and a text message on the HMI indicate the aircraft canopy is down. The canopy shall be fully retracted before the PBB can be moved forward.
  o A red indicator and a text message on the HMI and audible alarm indicate vertical drive column faults.

d. HMI Messages
The HMI provides status and fault information to the operator. A minimum of 100 Limit and 100 Fault messages shall be stored in permanent HMI memory. Standard HMI messages include the following:

Limit Messages:
Horizontal Extend Limit. Forward motion disabled.
Horizontal Retract Limit. Reverse motion disabled.
Vertical Up Limit reached. Drive PBB down.
Vertical Down Limit reached. Drive PBB up.
Cab Left Limit reached. Rotate cab right.
Cab Right Limit reached. Rotate cab left.
Left Swing Limit reached. Rotate PBB right.
Right Swing Limit reached. Rotate PBB left.
ACF Fault. Level floor manually.
Main contactor not energized. Check interlocks.
Limits Disabled. Use caution while driving the PBB with the Limits disabled.
Slope Up Limit reached. Reverse and up motion disabled.
Slope Down Limit reached. Reverse and down motion disabled.
Slowdown Sensor Activated. PBB in Horizontal Slow-down. Speed reduced by ½.
Main Contactor Disabled. To reset Main Contactor you must log OFF then ON.
Cab Cable Hoist Down. Horizontal Motion Disabled. Raise Cab Hoist.
Tunnel Cable Hoist Down. Horizontal Motion Disable. Raise Tunnel Hoist.
Horizontal motion disabled. Raise hoist to enable Horizontal motion.
Wing Root Contacted. Raise Bridge

Fault Messages:
Horizontal Extend Ultimate Limit. Call Maintenance.
Horizontal Retract Ultimate. Call Maintenance.
Cab Left Ultimate Limit. Call Maintenance.
Cab Right Ultimate Limit. Call Maintenance.
Vertical Column Fault. Call Maintenance.
Left Vertical Overload activated. Call Maintenance.
Right Vertical Overload. Call Maintenance.
Main Contactor Weld Fault. Press E-Stop and Call Maintenance.
Cab Left Contactor Weld Fault. Call Maintenance.
Cab Right Contactor Weld Fault. Call Maintenance.

e. HMI Calibrations
Maintenance or Admin Passwords will give access to calibration options. The calibration options shall include, as a minimum, the following:

**Calibration:**
- Height Calibration
- Cab Angle Calibration
- Rotunda/Bridge Angle Calibration
- Wheel Bogie Angle Calibration
- Extension Calibration (optional)

**Analog Limit Setup:**
- Vertical Up Limit Set
- Vertical Down Limit Set
- Cab Right Limit Set
- Cab Left Limit Set
- Swing Right Limit Set
- Swing Left Limit Set
- Extend Limit Set (optional)
- Retract Limit Set (optional)

**Password Control:**
- Change Passwords (Admin password required)

**Pre-position Setup:**
- Set Pre-positioning Points (optional) (Extend Position Sensor Required)

**Optional Features:**
- Others as required by options

**Adjustable Auto Level Timer:**
(1.0 – 10.0 Seconds)

f. HMI Maintenance Setup Screens
The PBB shall be designed to provide a quick method for programming the PLC to accept new operational parameters. The Maintenance / Set-up Screens shall allow maintenance personnel to complete initial set-up or reprogramming of the PBB operational parameters directly from the PBB HMI without the use of additional programming devices. These screens allow Bridge Position Calibration, Status Calibration, Date and Time Configuration, Feet/Meter Unit Selection, Auto Level timer setup and initial Bridge Operational Limit Set Up.

g. Status Calibration Screen:
The Status Calibration screen shall be provided to accommodate input of critical data used in establishing operational parameters for a particular gate location during the initial PBB set-up operation. The calibration includes the following data:

- **Calibrate Height**: The Calibrate Height screen provides the ability to establish a vertical data point that shall be used as the base for calculation of the vertical height measurements displayed on the screen. Upon selection of this screen, the operator shall position the PBB to a level height. The vertical height between the apron and top of cab spacer shall then be physically measured and the data input into the PLC using the touch keys of the HMI panel.

- **Calibrate Length**: The Calibrate Length screen shall provide the ability to establish a base data point that shall be used by the PLC to accurately identify the linear extended length of the PBB displayed on the screen. To calibrate the extension of the PBB, the operator shall enter two data points, referred to as “far” and “near” extension points. Extend the PBB to the “far” point and measure this length from the Rotunda center point to the forward edge of the cab spacer. Then, enter this length using the appropriate touch keys. Next, retract the PBB to the second, or “near” point, and again measure this length as before. Enter this value. This completes the extension calibration. Extending the PBB to the maximum extend length and entering the name plate full extend length value then retracting the PBB to the minimum retract length and entering the nameplate retract length value, will not require a measurement when calibrating the PBB length.

- **Bridge Limit Set-up**: The Bridge Limit Set-up screen shall be used to establish the specific gate operational limits of PBB movement. These limits include cab rotate right, cab rotate left, bridge swing left, bridge swing right, bridge extension, bridge retraction, vertical up, and vertical down limits. Moving the PBB to the desired limit of travel and touching the appropriate touch key completes the setup of each of these limits. The maintenance personnel shall be able to cancel limit setup if an incorrect position is selected.

### 9. Electrical and Communications

**a. PBB control cabinet**

- The PBB main control cabinet shall not be combined with the operator panel cabinet or with another dedicated cabinet.
- All PBB cabinets and junction boxes shall be designed in accordance to the best professional rules, considering 25% of free space / spare capacity.
- The cabling shall be neatly labelled and addressed. The cabling shall be according to the best practice in the professional standards.
- Critical components and common installations shall be available at the Israeli market. Suppliers of installations shall have an agent in Israel for spare parts and support.

**b. Communications**

- A high speed communication / networking cable has at least one spare cable for each active communication cable.
- Additionally no less than 2 extra spare bundles of a high speed communication / networking cable between the PBB cabin and rotunda column communication junction box.
- All cables shall consist of 4 pair each, at least Category Six, 24 gauge and should not exceed 80m length to the communication junction box.
- Outlets and cabling for the installation of services such as but not only: telephone, terminal building P/A, intercom equipment, cameras, and its spares are to be located on PBB as decided by the IAA.

**c. Cables and cable trays / conveyance systems**

- All cabling under movement conditions shall meet all relevant specifications and be defined for movement by the cable manufacturer.
- All other control cables shall meet all relevant specifications and shall be of a flexible type, white numbering on all conduct, excluding earthing conduct.
- All non-movement cabling ducts shall be of a high quality hot galvanized metal.
- All moving cables shall be mounted inside flexible trays (defined as "chain") shall meet all relevant specifications and be defined “for movement” by the chain manufacturer.
• A special design for cabling layout inside the flexible tray shall be made and approved for each of the different PBB types.
• All cabling flexible trays and its contains shall be approved by the tray manufacturer for all aspects (weight, length, movement, cabling, etc.)
• The PBB design shall keep the possibility to replace a complete flexible cable tray and its cabling (as a set).
• Flexible cable trays shall be of a well-known manufacturer that has an agency or authorized dealer in Israel capable to give support within 24 work hours from call. The trays shall be an “off the shelf” product, a common product, mounted and operating on at least 20 locations in Israel (industrial use).
• All cabling under movement conditions shall meet all relevant specifications and be defined for movement by the cable manufacturer. Cables with special structure for permanent movement in conveyance system for medium and high requirements with correct radii and speed. Cables with capability of gliding according to bridge measurements and freely suspension for travel distance. Oil-resistant, Halogen free, working temp. above 50°C, UV highly resistant, highly abrasion resistant, notch resistant.
• All cabling under movement that has multi cores shall be made of combined bundles and stranded together around the center for high tensile stress conditions.
• Shielded cables shall be with highly bending-resistant braided shields with min. 80% optical coverage and have to withstand permanent bending tests in energy chains of min. 2-4 million double strokes (back and forth movement) without damage and resistance increase > 20%.

d. Security provisions
The manufacturer shall install all needed electrical and communications (Cat 6 cabling) infrastructure for the following items:
• One exterior camera mounted under each fixed bridge,
• One exterior camera mounted on the roof of each fixed bridge.
• Three exterior cameras mounted under each apron drive bridge.
• Two exterior cameras mounted on the roof of each apron drive bridge.
• Two interior cameras mounted inside each fixed bridge; One next to the building connection and one next to the rotunda.
• Inside the control cabinet, a space of 15”x15”x10” shall be reserved for installation of a computer by a third party. The computer will be used by the Airport’s Video Management System (VMS).
• At or near the operating panel of the PBB, a 17” touch-screen shall be positioned to be operated by the security personell.
The cameras, computer and 17” screen to be provided by others. Locations of the equipment will be determined and approved by the IAA.

e. CCTV
CCTV cameras, designed for night vision and/or low visibility circumstances, shall be provided with coverage of the ramp area ahead, left and right of the cab and of the drive-wheel assembly so that any obstacles on the ramp can be seen. Cameras shall also be added to cover special situation in maneuvering the PBB, such as close passage to an aircraft engine or delicate item on the aircraft fuselage (antennas for example).

f. Proximity Sensor
Provide a proximity sensor to alert the operator if the PBB is getting close to an aircraft engine. The sensor shall be ultrasonic and may be calibrated via software.

 g. Power
Duplex outlets (un-switched 230 Volt, 50Hz, 1 phase, 16 amp) shall be installed. The locations to be approved by the IAA. Suggested locations as follows:
• On the rotunda column, one 3-phase and one single-phase boxes (waterproof exterior type)
• near drive column (waterproof exterior type)
• near terminal end of fixed bridge in corridor
• in rotunda corridor
• on operator console in cab
• in main PBB electrical compartment
h. Fire Alarm
The tunnel and rotunda shall be fitted with smoke detectors connected to the airside terminal fire alarm system and PBB emergency pressurization fan operation. Additionally to the detectors, a manual fire alarm shall be installed in the bridgehead. The system shall comply with NFPA 72 code.

i. Emergency Lighting
The tunnels, rotunda, cabin, cabin platform, electrical cabinet and fixed bridges shall be fitted with special LED lighting (in coordination with the IAA). The fixtures shall contain an internal battery. The fixtures shall be monitored and controlled by the BMS and shall have a self-check feature.

10. Control Features and Interlocks
The Bridge Manufacturer shall make provision for the interfaces. The point of interface will be a suitably labeled junction box located adjacent to the connection to the airside terminal node. The junction boxes shall be located under the fixed bridge, rain protected and shall be readily accessible.

a. System interlocks
- Bidirectional interfaces/interlocks with the VDGS system are needed.
- A dual side interface for an existing data collection central system is required.
- Interlock shall be provided to indicate when the PCA System is connected and operating. The PBB shall be in “Auto Level Mode” when the PCA system can be in operation.
- Interlocks shall be provided to prevent operation of the PCA until the boarding bridge has docked with the aircraft.
- Interlock shall be provided to indicate the 400Hz cable is connected to the aircraft.
- Physical Pushbuttons in conjunction with Software Interlocks are provided to prevent damage to control circuits or PBB components by selecting opposite motions simultaneously
- When the PBB in the “Logged Off” or “Auto Level Mode”, the controls for PBB movement are inoperative, except for the emergency back-off functionality.
- Basic software and input routines to protect the boarding bridge shall be programmed by the manufacturer and shall reside in non-volatile memory. The software monitors PBB position sensor inputs and operator control inputs to provide valid PBB motions. If a conflict arises between operator inputs and sensor inputs, error routines shall be executed to display messages on the HMI, turn on warning lights, sound an alarm and/or stop the bridge as necessary.

b. Control end units or devices
- All distance and location measurement control devices shall be no less than proximity sensors encoder or a digital encoder or a laser based measuring sensor in accordance with needed function.
- All of the control sensors, proximity switches, limit switches etc. shall be of a metal case, high quality production type.
- Columns non synchronization detector shall be installed.
- All control equipment and panels to be located within the boarding bridge, this ensuring a weather-proof enclosure and a good working environment for maintenance. In addition, there shall be a provision for maintenance personnel to operate the PBB from below by a hand-held remote.
- Proximity Sensors: Provide redundant proximity sensors to alert the operator if the PBB is getting close to an aircraft engine.
- PBB motions shall be protected by two levels of limits. First level limits provide warning to the operator of motion interruption. Motions selected by the operator that do not conflict with current limits shall be allowed. Other motions shall be disabled. Information suggesting allowable motions shall be displayed for the operator on the HMI. A second level of limits (ultimate limits) prevents physical travel that may
damage the PBB or endanger personnel. The ultimate limit devices interrupt PBB movement in the unsafe direction, but allow movement in the safe or opposite direction.

- The PLC monitors the limit fault. The error and instructions shall be displayed on the HMI. The PBB Swing Ultimate Limit, Vertical Ultimate Limits and Column Faults are the only limits where Maintenance personnel shall be required to resolve the fault and position the PBB to allow further PBB operation. A motion-enable interlock shall require that an operator shall initiate any bridge movement by activating a control panel switch. Otherwise, power cannot be applied to the energizing circuitry. As a result, if the PLC should command the bridge to move by sending an erroneous signal, the bridge will not move until a control console switch has been activated as well. Both the PLC command and the motion enable circuitry shall be activated prior to bridge movement.

11. Automatic Leveling

- The PBB shall be equipped with an automatic leveling system (auto leveler). This system allows the PBB to follow changes in the aircraft elevation that occur during aircraft loading and unloading. This system functions with equal reliability for all aircraft contours. The auto level arm shall be located on the right side of the PBB cab area, outside the canopy closure area. Make provision so that the PBB Operator can see the auto level arm.

- The auto leveler is engaged when the operator touches the “Auto Level Mode” touch button. The auto-leveling mode shall be reflected at the operating panel.

- The auto leveler circuit includes an adjustable sustained travel timer. A fault condition is assumed if the operation exceeds the set time limit. This fault condition causes all motor power to be disconnected and audible and visual alarms to sound. The timer shall be adjustable within a range of 1.0 to 10 seconds. The auto level circuit shall be engaged upon a 15 degree rotation of the auto level wheel. Once the Auto Level wheel activates, the PBB shall drive Up or Down until the auto level wheel rotates back to the neutral position.

- The auto leveler will be activated by encoder and not by limit switch. For redundancy, two encoders are required.

- The auto leveler is located outside the canopy. A window in the PBB cab area shall be positioned to visually show the position and employment of the auto leveler.

- Any failure of the auto leveler shall activate an audible and visual alarm.

12. Safety shoe

- Its function is to offset any leveling system insufficiencies or failures, notably in the case of rapid descent from the aircraft. Its operation shall be safe and entirely independent from the automatic leveling system. The safety lowering is operational even in the case of an emergency stop and power failure. This device comprises a sensitive sensor (safety shoe), positioned by the operator under the door of the aircraft at each docking. When the slide is activated, it acts directly on control of the elevation system descent.

- The safety shoe shall be projected for outdoor conditions.

- The safety shoe shall be easily replaceable (plug-and-play).

- The connection cable of the safety shoe shall be of the correct length for placing under the aircraft door (no over length).

- Detection of safety shoe presence
  - Detection of safety shoe presence in its storage position shall be performed by a photoelectric sensor.
  - Vocal alarm after safety shoe is activated (3 time signal).
  - Normal operation of the PBB shall only be possible if the safety shoe is in the storage position.
13. PBB System Cooling, Ventilation and Pressurization

The PBB Package, fixed bridges and telescoping bridges, shall be provided with cooling systems to maintain the required temperature per Part 1. Ambient conditions for the design of the cooling system are defined as follows: 35 Degrees Celsius, 62% RH.

Adequate ventilation shall be provided. Fresh air shall ventilate the PBB at all times. Subject to specific design by the PBB Manufacturer, the system shall generally consist of:

- All Passenger Boarding Bridges shall be connected with the airport HVAC system, through the dedicated chilled water air conditioning unit in Concourse E, to cool the fixed bridge section and preferably the movable PBB itself.
- HVAC system will be based on chilled water Supply & Return pipes (2” from AC system of Concourse E).
- The dedicated chilled water handling units shall be installed according to these specific requirements for concealed ducted fan and coil. The performance of the PBB chilled water AC system shall meet these specific requirements.
- Chilled water (temperature of 7/12°C) shall be guided from an 2” pipe in Concourse E towards an air dispenser in the ceiling of the fixed bridge section or/and the first telescopic tunnel (preferably) and introduced in the fixed bridge section and in the first tunnel of the movable PBB by means of gritted ducts along ceiling corners.
- HVAC piping shall be integrated in fixed bridge and PBB appearance, from Concourse/Pier E façade opening into ceiling distribution, including piping and/or hose between gatehouse and first tunnel adjacent to the Rotunda, to be provided, installed and connected by supplier PBB.
- The fixed bridge part and/or the first telescopic tunnel shall have facilities for respectively water return and air exhaust.
- The supply & return pipes will be insulated to operate sufficient under temperature conditions of 0°C up to 125°C. Covered duct or plate above rotunda shall give the rotunda a clean external appearance.
- The deflectable pipe (as in the preferred ideal situation) above the rotunda, realized as a flexible insulated hose shall also operate sufficient under temperature conditions of 0°C up to 125°C. Covered duct or plate above rotunda shall give the rotunda a clean external appearance.
- PBB HVAC piping/ducting, AC-units, plenums and grilles to be installed as indicated on approved, by the Contractor submitted, drawings) to be coordinated with HVAC contractor.
- HVAC piping, hose or duct shall be insulated to reduce loss of cooling capacity and prevent the cause of condensate. Material requirements PBB are applicable for ducts.
- HVAC control by the Concourse E Air Handling System.
- HVAC piping shall be integrated in fixed bridge and PBB.
- The roof-top unit, located on the first tunnel adjacent to the Rotunda, and serving the telescoping tunnels via interior ducts located at the ceiling next to each wall of the first tunnel. The ducts shall be carefully integrated with the design of the ceiling and walls. Diffusers shall distribute air at points along the first tunnel and air from the ends of the ducts shall serve the second and third tunnels.
- NOTE: Alternative is that the movable PBB shall have fan-coil units using cooling water available from the terminal building. The PBB manufacturer shall investigate if this system can be adjusted to the movable PBB. The manufacturer provide information on the required cooling water load and coordinate with the supplier of that system.
- The Bridgehead, or Cab, shall have a cassette type inverter DX-system to serve the Cab and the end of the second or third tunnel. This system shall be of a brand with an agent in Israel.
- The Fixed Bridge shall have fan-coil units using cooling water to be available from the terminal building.
- The manufacturer provide information on the required cooling water load and coordinate with the supplier of that system.
- The PBB HVAC chilled water system in the PBB shall be adjusted with leak-detection devices (switches).
- The PBB HVAC system shall be controlled from the PBB Control Station and remotely from the Terminal Building.
- The acoustic performance of the HVAC system shall be no more than 40dBA at 1m from the outlet.
- Full details of the HVAC chilled water system shall be submitted for approval by the IAA.
• The HVAC system of the PBB shall be fed from the 3x100 Amp PBB panel board supplied by the PBB contractor.

• A system shall be provided that, during a ramp fire emergency, will deliver a positive pressure throughout the PBB system (fixed bridge and apron drive bridge) from a source that shall remain uncontaminated in accordance with NFPA 415 and NFPA 92A. As part of this system, any sources of negative pressure in the PBB system shall be deactivated. The PBB manufacturer may consider drawing air from the terminal building in connection with the ventilation and pressurization requirements.

14. Building Management System

BMS shall monitor the aircraft Passenger Boarding Bridge equipment directly through their control and monitor equipment using the BMS main software. Passenger Boarding Bridge monitoring functions shall include, but is not limited to, power supply, alarm reporting, partial or total failure. As a minimum the following alarm/status signals shall be monitored:

- UPS:
  - 1x alarm, per bridge house.

- Passenger Boarding Bridge (PBB) control PLC:
  - Single master alarm and single master warning for each PBB. These to be interface relays to alert on the BMS central workstation of failure or imminent failure of any system, sub-system or component controlled of monitored by the control PLC.
  - Common alarm/monitoring for full status information on PBB monitored sub-systems and components.
  - The PBB contractor shall develop and supply necessary hardware interfaces, drivers and software protocols for conversion of the monitored information using either OPC or Modbus protocol in order for the BMS to handle and process this information.

- During a ramp fire emergency, a positive pressure system shall be activated in accordance with NFPA 415 and NFPA 92A. As part of this system, any sources of negative pressure in the PBB system (fixed bridge and apron drive bridge) shall be deactivated.

15. Interior Finishes and Lighting

• The interior finish of the PBB is to be designed to be durable and easy to clean. The materials shall be selected and time proven to withstand the environmental exposure of airport traffic. The usage of rotting materials like wood is prohibited. Tunnels shall be fire rated as required in NFPA 415. Manufacturer shall supply certificates to confirm this.

• Tunnel interior surfaces shall have a low surface flame-spread eating, be non-toxic and non-carcinogenic.

• The tunnel wall and ceiling finishes shall be high pressure decorative laminate panels or painted coil coated galvanized sheets. Panels shall be continuous for the full height of the wall and full width of the ceiling. Panel color as selected and approved. Provide special-profile aluminum moldings with a baked-on enamel finish at the junction of wall and ceiling and at side and end joints, with color as selected and approved. Provide system allowing removal/reinstallation of individual panels to enable commercial advertising on walls including communication and electricity infrastructure to enable installation of electronic advertisement and screens.

• The ceiling design to include linear accessories oriented parallel along the PBB direction, including linear light fixtures and HVAC grills.

• The tunnel lintels shall be covered by stainless steel.

• The interior light fixtures are to be recessed and blend with the ceiling design. Fixture trim is to be painted white. Tunnel interior lighting shall be provided by LED fixtures located approximately 250cm on center, or as necessary to achieve a light level of 150 lux, measured on the floor, throughout the PBB system from
terminal building to aircraft door. The lamps shall be LED with a warm white color. The light fixture in the rotunda shall be a surface mounted round LED to provide a minimum of 150 lux measured on the floor.

- The interior light fixtures shall be easy maintainable and replaceable.
- Light switches (with movement detectors) shall be located in the rotunda or beginning of the internal tunnel, near the service door and at the control console. These switches shall control the complete interior area of the PBB. Position and type to be approved by the IAA.

- IAA required LED emergency lighting fixtures shall be installed and powered by self-contained batteries. Centralized monitoring of these fixtures shall be optional.
- The location of exit signs and required emergency light intensity in the PBB to be determined by the life safety consultant of the IAA.

- Flooring
  - Provide similar flooring throughout the PBB Package including Telescoping Bridge, Fixed Bridge, Rotunda and Cab.
  - Approved flooring products:
    - Gerflor “Passport”
    - Altro “Designer 25”
    - Mondo “Drops”
    - Other flooring products will need approval from the IAA.
  - Color as selected from the manufacturer’s full range of standard style and colors within the indicated product line.
  - The IAA will have the option to add a ‘logo tile’.
  - Tactile warning surfaces shall be applied where required.
  - All flooring shall be appropriate for extremely heavy use in industrial environments and have a hammered surface or quartz particles for superior non-slip properties (greater than 0.6 per ASTM 2047 in general, and greater than 0.8 in the Cab). Flooring manufacturer shall recommend product for use in PBB with slopes up to 8.33%.
  - Provide “Safety Strip” flooring on transitions between tunnels, with bright contrasting color.
  - A metallic frame shall cover the edges of the rubber floor wherever the design requests in order to avoid its removal.
  - The gluing of the PVC to the floor will be made in preventing the penetration of water between them.
  - All floor covering shall be rated per the requirements of NFPA 415.
  - To protect the floor covering from damage through retracted and extracted movements of tunnel sections the floor of tunnel 2 and 3 (if present) shall be covered with guidance strips.

- Roller tracks or rails (Runner Profiles) should be covered by Stainless Steel.
- Other interior surfaces and trim exposed to passenger view are to be industrial painted RAL 9006 or other color for architect selection and approval, to meet the architectural interior color scheme with preparation per SSPC (Society for Protective Coatings) SP1 and SP3, primer per SSPC at a minimum of 50 microns dry-film thickness and a 50-100 micron dry-film thickness aliphatic polyurethane topcoat.
- All aluminum panels to be natural anodized aluminum or stainless steel appearance or other for architect selection and approval.
- Interior wall surfaces and structure not exposed to passenger view is to be protected by solvent cleaning (SSPC-SP1) the surface to remove any contaminants. The surface shall then be coated with a minimum of 50 microns dry-film thickness of primer per SSPC guidelines.
- The cabin will be equipped with stainless steel folding shelf and trash can.
16. Exterior Finishes and Lighting

- All exterior steel surfaces are to be abrasive blast cleaned in accordance with SSPC-SP6 commercial blast cleaning. The blast profile is 40 – 80 micron angular profile. All surfaces are then to be coated with an epoxy primer of 75 microns dry-film thickness followed a coat of high-build epoxy primer applied at 200 micron dry-film thickness. The top coat (color will be defined by the IAA) shall be 75 micron dry-film thickness aliphatic polyurethane. This will give a total surface of 350 micron dry-film thickness.
- Exterior walls to be aluminum / Alucobond cladding panels.
- Paint finish shall have a low surface spread of flame, be non-toxic and non-carcinogenic.
- Provide lighting under the Fixed Bridges using weatherproof LED or single or double lamp high-efficiency fluorescent fixtures located under the bridge as necessary to achieve a light level of 100 lux throughout the area under the bridge. Coordinate the placement of light fixtures with clearance signs under those Fixed Bridges providing GSE access to the gate.
- Jacking stand position to be marked on the PBB.
- PBB supplier shall coordinate with PAL3 project contractor all connection details between the PBB and the gate nodes of the building according to architectural plans and details (architectural drawings X-A64 and architectural details X-A93.147, X-A93.147A, X-A93.149, X-A91.262 in Appendix 1). Please note that the hammerhead PBBs at E6-E9 will be connected to aluminum / Alucobond wall cladding, while PBBs at E2-E5 will be connected to exposed architectural white concrete walls.

17. Electro Technical Facilities

a. General
The PBB shall be equipped with various electrical installations, including:
- Installations for the primary operation of the passenger boarding bridge
- General lighting
- Emergency lighting (anti panic lighting, exit signs and orientation lighting)
- Service wall sockets
- Connections for various systems
- Earthing and lightning protection for the passenger boarding bridge
- Control and signaling system
- Local camera system to guarantee safe operations of the passenger boarding bridge

In addition, the following third-party installations will be installed in the passenger boarding bridge:
- Surveillance cameras for security purposes
- Telephone
- Access control

The Specifications also applies to these installations. It will be determined in consultation with the department concerned whether the facilities (cables etc.) are to be included in the production of the PBB.

b. Basis
Electromagnetic compatibility (EMC)
In order to guarantee the uninterrupted operation of all equipment, systems and installations in and around the terminal complex, the PBB shall satisfy a number of requirements relating to electromagnetic compatibility (EMC):
- All electrical equipment used for the PBB shall meet the Israel Rules and Regulations for Electrical Installations (IRREI)

As regards immunity, the electrical equipment shall meet performance criterion A.

In order for the PBB to satisfy the EM Zoning requirements for Airports, special attention should be devoted to the installation techniques used and, in particular, to the following installation aspects:
- Earthing circuit for the PBB, including link to the terminal building
- Earthing of the structure
- Lightning protection
- Cable categories (classification in EMC levels)
- General requirements with respect to cable ducts and ladder racks
- General requirements with respect to cable separation

### Basis for electrical installations

The following Basis applies to the electro technical installations of the PBB:

- Nominal operating voltage: 400V 3 phase
- Frequency: 50 Hz
- Power factor / $\cos \phi$: 0.92 – 1.0
- Maximum starting current: 4 x I nominal

### Accessibility of the electrical installations

All electro technical components of the PBB shall be easily and safely accessible under any circumstances. One of the principal requirements is for the egress routes to meet the relevant definitions in the working conditions legislation.

c. Calculations

The following calculations shall be performed in the design phase for both new PBBs and those scheduled for replacement:

- Cable (core diameter, voltage loss and maximum cable length) and selectivity calculations.
- Power calculation, to determine the level / increase of the connected load and the level / increase of the expected simultaneous load. The IAA can use this calculation to provide insight into the consequences for the distribution infrastructure.
- Energy consumption, $\cos \phi$ and harmonic values to provide insight into the energy consumption (in kWh), $\cos \phi$ and harmonic values.

d. Measurements

Upon completion of the PBB the following measurements shall be performed to verify the calculations made:

- Nominal voltage ($U$)
- Nominal current ($I$)
- The power factor $\cos \phi$
- The nominal power in kVA (apparent), kVAr (wattles) and kW (actual)
- The maximum power in kVA (apparent), kVAr (wattles) and kW (actual)
- Proportional share of the higher harmonics (up to 50th)

e. Phase failure or unbalanced load

If one or more of the phases of the power supply for the installation fails or receives an unbalanced load, the installation shall respond as follows:

- Stop automatically;
- Switch off.

Once the power supply has been restored, the function auto levelling shall restart in case of the PBB is connected to an aircraft. All other functions can restart with a command on the control panel by the operator.

f. Casings

Wherever the box is exposed to environmental conditions, it shall be made of 316 stainless steel. The following requirements apply to the casing of the low-voltage distributors, starter boxes, control boxes and desks:

- Protective value: at least IP65
- Impact resistance: at least IK10

g. Cabling

The following requirements apply to the cabling of the PBB:

- All cables shall be made of not easily combustible, halogen-free material (MBZH). This also applies to all appurtenances, such as tubes, junction boxes etc.
- Low-voltage and telephone cables shall be guarded, if necessary.
- Low-voltage cables in a cable duct shall be separated from high-voltage cables so as to avoid EMC effects and the like.
- The cable ducts should offer sufficient space for third-party systems and future installations, such as PCA units.
- All cables shall be provided with labels at either end and at 10-metre intervals indelibly stating the relevant cable code.
- The cables to be installed on the outside of the PBB shall be hydrocarbon, oil and grease resistant and shall be resistant to weather-related influences.
- When cables are fed through metal, aluminum etc. measures shall be taken to prevent damage to the cable sheath:
  - when installing the PBB
  - or through the use of the PBB

**Recommended cables**

- **Power and control cables**
  - All cables shall be made of not easily combustible, halogen-free material (MBZH). This also applies to all appurtenances, such as tubes, junctions boxes etc.
- **Measurement cables**
  - Twisted pairs (cross-section 1 mm2) with shielding per braid
- **Ethernet cables**
  - Copper wire, shielded twisted pairs (STP), category 6, equipped with shielded RJ45 connectors.
- **Telephone**
  - Pairs (cross-section 9/10 mm2) with shielding of the SYT1LY series or equivalent.
- **Video**
  - 75 Ohms flexible coaxial cable

**h. Lighting**

**General**

The following requirements apply to all lighting to be installed in the PBB:

- Use of energy-efficient LED technology on the understanding that \( \cos \phi > 0.95 \).
- The fittings to be used shall allow easy and effective cleaning.
- The fittings to be used shall allow easy replacement.

**General lighting**

The PBB shall be lit subject to the following requirements:

- The average light intensity on the floor shall be at least 150 lux. This should not include daylight entering from outside and/or the light output of the apron lighting.
- The color temperature of the lights shall be 3000 to 4000 degrees Kelvin. Final decision will be done in coordination with IAA.

Fittings compliant with protection class IP67 shall be mounted on either side of the bridgehead closure. These fittings shall be dimmable.

Another fitting compliant with protection class IP67 shall be mounted on the outside of the PBB, above the door to the service staircase.

**Emergency lighting**

The following requirements apply to the emergency lighting:

- Israeli Planning and Building Law
- Safety Regulations (Ministry of Labor)
- Israeli Rules and Regulations for Electrical Installations (IRREI)
- The average light intensity on the floor shall be at least 10 lux, or as required by the safety consultant.
- The light intensity around the bridgehead, the sloping walkway and the rotunda shall be at least 10 lux.
• In calculating the light intensity, the lights marking the egress route are deemed to be part of the overall emergency lighting system.

Orientation lighting
Orientation lighting shall be installed in the PBB.

The following requirements apply to orientation lighting:
• For orientation lighting, the exit signs shall be on continuously. Self-backed up Emergency lighting will be lit automatically during a power failure.

Lights for technical spaces / cabinets
Any technical spaces in a PBB shall be fitted with lighting subject to the following requirements:
• The average light intensity on the floor shall be at least 250 lux. This should not include daylight entering from outside and/or the light output of the apron lighting.
• The space shall be provided with LED emergency lighting fixtures that offers a continuous light intensity on the floor of 10 lux. The fixtures shall be installed and powered by self-contained batteries. Centralized monitoring of these fixtures shall be optional.
• The color temperature of the lights shall be 4000 degrees Kelvin.

The lights in the technical cabinets shall be switched on and off automatically when the door is opened and closed.

i. Wall sockets and switches

Wall sockets
Wall sockets shall be mounted for the general use of:
• auxiliary tools
• extra work lights
• cleaning equipment
• etcetera

Wall sockets shall be projected on the following locations:
• one in the center of the fixed section (if applicable)
• onto the control panel
• in the maintenance areas where the use of electrical tools can be expected
• in the control box
• rotunda

The wall sockets shall be designed as follows:
• impact resistant
• childproof design in public areas
• in waterproof casing

The wall socket onto the control panel shall be provided with a wall socket combination subject to the following requirements:
• 2 plug sockets 16A 2P+E 400V
• 2 overload releases 16A 1p B-characteristic
• 1 earth leakage switch 25A 2p 0.03A
• protection class IP44

A CEE form wall socket shall be installed near the wheel set, 32 A, 4P+E 400V, protection class IP65. This wall socket shall be protected using 40A protection and earth leakage switch of 40A 3p 0.03A.

Switches
The switches shall be designed as follows:
• Impact resistant
• In humid areas protection class IP67,
  ○ Lightning protection, equipotential bonding and earthing

**General**

To ensure the proper and reliable functioning of the PBB, it shall be equipped with effective lightning protection, earthing and equipotential bonding. In the terminal building the lightning protection is combined with the equipotential bonding and earthing systems. This approach should be continued in the passenger boarding bridge.

**Equipotential bonding / lightning protection**

The PBB is to be equipped with an equipotential bonding system connected to a Caldwell plate. The Caldwell plate is part of the potential / lightning protection system of the terminal building.

The following shall be connected to the equipotential bonding cable:

- foreign conductive parts and metal frames that pose a contact hazard for persons
- all metal parts (in connection with the lightning protection)

In the control box all metal parts shall be connected to the earth rail inside the box. In turn, that rail should be connected to the equipotential bonding cable.

**Earthing**

The safety earthing for the control box, electrical machinery, lighting fixtures, wall sockets and the like shall be provided via the mechanical protective sheath of the feeder cables or the separate earth wire in the cable.

- Control box(es) and desk(s)

**General**

The following requirements apply to the control box(es) and desk(s):

- The box/desk shall be fitted with a lockable main switch.
- Inside the box/desk, the incoming feeder cable should be connected to the main switch along the shortest route. If the incoming feeder cable is guided through the box, it shall be given a separate duct with a lid in a conspicuous color or with stickers. This duct may not be used for any other cables!!
- Inside the box, high-voltage and low-voltage cables shall be installed in separate ducts in order to prevent cross-talk.
- All boxes, desks and components shall be coded with the text milled into stainless steel text plates.

j. **Electric motors**

Electric motors used to operate the PBB are subject to the following requirements:

- The maximum permitted starting current is 4x Inom
- The motors shall have a yield of at least 80%

k. **Frequency regulators**

If frequency regulators are used to ensure the smooth movement of the PBB, the following requirements apply:

- 12-pulse regulator suitable for 4-quadrant operation
- Filters to reduce harmonic currents
- Fitted with:
  - An energy-saving function
  - Short-circuit and earth leakage resistant electronic motor protection
  - Motor temperature protection
  - S-curve function to ensure smooth transition from rest mode to movement
  - Status and failure indicator(s)

l. **Camera system**
In order to enable the operator to see the wheel set of the passenger boarding bridge and other critical areas, a camera system shall be installed that includes the following elements:

- monitors
- cameras
- cables

**General requirements**

The following requirements apply to the camera system:

- Each operator position shall be equipped with a monitor showing the wheel set.
- The monitor shall offer a clear and focused view of the wheel set under all visibility conditions.
- The cameras shall be used to show clear images of the wheel set and working range from all angles. Camera system plan and cabling infrastructure shall be approved by the IAA.
- If multiple cameras are used, it shall be possible to activate the required camera using the driving joystick.
- The start-up time of the monitor shall not be more than 3 seconds.
- The images shown need not to be saved.
- The monitor affords clear views of the wheel set and working range, irrespective of the position of the PBB.

**Requirements relative to the camera images**

The following requirements apply to the camera images:

- **frame rate**: 25
- **image quality**: 4CIF
- **video code**: MPEG-4/AVC/H.264

The images should be in color.

**Requirements relative to the monitor**

The following requirements apply to the monitor:

- The monitors shall be integrated into the desk(s).
- It should not be possible for users to change the monitor settings, with the exception of the contrast setting (light/dark).
- For the visual comfort of the driver, the vertical angle of inclination of the screen shall be adjustable.
- The screen size shall be at least 10.4" minimum.

**Requirements relative to the camera**

The following requirements apply to the camera:

- All cameras shall be of industrial quality.
- Static cameras shall be used.
- The cameras shall be Wide Dynamic Range (WDR) with at least FHD resolution models to be approved by the IAA.
- The cameras are to be provided with a wide-angle lens (≥ 100º) to have a clear view at the bogie or other areas.
- The cameras shall be suitable for outdoor use, with due regard for local climate conditions.
- The cameras should produce clear and focused images both during the day and during dark hours.
- Backlight compensation for direct light into the lens.
- The cameras should not obstruct the regular movements of the passenger boarding bridge.
- Preference is given to IP cameras.
- For use during dark hours, the cameras can be set to work under apron lighting conditions. Apron lighting intensity is at least equal to the requirements of ICAO Annex 14.
- In the case of more than one camera, switching between views of different cameras is done via a selector. A split screen option shall be possible.

**Requirements relative to the camera mounting**
The cameras shall be mounted in such a way that they:
- produce stable and vibration-free images while the PBB is used
- produce clear images of the predefined area up to storm force 10

18. Safety Features
a. General
In order to prevent damage to the PBB and objects in its vicinity, including the aircraft, the PBB will have to be fitted out with various safety features, including:
- Remote sensors;
- Limit switches;
- Emergency limit switches;
- Mechanical stops.

Moving parts of the PBB shall be protected against technical and operational limiting values being exceeded as follows:
- The activation from the stated limiting of the operational limit switch shall be defined by supplier.
- The activation from the stated limiting of the emergency limit switch shall be defined by supplier.

Technical limiting values apply to all motion functions, such as:
- Driving/swiveling
- Lifting/lowering
- Turning

Operational limiting values are to be determined based on the applicable operational area of the PBB and will relate to the driving/swiveling function.

All moveable parts shall be equipped with a mechanical limiting position control that is strong enough to stop the movement of the PBB without any warping or failure of the control device.

All safety related components shall be failsafe engineered. That means that in case of cabling, power loss or communication loss the safety switches will be active.

b. Light Beacons
The PBB shall be supplied with the following light beacons:
- On the inside of the cabin:
  - One (1) amber flashing light, installed close to the canopy, activated when the canopy is moving.
- On the outside of the PBB:
  - Three (3) amber flashing lights (movement lights), activated when the passenger boarding bridge is in operate mode and may move at any moment. Two are installed on either side of the running gear, the third is attached under the bridgehead;
  - One (1) red flashing light, installed under the bridgehead, to signal an auto levelling fault;
  - One (1) green light, installed under the bridgehead, indicating that the passenger boarding bridge is in parking position;
  - One (1) red light, installed on top of the bridgehead, for obstacle illumination.

c. Audible warnings – Horns.
The passenger boarding bridge shall be supplied with the following audible warnings:
- Inside the cabin:
  - One (1) buzzer, integrated in the passenger boarding bridge control desk;
    - Continuous tone: Indicates an operator driving error; the requested movement is prohibited. The buzzer sounds for as long as the movement command is held;
    - Discontinuous tone: The passenger boarding bridge is moving at slow speed.
- Outside the passenger boarding bridge:
o One (1) siren activated when the passenger boarding bridge is moving and when a translation and/or elevation movement is in progress. This siren is installed under the tunnel exterior. This siren shall be at least 105dB.

o One (1) audible warning bell, to signal an auto levelling fault when the passenger boarding bridge is connected. This siren is installed under the bridgehead.

o One (1) siren, activated when a network voltage fault will appear. This siren is installed under the bridgehead.

Note: The tone of the sirens shall be differentiated. The siren sounds levels shall be validated during the study.

d. Sensors – fuselage contact detection
This device, different from the “proximity detector” stops extension and rotation movements of the passenger boarding bridge running gear on contact with the aircraft, in the docking direction, whatever the position of the running gear. This detection shall be performed by sensors without direct contact with the fuselage (the use of flexible rod or roller end of travel sensors is prohibited). To better adjust the bridgehead to the fuselage; At least three sensors shall be integrated in the floor (one to the right, one in the center and one to the left). Movement is stopped after activation of one of the sensors. However, in the case of activation of one of the end sensors, bridgehead rotation is authorized in the reverse direction. All movements are interrupted when the center sensor is activated.

e. Sensors – detection of cabin front door position
Detection of the front door "open/closed" positions shall be performed by magnetic sensors. The use of induction sensors is prohibited.

f. Sensors – detection of PBB position limits
Detection of PBB position limits (tunnel extension, rotunda rotation, running gear rotation) is performed by proximity switches.

19. Operation and functions Apron Drive PBB

a. Operation Apron Drive PBB
Detailed requested operation functions
The control panel shall be equipped with:
- a number of pushbuttons, such as:
- Start automatic docking
- Start manual control
- Start auto parking
- Start auto levelling
- Canopy up / down
- Shutter open / close
- Lamp test
- Signal lamps:
  o Parked
  o Failure

b. Operating Functions
PBB operation is provided with the following main operating functions:

General:
- STOP MODE,
- MANUAL MODE,
- AUTOMATIC MODE.

These functions are validated by a key switch on the control desk.

The STOP and MANUAL operating functions also allow access to the following operating sub-functions:
From STOP function:
- "STANDBY" sub-mode
- "NOT IN SERVICE" sub-mode

From MANUAL function:
- "MAINTENANCE 1 (Sizing)" sub-mode,
- "MAINTENANCE 2 (Mobile maintenance unit) sub-mode",
- "SAFETY BYPASS" sub-mode.

The emergency shut-down function is always active for all the operating modes

c. Stop Function
STOP mode is inherent to the parking position of the PBB. In this mode, the majority of control desk commands are inhibited.

If, while switching to STOP mode, the PBB is in contact with the aircraft (or aircraft presence is detected), then a warning message is displayed and the panel buzzer sounds to signal a fault.

Minimum necessary conditions to switch to STOP mode:
- The key switch is on "STOP" position (the key is released), or
- The PBB is in MANUAL mode and no command has been made for several minutes (settable value, to be defined)

Operation:
Switching of the PBB to STOP mode shall cause (at least) the following actions:
- The front roller shutter or doors are completely closes
- The canopy completely folds back
- The exterior lights switch off
- The orange flashing lights (movement lights) installed on the running gear and under the cabin switch off
- The sensor edges of the gear protection are deactivated
- The video screen and camera switch off
- The specific STOP mode screen is displayed on the operator terminal
- Auxiliaries related to motorization elements (integral transmission, motors) and certain elements of the control-command are down-powered

Commands available in STOP mode
- PBB interior lighting
- "MAINTENANCE " illuminated pushbutton (enables STANDBY STOP mode to be bypassed)
- "NOT IN SERVICE" selector (airport prohibition)
- Fault acknowledgement commands

d. Standby stop sub-mode
The purpose of this mode is to automatically switch off the PBB interior lighting at the end of a time delay (set at approximately 10 minutes, settable value). Note that this mode only affects the normal lighting on the PBB. Safety lighting remains permanently activated.

Minimum necessary conditions to switch to STANDBY STOP sub-mode
- The PBB is in STOP mode
- The “MAINTENANCE” illuminated pushbutton, located inside the control/command cabinet is not activated (the indicator is not lit)
- No lighting command for approximately 10 min

To exit from STANDBY STOP sub-mode
- Press the lighting push button (re-lighting for 10 min) => temporary exit from STANDBY STOP mode
• Press “MAINTENANCE” illuminated pushbutton (the indicator is lit) => definitive exit from STANDBY STOP mode (lighting remains on permanently when this is requested)

Commands available in STANDBY STOP mode
Identical to STOP mode

e. Not in service sub-mode
No function is possible in this mode, with the exception of PBB interior lighting.
The control screen displays a specific “PBB NOT IN SERVICE” message. This message shall be visible to the operator and be highlighted on the screen.
To be able to remove the PBB, this mode is not operational in MANUAL or AUTOMATIC mode.

Minimum necessary conditions to switch to NOT IN SERVICE sub-mode
• The PBB is in STOP or STANDBY STOP mode
• The “NOT IN SERVICE” selector is activated and/or the “Airport prohibition” command is transmitted by the aircraft stand supervisor

To exit from NOT IN SERVICE sub-mode
• “NOT IN SERVICE” selector deactivated and “Airport prohibition” command lifted by the aircraft stand supervisor

Commands available in NOT IN SERVICE mode
PBB interior lighting only

f. Manual mode
This mode authorizes maneuvers relative to PBB movement (docking of the aircraft and return to parking position), using commands from the control desk. These commands are made to the PBB auxiliaries and motorization elements.
This operating mode is subject to a driving authorized person.
This mode also makes available an automatic vertical pre-positioning according to the type of aircraft expected for docking.
In this mode, Elevation/descent, swivel and roll commands may be operated simultaneously without loss of performance.

Minimum necessary conditions to switch to MANUAL mode
• The key switch is in “MANUAL” position (the key is captive), and
• NOT IN SERVICE mode is deactivated (only valid during switch from “STOP” to “MANUAL” position, if switching from “AUTOMATIC” to “MANUAL” position, NOT IN SERVICE mode is ignored), and the Visual Guidance Docking System is not being used.

Operation
When all the previous conditions are met, switchover of the PBB to MANUAL mode shall cause (at least) the following actions
• The auto-levelling arm retracts if the PBB was previously in AUTOMATIC mode
• The video screen and camera switched on
• The sensor edges of the gear protection are activated
• All the panel commands become available
• The main MANUAL mode display panel is displayed on the operator terminal
• The orange flashing lights (movement lights) installed on the running gear and under the cabin are activated, to signal imminent movement on the PBB

Note: when MANUAL mode is in use, the safety lowering system (with safety shoe) shall be in its storage position, otherwise an alarm will be signaled at the end of a time delay (settable value). This alarm is automatically acknowledged when the slide it returned to its storage position.
Commands available in MANUAL mode
- All the control desk commands
- The “MAINTENANCE” illuminated pushbutton, to validate the MAINTENANCE 1 sub-mode
- The “NO BADGE” selector, to inhibit/validate badge read
- The “SAFETY BYPASS” switch, to clear the PBB if it is outside position limits

Height pre-positioning commands from the operator terminal

g. Maintenance 1 sub-mode
This mode authorizes access to the maintenance screens, available on the operator terminal. It notably enables PBB sizing and calibration operations
This mode is only accessible by maintenance personnel. It is obtained by pressing the "MAINTENANCE" timed illuminated pushbutton located inside the control/command cabinet.

Minimum necessary conditions to switch to MAINTENANCE 1 sub-mode
- The PBB is in MANUAL mode, and
- The «MAINTENANCE» illuminated pushbutton is activated (the indicator is lit), and
- The mobile maintenance unit shall not be connected otherwise the driving control desk commands are inoperable

To exit from MAINTENANCE 1 sub-mode
- The "MAINTENANCE" illuminated pushbutton is deactivated (the indicator is not lit). The illuminated pushbutton is automatically deactivated after a time delay (value to be defined, can be set from 0 to 60 min) or after the illuminated pushbutton is pressed a 2nd time before the end of the time delay
- No sizing/calibration operation is in progress on the PBB. In this case, the end of the calibration procedure will trigger exit from MAINTENANCE 1 mode

Commands available in MAINTENANCE 1 mode
Identical to MANUAL mode, additionally with all the maintenance functions of the operator terminal

h. Maintenance 2 sub-mode
This mode enables maintenance operators to maneuver the PBB using a button box. This is connected at the running gear and enables the main PBB movements to be performed from the runway
To achieve this it is first of all necessary to remove the “cap” connected to the connector. This action triggers an emergency stop, which shall be acknowledged before the box may be used
In this mode, commands from the control desk are inhibited PBB translation and rotation movements are performed at slow speed.

Minimum necessary conditions to switch to MAINTENANCE 2 sub-mode
- The PBB is in MANUAL mode, and
- The mobile maintenance unit is connected, and
- The emergency stop caused by removal of the “cap” is acknowledged

To exit from MAINTENANCE 2 sub-mode
- Disconnection of the mobile maintenance unit and replacement of the “cap” on the maintenance connector. This operation triggers and emergency stop, which shall be acknowledged before re-using the PBB

Commands available in MAINTENANCE 2 mode
- Raising/Descending the elevation gantry
- Left/Right rotation of the running gear (at slow speed)
- Forward/Reverse movement of the running gear (at slow speed)
- Left/Right rotation of the cabin
Special Specification for Airside PAL3 Project Ben-Gurion Terminal 3

- Emergency stop
- Emergency stop reset

i. Safety bypass sub-mode
The purpose of this mode is to inhibit the intrinsic safety features of the PBB to be able to clear it when it is positioned outside the authorized limits. These safety features encompass:
  - All over-travel (Elongation/Retraction, rotunda rotation, gear rotation, High/Low slopes)
  - All safety devices implemented for obstacle detection (aircraft wing contact, edge sensors under 400Hz rollers, other safety devices causing PBB blocking)
  - Locking of the PBB when the unconnected 400Hz cables are unrolled
  - Interlocking with the docking guidance system (VGDS) (option)
  - Where appropriate, the anti-collision system

In no case shall this mode inhibit the devices dedicated to personnel safety, i.e.:
  - emergency stops
  - gear protection edge sensors
  - the cabin front door position sensor

In this mode, running gear movement is performed at slow speed
A warning message is visibly displayed on the driving screen, in a window, highlighted and at the top of the screen so as not to mask relevant information. An intermittent audible signal sounds during the maneuvers
This mode is only accessible by maintenance personnel. It is obtained by operating the “SAFETY BYPASS” key switch located inside the control/command cabinet.

Minimum necessary conditions to switch to SAFETY BYPASS sub-mode
- The PBB is in MANUAL mode, and
- The "SAFETY BYPASS" switch is activated

To exit from SAFETY BYPASS sub-mode
- The "SAFETY BYPASS" switch shall be deactivated

Commands available in SAFETY BYPASS mode
Identical to MANUAL mode

j. Automatic mode
This is activated by the operator when the PBB is in contact with the aircraft. He validates:
  - the automatic levelling function in relation to the vertical displacement of the aircraft (the cabin automatically follows the aircraft fluctuations)
  - the safety lowering function (safety shoe)

For this mode, the driving control desk commands are inhibited

Minimum conditions necessary to switch to AUTOMATIC mode
- The key switch is in on the AUTOMATIC position (the key is released)

Operation
Switching of the PBB to AUTOMATIC mode shall cause (at least) the following actions:
  - The auto-levelling arm comes into contact with the aircraft fuselage
  - The canopy is totally deployed up to contact with the fuselage
  - The exterior lights switch off
  - The video screen and camera switches off
  - The specific AUTOMATIC mode screen is displayed on the operator terminal
  - Control desk commands are inhibited
  - The orange flashing lights (movement lights) installed on the running gear and under the cabin switch off
  - The gear protection sensor edges are inhibited
  - The air extractors are made operational at the end of 5 minutes
Note: in AUTOMATIC mode, the safety lowering system (with safety shoe) shall be installed under the door of the aircraft. If this remains in its storage position, an alarm is triggered at the end of a time delay (settable value). This alarm is automatically acknowledged when the slide is removed from its storage position.

Commands available in AUTOMATIC mode

- PBB interior lighting

k. Emergency stop function

The emergency stop is active whatever the operating mode of the PBB is. Pressing an emergency stop button triggers the immediate stopping of the PBB, with the exception of the safety lowering cycle, which shall remain operational.

Resetting an emergency stop requires technician intervention, which is carried out from:
- the "FAULT ACKNOWLEDGEMENT" push button inside the control/command cabinet, or
- the "RESET" push button on the mobile maintenance unit

Procedure to return the PBB to service

- Put the PBB in STOP mode
- Unlock the emergency stop locally
- Reset the fault
- Return to the operating mode preceding the fault

20. Operation of main PBB sub-assemblies

a. Running Gear / wheel bogie

The running gear / wheel bogie movement commands are operated from the control desk joystick. The joystick is fitted with a “dead man” safety handle.

When the running gear is moving, the exterior siren sounds to warn operators present in the PBB movement zone.

General conditions authorizing the running gear run command

- The PBB is in MANUAL mode
- The running gear has no faults (transmission, brake fault, etc.)
- Network voltage presence (Normal network)
- No emergency stop has been triggered
- The running gear protection edge sensors are not activated
- No over-travel is activated or the safety bypass is activated
- No obstacle contact detection safety device is operated (roller profile sensors, aircraft wing contact) or the safety bypass is activated
- The brakes are not manually released
- The cabin front door is closed or the PBB is very close to the aircraft (less than 10 cm)
- The PCA connectors are not connected or the PBB is unlocked
- The unconnected PCA hoses are not completely unrolled
- The maintenance unit is not connected
- The joystick “dead man” handle is pressed down

Running gear special stopping conditions according to requested movement

- Anti-collision stopping is activated (possible to move in reverse direction)
- The PBB has reached a limit position (extension/retraction, rotunda rotation, running gear rotation) possible to move in reverse direction
- The cabin floor makes contact with the aircraft fuselage during an extension movement (PBB retraction is possible)
- Obstacle presence detected (jet engine presence, aircraft wing lateral presence, adjacent PBB lateral presence) is activated (possible to move in reverse direction to avoid the obstacle)
Conditions leading to switching the running gear to slow speed:

- The cabin is located at a distance less than approx. 1.5 m from the aircraft fuselage
- The PBB is close to the extension/retraction limit position, rotunda left/right rotation and low/high slope
- The PBB enters the collision risk zone (slow zone)
- A PCA connector is connected and the other unconnected PCA connectors are rolled and the PBB is unlocked and a movement is carried out
- The safety bypass is activated and a movement is carried out

The running gear commands are made using the maintenance unit (refer to MAINTENANCE2 mode)

b. Elevation unit (in manual mode)
The elevation unit/gantry is controlled by the operator in MANUAL mode or automatically when the PBB is in auto-levelling.

Elevation unit/gantry movement commands are made using the two “raise/lower” push buttons of control desk. The automatic controller shall schedule interlocking in programmed logic in case of simultaneous pressure on the two buttons.

Elevation may also be triggered using the operator terminal if vertical pre-positioning is selected. In this case, the operator selects the type of aircraft from amongst a pre-defined list, the elevation unit/gantry moves automatically to the corresponding height. The operator shall be able to interrupt the vertical pre-positioning cycle at any moment and re-take manual control by pressing one of the two push buttons push buttons. To avoid any damage, the vertical pre-positioning cycle may only be triggered if the PBB is too close to the aircraft fuselage (the PBB shall not detect aircraft presence).

When the elevation unit/gantry is moving, the exterior siren sounds to warn the operators present in the PBB movement zone.

General conditions authorizing elevation gantry movement command (in MANUAL mode)

- The PBB is in MANUAL mode
- The hydraulic pump is not faulty (motor disconnection, oil level ok, no filter clogging...)
- Auto-levelling safety network presence
- No emergency stop has been triggered
- The running gear protection edge sensors are not activated
- No over-travel is operated or the safety bypass is activated
- No obstacle in contact detection safety device is operated (roller profile sensors, aircraft wing contact) or the safety bypass is operated
- The cabin floor is not in contact with the aircraft
- The canopy is not pressed against the aircraft fuselage
- The cabin front door is closed or the PBB is very close to the aircraft (< 10 cm)

The maintenance unit is not connected

Special stopping conditions of the elevation gantry according to the requested movement

- The high (low) position limit of the gantry is reached during an elevation (descent) movement
- The high (low) slope limit sensor is activated during an elevation (descent) movement
- The PBB has reached its retraction (extension) limit position during an elevation (descent) movement

An under PBB obstacle detection (e.g. aircraft wing presence) is activated during a descent movement (possibility to perform elevation movement to avoid the obstacle).

c. Elevation unit (in automatic mode)
In AUTOMATIC mode, the elevation gantry is controlled by the PBB automatic controller. This receives the relative cabin/aircraft height variations and compensates for these differences by directly operating the elevation system motorization to maintain a constant height between the cabin threshold and the door of the aircraft.

General conditions authorizing auto-levelling cycle start
• The PBB is in AUTOMATIC mode
• The hydraulic pump is not faulty (motor disconnection, oil level ok, no filter clogging)
• Auto-levelling safety network presence
• No emergency stop has been triggered
• No over-travel is operated
• No obstacle in contact detection safety device is operated (roller profile sensors, aircraft wing contact)
• There is no auto-levelling fault (*)
• The auto-levelling arm is in contact with the aircraft fuselage
• The safety lowering system (with safety shoe) is positioned under the door of the aircraft
• The safety lowering system (safety shoe) is not faulty and it is not activated
• A significant difference (greater than 25mm) is detected by the automatic controller

(*) An auto-levelling fault encompasses:
• Auto-levelling arm fault (arm motor disconnection, sensor fault)
• The auto-levelling cycle duration is too long (greater than 5 seconds
• The auto-levelling distance to correct is too large (greater than 50mm)

Special stopping conditions of the auto-levelling cycle according to movement
Identical to those of the elevating columns gantry in MANUAL mode

d. Auto-levelling arm
General conditions authorizing auto-levelling arm operation
• The auto-levelling arm is not faulty (motor disconnection, coder fault)
• Auto-levelling safety network presence
• No emergency stop has been triggered
• No over-travel is operated or the safety bypass is activated
• No obstacle contact detection safety device is operated (roller profile sensors, aircraft wing contact ...)
  or the safety bypass is activated

Conditions triggering output of the auto-levelling arm
• PBB switching from MANUAL to AUTOMATIC mode, or
• The PBB is in AUTOMATIC and a safety lowering cycle has finished (the arm goes out again automatically), or
• The PBB is in MAINTENANCE mode and an arm output command is triggered from the operator terminal

Conditions triggering re-entry of the auto-levelling arm
• PBB switching from AUTOMATIC to MANUAL mode, or
• The PBB is in AUTOMATIC mode and a safety lowering is activated, or
• The PBB is in MAINTENANCE mode and arm re-entry is triggered from the operator terminal

e. Safety lowering
The safety lowering (or rapid descent) is only operational in AUTOMATIC mode, and independently of PLC operation. Its function is to offset any levelling system insufficiencies or failures, notably in the case of rapid descent from the aircraft. Its operation shall be safe and entirely independent from the automatic levelling system. The safety lowering is operational even in the case of an emergency stop.

This device comprises a sensitive sensor (safety shoe), positioned by the operator under the door of the aircraft at each docking. When the slide is activated, it acts directly on control of the elevation system descent, which is powered by an uninterruptable quality network. At each pulse on the slide, the PBB descends at rapid speed with travel between 200 and 400 mm. An visual and audible alarm is activated during safety lowering. A brief pulse on the slide shall not trigger a rapid descent cycle.

The “working” position corresponds to placing of the slide under the door of the aircraft. The “idle” position corresponds to storage of the slide in a specific store (inside the cabin, against the control desk).
Conditions triggering safety lowering system
- The PBB is in AUTOMATIC mode
- The safety lowering system (with safety shoe) is not faulty (*)
- The safety shoe is positioned under the door of the aircraft (it does not remain in its storage position)
- The safety shoe is activated
- No limit is reached. This concerns the following limits:
  - Low position limit,
  - Low slope limit,
  - Extension and retraction limits

(*) A safety lowering system (with safety shoe) fault encompasses:
- The sensitive sensor has a short circuit,
- The sensitive sensor has an open circuit (rupture
- The shoe is operated for too long a time (greater than 5 seconds)
- The shoe is operated more than 3 times consecutively

f. Bridgehead
The cabin rotation commands are performed from the two “right/left” push buttons of the control desk. The automatic controller shall schedule inter-locking by programmed logic in case the two buttons are pressed simultaneously.

General conditions authorizing the cabin rotation command
- The PBB is in MANUAL mode
- The cabin is not faulty (motor disconnection...)
- Normal voltage presence (Normal network)
- No emergency stop has been triggered
- The running gear protection edge sensors are not activated
- No over-travel is operated or the safety bypass is activated
- No obstacle contact detection safety device is operated (roller profile sensors, aircraft wing contact ...) or the safety bypass is activated
- The central "aircraft contact" sensor is not activated
- The cabin front door is closed or the PBB is very close to the aircraft (<10 cm)
- The maintenance unit is not connected

Special stopping conditions of the cabin according to the requested movement
- The cabin right (left) rotation limit sensor is activated for a cabin rotation to the right (left), or
- The right (left) “aircraft contact” sensor is activated for a cabin rotation to the left (right), or
- Anti-collision stopping is activated (possibility to turn the cabin in the other direction), or
- An obstacle presence detection (e.g. aircraft wing proximity) is activated (possibility to turn the cabin in the other direction)

g. Canopy
The canopy extension/fold-back commands are controlled by two “retract / open” push buttons on the control desk. The automatic controller shall schedule inter-locking by programmed logic if the two buttons are pressed simultaneously.

General conditions authorizing canopy manual commands
- The PBB is in MANUAL mode
- The canopy is not faulty (motor disconnection)
- Normal network voltage presence
- No emergency stop has been triggered
- The running gear protection edge sensors are not activated
- No over-travel is operated or the safety bypass is activated
• No obstacle detection safety device is operated (roller profile sensors, aircraft wing contact, aircraft jet sensor) or the safety bypass is activated
• The maintenance unit is not connected

Conditions triggering automatic canopy opening
• Switching the PBB from MANUAL to AUTOMATIC mode and the canopy is not yet pressed against the aircraft fuselage, or
• The PBB is in AUTOMATIC and a safety lowering cycle has finished (the canopy opens again automatically)

Conditions triggering automatic canopy retraction
• Switching the PBB from MANUAL to STOP mode and the canopy is not yet completely folded back, or
• The PBB is in AUTOMATIC mode and a safety lowering is activated

h. Tunnel lighting
Next to the automatic light motion sensor the PBB tunnel lighting command is, next to the automatic sensor mode, controlled by two push buttons, one installed in or close to the rotunda, the other one integrated in the control desk, in the bridge head.
Operation of one of the two push buttons switches on the PBB interior lighting (normal lighting only), whatever the PBB mode. Once lit, a new operation on one of the two push buttons shall not switch off the lighting.
Gallery lighting switches off automatically when the PBB is in STANDBY STOP mode.

i. Exterior lighting
The exterior lighting command is controlled from the selector integrated in the control desk.
This command is only valid in MANUAL mode. In all other modes, the exterior lighting is switched on and off automatically.

21. PCA System interface
The supplier / manufacturer shall design the PBB in such a way as to enable the inclusion by a third part of PCA devices which has to be mounted under the moving and fixed part of the PBB system both during and after assembly. The supplier / manufacturer has to take in to account the following:
• Fixed and Telescopic ducts (simplified technical specifications):
  o Perform a layout study for the PCA equipment under the PBB and verify that the PCA equipment can co-exist under the same PBB
  o Outer diameters range between 340mm and 600mm.
  o Foreseen with inner polyurethane foam insulation
  o Telescopic ducts are equipped with a roller system appropriate for extremely heavy use in industrial environments
The fixed telescopic ducts have to be mounted under the fixed bridges of the PBB installation. The telescopic ducts have to be mounted under the telescopic two or three tunnel sections.
• Where a PCA unit is located under the PBB, there shall be at least 500mm safety distance between the PCA unit and the PBB in its lowest retracted maintenance position. If needed, a mechanical lock shall be set to prevent any collision. The PCA unit has 2,28m height.
• PCA Hose Management System (simplified technical specifications):
  o Dimensions (mm):
    o Length approx.: 6.000 / L c/w 27 m hose length x 950 W x 650 H
    o Weight approx.: 300 / 500kg including hose and aircraft adaptor
    o 27 m hose length - system on request
    o Electrical:
      o Power: 3ph, 400V, 50 Hz (other options available)
      o Electromechanical System
      o Variable frequency drive for power transmission
PCA hose management system has to be mounted under the PBB bridgehead.

- Interfaces with Aircraft Preconditioned air - PCA Equipment. The PBB work package shall be responsible for:
  - Schedule factory welded supports under the PBB tunnels as well as on the rotunda columns for flexible and rigid pipes,
  - Schedule factory supports for pipe rollers under the PBB tunnels,
  - Schedule support plates + protection elements for hosting pipe roller control boxes on the PBB running gear,
  - Schedule in factory positioning of power cables (pipe roller power supplies, etc.) and light currents (running gear control box, PBB PLC interfaces, inter-locking) in the cable chains,
  - Schedule in factory the positioning of PCA control box at the wheel bogie of the PBB,
  - The view of the operational camera’s showing the wheel bogie shall not be obstructed by PCA equipment.

- Take the following modifications into account in the PBB automatic controller:
  - Inter-locking with the PBB,
  - The possibility of unlocking the PBB with movement at slow speed when the pipes are connected to the aircraft, via use of the existing orange "unlocking" illuminated pushbutton on the desk,
  - Integrate in the operator terminal images, status and fault information for the PCA equipment.

- A portable thermostat registers aircraft cabin temperatures. The cable and thermostat with bracket to be provided by supplier PCA system. The thermostat control cable shall be connected to a terminal box at the Concourse/Pier E apron level.
  - The thermostat to be installed outside the PBB cabin by the PBB supplier. The cable to be installed by the PBB supplier, from the Concourse/Pier E crawl space connection box to the bridge cabin location with sufficient length. On both sides the cable to be connected by supplier PCA.
  - The control system of the Passenger Boarding Bridge shall interface with the PCA thermostat holder. The thermostat holder to be fitted with a position switch or proximity detector, to sense the position of the thermostat. This volt-free contact to be interlocked with the control PLC of the PBB. Activation of PBB control panel shall not have any response on horizontal bridge movement when the PCA thermostat is not positioned in its holder. This is to prevent the movement of the PBB when the thermostat is still deployed in the aircraft.
  - The PBB supplier will ensure that the PCA systems, including telescopic ducts, do not interfere with the operational maneuvering of the bridge and do not and do not create interference for connecting all types of aircrafts.
  - The PBB supplier will ensure that the PCA systems, including telescopic ducts, do not create interference to perform any maintenance operation.

Note:
Do not schedule integration of PCA emergency stops in the emergency stop chain the PBB. If the PCA control box installed at the leg of the PBB running gear has an emergency stop button, this may be reallocated to sequence stop (yellow or black color).

22. Additional Interfaces

The PBB Manufacturer shall make provision for the following interfaces. The point of interface for communication items will be a suitably labeled junction box located adjacent to the connection to the terminal node. The junction boxes shall be located under the fixed bridge and shall be readily accessible.

- Fire alarm / Public Address
- Telephone
- Two spares (for future EMS)
- Each PBB System shall operate on 400V 3 phase 50 Hz 4 wire, 100 Amp service for the PBB main supply, motors activators. Lighting and controls shall be by transformation by PBB equipment.
- Intercom system
- Operational signage shall be in Hebrew and English. Signage shall include a sign at the operator’s position indicating the Gate Number and Bridge Letter (at two bridge gates)...
- Modulating and fire/smoke damper mounting, control, power and distribution.
- Bridge cooling and ventilation control.
- Condensate drainage connection.
- Mains power connection points to various equipment items.
- Where shown, provision to be made for attachment of VGDS units to fixed bridge and installation of cables from VGDS local distribution panel to each VDGS unit. Location, loadings and fixings to be determined in consultation with VDGs supplier.
- At the drive unit shall be sufficient space to accommodate operating panels for the PCA system and a VDGs operating panel.

Note:
The PBB Manufacturer shall coordinate with the work of other Sections of these Specifications and other suppliers to establish the exact requirements for the above items.

23. Additional Items
The PBB Manufacturer shall provide within this contract the following additional items:
- Two (2) Towing Bars that attaches to tow-lugs on the lower drive column and can be used to pull the PBB on the apron in the event of a horizontal drive unit failure.
- One (1) each Hydraulic Jack, Manual Hydraulic Pump and Wheel Assembly Bar.
- Handling Accessories, tools and lifting equipment for installing and dismantling the Passenger Boarding Bridges including a jacking stand for maintenance work including tire changes.
- One (1) battery pack on a towable trolley to connect to the wheel bogie for emergency back-up during a power disruption.
- Two (2) sets of any unique tools, required for maintenance of the PBB shall be provided by the manufacturer as part of the contract.
- Two (2) hand held remote control units, which may be connected to a plug at the wheel bogie.
- An option shall be given for a practice dummy to practice PBB operations.

24. Name and Instruction Plates
- All name and instruction plates shall be Resopal hpl plated or stainless steel with the information engraved, stamped or etched thereon.
- Plates shall be attached with non-corrosive screws, bolts or rivets. All plates shall be mounted in a conspicuous place. As an alternate, information required in name and instruction plates can be engraved on the part.
- Each control or component part, which necessitates actuation or identification of any special or important procedures to be followed in operating or servicing of the equipment, shall be provided with a plate showing all necessary guide information in Hebrew and English language.
- These instruction plates shall include warnings and cautions and be so located and of sufficient size to be effective for the intended use.

- The nameplate of each PBB shall be provided with a unique installation number, which will remain linked to that particular PBB. In accordance with the most recent version of the Machinery Directive, the PBB shall be marked visibly, legibly and indelibly in English with the following particulars:
  o The business name and full address of the manufacturer and, where applicable, his authorized representative
  o Designation of the machinery
  o CE marking
  o Designation of series or type
  o Serial number, if any
  o Year of construction, i.e. the year in which the manufacturing process is completed
Special Specification for Airside

○ Maximum load on the floor and roof
○ Maximum number of people inside the PBB
○ Weight of the PBB
○ Maximum wind speeds for use
○ Maximum and minimum reach of the PBB

- In addition, each important component (such as engines, safety devices, switches and switch and distribution boxes) shall bear a visible, legible and inedible indication of its function and/or installation code.

Part 3. Execution

1. **Delivery, Storage, Handling and Installation**
   a. PBB installation shall be based on the PBB manufacturer’s approved submittal on installation and safety,
   b. Deliver PBB with protective covering to prevent exposure of interior to weather, dirt and construction debris.
   c. Store PBB on site in area designated by IAA and protect interior from weather, sand, dirt, water, chemical and mechanical injury and construction debris. Protect bearings and couplings against damage from sand grit and other foreign matters.
   d. Pipe and hose openings shall be closed with caps or plugs during installation upon completion of all work and prior to the acceptance of each module, the materials and equipment shall be thoroughly cleaned, adjusted and operated.
   e. Handle PBB according to manufacturer’s rigging and installation instructions (part of installation and safety submittal) for unloading, transporting and setting in final position.
   f. Extra caution shall be taken when loading, shipping and unloading of the PBB’s to prevent dents, scrapes or damages to the PBB and its components. Any damage to the PBB or components shall be documented on a damage report form with digital photos included.
   g. Do not install Passenger boarding Bridge components and materials that are wet, corroded, moisture damaged or mold damaged.
   h. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit. Passenger Boarding Bridge field erection to be performed according to manufacturer’s written instructions and warranty requirements.
   i. Install PBB and related systems in accordance with the design requirements in these specifications and the drawings
   j. Each PBB shall be demonstrated to the IAA to assure that its operation is in conformance with the contract documents. Demonstration of PBB shall be carried out by the Contractor prior to the PBB being placed in passenger service.
   k. Thoroughly clean PBB both interior and exterior before final acceptance by IAA. Touchup/repair any visibly damaged exterior and interior finishes and surfaces.
   l. The Manufacturer / Contractor shall be responsible for any damage, as a result of his work, to buildings and other equipment in the areas in which his work is performed. Damaged equipment shall be either repaired or replaced. Repairs required shall be made by mechanics skilled in the respective trades.

2. **Examination**
   a. The contractor to examine areas and conditions for compliance with requirements for maximum moisture content, access routes and clearances, installation tolerances and other conditions affecting performance of the Works.
   b. Examine all components before installation. Ensure any components that are moisture damaged, mold damaged and dust contaminated or in any way deteriorated are replaced prior to installation.
   c. Examine pathway elements intended for cables. Cable trays and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation.
3. Site Erection

a. The Manufacturer / Contractor shall furnish all plant, labor, material, equipment and services necessary to supply the PBB complete and in operative condition.

b. The work shall include, but not be limited to, preparation of shop drawings, fabrication, transportation, assembly and installation of the modules, electrical wiring, power connections and control devices, testing, adjustments, provision of operating and maintenance manuals and supply of initial spares.

c. All work shall be performed in accordance with these specifications with related sections and drawings, to the full satisfaction of the IAA.

d. During the installation the Contractor shall make appropriate mobile crane assistance available.

e. As erection progresses, the work shall be securely braced to maintain the structures in a stable position.

f. The Manufacturer / Contractor shall be responsible for field erection that basically consists of receiving and unloading the PBB components at the erection site, storing of the parts prior to their erection, erection of the machines and PBB components and adjusting of all parts ready for start-up, testing and delivery of the equipment to the IAA.

g. Before any shipment to the site, the Manufacturer / Contractor shall make inquiries on the condition of the storage and erection area and shall take note of the local safety rules and other regulations. An inspection report shall be submitted to the IAA or Engineer, including defects (if any) in structure, levels or foundations affecting the equipment or the installation thereof.

h. Installation of the PBBs shall begin after completion of the apron surface and the foundations for the support of the PBBs.

i. Within two weeks after the last PBB has been accepted, the Manufacturer / Contractor shall clean up the area used for storage and erection.

j. Manufacturer / Contractor to provide sufficient number of qualified manpower lead by a Project Manager, supported by engineers to receive, coordinate and supervise the installation of the PBB and related equipment at site. The Manufacturer / Contractor to appoint a representative at the erection site responsible for all the work done by the Manufacturer / Contractor and his Sub-contractors.

k. The Manufacturer / Contractor shall submit to the IAA an erection schedule consisting of a milestone chart covering all work prior to the start of the site preparation.

4. Progress of Manufacture and Equipment Delivery

a. The Manufacturer / Contractor shall keep the IAA informed of the progress of manufacturing throughout the duration of the Contract when - and in as much as - he deviates from his proposed and approved schedule.

b. The Manufacturer / Contractor shall notify the IAA three weeks in advance, in writing, as to when the equipment shall be ready for inspection and acceptance.

c. Delivery of equipment shall be scheduled by the Manufacturer / Contractor to suit building progress. The work shall be so organized that installation will proceed on a smooth continuing basis and in proper sequence to the completion of the installation.

d. The Manufacturer / Contractor shall coordinate the delivery schedule with the construction schedule to minimize required on-site storage space.

e. All goods to be shipped to the site shall be properly marked. Electric equipment in particular shall be packed expertly in order to protect it against damage during transport, handling and storage at site.

5. Storage and Protection of Material and Equipment

a. PBB components and equipment shall be covered and protected against damage from sand, dirt, water, chemical and mechanical injury and weather effects. Protect bearings and couplings against damage from sand grit and other foreign matters.

b. Pipe and hose openings shall be closed with caps or plugs during installation upon completion of all work and prior to the acceptance of each module, the materials and equipment shall be thoroughly cleaned, adjusted and operated.
c. The Manufacturer / Contractor shall be responsible for the proper protection and handling of all the equipment, materials and accessories during shipping, storage and construction. Retain shipping flange protective covers and protective coating during storage.
d. The Manufacturer / Contractor shall be responsible for any damage, as a result of his work, to buildings and other equipment in the areas in which his work is performed. Damaged equipment shall be either repaired or replaced. Repairs required shall be made by mechanics skilled in the respective trades.

6. Parts Supply, Purchase Contract and Inventory
a. A priced recommended spare parts list shall be provided by the manufacturer. The IAA takes into account a quantity of 5% for replaceable parts, with a minimum of three items.
b. The following list includes items to be provided with the amount that exceeds from the specified in paragraph 6 (a):

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canopy</td>
<td>1</td>
</tr>
<tr>
<td>Solid Wheels</td>
<td>4</td>
</tr>
<tr>
<td>Hydraulic Piston (for elevation system)</td>
<td>2 of each type</td>
</tr>
<tr>
<td>Service PBB access Door</td>
<td>1</td>
</tr>
<tr>
<td>Aircraft access Door</td>
<td>1</td>
</tr>
<tr>
<td>Safety Hoop (see Part 1 12(c))</td>
<td>1</td>
</tr>
</tbody>
</table>

c. A two year (after OMP) supply of Spare Parts shall be provided under this Contract.
d. In addition to the spare part provided under this Contract, an additional ten-year contract for purchase of spare parts shall be included, without obligation on the part of the IAA as to the volume of parts to be purchased. Maintenance Manuals shall provide a list of recommended spare parts, including unit prices, delivery time and general terms and conditions for each type of PBB installed.
e. Provide a list of all special tools and equipment necessary for adjustment, testing, maintenance, and repair of each type of PBB.
f. The manufacturer shall advise on storage conditions of the spare parts.
g. The contact details of the nearest supplier (preferably an Israeli supplier) shall be given for third party equipment.
h. All stock shall be maintained by the PBB manufacturer for a period of fifteen years after the last production of the PBB model purchased by the IAA. Any item that is not normally on the shelf or is a long lead time item shall be identified in the spare parts book with estimated time from order to delivery.
i. Service bulletins shall be provided to the IAA on modifications and improvements available for the PBB.

7. Manuals and Training
b. Operation and Maintenance Manuals and Parts Lists shall have content, and be in a format, approved by the IAA. Assembly drawings/diagrams, preventive maintenance requirements and problem solving procedures shall be included in the manuals. Manuals shall be provided in both Hebrew and English. Provide copy of the PLC operating system (both hard copy and electronic copy on CD) to the IAA.
c. Furnish ten (10) Operation and Maintenance Manuals and a CD-ROM of each manual. Manuals shall be provided in appropriate protection for extremely heavy use in industrial environments, durable binders with permanent index tabs dividing the various sections. Manuals shall be labeled and customized for each PBB model included. All content shall be covered in both Hebrew and English.
d. Operation and Maintenance Manuals:
Operation and Maintenance manuals for each type of product and / or component under this section. The O&M manual shall provide information necessary to perform installation, test, operation, adjustment, alignment, repair, parts replacement and calibration. All information shall accurately represent the system, equipment or function described. O&M manual shall include the following but is not limited to:

- A full description of work and function of each part of the PBB, the operation and the mechanical, electrical and hydraulic equipment.
- Diagrams of control systems, electrical circuits, hydraulic systems.
- Schedules of operating data, speeds, pressures and voltages.
- Authorities' approvals and certificates, including software licenses.
- List of compliance from manufacturer.
- Declaration of installation in accordance with specified requirements.
- Potential safety risks and the associated precautions and standard safety measures incorporated into the product.
- Inspection instructions including schedules for each system and component.
- Step by step procedures for preventive maintenance and standard inspections including schedules and maintenance record forms for each system and components.
- A schedule for periodic adjustments, lubrication and replacement of expendable parts.
- Systematic fault finding instructions.
- Recommended test and calibration equipment and other special tools.
- List of spare parts recommended for five (5) years maintenance and special tools, including parts identification.
- Cross-reference between the drawings and the recommended spare parts list to enable parts to be identified.
- Troubleshooting information and detailed step by step operating instructions under emergency conditions such as mechanical or electrical failure.
- List of manufacturers and suppliers.
- Drawing book.

Training Schedules:

- The training shall be given by instructors, who are skilled and qualified enough with all relevant technical and professional aspects.
- A training program shall be developed to give the operating personnel thorough knowledge, required for operation and familiarization with the functioning of the PBB in practice. The operators training will take place on site and the costs shall be included in Manufacturer / Contractor bid. The training shall take place in the English language. After the operators have successfully passed the test, a certificate will be issued. The Training shall also include a "train the trainer" qualification and certification for five (5) IAA employees.
- A training program shall be developed to give the maintenance personnel thorough knowledge, required for adequately maintaining the PBB in all aspects. The training shall be held out for IAA’s designated Electrical and Mechanical engineers which are involved with the PBB maintenance. The training shall include all aspects of PBB electrical supply and control systems, hardware, software, hydraulic system, mechanical components, assembly and disassembly, HVAC and all other aspects and procedures of maintenance, safety and trouble-shooting. Additional assembly and disassembly training shall be offered at the Manufacturer’s plant location. The training curriculums shall be set by the IAA in consultation with the Contractor. After the maintenance staff successfully has passed a test, a certificate shall be issued. The IAA shall be entitled to define different curriculums for every group of trainees.
- Additional training (Option):
  - The supplier submits a proposal for additional training, which will be priced on the basis of training day up to 5 trainees, at the Manufacturer’s plant location, up to 5 consecutive days. The training curriculums shall be set by the IAA in consultation with the Contractor.
In addition, the supplier submits a proposal for additional training, which will be priced on the basis of training day up to 10 trainees, at Ben-Gurion Airport, up to 5 consecutive days. The training curriculums shall be set by the IAA in consultation with the Contractor.

f. The Manufacturer / Contractor shall provide for three months after the date on the Certificate of Acceptance the services of a skilled technician, resident on site, who shall be competent to attend any fault which may develop and to carry out such adjustments, rectifications and replacements as may be required to keep the PBBs in working order.

g. Provide a proposal to the IAA for PC Simulator Training.

8. Documentation

a. The manufacturer shall prepare all drawings and computations. Metric dimensions shall be required on all drawings.

b. Each submittal shall clearly indicate the Contract Drawing Number or Specification Section used as reference. Each submittal shall be properly referenced with the project name, submittal contents and a unique number. The sequence of submission of the drawings shall be such that all information is available for checking each drawing when it is received.

c. Within 60 days after award of the Contract, the Manufacturer / Contractor shall submit for approval by the IAA four copies of the general drawings, data and samples of the PBB modules to be furnished and installed. The drawings shall show in sufficient detail all features of the PBBs and their operating equipment. Dimensions, clearances, performance and other characteristics shall be clearly indicated. Control and safety devices shall be shown, identified and located.

d. Any work done prior to the approval of shop drawings shall be at Manufacturer / Contractor risk. The IAA shall have the right to request any additional details and to require the Manufacturer / Contractor to make any changes in the work, which are necessary to conform to the provisions of the Contract Documents.

e. The approval of the drawings by the IAA shall not be construed as a complete check, but will indicate only that the general method of construction and detailing is satisfactory. Approval by the IAA shall not relieve the Manufacturer / Contractor of the obligation to meet these Specifications, or of the responsibility for the correctness of the drawings, or for correct fit of assembled parts in final position, or in general for the adequacy of the equipment furnished.

f. If revisions are made after a drawing has been approved, the Manufacturer / Contractor shall furnish for approval-revised copies as specified for the initial submission, subsequent to each revision.

g. Samples:

- Submit Samples for review of kind, color, pattern and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.

- The Contractor shall submit three samples of materials as required by the IAA or its representative for approval. Material samples to be at least 9 x 12 centimeters and representative of the material finish and color to be used. All samples to be submitted as an official submittal including technical specification of the suggested material/equipment. All samples to be submitted and approved prior to the mockup phase (FAT). The samples shall include, but are not limited to:
  - Flooring finishing material (for PBB and stairs);
  - Ceiling materials;
  - Lighting fixtures;
  - Exposed HVAC grills and exposed system accessories;
  - Wall cladding interior and exterior;
  - Painted steel for handrails;
  - Glass;
  - Aluminum parts;
  - Doors and hardware;
  - Signs;
  - Etcetera.
• Transmit Samples that contain multiple, related components such as accessories together in one submittal package.

• Identification: Attach label on unexposed side of Sample that includes the following:
  o Generic description of sample.
  o Product name and name of manufacturer.
  o Sample source.
  o Number and title of applicable specification section.
  o Technical specification of material components / composite materials.

• Disposition: maintain sets of approved Samples at Project site, available for quality control comparison throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
  o Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples shall be in an undamaged condition at time of use.
  o Samples not incorporated into the Work or otherwise designated as IAA’s property, are the property of Contractor.

h. Samples for Initial Selection:
  For each type of product specified in this section, submit manufacturer’s color charts of units or sections of units, showing the full range of colors, textures and patterns available.
  • Number of Samples: Submit one (1) full set of available choices where color, pattern, texture or similar characteristics are required to be selected from manufacturer’s product line. IAA, through Engineer will return submittal with options selected. Include similar Samples of PBB joints and accessories involving color selection.

i. Samples for Verification:
  For each type of product specified in this section, submit Samples of size indicated, prepared from same material to be used for the work, cured and finished on manner specified, and physically identical with material or product proposed for use and that show full range of color and texture variations expected. Samples include but are not limited to the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture and pattern; color range sets and components used for independent testing and inspection:
  • Number of samples: Submit three (3) sets of Samples. IAA or its representative will retain two (2) Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a Project record Sample.
  • Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation and other similar characteristics are to be demonstrated.
  • If variation on color, pattern, texture or other characteristic is inherent in material or product represented by Sample, submit at least three (3) sets of paired units that show approximate limits of variations.

h. Qualification Data:
  For qualified manufacturer, include list of completed projects of similar size and technical intricacy. The manufacturer shall demonstrate the reliability of their PBB by providing figures on MTBF (Mean Time Between Failures) and MTTR (Mean Time To Repair) from installations at International Airports. The calculations shall be based on the worst environmental conditions.

i. Design Approach:
  In designing the systems, it is desired to standardize all hardware and operating systems in order to facilitate long-term maintenance of the systems. However, the Contractor may propose an alternative solution to any of the design requirements. These alternatives shall be clearly delineated and shall be bid as options, in addition to the base design. Preference shall be given to vendor solutions which best integrate into the overall system design.

j. Interface Control Document (ICD):
  The Interface between the PBB and other systems shall be specified in detail in a so-called Interface Control Document (ICD) for each such interface. Each ICD need to be approved in writing by the Contractor and the other party, involved in the realization of the interface. The ICD is to include protocol descriptions and example data.

k. Seismic Qualification Certificates:
For PBB, accessories and components, from manufacturer:

- Basis for Certification: Indicate whether seismic withstand certification is based on actual test of assembled components or on calculation.
- Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
- Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1. Plans and procedures:
The manufacturer shall provide the following plans and procedures for approval by the IAA:

   - Factory Testing Procedure
   - Staging and Installation Plan
   - Installation Safety Plan
   - Operational Testing Plan
   - Commissioning Procedures

2. Shop Drawings:
For each type of product specified in this section, submit complete and detailed project-specific information, drawn accurately to scale. Do not base shop drawings on reproductions of the Contract documents or standard printed data. Include plans, elevations, sections, details and attachments to other works. Shop drawings for manufactured material and equipment shall include model numbers, dimensioned drawings, operating weights, material specifications, operating features and controls, wiring diagrams, performance characteristics, service procedures, including clearance requirements for maintenance work, and conformance to specified codes and code ratings. Note that in addition to these requirements, other specific submittal data, and forms of data submission, are required by the Contract Documents for particular items of equipment and material.

Shop drawings will include the following information:

- Detailed equipment assemblies and indicate dimensions, weights, loads, required clearances, service areas, method of field assembly, components and location and size of each field connection.
- Wiring diagrams detailed wiring for power, signals and control systems and differentiate between manufacturer-installed and field-installed wiring.
- Construction details.
- Finishes detailing; in plans, ceiling plans, sections, exterior and interior elevations and details.
- Connection details between the PBB and the gate nodes of the building according to the architectural plans and details (architectural drawings X-A64 and architectural details X-A93.147, X-A93.147A, X-A93.149, X-A91.262).
- No fabrication and/or assembly of any of the PBB components shall begin until the shop drawings for these components have been reviewed and approved by the IAA or its representative. Additional shop drawings shall be submitted if necessary to fully describe a PBB to be delivered and insure proper interface with the external surroundings.
- The work described in any Shop Drawing submission shall be carefully checked for clearances (including those required for maintenance and servicing), site conditions, maintenance or architectural and structural requirements and proper coordination with all other trades.

3. Coordination Drawings:
Drawings indicating location of equipment in relation to the PBB, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

- Electrical Systems, including UPS.
- Building Management System.
- Visual Docking Guidance System.
- Telephone System.
- Fire Alarm Systems.
- Public Address Systems
- HVAC System (air-conditioning-units).
- Video Surveillance System.
- Security Access Control System.
- 400 Hz equipment.
• PCA equipment.
• Fuel hydrants.
• Structural.
• Other relevant services into this section for interface and coordination in design and works.

o. Installation Drawings:
• The Bridge Manufacturer shall produce Builders Work Drawings showing all bases, holes, openings, chases and other builders work requirements associated with his package of works.
• In the event of any builders work being omitted, carried out incorrectly, or out of sequence, due to inaccuracies in the builders work drawings or because they have not been provided in accordance with the agreed program, the Bridge Manufacturer shall be held responsible for the cost of all necessary remedial works.

p. "As built" Drawings:
• After completion of the installation of the PBBs, the Manufacturer / Contractor shall supply one transparency and three prints of each of the approved "as built" drawings, consisting at least of:
  o General assembly drawing, showing principal dimensions and components.
  o All electrical, mechanical and hydraulic diagrams referred to in the maintenance instructions.
  o Assembly drawings necessary for dismantling, repairing and relocating of the PBBs.
• Above "as built" drawings shall be furnished to the IAA within one (1) month of the handover date.

9. Testing and Commissioning

a. The PBB system manufacturer shall allow for testing and demonstration of each of the systems described within the Products Section of this Specification, together with commissioning and setting to work of the equipment.

b. A commissioning consultant may be appointed to witness the PBB system manufacturer’s commissioning. The PBB system manufacturer shall allow for coordinating with him and providing all necessary attendance upon the consultant.

c. Provide all labor, material, instruments, supplies, services and temporary equipment and bear all costs for the tests herein specified. Any and all defects appearing during the tests shall be corrected, and the test repeated as required to remedy any defects disclosed. Leave the equipment clean and ready for use.

d. Perform any tests other than those specified which may be required by the local authorities, statutory agencies, and the Standards and Codes of Practice to whose requirements this work is to conform.

e. Quality control and testing Results for all Systems

  • Quality Control Manual: Manufacturer / Contractor to prepare a quality control manual (in accordance with ISO 9001:2015) acceptable to IAA. Manual to indicate inspection list and methods to be utilized for quality control inspection and testing in order to confirm compliance as specified.
  
  • Manufacturer / Contractor to appoint a Quality Assurance Representative acceptable to IAA to be responsible for the overall quality assurance implementation and monitoring of the general requirements. The quality assurance representative to be available on-site during the construction period at all times and be qualified to advise IAA on the overall scope of work (i.e., installation / removal procedures, refurbishing, provisioning, start-up and maintenance of the equipment).

f. Inspections and tests

  • IAA has the right to visit the Manufacturer’s production facilities to inspect the build quality of the products. Upon request the Manufacturer / Contractor is to inform the IAA where and when which products are produced. The IAA to be notified 2 weeks in advance of completion of the first production model of a product is expected.
  
  • The supplier shall provide the IAA with their planning. Regarding to the planning the IAA is free to define ‘stop and visit’ points which the supplier shall respect. Nevertheless the IAA is free to visit the supplier without notice.
  
  • Prior to transporting the PBB to Ben Gurion, Tel Aviv, the supplier shall schedule a Factory Acceptance Test (FAT) at the production site. To that end, the supplier will arrange a complete (pilot) installation of the entire 3-tunnel apron drive PBB and will inform the IAA in good time (i.e., at least two weeks in advance) about when the full or partial FAT is to take place.
• Once the PBB has been delivered and installed at Ben Gurion, Tel Aviv, the supplier will have to perform a Site Acceptance Test (SAT) to demonstrate that the entire installation functions smoothly and correctly. The SAT should also highlight any “non-happy flows”.
• The FAT and SAT shall be performed by representatives from the IAA or by an independent third party to be designated by the airport. The PBB shall be covered by a certificate of approval. If necessary, the supplier shall provide the required test load for the duration of the inspection.
• Electro technical installations shall be inspected prior to completion in accordance with the legislation and requirements regarding to the Israeli Airports Authority.
• The supplier is responsible for ensuring that all the personnel and equipment required for the inspections are available.

g. Factory Acceptance Test (FAT)
• The Contractor to provide a qualified representative of the equipment manufacturer(s) to supervise and witness the FATs.
• The FAT shall be completed at an Engineer approved test site.
• The PBB used for the FAT shall be a 3-tunnel type PBB.
• The purpose of the FAT is to validate that the system functions as a standalone system and all specified features are met including additional specifications and requirements. Any defect shall be recorded and corrected before shipment to site.
• The Manufacturer / Contractor shall provide (international) air transportation, local transportation, accommodation and per diem in accordance with international standards. Allow for five participants on behalf of the IAA per system.
• The Manufacturer / Contractor shall ensure that development of the system is complete, required approvals of submittals have been obtained, and sufficient equipment has been procured to completely demonstrate and test the system.
• If the Equipment fails to pass the FAT, the IAA may require part or all of the Tests to be repeated. The Manufacturer / Contractor to pay for all costs incurred by the IAA in attending the repeated Tests.
• The equipment shall be tested for complete functionality at the factory in accordance with the Manufacturer / Contractor proposed test procedures. The Manufacturer / Contractor shall prepare a test set. Any defects shall be recorded and corrected before shipment to site.
• For the Initial acceptance the Manufacturer / Contractor shall test on site all operating equipment and all PBB related equipment in the presence of the IAA.
• Physical check on fixing of equipment and that all connections shall be mechanically sound.
• During the test all controls, signals and safety devices shall be made to function by imposed conditions to demonstrate that the devices are in proper working order and operational readiness of the system.
• All operating controls shall be used to move the PBBs through each function to the limits of travel at the designed speeds without displaying any malfunction.
• FAT includes PBB interface tests with additional systems such as PBB control system, Telephone systems, PCA-devices, Air-conditioning and VDGS.
• Manufacturer / Contractor shall adjust any malfunction and / or defect and retest the unit to the satisfaction of the IAA that the unit meets the requirements specified in this section.
• After successful testing and acceptance of the complete installation, a “Certificate of Acceptance” signed by both the manufacturer and the Engineer will confirm the take-over.
• Record all test and inspection results.

h. Final Commissioning, Review and Acceptance (Site Acceptance Test, SAT)
• At a time designated, the entire system shall be reviewed for compliance with the Contract Drawings and Specifications. The Manufacturer / Contractor shall be available at all times during this Review.
• The Manufacturer / Contractor shall demonstrate prior to the Final Review that all systems and all equipment have been properly adjusted and are in compliance with the requirements of the Contract Documents. After these demonstration tests are completed satisfactorily, but prior to the Final Review field visit by the IAA, the Manufacturer / Contractor shall submit to the IAA a written certification that 1) attests to Contract Document compliance for this Project, and 2) certifies that the equipment and materials installed in this Project under this Section contain no asbestos or PCB.
• Certificates and Documents required herein shall be in order and presented to the Engineer at least two (2) weeks prior to the Final Review.
• After the Final Review, any changes or corrections noted as necessary for the Work to comply with these Specifications and the Drawings shall be accomplished without delay in order to secure final acceptance of the Work.

• Final Acceptance will be withheld until the following have been completed successfully:
  o Acceptance of all submittals.
  o Successful testing.
  o Delivery of final documentation.
  o Delivery full installation kit of all software, including all installation documentation.
  o Handing over of all specified and approved spare parts.
  o Completed Training as per the specifications as well as successful demonstration of the operation of the entire system.

• The Contractor is responsible for the following:
  o The preparation of commissioning procedures and test program for mechanical, electrical and hydraulic equipment and the control system, which shall be subject to approval by the IAA two (2) months prior to the commencement of the commissioning.
  o Commissioning of the machine to its intended function.
  o Provision of personnel to assist IAA’s employees in both maintenance and operation.
  o Until such time as the Certificate of Acceptance is issued, the Manufacturer / Contractor shall operate the equipment and carry out such modifications and adjustments - supplying all labor, equipment and materials - as are necessary to reach a stage of practical completion.
  o The Manufacturer / Contractor shall timely make available adequate power for start-up and testing of the machines, in order to realize the scheduled start-up date.

• During commissioning, the IAA will provide:
  o Personnel for training in equipment operation.
  o Mechanical and electrical personnel for training in maintenance and repair of the equipment.

• Acceptance
  o An Acceptance Certificate will be issued when the Equipment and Services have successfully passed the SAT, the Ground Checks, the Physical Inspection and the issue of the appropriate Facility Performance Categorization Certificate and any other tests required by the Engineer to ensure that the Plant, Materials and Services fully comply with the Specification.

End of Passenger Boarding Bridge Specification

Appendix 1:

• Drawings and layouts, see PBB tender drawing list below.
• Table of Compliance for PBB tender
• Milestones schedule for PBB tender
• Schedules of passenger boarding bridge service requirements,
### a. List of Drawings for PBB Tender

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<tr>
<th>Sheet File</th>
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<th>Sheet Description</th>
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### Drawings for General Information Only:

| ARCHITECTURE - GENERAL                                                                                                               |
| X-000010.DWG  | X-0 00.01| ARCHITECTURE - PBB TENDER COVER - for General Information Only                      | None  | IKA      |
| X-05010.DWG   | X-0 50.01| VICINITY PLAN                                                                               | 6000  | IKA      |
| X-A0010.DWG   | X-A 00.10| GENERAL NOTES                                                                               | None  | IKA      |
| X-A0020.DWG   | X-A 00.20| ABBREVIATIONS LIST                                                                         | None  | IKA      |
| X-A0021.DWG   | X-A 00.21| LEGENDS                                                                                     | None  | IKA      |
| X-A0022.DWG   | X-A 00.22| KEYNOTES                                                                                    | None  | IKA      |
| X-A10110.DWG  | X-A 10.11| GENERAL AVIATION PLAN                                                                       | 1250  | AJ       |
| X-A10112.DWG  | X-A 10.12| AVIATION PLAN CONCOURSE E & EAST HS                                                          | 750   | AJ       |
| X-A10330.DWG  | X-A 10.33| HORIZONTAL CONTROL PLAN                                                                     | 750   | IKA      |
| X-A10600.DWG  | X-A 10.60| BUILDING KEY PLAN                                                                           | 750   | IKA      |
| **ARCHITECTURE GENERAL PLANS**                                                                                                       |
| X-A12000.DWG  | X-A 12.08| CONCOURSE E TYPICAL FLOOR PLAN LEVEL G                                                       | 250   | IKA      |
| X-A13000.DWG  | X-A 13.08| CONCOURSE E TYPICAL FLOOR PLAN LEVEL 1                                                       | 250   | IKA      |
| X-A14000.DWG  | X-A 14.08| CONCOURSE E TYPICAL FLOOR PLAN LEVEL 2                                                       | 250   | IKA      |
| X-A15000.DWG  | X-A 15.08| CONCOURSE E TYPICAL FLOOR PLAN LEVEL R                                                        | 250   | IKA      |
| **ARCHITECTURE ENLARGED PLANS**                                                                                                       |
| X-A2210.DWG   | X-A 22.19| CONCOURSE E FLOOR PLAN SEGMENT E1 LEVEL G                                                    | 100   | IKA      |
| X-A2220.DWG   | X-A 22.20| CONCOURSE E FLOOR PLAN SEGMENT E2 LEVEL G                                                    | 100   | IKA      |
| X-A2221.DWG   | X-A 22.21| CONCOURSE E FLOOR PLAN SEGMENT E3 LEVEL G                                                    | 100   | IKA      |
| X-A2330.DWG   | X-A 23.20| CONCOURSE E FLOOR PLAN SEGMENT E2 LEVEL 1                                                    | 100   | IKA      |
| X-A2340.DWG   | X-A 23.21| CONCOURSE E FLOOR PLAN SEGMENT E3 LEVEL 1                                                    | 100   | IKA      |
| X-A2410.DWG   | X-A 24.19| CONCOURSE E FLOOR PLAN SEGMENT E1 LEVEL 2                                                    | 100   | IKA      |
| X-A2420.DWG   | X-A 24.20| CONCOURSE E FLOOR PLAN SEGMENT E2 LEVEL 2                                                    | 100   | IKA      |
| X-A2430.DWG   | X-A 24.21| CONCOURSE E FLOOR PLAN SEGMENT E3 LEVEL 2                                                    | 100   | IKA      |
| X-A2510.DWG   | X-A 25.19| CONCOURSE E FLOOR PLAN SEGMENT E1 LEVEL R                                                     | 100   | IKA      |
| X-A2520.DWG   | X-A 25.20| CONCOURSE E FLOOR PLAN SEGMENT E2 LEVEL R                                                     | 100   | IKA      |
| X-A2530.DWG   | X-A 25.21| CONCOURSE E FLOOR PLAN SEGMENT E3 LEVEL R                                                     | 100   | IKA      |
All project drawings sets of all disciplines are available and will be sent per request.
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<td>6</td>
<td>Full-length handrail at one side</td>
<td>Yes</td>
<td></td>
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<td>7</td>
<td>Anti-collision system double apron drive bridge situations</td>
<td>Yes</td>
<td></td>
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<td>8</td>
<td>Automatic pre-positioning possibility</td>
<td>Yes</td>
<td></td>
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<td>9</td>
<td>Automatic docking possibility</td>
<td>Yes</td>
<td></td>
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<tr>
<td>10</td>
<td>Self-leveling cab floor</td>
<td>Yes</td>
<td></td>
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<td>11</td>
<td>Automatic retractable floor cab platform</td>
<td>Yes</td>
<td></td>
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<td>12</td>
<td>Each side independent actuation aircraft closure (canopy)</td>
<td>Yes</td>
<td></td>
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<td>13</td>
<td>Positive pressure fans in accordance with NFPA 415</td>
<td>Yes</td>
<td></td>
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<td>14</td>
<td>Water cooled air-conditioning fixed bridges</td>
<td>Yes</td>
<td></td>
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<tr>
<td>15</td>
<td>Water cooled air-conditioning apron drive bridges (preferred)</td>
<td>Yes</td>
<td></td>
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<tr>
<td>16</td>
<td>Interlocks with VDGS and PCA</td>
<td>Yes</td>
<td></td>
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<tr>
<td>17</td>
<td>Installation complete PBB and fixed bridges on site</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Fixed bridge facade connection</td>
<td>Yes</td>
<td></td>
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<td>19</td>
<td>Delivery mounting bolt ring for columns</td>
<td>Yes</td>
<td></td>
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<td>20</td>
<td>Delivery of full revision package including:</td>
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<td>- all drawings</td>
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<tr>
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<td>- all documents</td>
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<td></td>
<td>- maintenance information</td>
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<tr>
<td></td>
<td>- all PBB calculations, loads and measurements</td>
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<tr>
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<td>- all component information and descriptions</td>
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<td>- complete descriptions of preservation and painting</td>
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<td>- etc.</td>
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c. Milestones schedule for PBB tender

<table>
<thead>
<tr>
<th>Milestones</th>
<th>2016</th>
<th>2017</th>
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<tr>
<td>Week 1</td>
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<td>Week 15</td>
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<td>Week 16</td>
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</tbody>
</table>

- Ben Gurion Airport Concourse E Passenger Boarding Bridges
- Milestones schedule for PBB tender
- Milestones include:
  1. Tender process notice and award
  2. Design A, Engineering
  3. Detailed design and shop drawings
  4. Substantive approval process
  5. Final Design
  6. Final Functional Design
  7. Functional acceptance test – PBBs
  8. Sample Installation
  9. Final Design
  10. Final Design
  11. Final Design
  12. Final Design
  13. Testing and Commissioning of PBBs
  14. PPM Integration Tests
  15. Final Design
  16. Hand-over of PBBs
d. **Schedule of Passenger Boarding Bridge Service Requirements**

**Gate E2, PBB LB 2**

<table>
<thead>
<tr>
<th>SL</th>
<th>Distance</th>
<th>Aircraft</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0.00 1</td>
<td>B767-300</td>
</tr>
<tr>
<td>B</td>
<td>303.94 1</td>
<td>B757-300, A300-600R, MD 81</td>
</tr>
<tr>
<td>C</td>
<td>762.91 1</td>
<td>B757-200, B737-400, B737-800, B737-900, A310-200, A320-100, EMBRAER 190 STD, EMBRAER 195 STD, A318, A319, BAe 146-300, BAe 146-100, A321 NEO-PW</td>
</tr>
</tbody>
</table>

SL = Stop Line

**Docking results - Bridge**

<table>
<thead>
<tr>
<th>Aircraft (stop line)</th>
<th>Door [min/max]</th>
<th>PB B</th>
<th>Operational length</th>
<th>Slope empty</th>
<th>Slope full</th>
<th>Column height</th>
<th>Closure slope</th>
<th>Cab angle</th>
</tr>
</thead>
<tbody>
<tr>
<td>B767-300 (A)</td>
<td>L1 [413.00/450.00 1]</td>
<td>1</td>
<td>2292.92 1</td>
<td>U1.2 %</td>
<td>D0.4 %</td>
<td>419.58 1</td>
<td>1.2 %</td>
<td>69.5 deg</td>
</tr>
<tr>
<td>B757-300 (B)</td>
<td>L1 [379.00/401.00 1]</td>
<td>1</td>
<td>2433.87 1</td>
<td>D0.9 %</td>
<td>D1.8 %</td>
<td>389.41 1</td>
<td>-0.0 %</td>
<td>72.3 deg</td>
</tr>
<tr>
<td>B757-200 (C)</td>
<td>L1 [379.00/401.00 1]</td>
<td>1</td>
<td>2899.16 1</td>
<td>D0.9 %</td>
<td>D1.7 %</td>
<td>389.44 1</td>
<td>-0.0 %</td>
<td>77.7 deg</td>
</tr>
<tr>
<td>A300-600R (B)</td>
<td>L1 [452.00/458.00 1]</td>
<td>1</td>
<td>2387.11 1</td>
<td>U1.5 %</td>
<td>U1.2 %</td>
<td>425.40 1</td>
<td>1.4 %</td>
<td>69.5 deg</td>
</tr>
<tr>
<td>B737-400 (C)</td>
<td>L1 [262.00/277.00 1]</td>
<td>1</td>
<td>3035.46 1</td>
<td>D4.9 %</td>
<td>D5.4 %</td>
<td>291.98 1</td>
<td>-0.0 %</td>
<td>68.8 deg</td>
</tr>
<tr>
<td>B737-800 (C)</td>
<td>L1 [256.00/264.00 1]</td>
<td>1</td>
<td>3033.07 1</td>
<td>D5.4 %</td>
<td>D5.6 %</td>
<td>287.63 1</td>
<td>-0.0 %</td>
<td>69.9 deg</td>
</tr>
<tr>
<td>B737-900 (C)</td>
<td>L1 [259.00/274.00 1]</td>
<td>1</td>
<td>3038.71 1</td>
<td>D5.0 %</td>
<td>D5.5 %</td>
<td>289.44 1</td>
<td>-0.0 %</td>
<td>70.9 deg</td>
</tr>
<tr>
<td>A310-200 (C)</td>
<td>L1 [442.10/453.60 1]</td>
<td>1</td>
<td>2825.18 1</td>
<td>U1.0 %</td>
<td>U0.6 %</td>
<td>425.60 1</td>
<td>0.9 %</td>
<td>69.5 deg</td>
</tr>
<tr>
<td>A320-100 (C)</td>
<td>L1 [339.00/346.00 1]</td>
<td>1</td>
<td>2975.30 1</td>
<td>D2.8 %</td>
<td>D3.0 %</td>
<td>350.30 1</td>
<td>-0.0 %</td>
<td>78.4 deg</td>
</tr>
<tr>
<td>EMBRAER 190 STD (C)</td>
<td>L1 [260.00/270.00 1]</td>
<td>1</td>
<td>3093.27 1</td>
<td>D5.2 %</td>
<td>D5.5 %</td>
<td>288.10 1</td>
<td>-0.0 %</td>
<td>77.7 deg</td>
</tr>
<tr>
<td>EMBRAER 195 STD (C)</td>
<td>L1 [259.00/268.00 1]</td>
<td>1</td>
<td>3094.30 1</td>
<td>D5.2 %</td>
<td>D5.5 %</td>
<td>287.37 1</td>
<td>-0.0 %</td>
<td>77.7 deg</td>
</tr>
<tr>
<td>A318 (C)</td>
<td>L1 [337.00/344.00 1]</td>
<td>1</td>
<td>2953.31 1</td>
<td>D2.8 %</td>
<td>D3.1 %</td>
<td>349.36 1</td>
<td>-0.0 %</td>
<td>74.1 deg</td>
</tr>
<tr>
<td>A319 (C)</td>
<td>L1 [338.00/345.00 1]</td>
<td>1</td>
<td>2959.07 1</td>
<td>D2.8 %</td>
<td>D3.0 %</td>
<td>349.95 1</td>
<td>-0.0 %</td>
<td>75.1 deg</td>
</tr>
<tr>
<td>MD 81 (B)</td>
<td>L1 [220.00/240.00 1]</td>
<td>1</td>
<td>2724.28 1</td>
<td>D6.8 %</td>
<td>D7.5 %</td>
<td>267.40 1</td>
<td>-0.0 %</td>
<td>72.3 deg</td>
</tr>
<tr>
<td>BAe 146-300 (C)</td>
<td>L1 [189.00/208.00 1]</td>
<td>1</td>
<td>3244.78 1</td>
<td>D6.9 %</td>
<td>D7.4 %</td>
<td>235.01 1</td>
<td>-0.0 %</td>
<td>73.6 deg</td>
</tr>
<tr>
<td>BAe 146-100 (C)</td>
<td>L1 [189.00/208.00 1]</td>
<td>1</td>
<td>3234.37 1</td>
<td>D6.9 %</td>
<td>D7.5 %</td>
<td>235.50 1</td>
<td>-0.0 %</td>
<td>72.5 deg</td>
</tr>
<tr>
<td>A321 NEO-PW (C)</td>
<td>L1 [337.00/346.00 1]</td>
<td>1</td>
<td>2959.11 1</td>
<td>D2.8 %</td>
<td>D3.1 %</td>
<td>350.65 1</td>
<td>-0.0 %</td>
<td>75.1 deg</td>
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Gate E3, PBB LB 3

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<tr>
<th>SL</th>
<th>Distance</th>
<th>Aircraft</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0.00 1</td>
<td>B767-300, B757-300, B757-200, A300-600R, B737-900, TU-154M, MD 81</td>
</tr>
<tr>
<td>B</td>
<td>618.81 1</td>
<td>B737-400, B737-800, A310-200, A320-100, EMBRAER 170 STD, EMBRAER 175 STD, EMBRAER 190 STD, EMBRAER 195 STD, A318, A319, BAe 146-100, BAe 146-300, A321 NEO-PW</td>
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SL = Stop Line

Docking results - Bridge

<table>
<thead>
<tr>
<th>Aircraft (stop line)</th>
<th>Door [min/max]</th>
<th>PB</th>
<th>Operational length</th>
<th>Slope empty</th>
<th>Slope full</th>
<th>Column height</th>
<th>Closure slope</th>
<th>Cab angle</th>
</tr>
</thead>
<tbody>
<tr>
<td>B767-300 (A)</td>
<td>L1 [413.00/450.00 1]</td>
<td>1</td>
<td>3074.43 1</td>
<td>D1.3 %</td>
<td>D2.4 %</td>
<td>453.29 1</td>
<td>-0.0 %</td>
<td>25.6 deg</td>
</tr>
<tr>
<td>B757-300 (A)</td>
<td>L1 [379.00/401.00 1]</td>
<td>1</td>
<td>3028.75 1</td>
<td>D2.7 %</td>
<td>D3.4 %</td>
<td>425.69 1</td>
<td>-0.0 %</td>
<td>25.4 deg</td>
</tr>
<tr>
<td>B757-200 (A)</td>
<td>L1 [379.00/401.00 1]</td>
<td>1</td>
<td>3035.79 1</td>
<td>D2.7 %</td>
<td>D3.4 %</td>
<td>425.58 1</td>
<td>-0.0 %</td>
<td>28.8 deg</td>
</tr>
<tr>
<td>A300-600R (A)</td>
<td>L1 [452.00/458.00 1]</td>
<td>1</td>
<td>2958.75 1</td>
<td>D6.0 %</td>
<td>D6.4 %</td>
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<td>B737-400 (B)</td>
<td>L1 [262.00/277.00 1]</td>
<td>1</td>
<td>3483.09 1</td>
<td>D6.0 %</td>
<td>D6.4 %</td>
<td>344.22 1</td>
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<tr>
<td>B737-800 (B)</td>
<td>L1 [256.00/264.00 1]</td>
<td>1</td>
<td>3480.64 1</td>
<td>D6.4 %</td>
<td>D6.6 %</td>
<td>331.11 1</td>
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<td>31.5 deg</td>
</tr>
<tr>
<td>B737-900 (A)</td>
<td>L1 [259.00/274.00 1]</td>
<td>1</td>
<td>3125.46 1</td>
<td>D6.5 %</td>
<td>D7.0 %</td>
<td>351.16 1</td>
<td>-0.0 %</td>
<td>23.8 deg</td>
</tr>
<tr>
<td>A310-200 (B)</td>
<td>L1 [442.10/453.60 1]</td>
<td>1</td>
<td>3294.64 1</td>
<td>D6.4 %</td>
<td>D6.6 %</td>
<td>331.11 1</td>
<td>-0.0 %</td>
<td>28.7 deg</td>
</tr>
<tr>
<td>A320-100 (B)</td>
<td>L1 [339.00/346.00 1]</td>
<td>1</td>
<td>3416.35 1</td>
<td>D4.2 %</td>
<td>D4.4 %</td>
<td>387.87 1</td>
<td>-0.0 %</td>
<td>39.3 deg</td>
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<tr>
<td>EMBRAER 170 STD (B)</td>
<td>L1 [254.00/263.00 1]</td>
<td>1</td>
<td>3532.82 1</td>
<td>D6.4 %</td>
<td>D6.6 %</td>
<td>327.73 1</td>
<td>-0.0 %</td>
<td>39.9 deg</td>
</tr>
<tr>
<td>EMBRAER 175 STD (B)</td>
<td>L1 [254.00/264.00 1]</td>
<td>1</td>
<td>3525.20 1</td>
<td>D6.3 %</td>
<td>D6.6 %</td>
<td>327.88 1</td>
<td>-0.0 %</td>
<td>40.0 deg</td>
</tr>
<tr>
<td>EMBRAER 190 STD (B)</td>
<td>L1 [260.00/270.00 1]</td>
<td>1</td>
<td>3532.42 1</td>
<td>D6.2 %</td>
<td>D6.4 %</td>
<td>331.53 1</td>
<td>-0.0 %</td>
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</tr>
<tr>
<td>EMBRAER 195 STD (B)</td>
<td>L1 [259.00/268.00 1]</td>
<td>1</td>
<td>3533.13 1</td>
<td>D6.2 %</td>
<td>D6.5 %</td>
<td>330.88 1</td>
<td>-0.0 %</td>
<td>40.0 deg</td>
</tr>
<tr>
<td>A318 (B)</td>
<td>L1 [337.00/344.00 1]</td>
<td>1</td>
<td>3409.20 1</td>
<td>D4.2 %</td>
<td>D4.4 %</td>
<td>387.01 1</td>
<td>-0.0 %</td>
<td>34.8 deg</td>
</tr>
<tr>
<td>A319 (B)</td>
<td>L1 [338.00/345.00 1]</td>
<td>1</td>
<td>3412.17 1</td>
<td>D4.2 %</td>
<td>D4.4 %</td>
<td>387.52 1</td>
<td>-0.0 %</td>
<td>35.9 deg</td>
</tr>
<tr>
<td>BAe 146-100 (B)</td>
<td>L1 [189.00/208.00 1]</td>
<td>1</td>
<td>3618.21 1</td>
<td>D7.7 %</td>
<td>D8.2 %</td>
<td>284.84 1</td>
<td>-0.0 %</td>
<td>35.9 deg</td>
</tr>
<tr>
<td>BAe 146-300 (B)</td>
<td>L1 [189.00/208.00 1]</td>
<td>1</td>
<td>3624.35 1</td>
<td>D7.7 %</td>
<td>D8.2 %</td>
<td>284.50 1</td>
<td>-0.0 %</td>
<td>37.0 deg</td>
</tr>
<tr>
<td>TU-154M (A)</td>
<td>L1 [359.00/377.00 1]</td>
<td>1</td>
<td>3001.95 1</td>
<td>D3.5 %</td>
<td>D4.0 %</td>
<td>412.55 1</td>
<td>-0.0 %</td>
<td>23.4 deg</td>
</tr>
<tr>
<td>A321 NEO-PW (B)</td>
<td>L1 [337.00/346.00 1]</td>
<td>1</td>
<td>3412.21 1</td>
<td>D4.2 %</td>
<td>D4.4 %</td>
<td>388.13 1</td>
<td>-0.0 %</td>
<td>35.9 deg</td>
</tr>
<tr>
<td>MD 81 (A)</td>
<td>L1 [220.00/240.00 1]</td>
<td>1</td>
<td>3204.58 1</td>
<td>D7.4 %</td>
<td>D8.0 %</td>
<td>316.97 1</td>
<td>-0.0 %</td>
<td>28.7 deg</td>
</tr>
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</table>
### Gate E4, PBB LB 4

<table>
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<th>SL</th>
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<th>Aircraft</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0.00 1</td>
<td>B737-900W, B737-800</td>
</tr>
<tr>
<td>B</td>
<td>346.95 1</td>
<td>A320-100, A318, A319, EMBRAER 175 STD, EMBRAER 195 STD, B737-400</td>
</tr>
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</table>

SL = Stop Line

Docking results – E4

<table>
<thead>
<tr>
<th>Aircraft (stop line)</th>
<th>Door [min/max]</th>
<th>PBB</th>
<th>Operational length</th>
<th>Slope empty</th>
<th>Slope full</th>
<th>Column height</th>
<th>Closure slope</th>
<th>Cab angle</th>
</tr>
</thead>
<tbody>
<tr>
<td>A320-100 (B)</td>
<td>L1 [339.00/346.00 1]</td>
<td>1</td>
<td>2796.65 1</td>
<td>D4.7 %</td>
<td>D4.9 %</td>
<td>381.64 1</td>
<td>2.3 %</td>
<td>-27.3 deg</td>
</tr>
<tr>
<td>A318 (B)</td>
<td>L1 [337.00/344.00 1]</td>
<td>1</td>
<td>2817.72 1</td>
<td>D4.7 %</td>
<td>D5.0 %</td>
<td>379.45 1</td>
<td>2.6 %</td>
<td>-31.7 deg</td>
</tr>
<tr>
<td>A319 (B)</td>
<td>L1 [338.00/345.00 1]</td>
<td>1</td>
<td>2813.87 1</td>
<td>D4.7 %</td>
<td>D4.9 %</td>
<td>380.31 1</td>
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<td>EMBRAER 175 STD (B)</td>
<td>L1 [254.00/264.00 1]</td>
<td>1</td>
<td>2801.24 1</td>
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<td>D7.8 %</td>
<td>321.26 1</td>
<td>3.3 %</td>
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<tr>
<td>EMBRAER 195 STD (B)</td>
<td>L1 [259.00/268.00 1]</td>
<td>1</td>
<td>2809.44 1</td>
<td>D7.3 %</td>
<td>D7.6 %</td>
<td>324.33 1</td>
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<tr>
<td>B737-900W (A)</td>
<td>L1 [259.00/274.00 1]</td>
<td>1</td>
<td>2979.72 1</td>
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<tr>
<td>B737-800 (A)</td>
<td>L1 [256.00/264.00 1]</td>
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<td>2784.59 1</td>
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<td>B737-400 (B)</td>
<td>L1 [262.00/277.00 1]</td>
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### Gate E5, PBB LB 5

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<td>B</td>
<td>185.23 1</td>
<td>B737-900W</td>
</tr>
<tr>
<td>C</td>
<td>390.88 1</td>
<td>B737-800, EMBRAER 195 STD</td>
</tr>
<tr>
<td>D</td>
<td>763.16 1</td>
<td>B737-400, A320-100, EMBRAER 170 STD, A318, A319, BAe 146-100, BAe 146-300</td>
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SL = Stop Line

Docking results – E5

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<tr>
<th>Aircraft (stop line)</th>
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<th>PBB</th>
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<th>Slope full</th>
<th>Column height</th>
<th>Closure slope</th>
<th>Cab angle</th>
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<tbody>
<tr>
<td>B757-200 (A)</td>
<td>L2 [384.00/401.00 1]</td>
<td>1</td>
<td>2215.05 1</td>
<td>U0.9 %</td>
<td>U0.1 %</td>
<td>378.15 1</td>
<td>0.9 %</td>
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</tr>
<tr>
<td>B737-400 (D)</td>
<td>L1 [262.00/277.00 1]</td>
<td>1</td>
<td>2220.32 1</td>
<td>D4.8 %</td>
<td>D5.4 %</td>
<td>282.67 1</td>
<td>-0.0 %</td>
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<tr>
<td>B737-800 (C)</td>
<td>L1 [256.00/264.00 1]</td>
<td>1</td>
<td>1848.42 1</td>
<td>D6.3 %</td>
<td>D6.7 %</td>
<td>285.29 1</td>
<td>-0.0 %</td>
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<tr>
<td>A320-100 (D)</td>
<td>L1 [339.00/346.00 1]</td>
<td>1</td>
<td>2164.56 1</td>
<td>D1.7 %</td>
<td>D2.0 %</td>
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### Gate E5 Cont.

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<th>Cab angle</th>
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<tr>
<td>EMBRAER 170 STD (D)</td>
<td>L1 [254.00/263.00 1]</td>
<td>1</td>
<td>2277.24 1</td>
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<td>D5.8 %</td>
<td>274.56 1</td>
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<tr>
<td>EMBRAER 195 STD (C)</td>
<td>L1 [259.00/268.00 1]</td>
<td>1</td>
<td>1907.13 1</td>
<td>D6.0 %</td>
<td>D6.5 %</td>
<td>284.22 1</td>
<td>-0.0 %</td>
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</tr>
<tr>
<td>A318 (D)</td>
<td>L1 [337.00/344.00 1]</td>
<td>1</td>
<td>2140.77 1</td>
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<td>D2.1 %</td>
<td>338.29 1</td>
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<tr>
<td>A319 (D)</td>
<td>L1 [338.00/345.00 1]</td>
<td>1</td>
<td>2146.78 1</td>
<td>D1.7 %</td>
<td>D2.1 %</td>
<td>338.91 1</td>
<td>-0.0 %</td>
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<tr>
<td>BAe 146-100 (D)</td>
<td>L1 [189.00/208.00 1]</td>
<td>1</td>
<td>2422.62 1</td>
<td>D7.4 %</td>
<td>D8.2 %</td>
<td>226.85 1</td>
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<tr>
<td>BAe 146-300 (D)</td>
<td>L1 [189.00/208.00 1]</td>
<td>1</td>
<td>2433.39 1</td>
<td>D7.4 %</td>
<td>D8.2 %</td>
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<td>B737-900W (B)</td>
<td>L1 [259.00/274.00 1]</td>
<td>1</td>
<td>1653.01 1</td>
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<td>D7.3 %</td>
<td>291.89 1</td>
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### Gate E6, PBB LB 6A and LB 6B

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<th>Aircraft</th>
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<td>A</td>
<td>0.00 1</td>
<td>B747-400, B767-300, B777-200, A340-600, A350-900, B767-400ER, B757-300, B777-300ER, B747-8, A340-300, B787-8, B787-9</td>
</tr>
<tr>
<td>B</td>
<td>639.94 1</td>
<td>B757-200, A300-600R, A310-200, EMBRAER 195 STD</td>
</tr>
<tr>
<td>C</td>
<td>1115.83 1</td>
<td>B737-400, B737-800, B737-900, A320-100, A318, A319, A321 NEO-PW, TU-154M</td>
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**SL = Stop Line**

### Docking results – E6

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<tr>
<th>Aircraft (stop line)</th>
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<th>PBB</th>
<th>Operational length</th>
<th>Slope empty</th>
<th>Slope full</th>
<th>Column height</th>
<th>Closure slope</th>
<th>Cab angle</th>
</tr>
</thead>
<tbody>
<tr>
<td>B747-400 (A)</td>
<td>L1 [474.00/518.00 1]</td>
<td>1</td>
<td>1751.19 1</td>
<td>U4.8 %</td>
<td>U2.4 %</td>
<td>474.23 1</td>
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<td>55.9 deg</td>
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<tr>
<td>B747-400 (A)</td>
<td>L2 [480.00/515.00 1]</td>
<td>2</td>
<td>2288.02 1</td>
<td>U1.3 %</td>
<td>D0.1 %</td>
<td>496.91 1</td>
<td>1.0 %</td>
<td>46.3 deg</td>
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<tr>
<td>B757-200 (B)</td>
<td>L1 [379.00/401.00 1]</td>
<td>1</td>
<td>2182.94 1</td>
<td>D1.4 %</td>
<td>D2.4 %</td>
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<td>-0.0 %</td>
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<tr>
<td>B767-300 (A)</td>
<td>L1 [413.00/450.00 1]</td>
<td>1</td>
<td>1728.63 1</td>
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<td>D0.9 %</td>
<td>432.17 1</td>
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<tr>
<td>B767-300 (A)</td>
<td>L2 [416.00/447.00 1]</td>
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<td>2363.07 1</td>
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<td>B777-200 (A)</td>
<td>L1 [471.00/500.00 1]</td>
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<td>B777-200 (A)</td>
<td>L2 [488.00/507.00 1]</td>
<td>2</td>
<td>2306.14 1</td>
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<td>U0.2 %</td>
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<tr>
<td>A340-600 (A)</td>
<td>L1 [453.00/478.00 1]</td>
<td>1</td>
<td>1532.51 1</td>
<td>U3.0 %</td>
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<td>445.62 1</td>
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<td>A340-600 (A)</td>
<td>L2 [480.00/500.00 1]</td>
<td>2</td>
<td>2800.32 1</td>
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<td>D0.3 %</td>
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<td>A350-900 (A)</td>
<td>L1 [507.00/537.00 1]</td>
<td>1</td>
<td>1778.71 1</td>
<td>U5.6 %</td>
<td>U4.1 %</td>
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<td>A350-900 (A)</td>
<td>L2 [510.00/533.00 1]</td>
<td>2</td>
<td>2534.22 1</td>
<td>U1.8 %</td>
<td>U0.9 %</td>
<td>511.22 1</td>
<td>1.4 %</td>
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<td>Angle</td>
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<tr>
<td>B767-400ER (A)</td>
<td>143 m</td>
<td>39.5 m</td>
<td>13.0 m</td>
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<td>B757-300 (A)</td>
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<tr>
<td>B757-300 (A)</td>
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<td>B747-8 (A)</td>
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<tr>
<td>B747-8 (A)</td>
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<td>56.7 deg</td>
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<tr>
<td>A300-600R (B)</td>
<td>281.1 m</td>
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<tr>
<td>A340-300 (A)</td>
<td>154.3 m</td>
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<td>45.0 deg</td>
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<tr>
<td>A340-300 (A)</td>
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<td>B737-400 (C)</td>
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<td>A310-200 (B)</td>
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<td>A320-100 (C)</td>
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<td>EMBRAER 195 STD</td>
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<tr>
<td>A318 (C)</td>
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<tr>
<td>A319 (C)</td>
<td>267.8 m</td>
<td>34.5 m</td>
<td>13.0 m</td>
<td>66.9 deg</td>
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<td>168.7 m</td>
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<td>49.7 deg</td>
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<td>B787-8 (A)</td>
<td>223.5 m</td>
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<td>TU-154M (C)</td>
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### Gate E7, PBB LB 7

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<td>1148.34 1</td>
<td>B737-900W, A310-200, A320-100, A318, A319, EMBRAER 195 AR, BAe 146-100, BAe 146-300, EMBRAER 175 STD, B737-400, B737-800</td>
</tr>
</tbody>
</table>

SL = Stop Line

### Docking results – E7

<table>
<thead>
<tr>
<th>Aircraft (stop line)</th>
<th>Door [min/max]</th>
<th>PBB</th>
<th>Operational length</th>
<th>Slope empty</th>
<th>Slope full</th>
<th>Column height</th>
<th>Closure slope</th>
<th>Cab angle</th>
</tr>
</thead>
<tbody>
<tr>
<td>B757-300 (B)</td>
<td>L1 [379.00/401.00 1]</td>
<td>1</td>
<td>2343.54 1</td>
<td>D1.1 %</td>
<td>D2.0 %</td>
<td>396.15 1</td>
<td>-0.0 %</td>
<td>70.0 deg</td>
</tr>
<tr>
<td>B757-200 (B)</td>
<td>L1 [379.00/401.00 1]</td>
<td>1</td>
<td>2360.83 1</td>
<td>D1.1 %</td>
<td>D2.0 %</td>
<td>396.11 1</td>
<td>-0.0 %</td>
<td>73.2 deg</td>
</tr>
<tr>
<td>B737-900W (C)</td>
<td>L1 [259.00/274.00 1]</td>
<td>1</td>
<td>3500.32 1</td>
<td>D4.7 %</td>
<td>D5.1 %</td>
<td>298.83 1</td>
<td>-0.0 %</td>
<td>71.4 deg</td>
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<tr>
<td>A300-600R (B)</td>
<td>L1 [452.00/458.00 1]</td>
<td>1</td>
<td>2297.13 1</td>
<td>U1.3 %</td>
<td>U1.1 %</td>
<td>425.50 1</td>
<td>1.2 %</td>
<td>67.2 deg</td>
</tr>
<tr>
<td>A310-200 (C)</td>
<td>L1 [442.10/453.60 1]</td>
<td>1</td>
<td>3286.13 1</td>
<td>U0.5 %</td>
<td>U0.2 %</td>
<td>429.91 1</td>
<td>0.5 %</td>
<td>70.0 deg</td>
</tr>
<tr>
<td>A320-100 (C)</td>
<td>L1 [339.00/346.00 1]</td>
<td>1</td>
<td>3436.26 1</td>
<td>D2.7 %</td>
<td>D2.9 %</td>
<td>357.50 1</td>
<td>-0.0 %</td>
<td>78.9 deg</td>
</tr>
<tr>
<td>A318 (C)</td>
<td>L1 [337.00/344.00 1]</td>
<td>1</td>
<td>3414.13 1</td>
<td>D2.7 %</td>
<td>D2.9 %</td>
<td>356.59 1</td>
<td>-0.0 %</td>
<td>74.6 deg</td>
</tr>
<tr>
<td>A319 (C)</td>
<td>L1 [338.00/345.00 1]</td>
<td>1</td>
<td>3419.91 1</td>
<td>D2.7 %</td>
<td>D2.9 %</td>
<td>357.15 1</td>
<td>-0.0 %</td>
<td>75.6 deg</td>
</tr>
<tr>
<td>MD 81 (B)</td>
<td>L1 [220.00/240.00 1]</td>
<td>1</td>
<td>2630.27 1</td>
<td>D7.2 %</td>
<td>D7.9 %</td>
<td>292.46 1</td>
<td>-0.0 %</td>
<td>70.3 deg</td>
</tr>
<tr>
<td>EMBRAER 195 AR (C)</td>
<td>L1 [259.00/267.00 1]</td>
<td>1</td>
<td>3554.82 1</td>
<td>D4.8 %</td>
<td>D5.1 %</td>
<td>296.96 1</td>
<td>-0.0 %</td>
<td>78.2 deg</td>
</tr>
<tr>
<td>BAe 146-100 (C)</td>
<td>L1 [189.00/208.00 1]</td>
<td>1</td>
<td>3694.92 1</td>
<td>D6.3 %</td>
<td>D6.8 %</td>
<td>246.94 1</td>
<td>-0.0 %</td>
<td>72.9 deg</td>
</tr>
<tr>
<td>B767-300 (B)</td>
<td>L1 [413.00/450.00 1]</td>
<td>1</td>
<td>2494.55 1</td>
<td>U0.9 %</td>
<td>D0.6 %</td>
<td>423.12 1</td>
<td>0.8 %</td>
<td>69.2 deg</td>
</tr>
<tr>
<td>BAe 146-300 (C)</td>
<td>L1 [189.00/208.00 1]</td>
<td>1</td>
<td>3705.36 1</td>
<td>D6.2 %</td>
<td>D6.8 %</td>
<td>246.49 1</td>
<td>-0.0 %</td>
<td>74.0 deg</td>
</tr>
<tr>
<td>EMBRAER 175 STD (C)</td>
<td>L1 [254.00/264.00 1]</td>
<td>1</td>
<td>3552.10 1</td>
<td>D4.9 %</td>
<td>D5.2 %</td>
<td>293.52 1</td>
<td>-0.0 %</td>
<td>78.4 deg</td>
</tr>
<tr>
<td>B737-400 (C)</td>
<td>L1 [262.00/277.00 1]</td>
<td>1</td>
<td>3497.05 1</td>
<td>D4.6 %</td>
<td>D5.0 %</td>
<td>301.22 1</td>
<td>-0.0 %</td>
<td>69.4 deg</td>
</tr>
<tr>
<td>B737-800 (C)</td>
<td>L1 [256.00/264.00 1]</td>
<td>1</td>
<td>3494.64 1</td>
<td>D4.9 %</td>
<td>D5.2 %</td>
<td>297.06 1</td>
<td>-0.0 %</td>
<td>70.4 deg</td>
</tr>
<tr>
<td>B787-8 (A)</td>
<td>L2 [445.00/475.00 1]</td>
<td>1</td>
<td>3256.90 1</td>
<td>U1.2 %</td>
<td>U0.3 %</td>
<td>444.75 1</td>
<td>1.2 %</td>
<td>79.7 deg</td>
</tr>
</tbody>
</table>
Gate E8, PBB LB 8A and LB 8B

<table>
<thead>
<tr>
<th>SL</th>
<th>Distance</th>
<th>Aircraft</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0.00</td>
<td>B777-200, B747-400, B757-200, B767-300, A330-300, A340-300, A340-600, A350-900, B767-400ER, B757-300, B777-300ER, B747-8, B787-8, B787-9</td>
</tr>
<tr>
<td>B</td>
<td>646.87</td>
<td>MD 81, A300-600R, B737-400, B737-800, A310-200, A320-100, EMBRAER 195 STD, A318, A319, A321 NEO-PW, TU-154M, B737-900W</td>
</tr>
</tbody>
</table>

SL = Stop Line

Docking results – E8

<table>
<thead>
<tr>
<th>Aircraft (stop line)</th>
<th>Door [min/max]</th>
<th>PBB</th>
<th>Operational length</th>
<th>Slope empty</th>
<th>Slope full</th>
<th>Column height</th>
<th>Closure slope</th>
<th>Cab angle</th>
</tr>
</thead>
<tbody>
<tr>
<td>B777-200 (A)</td>
<td>L1 [471.00/500.00]</td>
<td>1</td>
<td>3086.67</td>
<td>D0.0 %</td>
<td>D0.9 %</td>
<td>481.30</td>
<td>-0.0 %</td>
<td>62.1 deg</td>
</tr>
<tr>
<td>B777-200 (A)</td>
<td>L2 [488.00/507.00]</td>
<td>2</td>
<td>2803.15</td>
<td>D0.4 %</td>
<td>D1.1 %</td>
<td>492.80</td>
<td>-0.0 %</td>
<td>62.9 deg</td>
</tr>
<tr>
<td>B747-400 (A)</td>
<td>L1 [474.00/518.00]</td>
<td>1</td>
<td>3200.32</td>
<td>U0.5 %</td>
<td>D0.8 %</td>
<td>495.34</td>
<td>0.5 %</td>
<td>69.2 deg</td>
</tr>
<tr>
<td>B747-400 (A)</td>
<td>L2 [480.00/515.00]</td>
<td>2</td>
<td>2785.95</td>
<td>D0.1 %</td>
<td>D1.4 %</td>
<td>498.48</td>
<td>-0.0 %</td>
<td>63.0 deg</td>
</tr>
<tr>
<td>B757-200 (A)</td>
<td>L2 [384.00/401.00]</td>
<td>1</td>
<td>3889.91</td>
<td>D2.7 %</td>
<td>D3.2 %</td>
<td>404.53</td>
<td>-0.0 %</td>
<td>76.3 deg</td>
</tr>
<tr>
<td>B767-300 (A)</td>
<td>L1 [413.00/450.00]</td>
<td>1</td>
<td>3161.12</td>
<td>D1.6 %</td>
<td>D2.7 %</td>
<td>444.74</td>
<td>-0.0 %</td>
<td>67.8 deg</td>
</tr>
<tr>
<td>B767-300 (A)</td>
<td>L2 [416.00/447.00]</td>
<td>2</td>
<td>2853.24</td>
<td>D2.5 %</td>
<td>D3.5 %</td>
<td>450.03</td>
<td>-0.0 %</td>
<td>62.1 deg</td>
</tr>
<tr>
<td>MD 81 (B)</td>
<td>L1 [220.00/240.00]</td>
<td>1</td>
<td>3924.39</td>
<td>D6.8 %</td>
<td>D7.3 %</td>
<td>261.33</td>
<td>-0.0 %</td>
<td>71.9 deg</td>
</tr>
<tr>
<td>A330-300 (A)</td>
<td>L1 [441.00/455.00]</td>
<td>1</td>
<td>2952.35</td>
<td>D1.4 %</td>
<td>D1.9 %</td>
<td>448.79</td>
<td>-0.0 %</td>
<td>63.8 deg</td>
</tr>
<tr>
<td>A330-300 (A)</td>
<td>L2 [467.00/483.00]</td>
<td>2</td>
<td>2804.16</td>
<td>D1.2 %</td>
<td>D1.8 %</td>
<td>475.72</td>
<td>-0.0 %</td>
<td>62.4 deg</td>
</tr>
<tr>
<td>A340-300 (A)</td>
<td>L1 [445.00/465.00]</td>
<td>1</td>
<td>2948.41</td>
<td>D1.1 %</td>
<td>D1.8 %</td>
<td>455.96</td>
<td>-0.0 %</td>
<td>62.6 deg</td>
</tr>
<tr>
<td>A340-300 (A)</td>
<td>L2 [465.00/491.00]</td>
<td>2</td>
<td>2806.90</td>
<td>D1.0 %</td>
<td>D1.9 %</td>
<td>481.41</td>
<td>-0.0 %</td>
<td>62.3 deg</td>
</tr>
<tr>
<td>A340-600 (A)</td>
<td>L1 [453.00/478.00]</td>
<td>1</td>
<td>2941.05</td>
<td>D0.7 %</td>
<td>D1.5 %</td>
<td>465.21</td>
<td>-0.0 %</td>
<td>60.9 deg</td>
</tr>
<tr>
<td>A340-600 (A)</td>
<td>L2 [480.00/500.00]</td>
<td>2</td>
<td>3374.19</td>
<td>D0.7 %</td>
<td>D1.3 %</td>
<td>488.14</td>
<td>-0.0 %</td>
<td>67.2 deg</td>
</tr>
<tr>
<td>A350-900 (A)</td>
<td>L1 [507.00/537.00]</td>
<td>1</td>
<td>3220.09</td>
<td>U1.1 %</td>
<td>U0.2 %</td>
<td>509.33</td>
<td>1.0 %</td>
<td>64.6 deg</td>
</tr>
<tr>
<td>A350-900 (A)</td>
<td>L2 [510.00/533.00]</td>
<td>2</td>
<td>3073.01</td>
<td>U0.4 %</td>
<td>D0.4 %</td>
<td>512.50</td>
<td>0.3 %</td>
<td>65.2 deg</td>
</tr>
<tr>
<td>B767-400ER (A)</td>
<td>L1 [413.00/439.00]</td>
<td>1</td>
<td>3155.75</td>
<td>D1.9 %</td>
<td>D2.7 %</td>
<td>436.61</td>
<td>-0.0 %</td>
<td>68.1 deg</td>
</tr>
<tr>
<td>B767-400ER (A)</td>
<td>L2 [441.00/459.00]</td>
<td>2</td>
<td>3155.42</td>
<td>D2.0 %</td>
<td>D2.5 %</td>
<td>457.51</td>
<td>-0.0 %</td>
<td>64.9 deg</td>
</tr>
<tr>
<td>B757-300 (A)</td>
<td>L1 [379.00/401.00]</td>
<td>1</td>
<td>3012.56</td>
<td>D3.2 %</td>
<td>D3.9 %</td>
<td>409.50</td>
<td>-0.0 %</td>
<td>69.1 deg</td>
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<td>Aircraft</td>
<td>Gate</td>
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<td>L2</td>
<td>L3</td>
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<tr>
<td><strong>B777-300ER (A)</strong></td>
<td>L1</td>
<td>[471.00/500.00]</td>
<td>1</td>
<td>1</td>
<td>3123.75</td>
<td>D0.0%</td>
<td>D0.9%</td>
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<tr>
<td><strong>B777-300ER (A)</strong></td>
<td>L2</td>
<td>[488.00/507.00]</td>
<td>1</td>
<td>2</td>
<td>2803.15</td>
<td>D0.4%</td>
<td>D1.1%</td>
<td>492.80</td>
</tr>
<tr>
<td><strong>B747-8 (A)</strong></td>
<td>L1</td>
<td>[480.00/541.00]</td>
<td>1</td>
<td>1</td>
<td>3205.13</td>
<td>U1.3%</td>
<td>D0.6%</td>
<td>512.72</td>
</tr>
<tr>
<td><strong>B747-8 (A)</strong></td>
<td>L2</td>
<td>[488.00/513.00]</td>
<td>1</td>
<td>2</td>
<td>3157.58</td>
<td>D0.3%</td>
<td>D1.1%</td>
<td>497.77</td>
</tr>
<tr>
<td><strong>A300-600R (B)</strong></td>
<td>L1</td>
<td>[452.00/458.00]</td>
<td>1</td>
<td>1</td>
<td>3583.51</td>
<td>D1.3%</td>
<td>D1.5%</td>
<td>450.21</td>
</tr>
<tr>
<td><strong>B737-400 (B)</strong></td>
<td>L1</td>
<td>[262.00/277.00]</td>
<td>1</td>
<td>1</td>
<td>3788.95</td>
<td>D6.0%</td>
<td>D6.4%</td>
<td>297.49</td>
</tr>
<tr>
<td><strong>B737-800 (B)</strong></td>
<td>L1</td>
<td>[256.00/264.00]</td>
<td>1</td>
<td>1</td>
<td>3786.60</td>
<td>D6.4%</td>
<td>D6.6%</td>
<td>292.60</td>
</tr>
<tr>
<td><strong>A310-200 (B)</strong></td>
<td>L1</td>
<td>[442.10/453.60]</td>
<td>1</td>
<td>1</td>
<td>3573.86</td>
<td>D1.4%</td>
<td>D1.7%</td>
<td>446.87</td>
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<tr>
<td><strong>A320-100 (B)</strong></td>
<td>L1</td>
<td>[339.00/346.00]</td>
<td>1</td>
<td>1</td>
<td>3726.48</td>
<td>D4.3%</td>
<td>D4.5%</td>
<td>356.60</td>
</tr>
<tr>
<td><strong>EMBRAER 195 STD (B)</strong></td>
<td>L1</td>
<td>[259.00/268.00]</td>
<td>1</td>
<td>1</td>
<td>3847.12</td>
<td>D6.2%</td>
<td>D6.5%</td>
<td>292.21</td>
</tr>
<tr>
<td><strong>A318 (B)</strong></td>
<td>L1</td>
<td>[337.00/344.00]</td>
<td>1</td>
<td>1</td>
<td>3705.18</td>
<td>D4.3%</td>
<td>D4.5%</td>
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</tr>
<tr>
<td><strong>A319 (B)</strong></td>
<td>L1</td>
<td>[338.00/345.00]</td>
<td>1</td>
<td>1</td>
<td>3710.83</td>
<td>D4.3%</td>
<td>D4.5%</td>
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<tr>
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<td>L1</td>
<td>[432.00/462.00]</td>
<td>1</td>
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<tr>
<td><strong>B787-8 (A)</strong></td>
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<td>[445.00/475.00]</td>
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<td>2</td>
<td>2704.14</td>
<td>D1.5%</td>
<td>D2.6%</td>
<td>470.27</td>
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<tr>
<td><strong>A321 NEO-PW (B)</strong></td>
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<td>[337.00/346.00]</td>
<td>1</td>
<td>1</td>
<td>3710.88</td>
<td>D4.3%</td>
<td>D4.5%</td>
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<tr>
<td><strong>TU-154M (B)</strong></td>
<td>L1</td>
<td>[359.00/377.00]</td>
<td>1</td>
<td>1</td>
<td>3576.53</td>
<td>D3.5%</td>
<td>D4.0%</td>
<td>374.00</td>
</tr>
<tr>
<td><strong>B737-900W (B)</strong></td>
<td>L1</td>
<td>[259.00/274.00]</td>
<td>1</td>
<td>1</td>
<td>3792.08</td>
<td>D6.1%</td>
<td>D6.5%</td>
<td>294.61</td>
</tr>
</tbody>
</table>
## Gate E9, PBB LB 9A and LB 9B

<table>
<thead>
<tr>
<th>SL</th>
<th>Distance</th>
<th>Aircraft</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0.00 1</td>
<td>B747-400</td>
</tr>
<tr>
<td>C</td>
<td>716.44 1</td>
<td>B757-300</td>
</tr>
<tr>
<td>D</td>
<td>1425.76 1</td>
<td>B737-400, B737-800, A310-200, A320-100, EMBRAER 195 STD, A318, A319, A321 NEO-PW, TU-154M, B737-900W</td>
</tr>
</tbody>
</table>

SL = Stop Line

### Docking results – E9

<table>
<thead>
<tr>
<th>Aircraft (stop line)</th>
<th>Door [min/max]</th>
<th>PBB</th>
<th>Operational length</th>
<th>Slope empty</th>
<th>Slope full</th>
<th>Column height</th>
<th>Closure slope</th>
<th>Cab angle</th>
</tr>
</thead>
<tbody>
<tr>
<td>B747-400 (A)</td>
<td>L1 [474.00/518.00 1]</td>
<td>1</td>
<td>1831.33 1</td>
<td>U1.4 %</td>
<td>D0.7 %</td>
<td>487.53 1</td>
<td>0.8 %</td>
<td>32.3 deg</td>
</tr>
<tr>
<td>B747-400 (A)</td>
<td>L2 [480.00/515.00 1]</td>
<td>2</td>
<td>2659.97 1</td>
<td>U0.7 %</td>
<td>D0.5 %</td>
<td>491.08 1</td>
<td>0.4 %</td>
<td>35.3 deg</td>
</tr>
<tr>
<td>B767-300 (B)</td>
<td>L1 [413.00/450.00 1]</td>
<td>1</td>
<td>1906.59 1</td>
<td>D1.9 %</td>
<td>D3.6 %</td>
<td>447.91 1</td>
<td>-0.0 %</td>
<td>32.1 deg</td>
</tr>
<tr>
<td>B767-300 (B)</td>
<td>L2 [416.00/447.00 1]</td>
<td>2</td>
<td>2797.66 1</td>
<td>D1.7 %</td>
<td>D2.7 %</td>
<td>442.98 1</td>
<td>-0.0 %</td>
<td>36.8 deg</td>
</tr>
<tr>
<td>B777-200 (B)</td>
<td>L1 [471.00/500.00 1]</td>
<td>1</td>
<td>1837.36 1</td>
<td>U0.5 %</td>
<td>D0.9 %</td>
<td>476.85 1</td>
<td>0.2 %</td>
<td>25.2 deg</td>
</tr>
<tr>
<td>B777-200 (B)</td>
<td>L2 [488.00/507.00 1]</td>
<td>2</td>
<td>2737.86 1</td>
<td>U0.4 %</td>
<td>D0.3 %</td>
<td>485.77 1</td>
<td>0.2 %</td>
<td>37.1 deg</td>
</tr>
<tr>
<td>A330-300 (B)</td>
<td>L1 [441.00/455.00 1]</td>
<td>1</td>
<td>1776.75 1</td>
<td>D1.7 %</td>
<td>D2.4 %</td>
<td>451.35 1</td>
<td>-0.0 %</td>
<td>23.8 deg</td>
</tr>
<tr>
<td>A330-300 (B)</td>
<td>L2 [467.00/483.00 1]</td>
<td>2</td>
<td>2749.02 1</td>
<td>D0.5 %</td>
<td>D1.0 %</td>
<td>468.67 1</td>
<td>-0.0 %</td>
<td>36.6 deg</td>
</tr>
<tr>
<td>A340-300 (B)</td>
<td>L1 [445.00/465.00 1]</td>
<td>1</td>
<td>1779.63 1</td>
<td>D1.2 %</td>
<td>D2.2 %</td>
<td>456.89 1</td>
<td>-0.0 %</td>
<td>22.4 deg</td>
</tr>
<tr>
<td>A340-300 (B)</td>
<td>L2 [465.00/491.00 1]</td>
<td>2</td>
<td>2754.19 1</td>
<td>D0.2 %</td>
<td>D1.1 %</td>
<td>474.38 1</td>
<td>-0.0 %</td>
<td>36.5 deg</td>
</tr>
<tr>
<td>B757-300 (C)</td>
<td>L1 [379.00/401.00 1]</td>
<td>1</td>
<td>2241.25 1</td>
<td>D3.8 %</td>
<td>D4.7 %</td>
<td>414.53 1</td>
<td>-0.0 %</td>
<td>43.4 deg</td>
</tr>
<tr>
<td>B757-300 (C)</td>
<td>L2 [384.00/401.00 1]</td>
<td>2</td>
<td>3036.94 1</td>
<td>D3.1 %</td>
<td>D3.6 %</td>
<td>408.52 1</td>
<td>-0.0 %</td>
<td>40.4 deg</td>
</tr>
<tr>
<td>B767-400ER (B)</td>
<td>L1 [413.00/439.00 1]</td>
<td>1</td>
<td>1893.01 1</td>
<td>D2.4 %</td>
<td>D3.6 %</td>
<td>441.54 1</td>
<td>-0.0 %</td>
<td>32.4 deg</td>
</tr>
<tr>
<td>B767-400ER (B)</td>
<td>L2 [441.00/459.00 1]</td>
<td>2</td>
<td>3014.12 1</td>
<td>D1.3 %</td>
<td>D1.8 %</td>
<td>451.22 1</td>
<td>-0.0 %</td>
<td>41.9 deg</td>
</tr>
<tr>
<td>A350-900 (B)</td>
<td>L1 [507.00/537.00 1]</td>
<td>1</td>
<td>1930.81 1</td>
<td>U2.2 %</td>
<td>U0.8 %</td>
<td>499.86 1</td>
<td>1.1 %</td>
<td>30.2 deg</td>
</tr>
<tr>
<td>A350-900 (B)</td>
<td>L2 [510.00/533.00 1]</td>
<td>2</td>
<td>2932.27 1</td>
<td>U1.1 %</td>
<td>U0.4 %</td>
<td>505.72 1</td>
<td>0.7 %</td>
<td>41.5 deg</td>
</tr>
<tr>
<td>B757-200 (B)</td>
<td>L2 [384.00/401.00 1]</td>
<td>1</td>
<td>2464.30 1</td>
<td>D3.6 %</td>
<td>D4.3 %</td>
<td>411.68 1</td>
<td>-0.0 %</td>
<td>51.2 deg</td>
</tr>
<tr>
<td>A300-600R (B)</td>
<td>L1 [452.00/458.00 1]</td>
<td>1</td>
<td>1775.00 1</td>
<td>D1.5 %</td>
<td>D1.8 %</td>
<td>453.01 1</td>
<td>-0.0 %</td>
<td>26.2 deg</td>
</tr>
<tr>
<td>Aircraft Type</td>
<td>Length (m)</td>
<td>Gate Location</td>
<td>Height (m)</td>
<td>Width (m)</td>
<td>Rotation (deg)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------------</td>
<td>------------</td>
<td>---------------</td>
<td>------------</td>
<td>-----------</td>
<td>----------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A300-600R (B)</td>
<td>L2 [461.00/470.00 1 ]</td>
<td>2</td>
<td>2497.82</td>
<td>D0.8 %</td>
<td>D1.2 %</td>
<td>459.43</td>
<td>28.0 deg</td>
<td></td>
</tr>
<tr>
<td>B737-400 (D)</td>
<td>L1 [262.00/277.00 1 ]</td>
<td>1</td>
<td>2943.01</td>
<td>D7.2 %</td>
<td>D7.7 %</td>
<td>305.87</td>
<td>-0.0 %</td>
<td>48.7 deg</td>
</tr>
<tr>
<td>B737-800 (D)</td>
<td>L1 [256.00/264.00 1 ]</td>
<td>1</td>
<td>2940.56</td>
<td>D7.7 %</td>
<td>D8.0 %</td>
<td>301.25</td>
<td>-0.0 %</td>
<td>49.7 deg</td>
</tr>
<tr>
<td>A310-200 (D)</td>
<td>L1 [442.10/453.60 1 ]</td>
<td>1</td>
<td>2728.51</td>
<td>D1.5 %</td>
<td>D1.9 %</td>
<td>447.45</td>
<td>-0.0 %</td>
<td>47.9 deg</td>
</tr>
<tr>
<td>A320-100 (D)</td>
<td>L1 [339.00/346.00 1 ]</td>
<td>1</td>
<td>2874.27</td>
<td>D5.1 %</td>
<td>D5.4 %</td>
<td>362.19</td>
<td>-0.0 %</td>
<td>57.8 deg</td>
</tr>
<tr>
<td>EMBRAER 195 STD (D)</td>
<td>L1 [259.00/268.00 1 ]</td>
<td>1</td>
<td>2999.96</td>
<td>D7.5 %</td>
<td>D7.8 %</td>
<td>300.24</td>
<td>-0.0 %</td>
<td>57.9 deg</td>
</tr>
<tr>
<td>A318 (D)</td>
<td>L1 [337.00/344.00 1 ]</td>
<td>1</td>
<td>2859.21</td>
<td>D5.2 %</td>
<td>D5.4 %</td>
<td>361.69</td>
<td>-0.0 %</td>
<td>53.4 deg</td>
</tr>
<tr>
<td>A319 (D)</td>
<td>L1 [338.00/345.00 1 ]</td>
<td>1</td>
<td>2863.75</td>
<td>D5.2 %</td>
<td>D5.4 %</td>
<td>362.18</td>
<td>-0.0 %</td>
<td>54.5 deg</td>
</tr>
<tr>
<td>B787-8 (B)</td>
<td>L1 [432.00/462.00 1 ]</td>
<td>1</td>
<td>1874.40</td>
<td>D1.3 %</td>
<td>D2.7 %</td>
<td>455.02</td>
<td>-0.0 %</td>
<td>28.2 deg</td>
</tr>
<tr>
<td>B787-8 (B)</td>
<td>L2 [445.00/475.00 1 ]</td>
<td>2</td>
<td>2684.76</td>
<td>D0.7 %</td>
<td>D1.8 %</td>
<td>462.94</td>
<td>-0.0 %</td>
<td>34.6 deg</td>
</tr>
<tr>
<td>A321 NEO-PW (D)</td>
<td>L1 [337.00/346.00 1 ]</td>
<td>1</td>
<td>2863.81</td>
<td>D5.1 %</td>
<td>D5.4 %</td>
<td>361.45</td>
<td>-0.0 %</td>
<td>54.5 deg</td>
</tr>
<tr>
<td>TU-154M (D)</td>
<td>L1 [359.00/377.00 1 ]</td>
<td>1</td>
<td>2750.97</td>
<td>D4.2 %</td>
<td>D4.8 %</td>
<td>379.16</td>
<td>-0.0 %</td>
<td>51.7 deg</td>
</tr>
<tr>
<td>B737-900W (D)</td>
<td>L1 [259.00/274.00 1 ]</td>
<td>1</td>
<td>2944.79</td>
<td>D7.4 %</td>
<td>D7.9 %</td>
<td>303.11</td>
<td>-0.0 %</td>
<td>50.8 deg</td>
</tr>
</tbody>
</table>