Terminal 3 of Changi Airport Singapore

WEAVING THE AIRPORT'S GREEN TAPESTRY

Text by Franklin Po
Images as credited

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PROJECT CREDITS

Location: 65 Airport Boulevard Singapore **Client:** Civil Aviation Authority of Singapore **Completion Date:** 2008 **Architect:** Airport Design Division CPG **Landscape Architect:** Tierra Design (S) Pte Ltd **Design Consultant:** SOM New York **Interior Designer:** Woodhead Wilson **Main Contractor:** Shimizu (S) Pte Ltd **Landscape Contractor:** Hortiflora Pte Ltd **GFA:** 380,000 m^2

There are many green walls and significant landscape projects around the world, but the Green Tapestry is unique, since the airport is operational 24 hours a day, 7 days a week.

The highly dense city-state of Singapore made a commitment to create a sustainable balance between the demands of growth and the greening of its environment. From a "Garden City", it aspired to and became the "City in a Garden". The client, Civil Aviation Authority of Singapore, was committed to the idea of bringing the City-in-a-Garden concept to Changi Airport Singapore. Opened in 2008, Terminal 3 was constructed to meet the increase in air traffic. The 380,000-square-metre terminal has three basements and four aboveground levels, and an annual handling capacity of 22 million passengers.

Commencing in 2000, the landscape design was incorporated at the very early stages of the project, allowing for a holistic design approach. The landscape designers from Tierra Design sought to create living spaces without borders between buildings and garden, or architecture and landscape, by combining building technology and a living green "veil"—the Green Tapestry. The latter is one of the terminal building's highlights, a feature green wall, and a perfect example of how vertical planting can significantly affect overall interior ambience with a small footprint in plan. The interior space is seen as a continuation of the exterior airport gardens, which are visible through the wide and tall glass "skin" of the building.

The architecture of Terminal 3 sought to offer the latest in airport facilities and a new experience for passengers, guided by four design principles: clarity, natural lighting, external views, and maintainability. The interior architecture is conceived with layers of ceiling panels, baffles, skylights, and high-tech "butterflies" that evoke the imagery of a rainforest canopy. The unique roof lets soft natural light into the building yet keeps tropical heat out with 919 skylights, each designed with special reflector panels that automatically adjust to maintain ideal levels of soft and uniform daylight indoors. The other aspect of the architecture focused on reducing the energy demands of the round-the-clock facility, through an intelligent building management system.

Located in the transitional zone of Terminal 3, the Green Tapestry separates two spaces, the landside check-in and the airside lounges, from each other. Both the architects and landscape designers wanted to establish an interior environment where planting has an integral role in blending and interacting with the architecture, not just as accents and decoration. The intent was to use landscape elements to develop a unique landscape design palette appropriate to the scale and use of the building. Visible from 100 metres away, the large wall that is now a living green tapestry and stretches five storeys tall provided an opportunity to present plants *en masse*.

The green wall was an innovative solution to the task of creating the greatest impact with plants in the least amount of floor plan space and "softening" the otherwise brutal, hard, and unfriendly wall between the landside and airside. Spanning 300 metres and 4,200 square metres, the vertical garden is separated by four water features. The suspended I-beams and stainless steel cable structure are covered with vines, creepers, and epiphytes. Passengers walking through the Terminal 3 building can enjoy the interior suspended vertical garden from not only the departure area but also the arrival area.

Unprecedented at such a scale at the time of the design, introducing so much greenery into an air-conditioned space posed a great challenge. Unfazed, the landscape architects felt that "conditions seemed right to attempt something bold". The solution had to include a low-cost, lightweight system for growing massed climbing plants. Suitable plant species had to be tested for viability in an indoor, low-light, and air-conditioned environment. Plants potentially suitable were installed on test racks in Terminal 1 for four years to ascertain their performance in comparable environmental conditions.

Seven species of climbers and a dozen species of epiphytes were identified and selected based on their growth rate, tolerance of light levels, foliage quality, flowering capability, ease of maintenance, and

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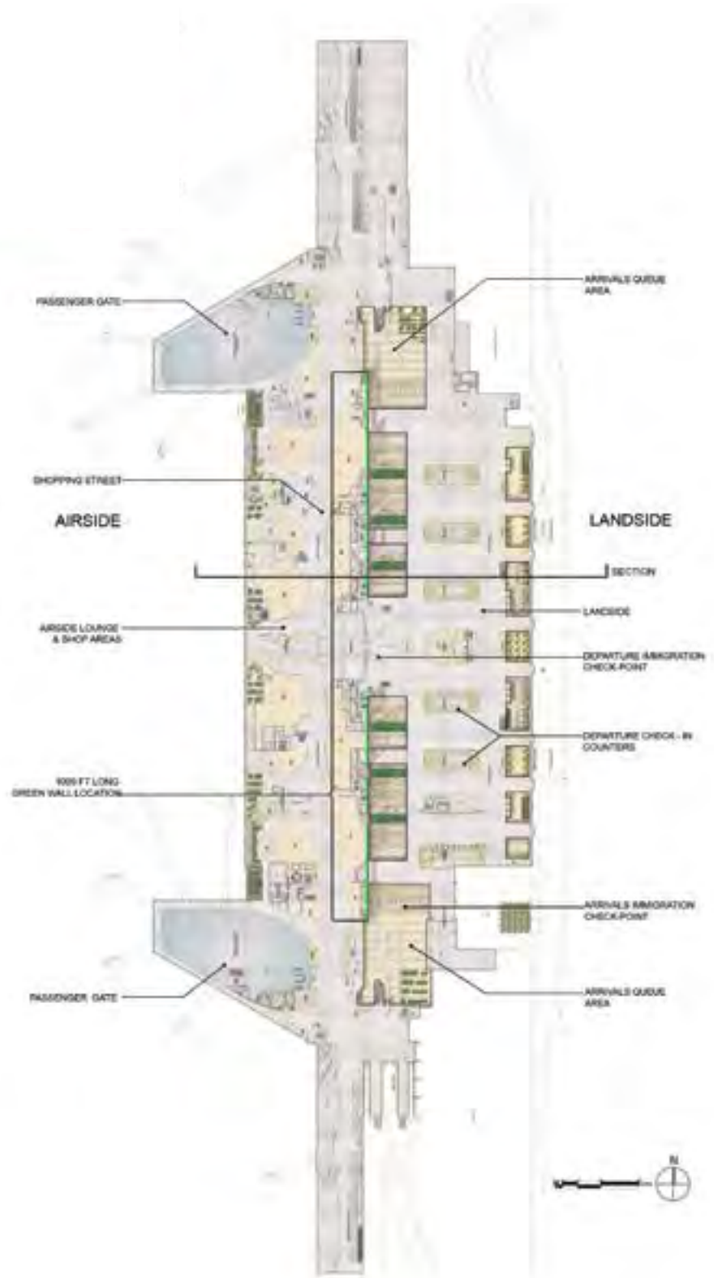

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Landscape Design Plan Used to Articulate Various Programmes (Drawing: Tierra Design (S) Pte Ltd)

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1. The Green Tapestry is visually spectacular in the transitional zone of Terminal 3 (Photo: CPG Consultants Pte Ltd).

2, 3. The five-storey-tall vertical garden is 300 metres long and spans 4,200 square metres (Photos: Tierra Design (S) Pte Ltd).

5. Inspired by a rainforest canopy, the landscape design and interior architecture were conceived to integrate seamlessly (Photo: CPG Consultants Pte Ltd).

6. Interior spaces are enhanced by floor and wall surface patterns and textures (Photo: Tierra Design (S) Ptd Ltd).

8-10. The green wall consists of over 10,000 plants, including 7 species of climbers and 12 epiphytes identified and tested for their feasibility (Photos: Albert KS Lim).

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Cross Section of Green Wall (Drawing: Tierra Design (S) Pte Ltd)

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sustainability. Climbers included the Elephant Climber (*Argyreia nervosa*), Porcelain Flower (*Hoya carnosa*), and Red Jade Vine (*Mucuna bennetti*), while epiphytes included bromeliads, ferns, orchids, and philodendrons. As opposed to pattern making, the design of the infrastructure system was about how to allow vines to grow and cling. The process is compared to "gardening", except in the air instead of on the ground, which takes time, commitment, patience, care, and nurturing.

The unique characteristic of plants found in a tropical rainforest inspired the selection of plants for the vertical garden. In the rainforest, vines, and epiphytes successfully compete for growing space by lifting themselves up off the ground with the help of taller neighbours, or volunteering themselves onto wet bark of living trees. They manage to survive and thrive with less neighbours crowding about them; in this manner they are able to reach further to the rainforest canopy to gather light for life-sustaining photosynthesis.

At Terminal 3, the Green Tapestry consists of more than 10,000 plants. The design maximises planting space in order to introduce more greenery, warmth, and softness to the predominantly stone, glass, and steel structure of this megastructure. It achieves this without losing valuable floor space. An irrigation system provides water, with the help of occasional misting to replace humidity removed by air-conditioning. Extensive skylights allow sufficient light for plants to thrive. Hanging three metres over the baggage claim area, the green wall rises 14 metres into the voluminous cavity of the building.

There are many green walls and significant landscape projects around the world, but the Green Tapestry is unique, since the airport is operational 24 hours a day, 7 days a week. It had to be designed to be maintained easily without the need for scaffolding. The plants are grown on stainless steel cables secured to the steel infrastructure system and each cable is removable if there is a need to replace plants individually. Catwalks were designed to allow safe access to the planters from behind the planting layers.

Like any garden, the Green Tapestry has matured and evolved in response to the care that it is given, and the Airport Authority has been 100 percent committed to the maintenance of the green wall. The vertical garden will be an ever changing tapestry of living textures—a demonstration of dynamic landscape architecture. The impact of this green concept has been far reaching, with the Airport Authority now greening and upgrading the older terminals through the introduction of different types of gardens. CG

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