For Discussion
on 15 March 2016

Legislative Council Subcommittee to Follow Up Issues Relating to the Three-runway System at the Hong Kong International Airport

Third Runway Concourse and Related Terminal Facilities, Including Green/Environmental-friendly and Innovative Features

Introduction

This paper introduces the conceptual design for the Third Runway Concourse ("TRC") and related terminal facilities, focusing on the environmental-friendly ("green") and innovative features that are proposed for the expansion of the Hong Kong International Airport ("HKIA").

Background

2. At the meeting on 1 December 2015, Members were given an overview of the scope of the three-runway system ("3RS") project, covering, inter alia, the construction of the TRC (LC Paper No. CB(4)275/15-16(01)). This paper will focus on the green and innovative aspects of the TRC and related terminal facilities ("3RS Buildings") and how these features complement HKIA's commitment of being one of the World's Greenest Airports and its vision of becoming a smart airport. In setting out the green design principles for the 3RS Buildings, it should be noted that the design will be finalized only after detailed design. As regards innovative features, Airport Authority Hong Kong ("AAHK") has developed a technology roadmap to guide the implementation of technologies that are relevant to the development of HKIA to becoming a smart airport. Nevertheless, innovation and technologies advancement are fast changing, therefore their implementation at HKIA may be refined later taking into account the availability and readiness of the technologies and applications prevailing at that time.

Green Design Principles for the 3RS Buildings

3. On the basis of the scope as set out in AAHK's Master Plan 2030, the 3RS is planned to cater for an additional 30 million passengers per annum ("mppa"). Upon completion of the 3RS, HKIA would have the capacity of handling around 100 mppa by the year 2030, with the potential for further expansion, if and when necessary. The sheer size of the project offers significant and timely opportunities to incorporate various green and sustainable initiatives in the design, construction and operation aspects of the 3RS Buildings to help make HKIA one of the greenest airports in the world.

4. In general, the green credentials of a building are awarded on aspects of energy efficiency, water consumption, air quality and waste management. For the 3RS Buildings, we would strive to achieve, where practicable, the highest possible rating in the BEAM Plus Assessment[1], which is a standard that defines building quality. This initiative is a positive response to the recommendation by the Advisory Council on the Environment during the approval of the 3RS Environmental Impact Assessment Report, and to meet our pledge to develop HKIA as one of the world's greenest airports. It should be noted that under the BEAM Plus Assessment, it might be more straightforward for commercial and residential buildings to obtain a high rating than special prototype mega-architecture such as those of the 3RS buildings.

<u>Energy Efficiency</u>

5. In Hong Kong, buildings account for a significant portion of total energy consumption. Reducing energy consumption helps reduction of fuel consumption which in turn reduces the corresponding emissions of pollutants and greenhouse gases. To profile energy consumption and identify potential savings for the 3RS Buildings, detailed energy modelling will be conducted taking into account building envelope parameters, mechanical and electrical services, climatic data and occupancy schedules. Energy conservation strategies will then be developed for the planning and design of the 3RS Buildings, including the formulation of a shading strategy which aims to achieve the optimum energy performance through reducing solar heat gain, thereby lowering energy consumption by the cooling system.

---

[1] BEAM Plus is a comprehensive environmental assessment scheme for buildings recognized by the Hong Kong Green Building Council Limited ("HKGBC").

6. In general, passive and active design methodologies will be considered and adopted where practicable to achieve higher energy efficiency. Passive design techniques primarily capitalize on the use of natural daylight to offset demand for artificial light use. The availability of daylight in the building will be optimized by featuring a mixture of high performance façade glazing and roof glazing strategy while maintaining visual comfort and preventing excessive cooling load at the same time. Different sky conditions that Hong Kong experiences will be considered in the daylighting design to achieve the best energy performance in terms of daylight and cooling load for the 3RS Buildings. **Figures 1** and **2** illustrate the overall shading design strategy and the 3RS Buildings envelope façade performance.

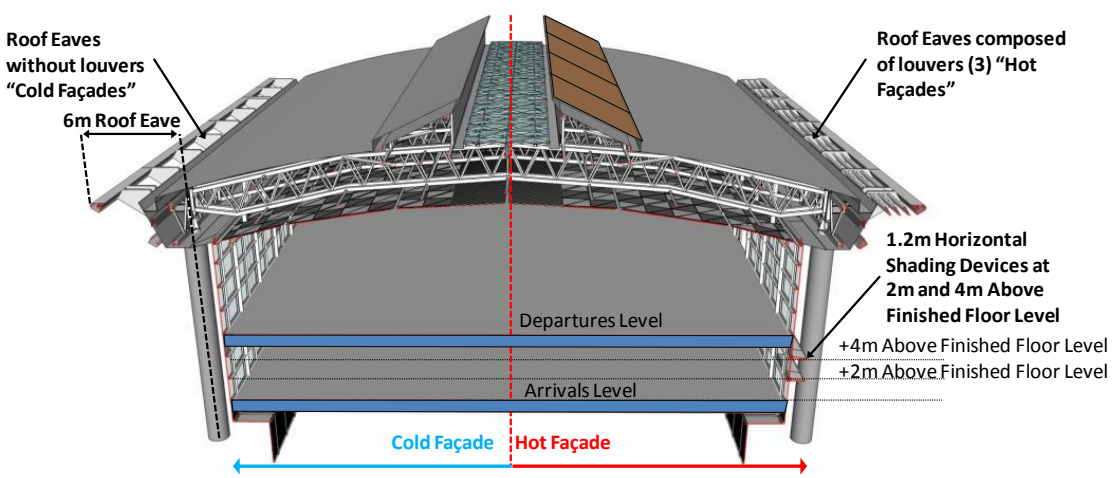

Figure 1 : Overall Shading Design Strategy

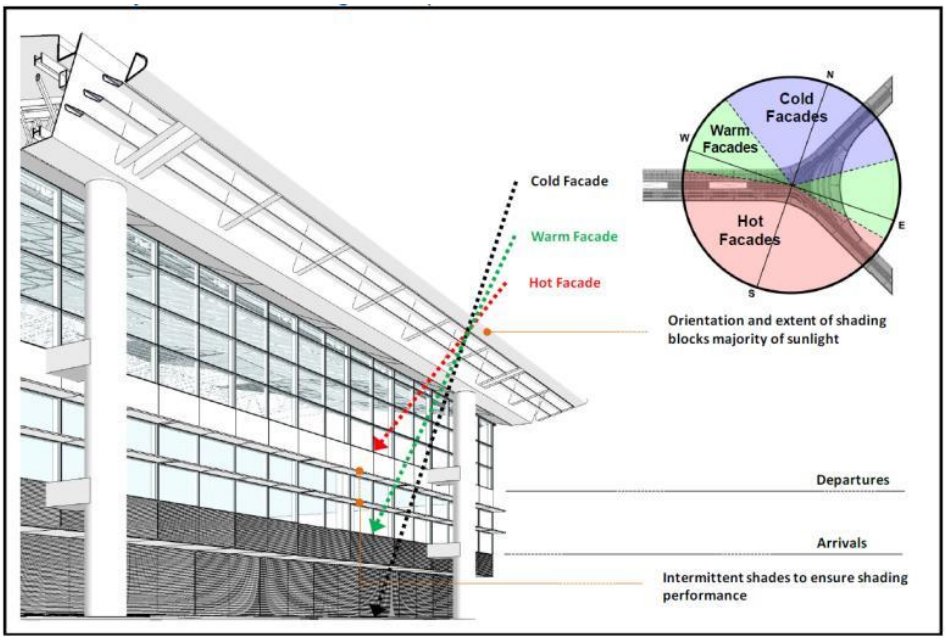

Figure 2 : 3RS Buildings Envelope Façade Performance

7. In summary, the key energy saving features proposed for the 3RS Buildings façade are :

(a) balance of window to wall area to optimize shading effect, insulation and natural light to public spaces;
(b) high performance glazing;
(c) high reflectance roof material;
(d) photovoltaic panels integrated into the roof (thereby providing a source for renewable energy); and
(e) opaque façade elements to reduce heat transfer into the building.

8. Furthermore, the introduction of courtyards in the TRC can transform a typical deep plan concourse into a shallow plan concourse that improves daylight conditions. With proper design of the courtyards in terms of sizing, landscape and connectivity to its surroundings, they can serve as a potential fresh air intake to the air-conditioning system for the concourse. Courtyards can also perform as transient environments, providing the opportunity for passengers to experience diverse microclimatic conditions that differ from the typical indoor constant environment. In short, courtyards can help energy savings on lighting and air-conditioning whilst achieving passenger comfort. **Figures 3** and **4** show the artist impression of the central courtyard from the departure corridor and the sunken courtyard from the arrival corridor respectively.

Figure 3 : Artistic Impression of the Central Courtyard (at the left)from the departure corridor

Figure 4 : Artistic Impression of the Sunken Courtyard (at the left) from the arrival corridor

9. Apart from passive design strategies, low energy active design techniques also help deliver services (e.g. lighting, cooling, water pumping etc.) to the buildings in the most efficient way. Efficient lighting design and the use of the latest technology represents opportunities for energy savings. The lighting design strategy for 3RS Buildings focuses on providing the correct amount and quality of light to the appropriate spaces. Features of an integrated lighting design include skylight for natural daylight penetration with added louvers to reduce heat transfer to the building, optimized downlights and uplights, high-quality LEDs for specific light spaces and lighting control sensors in not normally occupied spaces to further enhance energy performance. External lighting is only provided where necessary for the safety and functionality of the airport.

10. In addition, the extensive roof area that would be exposed to sunlight for the 3RS Buildings provide the opportunity for photovoltaic ("PV") panels to be utilized. Optimum use of PV panels can convert the solar energy into electricity effectively and therefore reduce overall electricity demand on the main systems.

Water Consumption

11. The water management approach applies a hierarchical approach to water consumption, with a focus on initially reducing potable water consumption and then investigating options for reuse. The primary strategy for the reduction of potable water consumption in the 3RS Buildings is to use direct seawater in cooling system and treated seawater for all toilets flushing in the building. In addition, low water consumption flush fittings will be adopted.

12. Grey water from washing basins, cleaner's sinks, showers, kitchen sinks as well as air-conditioning condensate will be collected and treated by the grey water treatment plant for reuse as irrigation water. Furthermore, it is proposed to utilize the building roofs to collect rainwater, distribute the water collected to wash bays where it will be stored, treated and used for cleaning aircraft, vehicle washing and general cleaning where suitable.

Air Quality Management

13. AAHK's approach to air quality management is to reduce air emissions that are under AAHK's direct control (i.e. emissions related to AAHK vehicles), and to facilitate emissions reduction which AAHK can guide or influence. The latter includes airside vehicles operated by airport business partners and aircraft on the ground.

14. AAHK has stipulated specifications on emission standards in the requirements of Airside Vehicle License, with which all airside vehicles must comply. Since electric vehicles ("EVs") produce no tail pipe emissions, eliminating diesel-powered vehicles in the airfield through the use of EVs has the potential to significantly benefit air quality in the airport. As part of AAHK's ongoing efforts to facilitate the transition to EVs and electric ground service equipment, charging stations will be installed widely as part of the 3RS project. By the end of 2017, all airside saloon vehicles will be EVs. The number of charging stations for EVs and electric ground support equipment will be increased to 290 by end of 2018. **Figure 5** shows the existing EV and charging station.

Figure 5 : Existing EV and Charging Station

15. Since the end of 2014, all aircraft at frontal stands have been banned from using Auxiliary Power Units to reduce emissions. As an on-going commitment to reduce emissions from the aircraft parked at the gates in the TRC, aircraft stands will be equipped with fixed ground power and pre-conditioned air to maintain the aircraft systems running while the engine is shut off.

16. As for the improvement of indoor air quality, elimination of pollutant sources is important and low-emitting materials such as low volatile organic compound materials will be selected for use in the 3RS Buildings to aim for Excellent classification of Environmental Protection Department's Indoor Air Quality Certification Scheme for Offices and Public Places.

Waste Management

17. Waste management is one of Hong Kong's most pressing environmental issues. HKIA focuses on minimizing and reducing the absolute amount of waste generated and facilitating waste separation at source to promote recycling. An effective way to minimize waste during the project development process is through green procurement i.e. the purchasing of products and services that cause minimal adverse environmental impacts. It incorporates human health and environmental concerns into the search for high quality products and services at competitive prices. Green procurement is one aspect of AAHK's environmental footprint reduction measures as set out in its Five-Year Environmental Plan.

18. There is certainly an opportunity to utilize green procurement contract processes to deliver green commitments and additional performance improvements as part of the 3RS project. Drawing from the current HKIA and global best practices, different options will be considered for the 3RS project, e.g. the use of reused or recycled materials; regionally manufactured materials in construction; use of modular and/or pre-fabricated design; specification of good and simple construction practices; and reduced construction waste. Similar to the existing tenants in T1 and T2, green guidelines will be provided to facilitate the future tenants of 3RS Buildings working towards a green operation. In terms of waste recycling, AAHK will continue with its policy of facilitating the segregation of recyclable wastes at source.

Innovation and Technology in HKIA

Smart Airport

19. HKIA is envisioned to become a "smart airport" that makes effective use of technology and innovation to improve passenger experience and operation efficiency. AAHK has developed a roadmap to provide implementation guidelines for the technology development in HKIA to achieve the smart airport vision as well as to complement the future expansion of the airport.

Smart Infrastructure

20. To enable the transformation of HKIA into a smart airport, it is necessary to set up the supporting smart infrastructure. Currently, the airport IT network, which includes both wired and wireless connections, covers the majority of the airport area. There are, however, silo networks such as those for building management and surveillance services. AAHK is progressively implementing plans to improve and upgrade the smart infrastructure to connect the silo systems to the main airport network with a view to building a seamless integration of information from all airport processes at real-time such that timely and comprehensive information will be collaborated for better decision making and enhanced airport operation.

21. In addition, new sensing networks for Internet-of-Things ("IoT") [2] such as i-Beacon [3] infrastructure, platforms to enable data analytics and open data will be built to further enrich the infrastructure. Furthermore, the HKIA is studying various options of next generation wireless communication platform to further improve the wireless coverage, throughput and reliability to facilitate an agile workforce and to enhance passenger connectivity.

22. Leveraging on the enhanced smart infrastructure, AAHK envisions that the application of innovation and technology in HKIA will achieve four major objectives :

---

[2] Internet of Things refers to the ever-growing network of smart physical objects (things) connected to internet and the communication that occurs between these objects and other internet-connected devices and systems. An example applied to an airport is smart sensors (environmental, traffic, object tracking etc.) which provides enormous opportunities for monitoring, control and process optimization.

[3] In simple terms, iBeacon technology, through the use of its Bluetooth Low Energy, allows Mobile Apps to understand their position on a micro-local scale, and deliver hyper-contextual content to users based on location.

(A) Increasing automation to become less labour-dependent;
(B) Enhancing personalized services;
(C) Maximizing self-services; and
(D) Facilitating efficient processes.

(A) Increasing Automation to Become Less Labour-dependent

23. Aviation is a time critical industry. Increasing automation and use of robotics not only can enhance efficiency but also reduce reliance on labour. This is important to enhance the efficient operation of HKIA as one of the busiest airports in the world. Amongst all operating procedures, a sophisticated and reliable Baggage Handling System ("BHS")/procedure is one of the critical success factors for an efficient airport operation. As such, AAHK will be investing into state-of-the-art BHS technology in the years to come, including that of the 3RS project.

24. Currently, baggage to and from the Terminal 1 ("T1") baggage hall is transported by a manual "tug-and-dolly" system. Given the long distance between the TRC and the baggage hall at the expanded Terminal 2 ("T2") (over 2.6km), a high speed and fully automated BHS will be built to ensure a high level of baggage delivery service. The BHS will connect the TRC with T2 and provide baggage security screening and early baggage storage facilities. A high speed Individual Carrier System ("ICS") will be adopted in the TRC BHS design. This ICS is capable of working up to 10 m/sec in BHS tunnel section, as compared to the speed of the existing conveyor based T1 BHS system at 2 m/sec. This will ensure that the first arrival bag is delivered to the baggage carousel within 20 minutes of arrival.

25. To complement the BHS, the tool-assisted baggage loading system, Stack@Ease (**Figure 6**), which was successfully trialled at HKIA in 2015, is planned for full implementation in 2016/17. This loading aid solution takes the heavy lifting condition out of the baggage handling environment. It helps operators load containers and carts efficiently, and minimizes their physical workload. This greatly reduces the risk of strain and injury caused by heavy lifting tasks and makes such working environment more amenable to female workers.

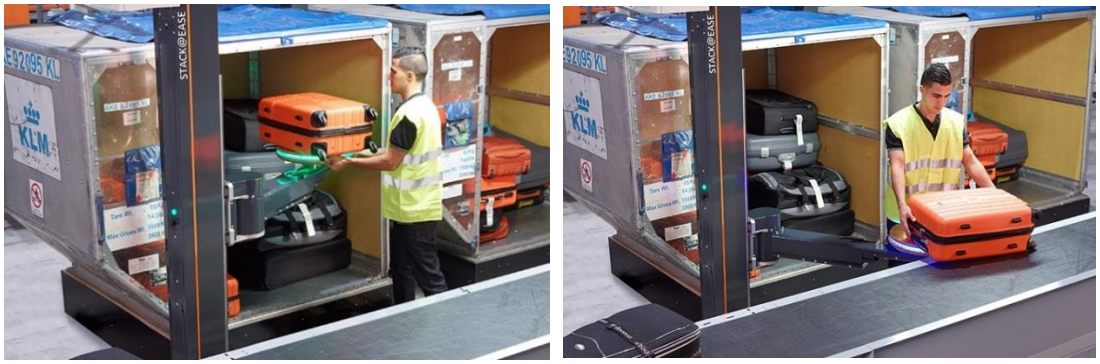

Figure 6 : STACK@EASE

26. The possibility of adopting other new opportunities such as robots with natural language recognition and processing for customer services, service robots for cleaning, patrol, baggage loading and unloading, and autonomous vehicle would be further explored in the course of the detailed design of the 3RS project.

(B) Enhancing Personalized Services

27. There is an increasing expectation of seamless and personalized services, including those of airport services. Passengers expect personalized and intelligent information and services to be delivered at the right time and at the right place. Riding on HKIA's mobile application "HKG MyFlight" which already offers context-aware (time, location, flight taken) push notifications, such as flight status alerts and marketing promotion, more personalized notification, including baggage arrival notification and location based boarding alerts will be added. In addition, location-based way finding solution[4] with augmented reality, next generation displays and customer services with wearables are in the pipeline for the carrying out of feasibility study and/or implementation.

(C) Maximizing Self-Services

28. Passengers expect more choices and control during their travel journey. Self-service is an option preferred by more than 75% of passengers[5]. Our vision for the future airport is to enable convenient, fast and hassle-free travel via full self-service facilities from check-in, through airside entry, security and border control, to boarding with

[4] Location-based way-finding solution means that the system will provide a point-to-point detailed path from the current location of the requester to his point-of-interest.

[5] Source : International Air Transport Association ("IATA")'s 2014 Global Passenger Survey

biometrics. Common Use Self Service ("CUSS") kiosks have been implemented at HKIA since 2007. Installation of Self Bag Drop started in late 2015. Moving to the next stage, new services such as the NextGen Kiosk (i-CUSS), automatic document check (i.e. passport and travel VISA check), flight rebooking, self-boarding and late/lost bag recovery are being planned.

(D) Facilitating Efficient Processes

29. With the commissioning of the 3RS, HKIA will expand in size and its management and operation will become more complex. To upkeep the expanded infrastructure and environment, smart technologies have to be deployed to continuously monitor and control the environment. Radio Frequency Identification ("RFID") tracking on baggage and Global Positioning System ("GPS") tracking of motorized vehicles have been implemented. Trials are being conducted on baggage trolley tracking and high speed camera maintenance inspection with intelligent analysis. Other technologies, such as video/image analytics for passenger flow and queue management, smart sensors/IoT for environment control, big data analytics for automatic fault detection/prediction, mobile solution for asset management, enterprise Geographical Information System ("GIS") and Building Information Modelling ("BIM") will be explored in the next phase.

30. Good and seamless communication and information flow among the community is a key success factor for the overall efficiency of an airport, with aircraft turn-around and pre-departure sequencing process being one of the critical functions. HKIA is in the process of implementing the Airport Collaborative Decision Making ("A-CDM") which is a system that promotes information sharing and improve information flow amongst partners of the airport community.

Providing Platform to Promote Innovation and Technology

31. While the aviation industry has been consistently searching for new technologies to improve efficiency and cost-effectiveness in providing better products and services, Hong Kong is home to a great number of technology companies and research institutes at the forefront of developing these technologies and applications.

32. To drive systematic technology application and development for supporting HKIA's long-term vision as a smart airport, the AAHK Technovation Board was established in 2015. Representatives from the

aviation industry, research and development experts and technology professionals have been contributing professional and technological inputs to innovative ideas and business challenges faced by HKIA; advise on visionary and futuristic technology and innovation for HKIA; and facilitate the participation and development of local technologies at HKIA.

33. Furthermore, partnership with local universities and research institutes on studies of applying new technologies in HKIA will be initiated while small-and-medium enterprise and start-up companies will be invited to join the research projects. In this regard, the Technovation Fund set up by AAHK recently approved funds for these projects. Currently, two innovation projects with HK Science and Technology Park incubated startups to apply video and high speed imaging for fault detection to improve operations efficiency are in progress.

Advice Sought

34. Members are invited to note and comment on the issues covered in this paper.

Airport Authority Hong Kong
March 2016