SUMMARY OF TECHNICAL ASPECTS OF THE ELEVATED HIGHWAY

1. The South Asia Subregional Economic Cooperation (SASEC) Port Access Elevated Highway (PAEH) Project will construct about 5.3 kilometers (km) of a four-lane elevated toll highway with related facilities between the New Kelani Bridge (NKB) and Galle Face in central Colombo.[1] It will provide a direct link to the Colombo–Katunayake Expressway (CKE) via the NKB from the city center and the port, and then constitute a part of the expressway network of Sri Lanka.[2]

2. The proposed alignment, the entire section of which is located inside Colombo port premises, will enable the project to be practically implementable without considerable negative social impact. However, the limitation of the right-of-way constrains the horizontal alignment, pier locations, and construction management.

3. **Alignment**. The elevated highway starts from the NKB at an elevation of 15 meters (m). It extends right on the top of the existing port access road for about 1.4 km, then goes along the port property boundary wall, keeping the elevation between 14.7 m and 22.7 m across the existing canal, and finally reaches the Galle Face at ground level with 4% slope (Figure 1).[3]

Figure 1: Proposed Port Access Elevated Highway

Source: Road Development Authority, Sri Lanka.

4. **Design criteria.** These include the following:

- Design speed: 80 km per hour
- Loading:[4] 45 units HB loading (BS5400), the worst case or highest loading scenario
- Vertical clearance: 5.2 m outside the port area and 10.0 m inside the port area
- Design life of 120 years
- Seismic factor:[5] 0.1g

5. **Ramp**. The design speed for the ramp is 50 km per hour. The desirable distances between ramps in urban areas are 2.5 to 5.0 km. However, based on the traffic study and the requirement of the Sri Lanka Port Authority (SLPA), there are three ramp points and each point has one on-ramp and one off-ramp:

(i) Ingurukade ramps include on-ramp to port city direction and off-ramp from the port city to NKB direction. This project provides for future ramp construction in the future.

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[1] The project will construct along the route a dedicated ramp to the port for port-related traffic.

[2] Japan International Cooperation Agency (JICA). 2014. *Ex-Ante Evaluation: New Bridge Construction Project over the Kelani River*. JICA is financing the NKB.

[3] The elevation is the level of surface of highway, including the height of piers, beams, and pavement.

[4] In the Bridge Design Manual 1997 issued by Sri Lanka's Road Development Authority (RDA), HB 30 unit is recommended. Considering the usage of port cargo and for consistency with the connecting NKB, 45 units HB loading is applied.

[5] This project is the first highway project in Sri Lanka to consider the seismic factor. The Road Development Authority has decided to include seismic analysis based on the draft design criteria for structures on expressways that were prepared in April 2016.

(ii) Pettah ramps serve the future transport terminal at the western side of the PAEH. This project will construct the sections of the on-ramp up to 355 m long, and 50 m span for off-ramp. The Pettah on-ramp is set as third level right-turn structure clearing the PAEH through a 44-meter-long span box girder.

(iii) Port ramp has 695 m on-ramp from the port to NKB direction and 589 m off-ramp from the NKB to the port.

6. **Superstructure.** The superstructures for the mainline viaduct comprise twin 11.7 m wide precast (PC) box girder to be constructed with 100 millimeter (mm) gap at the median.[6] At some sections of the mainline viaduct (e.g., merging and diverging points of ramps, curve widening), the width of the box girder varies from 13.5 m to 28 m.

7. The PAEH has many curves due to right-of-way limitation. At sections where the curve radii range from 252 m to 280 m, curve widening is adopted. Subsequently, the column dimensions increase due to unbalanced movement resulting from the eccentricity of the wide structures on curve. Around 22% (1.17 km) of the total elevated highway need curve widening.

8. In addition, the width of the beam increases to as much as 47.5 m at the ramp location

9. **Substructure**. There are 118 piers and one abutment on the mainline and 19 piers for the ramp. On the mainline, all piers are over 11 m in height except the last three piers connecting to the ground. At least 85 piers are over 15–20 m in height. The six piers for the Pettah ramp are 18–26 m high as the ramp needs to fly over the mainline to merge the highway.

10. **Pier location.** Due to right-of-way limitation, avoidance of existing utility lines, and the requirement of four lanes for the existing port access road during construction, two types of column pier (center columns and portal pier) are used except for four telescopic piers at particular locations. The pier locations are fixed with different intervals. In turn, the structural spans vary from 26 m to 54 m. There are 36 spans longer than 45 m. The design engineer suggested precast segmental method for center pier construction—considering the operation arrangement, limited construction space, and reduced construction period. Yet, cast-in-situ is generally less expensive than the precast segmental method as the precast mold and transport are costly. The cost estimation is based on the precast method at most, while bidders are allowed to propose the appropriate construction method.

11. Pier-head rotation construction method is recommended by the design engineer although it is more costly than the fixed pier-head construction method because of the limitation of right-of way and space constraints of the construction site.

12. **Foundation**. The elevated structures will generally be founded on bored piles with pile cap except at three specific locations where telescopic piers are recommended due to space restrictions. The telescopic piers will be supported by bored piles without pile cap (pile bent). As the project is located near the western coast of Sri Lanka, the geological conditions are considerably complex and poor. The rock level varies widely from one location to another. At many locations, bedrock is observed at depths between 5 m and 35 m. However, the depth of the sound bedrock varied from about 10 m to 75 m. The pile tip has to reach the bearing stratum for

[6] Rigid frame box girder is more economical than the I girder or simple box girder when designing with the higher loading standard and with a long span of 45 m.

enough support. Thus, the length of the piles varies from 9 m to 78 m. The pile construction shall be cast-in-situ.

13. **Construction management**. The SLPA requires no disruption to traffic flow in the port area: (i) at least two lanes per direction will be maintained during the construction phases of the project for widening of the existing road (1.4 km); (ii) only limited working space is allowed due to the right-of-way limitation. Rotating capping method is recommended to save space. For most of the alignment, only a 13-m wide temporary construction site is given to contractors; and (iii) to maintain the normal operation of the port, working hours are to be controlled.