For Discussion
on 16 May 2008

Legislative Council Panel on Transport
Hong Kong-Zhuhai-Macao Bridge

PURPOSE

This paper provides Members with supplementary information on the preparation work and studies to-date on the Hong Kong-Zhuhai-Macao Bridge (HZMB).

BACKGROUND

2. At the meeting of the Legislative Council Panel on Transport held on 25 April 2008, we briefed members on the progress of the planning work for the HZMB, the Hong Kong Boundary Crossing Facilities (HKBCF) and the link road in Hong Kong, and sought Members' support for funding applications to be made to the Public Works Subcommittee and the Finance Committee for the preconstruction works for the HZMB, and the investigation and preliminary design (I&PD) study for the HKBCF. We undertook to provide more information on the traffic projection and economic benefits of the HZMB. We also agreed to provide additional information on the split of government subsidy for the HZMB, as well as a more detailed breakdown of the cost of the preconstruction works for the project.

3. Our next stage of work is to commence the preconstruction works for the HZMB including the tender exercise, as well as to carry out related studies. Therefore it must be pointed out that some of the additional information provided in the ensuing paragraphs is inevitably preliminary in nature (for

example, traffic projection) and that some information requested is still not available at this stage (for example, the exact amount of government subsidy). Such information will be further refined or provided upon completion of further studies and in light of proposals from and negotiation with the future investor.

TRAVELLING TIME

4. The HZMB will result in a significant reduction in relevant travelling time between Hong Kong and the Western Pearl River Delta (PRD). As illustrated by the table below, the travelling time between Zhuhai on the one hand, and the Kwai Chung Container Port and the Hong Kong International Airport on the other, will be reduced by more than 60% and 80% respectively.

Origin – Destinations	**Current Distance and Travelling Time**	**Distance and Travelling Time with HZMB**	**Reduction in Distance and Travelling Time**
Zhuhai — Kwai Chung Container Port	approx. 200km approx. 3.5hrs	approx. 65km approx. 75mins	> 60%
Zhuhai — Hong Kong International Airport	over 200km approx. 4hrs	approx. 40km approx. 45mins	> 80%

TRAFFIC PROJECTION

5. The present freight and passenger traffic between the western PRD[1] and Hong Kong is predominantly water-borne. Land transport to and from Hong Kong via the Humen Bridge, due to its northern location in the PRD, is not attractive to the western coastal cities such as Zhuhai, Zhongshan, Jiangmen in the western PRD. According to a traffic survey conducted by Planning Department in 2003, only about 1.8% of the traffic using the Humen Bridge was destined to or originated from Hong Kong.

6. With the HZMB, we expect more intense economic activities and therefore significant growth in freight and passenger traffic between the western PRD and Hong Kong. According to the assessment of the China Highway Planning and Design Institute (HPDI) in carrying out the Feasibility Study of the project, the volume of cross boundary freight traffic between Zhuhai, Jiangmen as well as Zhongshan and Hong Kong will increase from 16 million tonnes per year in 2005 to 93 million tonnes per year in 2035. The cities within the hinterlands of the HZMB in the western PRD will experience different degrees of growth in population, economic activities, inter-city and intra-city traffic including cross boundary traffic to and from Hong Kong in the coming years. Among them, Zhuhai and Zhongshan will be the major growth areas. The population of Zhuhai is forecast to double from 1.42 million in 2005 to 2.87 million in 2035. For Zhongshan, the population is forecast to go up by 26% from 1.41 million in 2005 to 1.78 million in 2035. Their average annual GDP will grow by about 10~11% within the same period.

7. The traffic projection would vary according to the assumptions adopted for the quota system for cross-boundary vehicles and toll levels. We wish to emphasise that parallel work is on-going to investigate the feasibility of relaxing the current quota system. Purely for the purpose of calculating the economic benefits of the HZMB as part of the feasibility study on the project,

[1] For the purpose of the various quantification/projections in this paper, we have defined the western PRD as broadly covering Zhuhai, Jiangmen and Zhongshan.

the HPDI has adopted a very conservative assumption that the quota system will remain as it is, and hence arrived at conservative ranges of the two-way traffic projections as set out below. The lower end of the ranges has been adopted as input assumptions into the calculation of economic benefits.

Year	HK – Mainland (Vehicles / Day)	HK – Macao (Vehicles / Day)	Total (Vehicles / Day)
2016	5,550 – 10,100	3,650 – 3,900	9,200 – 14,000
2020	9,550 – 16,200	5,800 – 6,100	15,350 – 22,300
2030	18,650 – 27,200	8,750 – 11,600	27,400 – 38,800
2035	25,500 – 38,650	10,200 – 10,550	35,700 – 49,200

As there would not be traffic between Macao and Zhuhai on the bridge, all the traffic will have Hong Kong either as the origin or destination, and slightly more than 60% of this is with the Mainland, and less than 40% with Macao.

8. Similarly, the lower end of the following ranges of two-way passenger projections has been assumed in the calculations of economic benefits.

Year	HK - Mainland (Passengers / Day)	HK - Macao (Passengers / Day)	Total (Passengers / Day)
2016	22,950 – 32,150	32,900 – 37,050	55,850 – 69,200
2020	42,700 – 57,100	48,550 – 55,850	91,250 – 112,950
2030	88,200 – 115,250	65,700 – 74,500	153,900 – 189,750

2035	119,350 – 153,250	71,900 – 80,600	191,250 – 233,850

9. We have engaged a traffic consultant to explore and review possible options for regulating crossing boundary vehicles after the commissioning of the HZMB, and to recommend the preferred arrangement for these vehicles. Upon commissioning of the HZMB, there is likely to be scope for relaxing the quota system and the actual traffic volume would likely be higher than the traffic volume assumed above.

STRATEGIC VALUE OF HZMB

Direct Benefits

10. The HPDI has carried out a detailed study on the economic impact of the HZMB. The economic assessment methodology adopted is based on the Mainland's current economic analysis guidelines for transportation projects which are in line with international standards. The approach distinguishes between different categories of direct economic costs and benefits, and includes a cost-benefit analysis over a 20-year period.

11. The traffic volume forecast is a fundamental element in determining the direct economic benefits of the HZMB. These benefits include, for example, savings in transport costs, value of time saved for travellers, induced traffic volume generated between the three territories, and value of time saved for goods on road. The benefits are then apportioned to the three territories taking into account the places of origin and destination of the traffic. The discounted total benefits brought to the three places and their related ratio are set out below:

Economic Benefits	Hong Kong	Mainland	Macao	Total
Discounted Total Benefits (RMB￥ billion)	42.8	24.1	7.1	74.0
Discounted Total Benefits Ratio	57.8%	32.6%	9.6%	100%

It is estimated that the discounted present value of economic benefits to Hong Kong, minus the discount present value of costs contributed by Hong Kong to the project, or the net economic benefits at discounted present value (i.e. ENPV) will be around RMB￥23 billion over the 20-year period, as compared to RMB ￥13 billion for the Mainland and RMB￥4 billion for Macao.

12. The economic analysis also computes the Economic Internal Rate of Return (EIRR) of the project. EIRR is one of the key indicators on the economic viability of a project. It is defined as the discount rate per annum at which the present value of total return from the project over the assessment period would just cover the present value of total investment [i.e. when the Net Present Value (NPV) = 0]. Generally speaking the higher a project's EIRR, the more desirable it is to undertake the project. The HZMB is estimated to have an EIRR of 8.8% for Hong Kong over a 20–year period, or 12% over 40 years. It compares favorably with a number of other infrastructure projects we are undertaking:

Projects	**EIRR**
South Island Line (East)	9%
West Island Line	8%
Shatin to Central Link	10%

Hong Kong Section of the Guangzhou-Shenzhen-Hong Kong Express Rail Link	9%

Indirect Benefits

13. There are at present four road crossings between Hong Kong and PRD, all of which provide connection with the eastern part of the PRD. As a result, most of the business activities, including in particular cargo and passenger flows, between Hong Kong and the PRD concentrate on the eastern part. As the eastern PRD[2] can be covered within a 3-hour trip from Hong Kong, such geographical advantage has resulted in this part of the PRD attracting the bulk of foreign direct investment. In 2006, foreign direct investment actually used in the eastern PRD amounted to US$ 5.1 billion, accounting for nearly 40% of the total in all nine cities of the PRD as compared to 17% of the respective figure in the western PRD.

14. However most cities in the eastern region are now facing challenges in term of exhaustion of developable land reserves, rapid escalation of labour costs, shortage of water, electricity, energy and environmental degradation. Average monthly wage of staff and workers in 2006 is reportedly at around US$325-367 in the eastern PRD, considerably higher than that of US$174-261 on the western side. Apart from the ample and cheaper labour resources, the western region also has relatively more abundant land yet to be fully exploited, hence significant development potentials. The total land area of the eastern PRD is around 4,418 km^2, whereas the western part is almost three times bigger. The HZMB will provide the much needed infrastructure to connect Hong Kong

[2] For the purpose of the various quantification/projections covered in this paper, we have defined the eastern PRD as broadly covering Shenzhen and Dongguan.

to this land of great development potential.

15. The direct economic benefits have been quantified in paragraphs 10-12 above. There are substantial strategic value and indirect benefits of the HZMB to the local economies, but they have not been included in the calculation of benefits for the allocation of costs for the project as these do not normally form part of EIRR calculations. The absence of a direct road link from Hong Kong to Zhuhai has been perceived as one of the reasons why Hong Kong investment in the western PRD has been relatively low compared to that on the east bank. Investing in this less developed region, upon commissioning of the HZMB, would benefit Hong Kong investors, as costs of labour and land resources are cheaper. Hong Kong will also gain from an increase in tourism, due to the improved convenience of travelling between Hong Kong and Pearl River West, and the increasing spending power of its residents over the coming years as the economy takes off. These would be similar to how the rapid economic development of the eastern PRD due to the efficient transport links with Hong Kong in the past years has brought about substantial economic benefits to Hong Kong. Hong Kong has become a preferred destination for visitors from the eastern PRD. With better income and purchasing power, visitors from the eastern PRD thus contribute more to tourist spending in Hong Kong. There is also positive spill-over on other industries such as restaurants, hotels and transports in Hong Kong. Furthermore, according to trade figures, Shenzhen alone accounts for 45% and 44% of Guangdong's total exports to and trade with Hong Kong respectively. This hectic and close business relationship is beneficial to our external trade and logistics industries, not to mention the ancillary/supporting industries like finance, transport and warehouse, insurance etc. We can expect similarly close economic ties with the western PRD after the HZMB has been built.

16. Hong Kong will also benefit from an increase of travellers flying in or out of Hong Kong due to the HZMB, as more visitors will be induced to fly to

the Hong Kong International Airport and travel to the Mainland via Hong Kong, or vice versa. The proposed HKBCF off the waters at the northeast of the Hong Kong International Airport will further provide a convenient interface between the land and air modes of traffic for the travellers. The HZMB also connects the domestic flight network of Zhuhai airport to the well-established international network of the Hong Kong International Airport, thereby creating synergy for the two airports.

17. The timely implementation of the HZMB is consistent with the strategic proposals put forward in 2007 by the Focus Group on Maritime, Logistics and Infrastructure set up under the Economic Summit on "China's 11th Five-Year Plan and the Development of Hong Kong", which include, among other things, the development of cross-boundary transportation network by adopting a forward-looking perspective on regular development, and the optimization of cross-boundary transportation networks so as to establish efficient and convenient direct links with neighboring comprehensive transportation hubs, shorten the spatial distance with the Mainland and extend the hinterlands of Hong Kong's airport and ports.

COST ALLOCATION FOR THE CONSTRUCTION OF HZMB

18. When considering the most appropriate way of allocating costs among the three territories, it has been recommended by HPDI and agreed among the three Governments that it will be most appropriate and fairest to allocate costs in proportion to direct benefits received by each territory.

19. Benefits are assessed over a period of 20 years, which is a usual practice for projects in the Mainland. Using standard project appraisal techniques, benefits and costs which are expected to arise are discounted using social discount rates regularly adopted in the territories. Developed countries

generally apply lower discount rates than developing countries. These range from 3 – 7% for the former, and 8 – 15% for the latter. In the case of Hong Kong and Macao, the social discount rates regularly applied are 4%, while in the case of the Mainland, the discount rate is regularly 8%. The Mainland's adoption of a higher discount rate as compared to Hong Kong and Macao reflects the less developed nature of the Mainland economy.

20. The analysis undertaken by HPDI indicated that the ratio of expected benefits to costs for the Project is likely to exceed 2 (i.e. over the assessment period, total benefits will be more than double the total costs). After considering how the benefits are likely to be apportioned among the territories, it was concluded that the costs should be shared among Hong Kong, Zhuhai and Macao in the same ratio (i.e. 57.8:32.6:9.6). In other words, the costs are split based on the principle of equalization of benefit to cost ratio, i.e. an approach to equalize the ratio for the estimated benefit obtained to the estimated cost incurred for a joint investment from different territories. Taking into account the fact that each territory has already agreed to fund the costs of connecting roads directly, contributions to the costs of the Main Bridge is accordingly adjusted to a ratio of 50.2: 35.1:14.7.

21. We will continue to discuss with the governments of Guangdong and Macao regarding the shares in the ownership of the HZMB after the expiry of the Build, Operate and Transfer concession period and, in case of default, how the three governments will shoulder the financial burden arising from the construction of the project. We will update the Panel of the outcome of the discussions of the three governments in due course.

Preconstruction Works and Hong Kong Boundary Crossing Facilities

22. We would require $46.6 million in MOD prices for the preconstruction

works of the HZMB. Detailed breakdown is set out in **Annex A**.

23. We would require $86.9 million in MOD prices for the investigation and preliminary design for the HZMB Hong Kong Boundary Crossing Facilities. Detailed breakdown is set out in **Annex B**.

ADVICE SOUGHT

24. Members are invited to note the content of this paper and indicate support for the funding applications for the preconstruction works for the HZMB, and the I&PD study of the HKBCF.

Transport and Housing Bureau
13 May 2008

Annex A

Funding and Cash-flow Requirements
of Preconstruction Works for HZMB

The estimated cost is $46.6 million in MOD prices, made up as follows–

		$ million	
(a)	Physical modelling study		26.9
	(i) Physical model to simulate local impacts on ports and navigation in the Pearl River Estuary (such as sedimentation and tidal current impacts) upon construction of artificial islands and bridge substructures	7.2	
	(ii) Associated mathematical model on impacts	0.7	
	(iii) Physical model to simulate global impacts on flooding in the Pearl River Estuary (such as impacts due to flow obstructions and sedimentation) upon construction of artificial islands and bridge substructures	11.5	
	(iv) Associated mathematical models on flooding	3.5	

	(v) Associated technical studies such as surveying and seabed profiling to collect data to support the modelling study	4.0		
(b)	Associated design refinement for the HZMB (including refinement in the design of the various elements of the project such as the bridge and immersed tunnel structures, artificial islands, bridge appearance, environmental protection measures and safety aspects etc.)		9.1	
(c)	Works relating to the tender for the HZMB Main Bridge (including issue of tender documents, briefing sessions for potential bidders, assistance with negotiation process)		4.0	
(d)	Contingencies		4.0	
	Sub-total		44.0	(in September 2007 prices)
(e)	Provision for price adjustment		2.6	
	Total		46.6	(in MOD prices)

2. The expenditure will be phased as follows –

Year	$ million (Sep 2007)	Price Adjustment Factor	$ million (MOD)
2008 – 2009	9.0	1.02575	9.2
2009 – 2010	31.0	1.06293	33.0
2010 – 2011	4.0	1.10545	4.4
	44.0		46.6

3. We have derived the MOD estimate on the basis of the Government's latest forecast of trend rate of change in the prices of public sector building and construction output for the period 2008 to 2011. The three governments will engage consultants to undertake the preconstruction works for the HZMB on a lump-sum basis without provision for price adjustment as the duration of each consultancy will not exceed 12 months.

Annex B

Funding and Cash-flow Requirements of Hong Kong–Zhuhai–Macao Bridge Hong Kong Boundary Crossing Facilities

The estimated cost is $86.9 million in MOD prices, made up as follows –

			$ million	
(a)	Consultants' fees		45.0	
	(i) review of the findings of previous studies, and examination of design options	5.0		
	(ii) impact assessments (environmental, traffic, marine and aviation, etc.)	25.1		
	(iii) preliminary design for			
	(iiia) reclamation work	4.2		
	(iiib) civil and building works	9.1		
	(iv) supervision of site investigation	1.6		
(b)	Site investigation		29.1	
(c)	Contingencies		7.4	
		Sub-total	81.5	(in September 2007 prices)
(d)	Provision for price adjustment		5.4	
		Total	86.9	(in MOD prices)

A breakdown of the estimated consultants' fees is in paragraph 4 below.

2. The expenditure will be phased as follows –

Year	$ million (Sep 2007)	Price Adjustment Factor	$ million (MOD)
2008 – 2009	19.9	1.02575	20.4
2009 – 2010	36.9	1.06293	39.2
2010 – 2011	24.7	1.10545	27.3
	81.5		86.9

3. We have derived the MOD estimate on the basis of the Government's latest forecast of trend rate of change in the prices of public sector building and construction output for the period 2008 to 2011. We will engage consultants to undertake the I&PD study on a lump-sum basis with provision for price adjustment as the duration of the consultancy will exceed 12 months. The consultants will supervise site investigation works under a contract to be awarded through tendering.

4. Breakdown of estimates for consultants' fees and site investigation works is as follows-

			Estimated man-months	Average MPS* salary point	Multiplier (Note 1)	Estimated fee ($ million)
Consultants' staff costs						
(a)	Review of the findings of previous studies, and examination of design options	Professional	28	38	2.0	3.2
		Technical	48	14	2.0	1.8
(b)	Impact assessments (environmental, traffic, marine and aviation, etc.)	Professional	153	38	2.0	17.4
		Technical	204	14	2.0	7.7

(c)	Preliminary design for					
	(i) reclamation work	Professional	26	38	2.0	3.0
		Technical	32	14	2.0	1.2
	(ii) civil and building works	Professional	57	38	2.0	6.5
		Technical	70	14	2.0	2.6
(d)	Supervision of site investigation	Professional	10	38	1.6	0.9
		Technical	23	14	1.6	0.7
					Total consultants' staff costs	45.0

Out-of-pocket expenses
(Note 2)

(a) Site investigation		29.1
	Total	74.1

* MPS = Master Pay Scale

Note

(i) A multiplier of 2.0 is applied to the average MPS point to arrive at the full staff costs including the consultants' overheads and profit as the staff will be employed in the consultants' offices. A multiplier of 1.6 is applied to the average MPS point in the case of resident site staff supplied by the consultants. (At 1 April 2007, MPS pt. 38 = $56,945 per month and MPS pt. 14 = $18,840 per month).

(ii) Out-of-pocket expenses are the actual cost to be incurred. The consultants are not entitled to any additional payment for the overheads or profit in respect of these items.

(iii) The figures given above are based on estimates prepared by the Director of Highways. We will know the actual man-months and fees only after we have selected the consultants through the usual competitive lump-sum fee bid system.