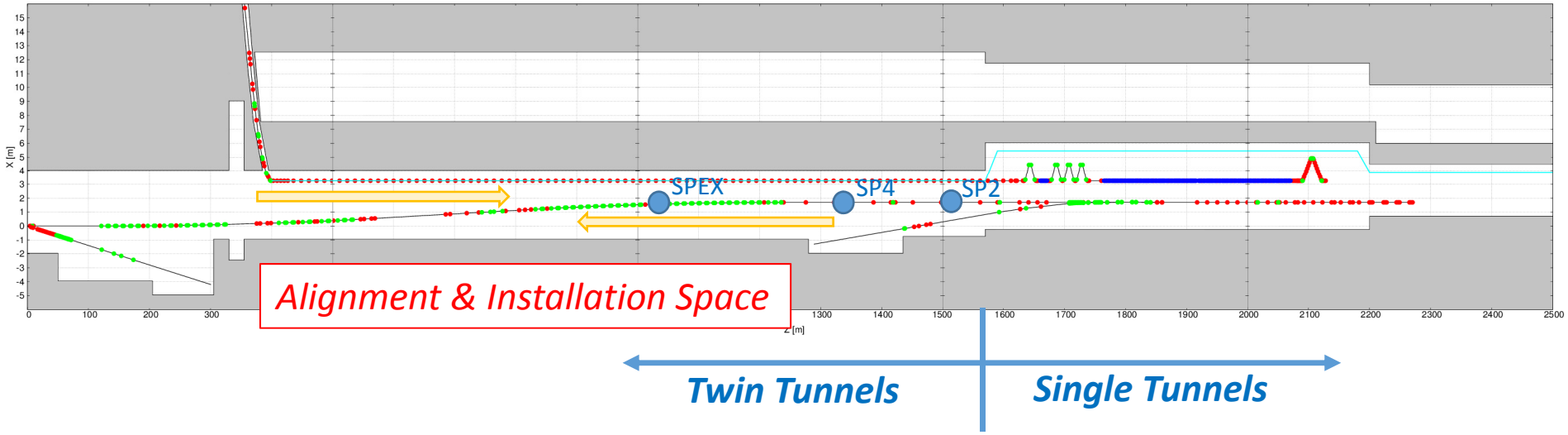
Positron BDS tunnel

Toshiyuki OKUGI, KEK
2016/10/11
ILC CR meeting

Positron BDS tunnel layout

Tunnel Width

Service tunnel was temporally set to 4-5 m for twin tunnel
(tunnel width should be fixed to make cost minimum).

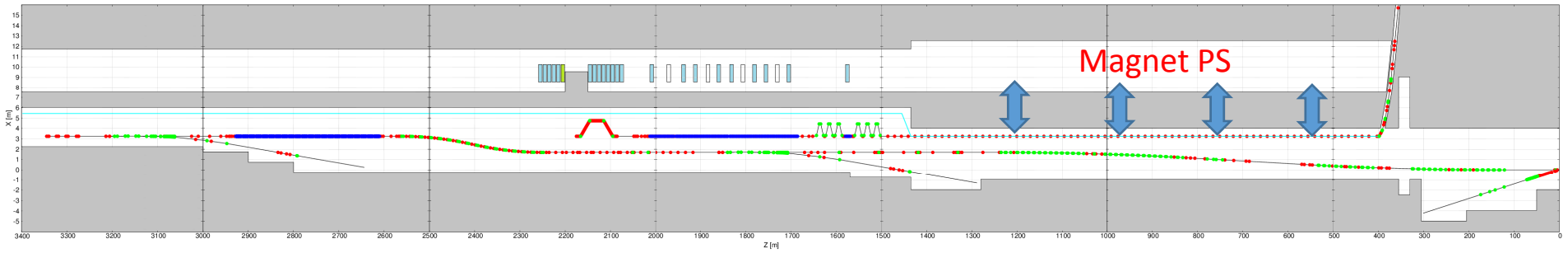


Accelerator tunnel width was set to 5 m (or more)
in order to make the alignment & installation space.

Tunnel width for twin tunnel ; 5.0m + 4-5 m (or smaller for service tunnel)

Tunnel width for Kamaboko tunnel ; 5.0m+1.5m+3.5m=10.0m

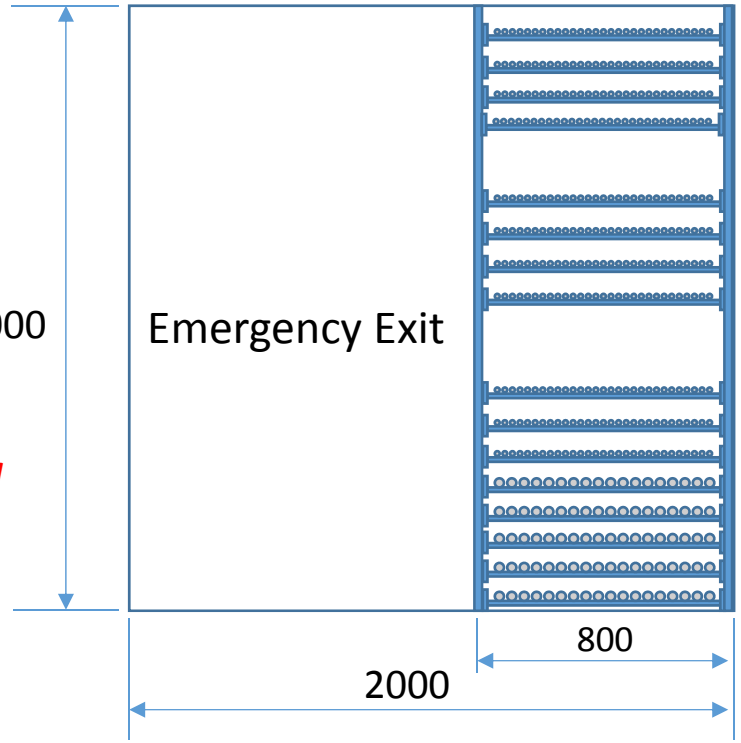
Cable penetration in twin tunnel



We need the penetration tunnel every 300m in twin tunnel for the emergency exit and cabling the devices.

Cable & Waveguide penetration is expensive and hard to construct.

Number of penetration can be reduced by combined to the emergency exit.



AC and Network cables

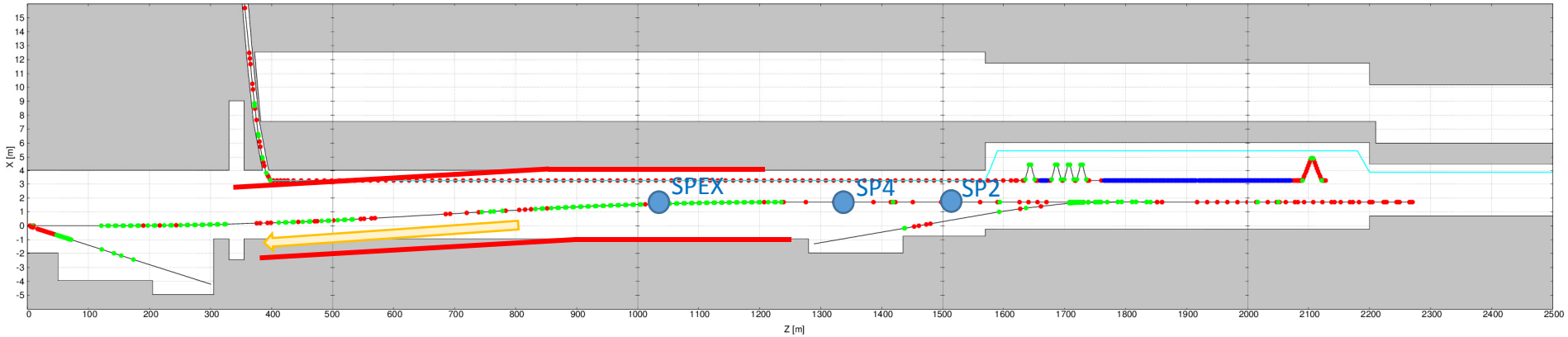
Monitor Cables & Mover control Cables

Magnet Cables

Positron BDS tunnel layout

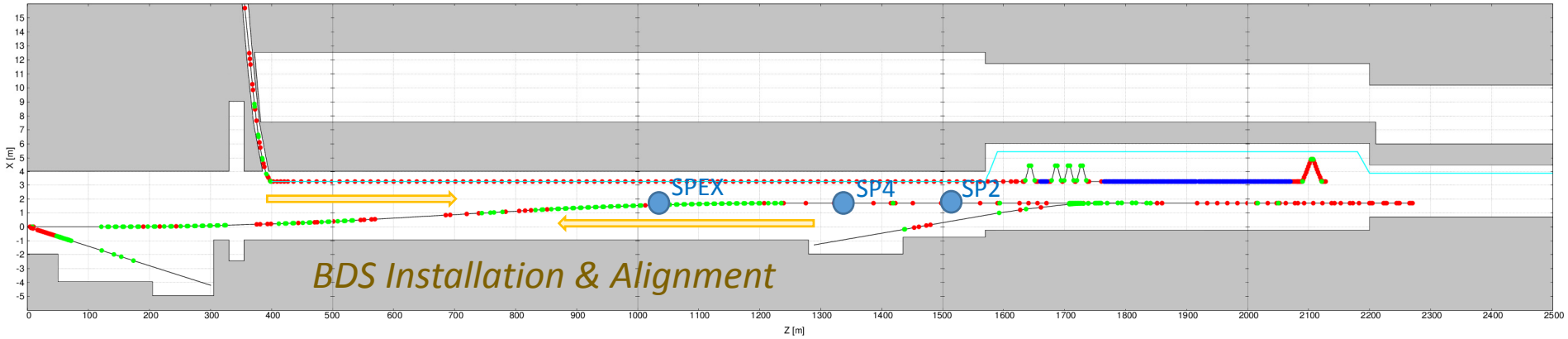
Tunnel Width

If we bend the tunnel along the BDS beamline,
the tunnel width is same to keep the alignment & installation space.



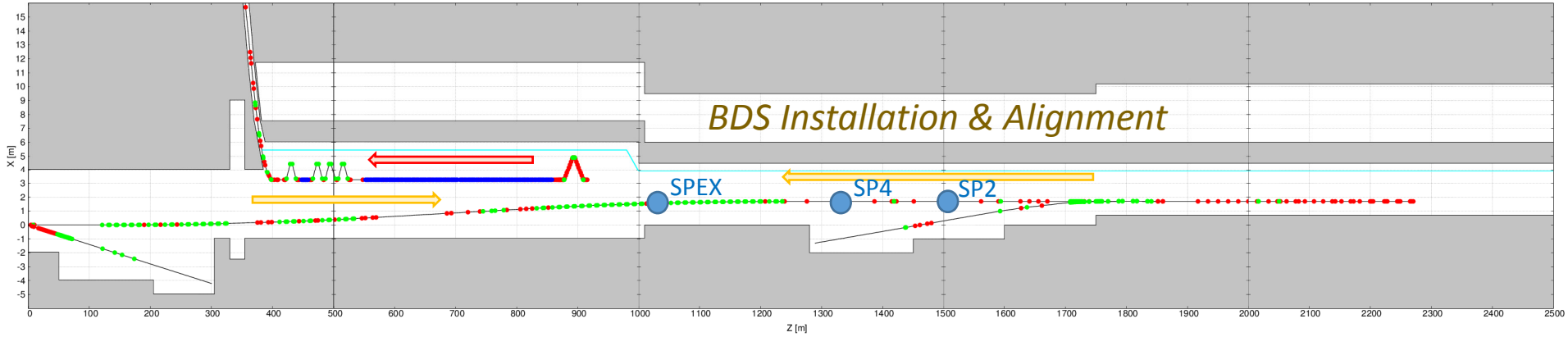
Twin & Kamaboko Tunnel

Twin Tunnel



Tunnel width of accelerator tunnel ; 5.0m + 0.0-1.0m = 5.0-6.0m.

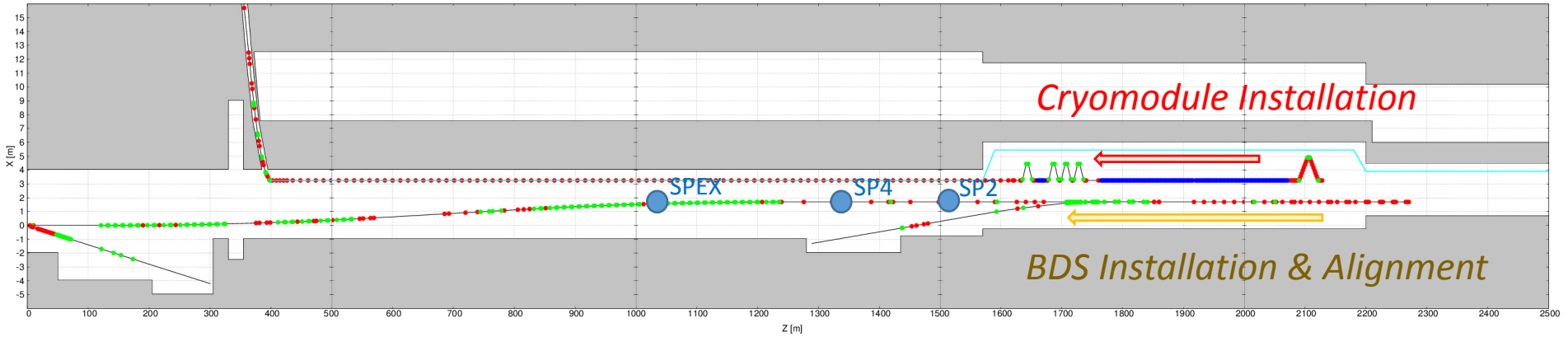
Kamaboko Tunnel



Tunnel width of accelerator tunnel ; 3.8m + 0.5-2.5m = 4.3-6.3m.

Electron Source Area

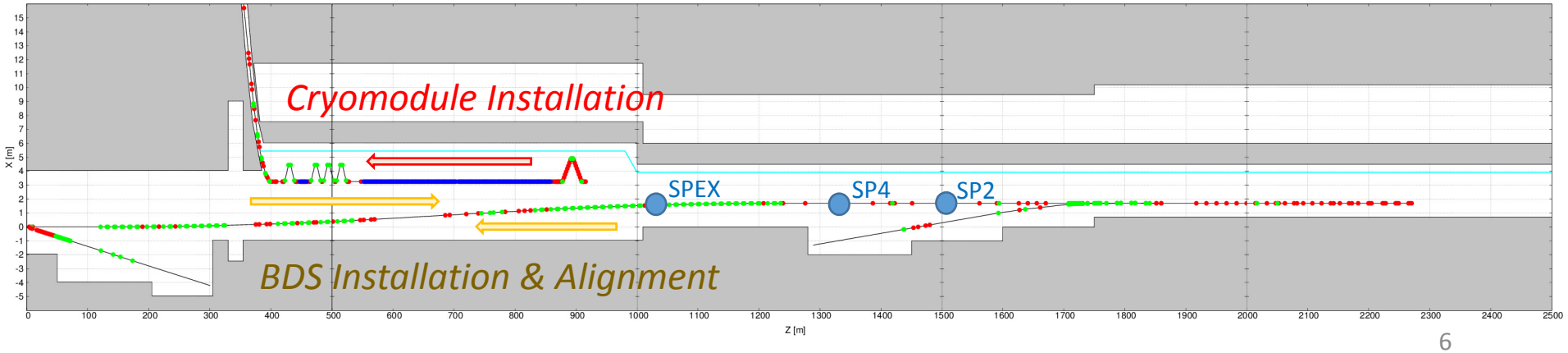
Twin Tunnel



Accelerator tunnel width was set to 6.8 m (or more) in order to put the electron sources with chicane.

Tunnel width for Kamaboko tunnel
6.8m+1.5m+3.7m=12.0m or more

Kamaboko Tunnel



Presented by M. Miyahara at ILC-CR topical meeting.

BDS Tunnel Construction Cost Study

Cost Comparison of Twin-tunnel & Single-tunnel

Twin **Kamaboko** **Kamaboko**

	Baseline		Option_1 w10.0, h5.0		Option_2 w11.0, h5.5		Option_3 w12.0, h6.0		Option_4 w13.0, h6.5	
	Qt. m3/m	Amount kJPY	Qt. m3/m	Amount kJPY	Qt. m3/m	Amount kJPY	Qt. m3/m	Amount kJPY	Qt. m3/m	Amount kJPY
Beam Tunnel										
Width (m)	8.0		10.0		11.0		12.0		13.0	
Height (m)	5.0		5.0		5.5		6.0		6.5	
Excavation	41.9	1,220	54.5	1,510	63.7	1,730	73.2	1,950	83.1	2,180
Shield W	-	-	-	410	-	425	-	440	-	455
Sub total		1,220		1,920		2,155		2,390		2,635
Service Tunnel	4.5		-		-		-		-	
Excavation	21.9	890	-	-	-	-	-	-	-	-
Sub total		890	-		-		-		-	
Total unit cost	2,110		1,920 (-190)		2,155 (45)		2,390 (280)		2,635 (525)	
Cost impact (L=5,040m)	10,634 MJPY		9,677 MJPY (-957 MJPY)		10,861 MJPY (227 MJPY)		12,046 MJPY (1,412 MJPY)		13,280 MJPY (2,646 MJPY)	
Ratio	100%		91%		102%		113%		125%	

- Notice: Cost of TDR Baseline does not include the Penetration Cost

- BDS service tunnel length
  e+ : 2,330 m - 350 m = 1,980 m
  e- : 3,410 m - 350 m = 3,060 m
  Total approx. 5,040 m

This slide: Confidential

Presented by M. Miyahara at ILC-CR topical meeting.

BDS Tunnel Construction Cost Study

Cost Comparison of Twin-tunnel & Single-tunnel

Twin **Kamaboko** **Kamaboko**

	Baseline		Option_1 w10.0, h5.0		Option_2 w11.0, h5.5		Option_3 w12.0, h6.0		Option_4 w13.0, h6.5	
	Qt. m3/m	Amount kJPY	Qt. m3/m	Amount kJPY	Qt. m3/m	Amount kJPY	Qt. m3/m	Amount kJPY	Qt. m3/m	Amount kJPY
Beam Tunnel										
Width (m)	8.0		10.0		11.0		12.0		13.0	
Height (m)	5.0		5.0		5.5		6.0		6.5	
Excavation	41.9	1,220	54.5	1,510	63.7	1,730	73.2	1,950	83.1	2,180
								440	-	455
								2,390		2,635
							-		-	
Excavation	21.9	890	-	-	-	-	-	-	-	-
Sub total		890		-		-		-		-
Total unit cost	2,110		1,920 (-190)		2,155 (45)		2,390 (280)		2,635 (525)	
Cost impact (L=5,040m)	10,634 MJPY		9,677 MJPY (-957 MJPY)		10,861 MJPY (227 MJPY)		12,046 MJPY (1,412 MJPY)		13,280 MJPY (2,646 MJPY)	
Ratio	100%		91%		102%		113%		125%	

Tunnel width of accelerator tunnel for the proposed BDS tunnel is thinner than that of TDR baseline.

- Notice: Cost of TDR Baseline does not include the Penetration Cost

- BDS service tunnel length
  e+ : 2,330 m - 350 m = 1,980 m
  e- : 3,410 m - 350 m = 3,060 m
  Total approx. 5,040 m

This slide: Confidential

BDS Tunnel Construction Cost Study

Cost Comparison of Twin-tunnel & Single-tunnel

	Baseline		5.0m Twin		Option_1 w10.0, h5.0		Option_3 w12.0, h6.0	
	Qt. m3/m	Amount kJPY	Qt. m3/m	Amount kJPY	Qt. m3/m	Amount kJPY	Qt. m3/m	Amount kJPY
Beam Tunnel								
Width (m)	8.0		**5.0**		10.0		12.0	
Height (m)	5.0		5.0		5.0		6.0	
Excavation	41.9	1,22	**??**	**< 1,000**	54.5	1,510	73.2	1,950
Shield W	-	-	-	-	-	410	-	440
Sub total		1,220		**< 1,000**		1,920		2,390
Service Tunnel	4.5		4.5		-		-	
Excavation	21.9	890	21.9	890	-	-	-	-
Sub total		890		890	-		-	
Total unit cost	2,110		**< 1,890 + penetration**		1,920 (-190)		2,390 (280)	
Cost impact (L=5,040m)	10,634 MJPY				9,677 MJPY (-957 MJPY)		12,046 MJPY (1,412 MJPY)	
Ratio	100%				91%		113%	

The cost of Twin tunnel (5.0m + 4.5m)
is roughly comparable to that of 10 m width Kamaboko tunnel (we should evaluate).

We can make the distance between accelerator and service tunnels longer.