

**Main Electrical Components for Novaroute  
Single Immersed Tube Highway Tunnel Option**

Length of each tunnel= 20300 m  
Tunnel width= 9.5 m

Number of tunnels= 1

Item	Component	Unit	Qty	Unit Cost	Total Cost
	<b>Lighting</b>				
	Threshold + transition (1st 700m)	m2	7280	315	2293200
	Interior (balance)	m2	186200	120.00	22344000
<b>Lighting subtotal</b>					0
	<b>Substations, generators, UPS</b>				
	Substations	Ea	2	1337000	2674000
	Emergency generator	Ea	1	955000	955000
	UPS (Battery system)	Ea	1	573000	573000
<b>Substations, generators, UPS subtotal</b>					4202000
	<b>CCTV system</b>				
	Cameras (every 60m)	Each	338	3100	1047800
	Control station	Each	1	30000	30000
<b>CCTV system subtotal</b>					1077800
	<b>Provide power for gas detection, ventilation etc.</b>				
	Power provision	m	20300	45	913500
<b>Power subtotal</b>					913500
	<b>Lane control system</b>				
	Fibre optic display (every 200m)	Each	101	12500	0
<b>Lane control system subtotal</b>					0

Lighting costed elsewhere.

Total Electrical 6193300

## Initialisation

**Project:** Newfoundland Fixed Link Pre-feasibility Study

**Section:** North Approach

**Option:** IT Highway Tunnel

**Date:** 8-Jun-04

**Calculations by:** ANW

Surface gradient  %

+ sloping same way as track/road  
- sloping against track/road

Track/Road Gradient  %

Ground elevation  
at portal  m

Bottom of slab  
elevation at portal  m

Total length= 306.6667 m

Total Cost=\$ 5.5 M

## UNIT RATES

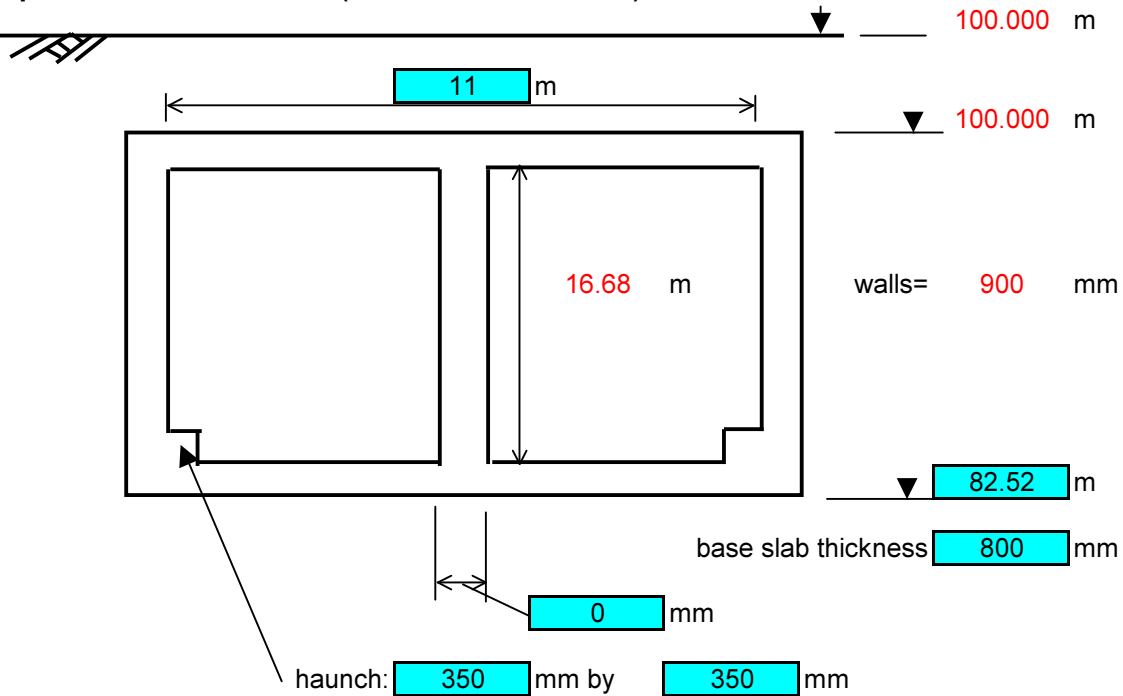
### Materials

Item	unit	Rate
excavation	m3	60
concrete	m3	190
rebar	tonnes	1600
formwork/falsework	m2	140
SP&L<=4.6m deep	m2	0
4.6<SP&L<=6.7m deep	m2	0
6.7<SP&L<=10.6m deep	m2	0
10.6<SP&L<=13.7m deep	m2	0
13.7<SP&L<=16.8m deep	m2	0
16.8<SP&L<=20.0m deep	m2	0
20<SP&L<=25m deep	m2	0
backfill + compact	m3	40
surface reinstatement	m2	30

Section Cut and Cover  
 Length of section: 30.66667 m

Section 1

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	6861.5	m3	
concrete=	1242.276	m3	
rebar=	149.1	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	1023.04	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	1072.1	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	392.5333	m2	

**Calculated costs**

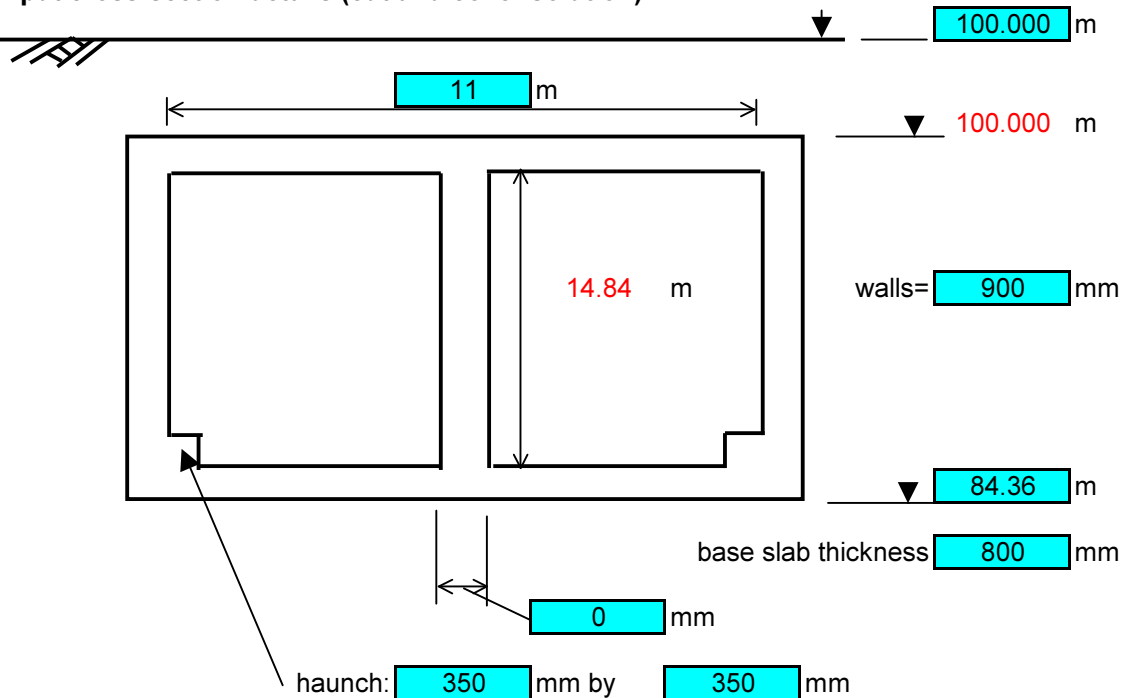
Item	Unit	Quantity	Rate	Cost
excavation	m3	6861.5	60	411689
concrete	m3	1242.276	190.0	236032.4
rebar	tonnes	149.1	1600	238517
formwork/falsework	m2	1023.04	140	143225.6
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	1072.1	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	392.5333	30	11776

Total 1041240

Section Cut and Cover  
Length of section: 30.66667 m

Section 2

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	6139.2	m3	
concrete=	1140.708	m3	
rebar=	136.9	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	910.1867	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	959.3	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	392.5333	m2	

**Calculated costs**

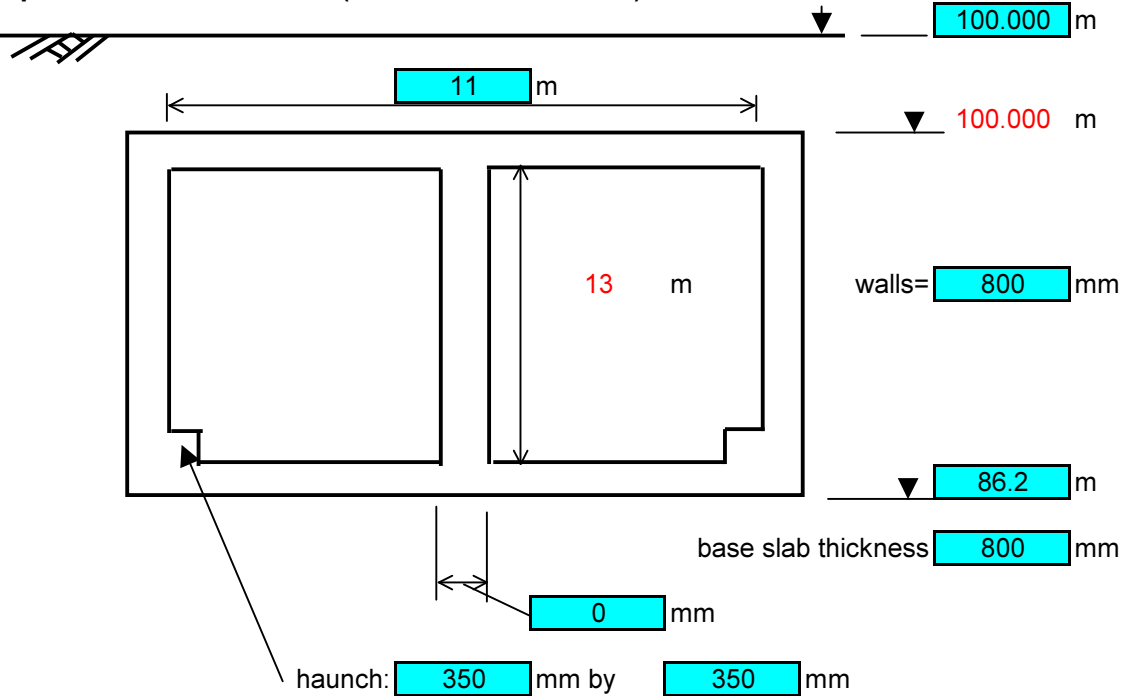
Item	Unit	Quantity	Rate	Cost
excavation	m3	6139.2	60	368353.3
concrete	m3	1140.708	190.0	216734.5
rebar	tonnes	136.9	1600	219015.9
formwork/falsework	m2	910.1867	140	127426.1
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	959.3	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	392.5333	30	11776

Total 943305.9

Section Cut and Cover  
Length of section: 30.66667 m

Section 3

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	5332.3	m3	
concrete=	954.5	m3	
rebar=	114.5	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	797.3333	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	846.4	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	386.4	m2	



**Calculated costs**

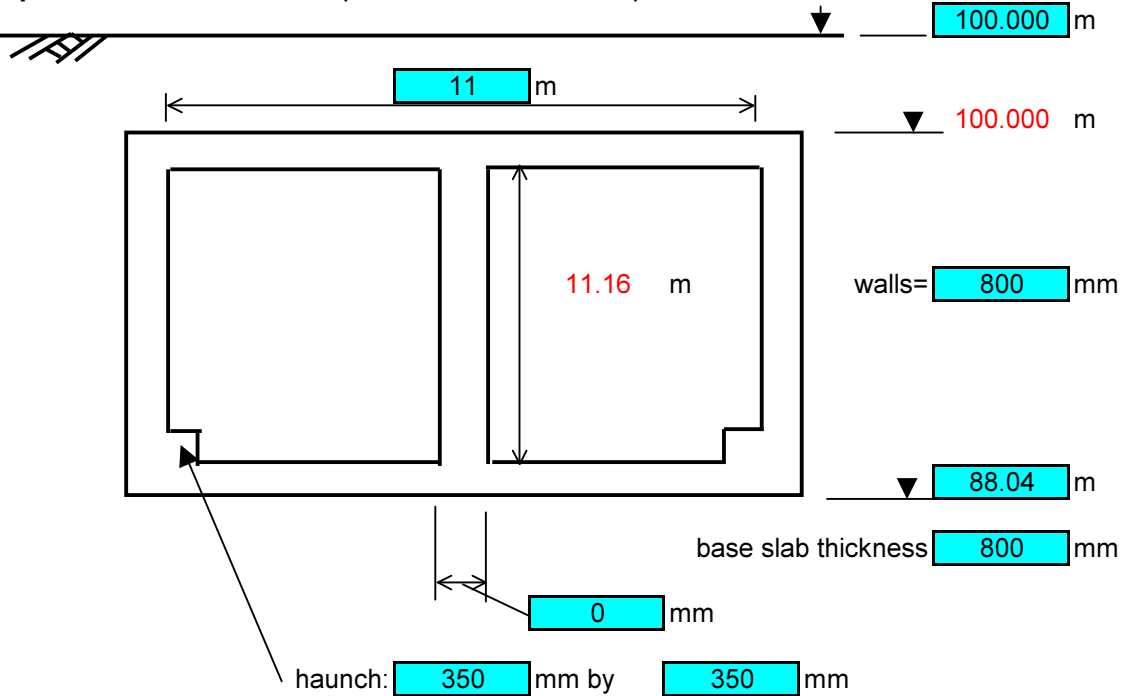
Item	Unit	Quantity	Rate	Cost
excavation	m3	5332.3	60	319939.2
concrete	m3	954.5	190.0	181355
rebar	tonnes	114.5	1600	183264
formwork/falsework	m2	797.3333	140	111626.7
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	846.4	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	386.4	30	11592

Total 807776.9

Section Cut and Cover  
 Length of section: 30.66667 m

Section 4

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	4621.3	m3	
concrete=	864.2173	m3	
rebar=	103.7	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	684.48	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	733.5	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	386.4	m2	

**Calculated costs**

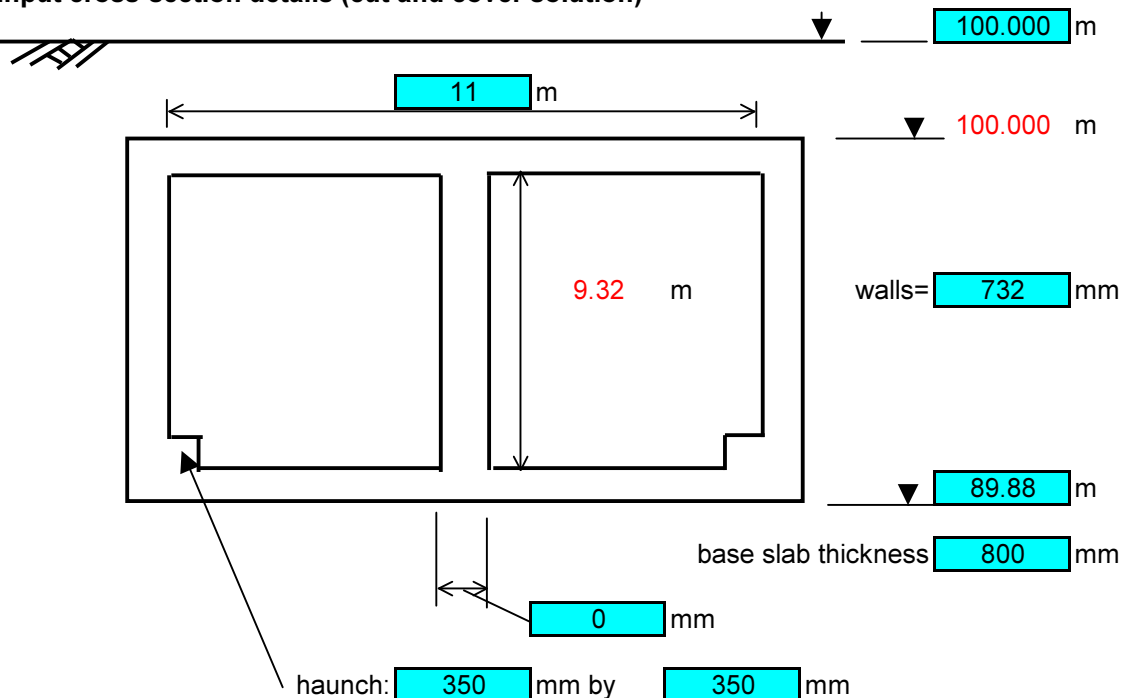
Item	Unit	Quantity	Rate	Cost
excavation	m3	4621.3	60	277280.6
concrete	m3	864.2173	190.0	164201.3
rebar	tonnes	103.7	1600	165929.7
formwork/falsework	m2	684.48	140	95827.2
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	733.5	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	386.4	30	11592

Total 714830.9

Section Cut and Cover  
Length of section: 30.66667 m

Section 5

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	3868.2	m3	
concrete=	731.7275	m3	
rebar=	87.8	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	571.6267	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	620.7	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	382.2293	m2	

**Calculated costs**

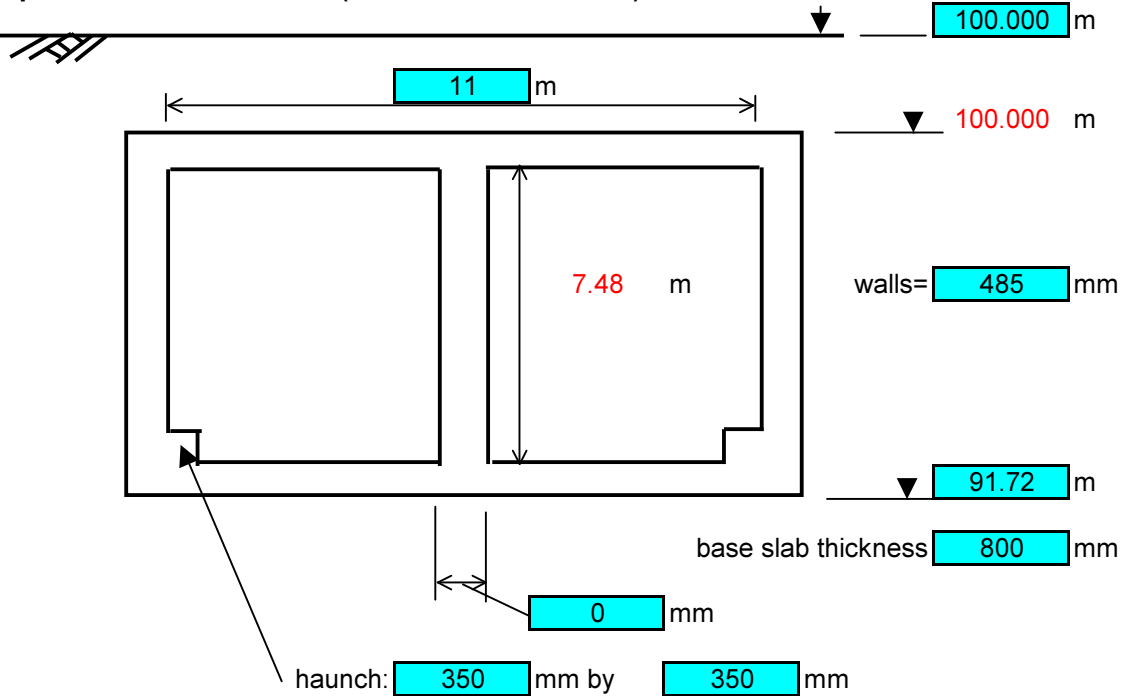
Item	Unit	Quantity	Rate	Cost
excavation	m3	3868.2	60	232089.7
concrete	m3	731.7275	190.0	139028.2
rebar	tonnes	87.8	1600	140491.7
formwork/falsework	m2	571.6267	140	80027.73
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	620.7	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	382.2293	30	11466.88

Total 603104.2

Section Cut and Cover  
 Length of section: 30.66667 m

Section 6

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	3039.4	m3	
concrete=	523.6824	m3	
rebar=	62.8	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	458.7733	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	507.8	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	367.08	m2	

**Calculated costs**

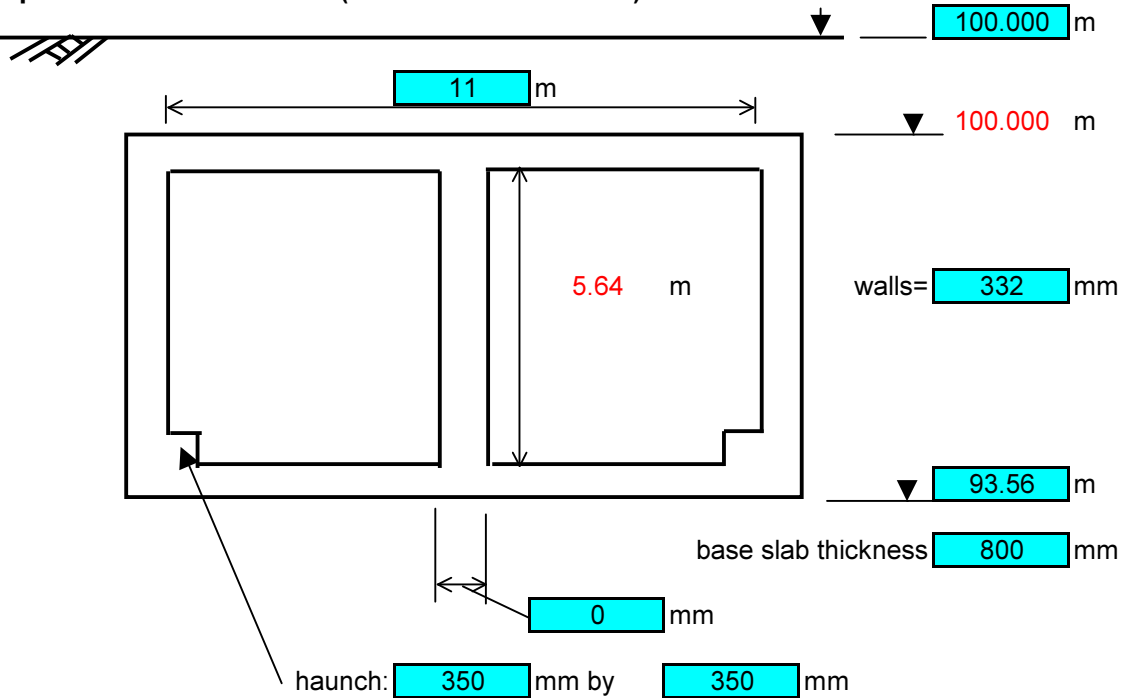
Item	Unit	Quantity	Rate	Cost
excavation	m3	3039.4	60	182365.3
concrete	m3	523.6824	190.0	99499.66
rebar	tonnes	62.8	1600	100547
formwork/falsework	m2	458.7733	140	64228.27
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	507.8	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	367.08	30	11012.4

Total 457652.7

Section Cut and Cover  
Length of section: 30.66667 m

Section 7

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	2303.6	m3	
concrete=	408.5156	m3	
rebar=	49.0	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	345.92	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	395.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	357.696	m2	

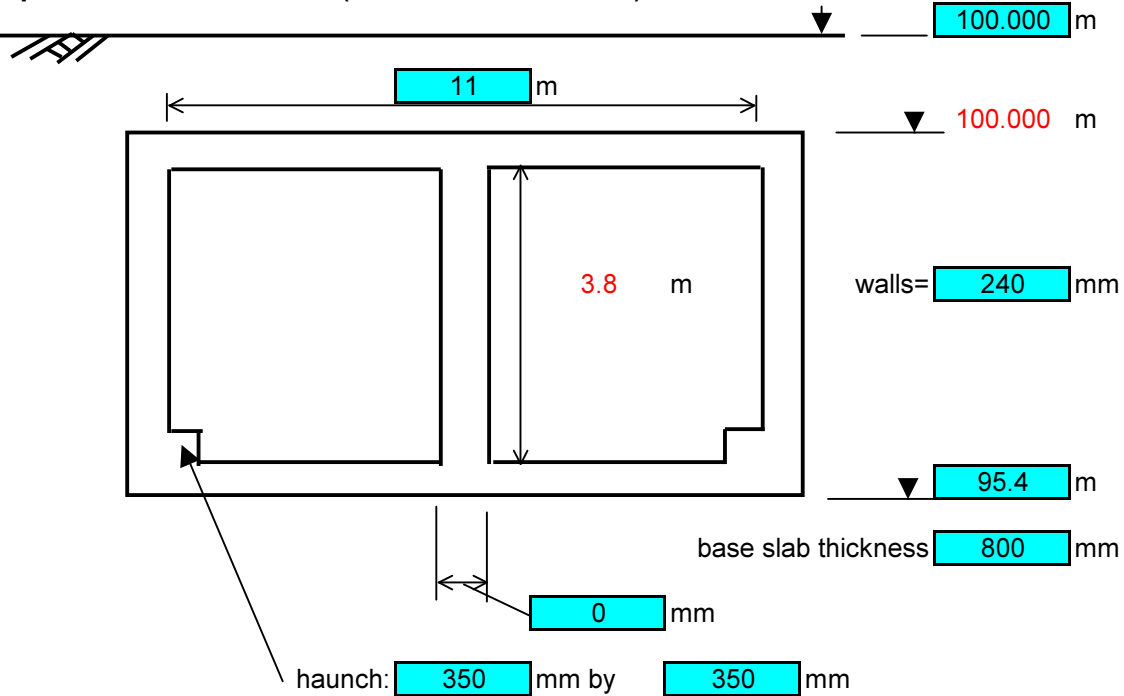


**Calculated costs**

Item	Unit	Quantity	Rate	Cost
excavation	m3	2303.6	60	138213.7
concrete	m3	408.5156	190.0	77617.96
rebar	tonnes	49.0	1600	78434.99
formwork/falsework	m2	345.92	140	48428.8
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	395.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	357.696	30	10730.88
Total				<u>353426.4</u>

Section Cut and Cover  
 Length of section: 30.66667 m Section 8

Input cross-section details (cut and cover solution)



Calculated Quantities

excavation=	1619.4	m3	
concrete=	345.092	m3	
rebar=	41.4	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	233.0667	m2	
SP&L<=4.6m deep	282.1	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	352.0533	m2	

**Calculated costs**

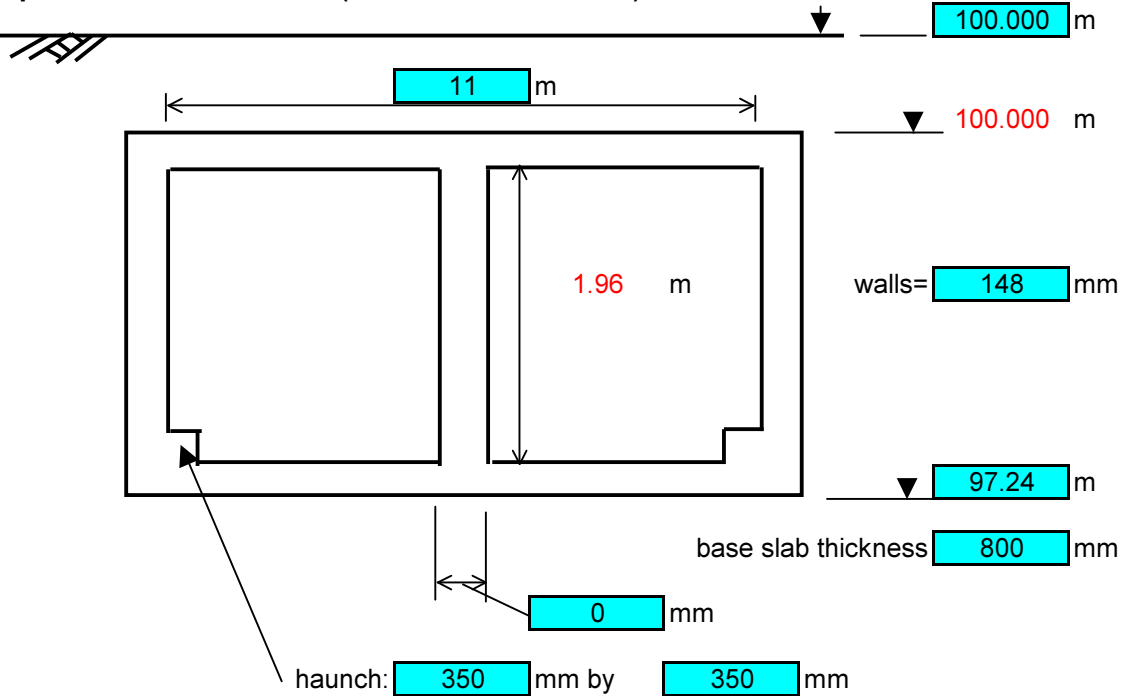
Item	Unit	Quantity	Rate	Cost
excavation	m3	1619.4	60	97166.72
concrete	m3	345.092	190.0	65567.48
rebar	tonnes	41.4	1600	66257.66
formwork/falsework	m2	233.0667	140	32629.33
SP&L<=4.6m deep	m2	282.1	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	352.0533	30	10561.6

Total 272182.8

Section Cut and Cover  
Length of section: 30.66667 m

Section 9

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	956.1	m3	
concrete=	302.4334	m3	
rebar=	36.3	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	120.2133	m2	
SP&L<=4.6m deep	169.3	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	346.4107	m2	

**Calculated costs**

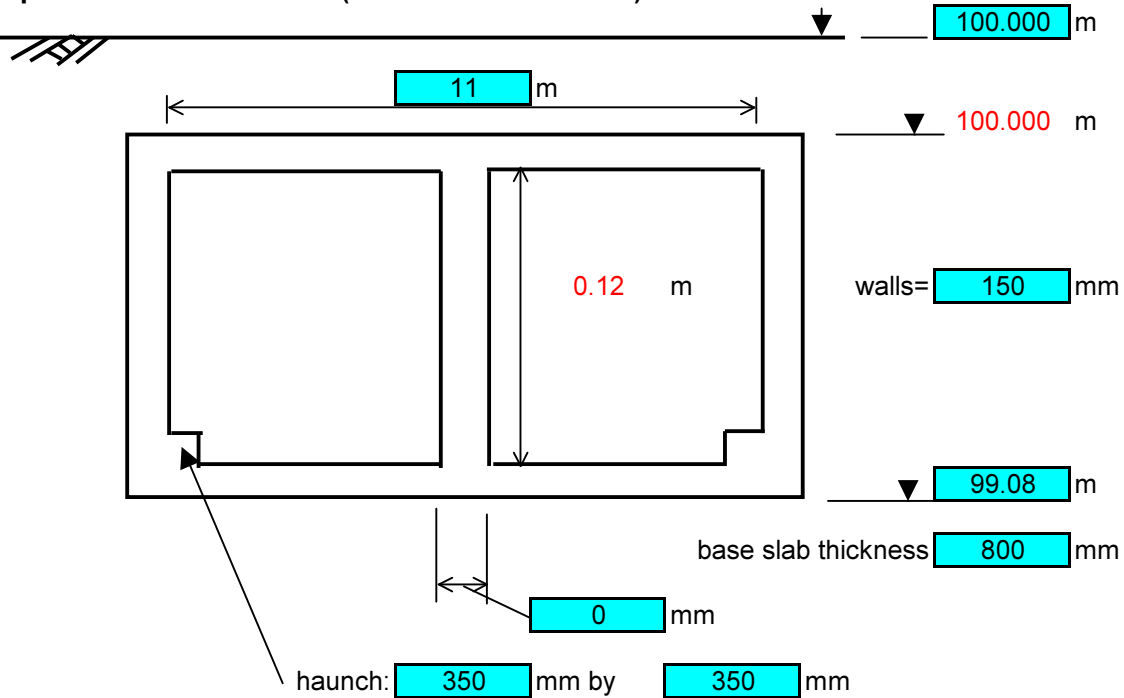
Item	Unit	Quantity	Rate	Cost
excavation	m3	956.1	60	57365.61
concrete	m3	302.4334	190.0	57462.35
rebar	tonnes	36.3	1600	58067.22
formwork/falsework	m2	120.2133	140	16829.87
SP&L<=4.6m deep	m2	169.3	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	346.4107	30	10392.32

Total 200117.4

Section Cut and Cover  
Length of section: 30.66667 m

Section 10

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	318.8	m3	
concrete=	285.844	m3	
rebar=	34.3	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	7.36	m2	
SP&L<=4.6m deep	56.4	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	346.5333	m2	

**Calculated costs**

Item	Unit	Quantity	Rate	Cost
excavation	m3	318.8	60	19128.64
concrete	m3	285.844	190.0	54310.36
rebar	tonnes	34.3	1600	54882.05
formwork/falsework	m2	7.36	140	1030.4
SP&L<=4.6m deep	m2	56.4	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	346.5333	30	10396

Total 139747.4

**Newfoundland Fixed Link Pre-feasibility Study**  
**North Approach**  
**IT Highway Tunnel**

**Date:** 8-Jun-04  
**Calculations by:** ANW

**Summary of Costs**

Markup for adjacent 0 %

<b>Section</b>	<b>Cost</b>
1	1041240
2	943305.9
3	807776.9
4	714830.9
5	603104.2
6	457652.7
7	353426.4
8	272182.8
9	200117.4
10	139747.4
Sub-total	<u>5533384</u>



**Newfoundland Fixed Link Pre-feasibility Study**  
**Highway IT Tunnel - North Approach**  
**Tunnel Final Liner Cost Estimate**

Tunnel length= 2375 m  
 Liner cross section area= 17.20 m<sup>2</sup>

**Shift pattern**

Shifts	Hours	Days
3	8	5

Advance rate= 20 m/day

Rebar ratio= 0.12 t/m<sup>3</sup> of concrete

Concrete supply=\$ 135 /m<sup>3</sup>

Rebar supply=\$ 900 /t

Initial form set-up time= 4 weeks

**Durations**

Number of days= 139 days  
 Number of hours= 3330 hours  
 Number of weeks= 28 weeks

**Labour**

Crew size 20  
 Average labour rate \$ 47 /hour

Total labour cost=\$ 3,130,200

**Equipment**

Form \$ 1000000  
 Weekly cost of other equipment \$ 15000 (see TED 2370)

Total equipment cost=\$ 1,416,250

**Materials**

Concrete= 40850 m<sup>3</sup>  
 Rebar= 4902  
 Concrete cost=\$ 5,514,750  
 Rebar cost=\$ 4,411,800

Total material cost=\$ 9,926,550

**Cost Summary**

Labour 3,130,200  
 Equipment 1,416,250  
 Materials 9,926,550  
 Total 14,473,000

**Newfoundland Fixed Link Pre-feasibility Study**  
**Highway IT Tunnel - North Approach**  
**Tunnel Drill and Blast Cost Estimate**

Drill & blast excavation @ \$ 300 /m<sup>3</sup>

Tunnel length= 2375 m

Tunnel excavated diameter= 10 m

Excavated volume= 186532.1 m<sup>3</sup>

Excavation cost=\$ 55,959,619

**Newfoundland Fixed Link Pre-feasibility Study**  
**Highway IT Tunnel - North Approach**  
**Cost Summary**

D&B Excavation	55,959,619
Liner	14,473,000
Shaft	<u>0</u>
	<u>70,432,619</u>

**Newfoundland Fixed Link Pre-feasibility Study**  
**Highway IT Tunnel - North Vent Adit**  
**Tunnel Final Liner Cost Estimate**

Tunnel length= 1500 m  
 Liner cross section area= 5.47 m<sup>2</sup>

**Shift pattern**

Shifts	Hours	Days
3	8	5

Advance rate= 30 m/day

Rebar ratio= 0.12 t/m<sup>3</sup> of concrete

Concrete supply=\$ 135 /m<sup>3</sup>

Rebar supply=\$ 900 /t

Initial form set-up time= 4 weeks

**Durations**

Number of days= 70 days  
 Number of hours= 1680 hours  
 Number of weeks= 14 weeks

**Labour**

Crew size 15  
 Average labour rate \$ 47 /hour

Total labour cost=\$ 1,184,400

**Equipment**

Form \$ 1000000  
 Weekly cost of other equipment \$ 15000 (see TED 2370)

Total equipment cost=\$ 1,210,000

**Materials**

Concrete= 8199.5568 m<sup>3</sup>  
 Rebar= 983.94682

Concrete cost=\$ 1,106,940  
 Rebar cost=\$ 885,552

Total material cost=\$ 1,992,492

**Cost Summary**

Labour 1,184,400  
 Equipment 1,210,000  
 Materials 1,992,492  
 Total 4,386,892

**Newfoundland Fixed Link Pre-feasibility Study**  
**Highway IT Tunnel - North Vent Adit**  
**Tunnel Drill and Blast Cost Estimate**

Drill & blast excavation @ \$ 250 /m3

Tunnel length= 1500 m

Tunnel excavated diameter= 6.5 m

Excavated volume= 49774.6 m3

Excavation cost=\$ 12,443,652

**Newfoundland Fixed Link Pre-feasibility Study**  
**Highway IT Tunnel - North Vent Adit Shaft**  
**Tunnel Drill and Blast Cost Estimate**

shaft excavated diameter= 5.5 m  
 depth= 70 m  
 shaft final diameter= 6.1 m

From graph

unlined shaft cost=\$ 17000 /m

**Quantities**

Concrete Base= 24 m3  
 Shotcrete= 121 m3  
 Rockbolts= 1210 m2  
 final cast in place liner= 383 m3

**Direct Costs**

				\$ - Cost	
shaft excavation etc.	70	*	17000	1190000	
Concrete Base	24	*	150	3564	
Shotcrete	121	*	500	60476	
Rockbolts	1210	*	10	12095	
liner	383	*	600	229588	(includes steel & forms)
Total Direct Cost=				<u>1495722</u>	

**Newfoundland Fixed Link Pre-feasibility Study**  
**Highway IT Tunnel**  
**North Vent Adit**

D&B Excavation	12,443,652
Liner	4,386,892
Shaft	<u>1,495,722</u>
	<u>18,326,267</u>

## Initialisation

**Project:** Newfoundland Fixed Link Pre-feasibility Study

**Section:** South Approach

**Option:** Bored Highway Tunnel

**Date:** 8-Jun-04

**Calculations by:** ANW

Surface gradient  %

+ sloping same way as track/road  
- sloping against track/road

Track/Road Gradient  %

Ground elevation  
at portal  m

Bottom of slab  
elevation at portal  m

Total length= 1500 m

Total Cost=\$ 39.5 M



**Newfoundland Fixed Link Pre-feasibility Study**  
**South Approach**  
**Bored Highway Tunnel**

**Date:** 8-Jun-04  
**Calculations by:** ANW

**UNIT RATES**

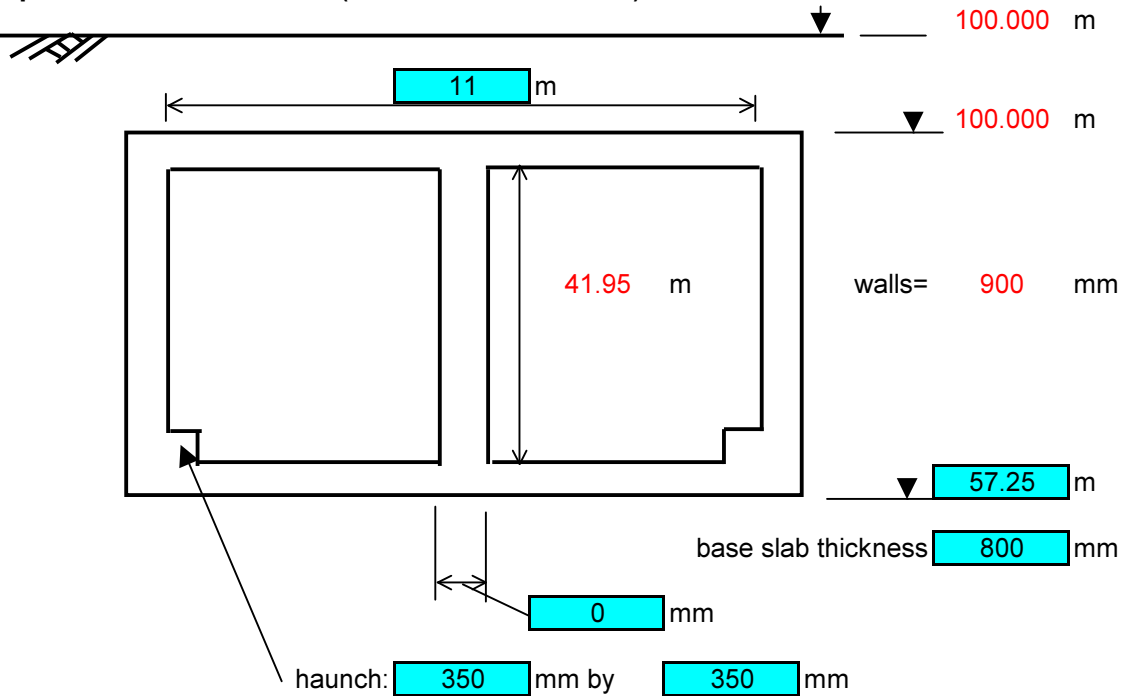


**Materials**

Item	unit	Rate
excavation	m3	60
concrete	m3	190
rebar	tonnes	1600
formwork/falsework	m2	140
SP&L<=4.6m deep	m2	0
4.6<SP&L<=6.7m deep	m2	0
6.7<SP&L<=10.6m deep	m2	0
10.6<SP&L<=13.7m deep	m2	0
13.7<SP&L<=16.8m deep	m2	0
16.8<SP&L<=20.0m deep	m2	0
20<SP&L<=25m deep	m2	0
backfill + compact	m3	40
surface reinstatement	m2	30

Section Cut and Cover  
 Length of section: 150 m Section 1

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	82080.0	m3	
concrete=	12899.25	m3	
rebar=	1547.9	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	12585	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	1920	m2	

**Newfoundland Fixed Link Pre-feasibility Study**  
**South Approach**  
**Bored Highway Tunnel**

**Date:** 8-Jun-04  
**Calculations by:** ANW  
**Page 2 of 2**

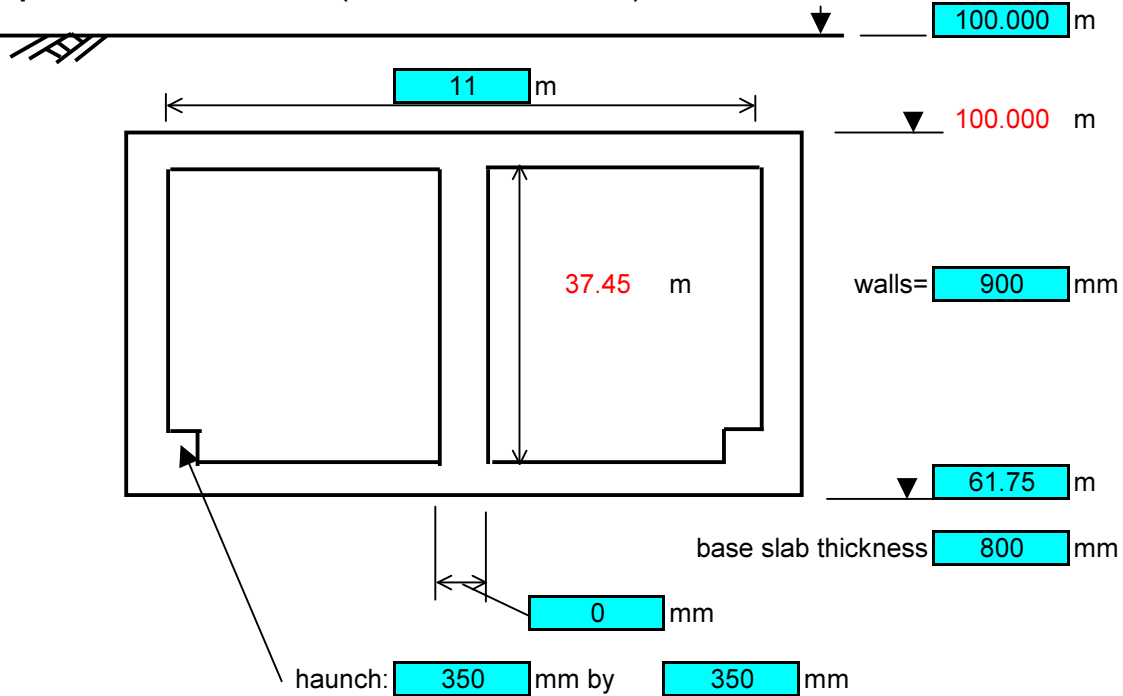
**Calculated costs**

Item	Unit	Quantity	Rate	Cost
excavation	m3	82080.0	60	4924800
concrete	m3	12899.25	190.0	2450858
rebar	tonnes	1547.9	1600	2476656
formwork/falsework	m2	12585	140	1761900
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	1920	30	57600

Total 11671814

Section Cut and Cover  
 Length of section: 150 m Section 2

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	73440.0	m3	
concrete=	11684.25	m3	
rebar=	1402.1	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	11235	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	1920	m2	

**Newfoundland Fixed Link Pre-feasibility Study**  
**South Approach**  
**Bored Highway Tunnel**

**Date:** 8-Jun-04  
**Calculations by:** ANW  
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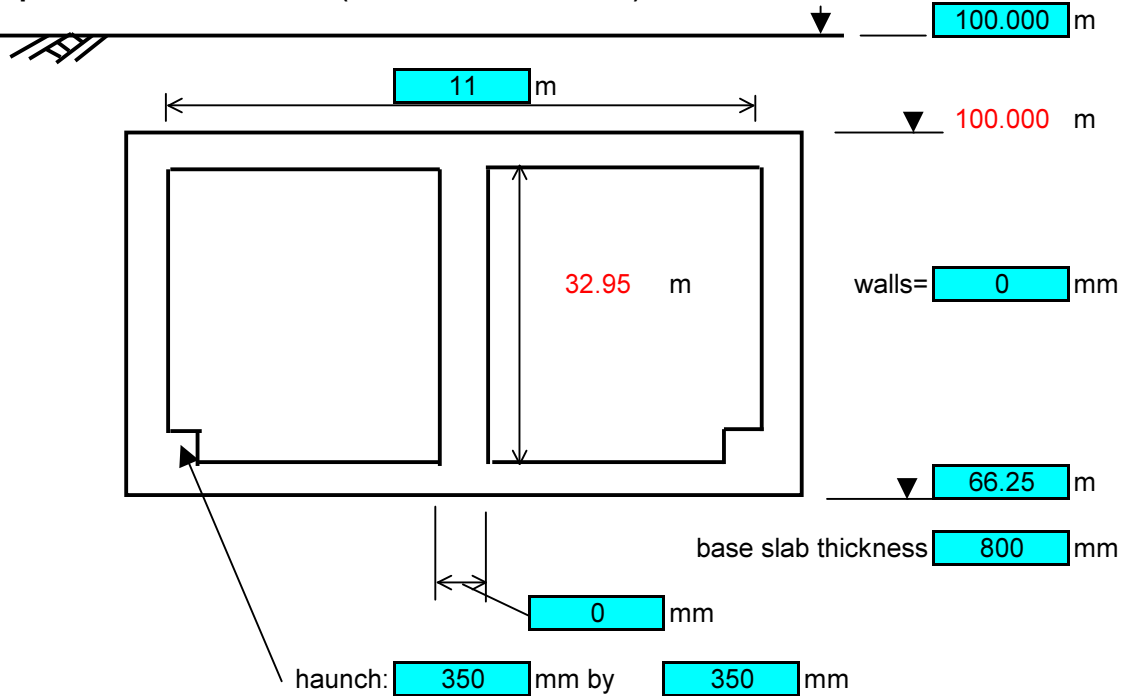
**Calculated costs**

Item	Unit	Quantity	Rate	Cost
excavation	m3	73440.0	60	4406400
concrete	m3	11684.25	190.0	2220008
rebar	tonnes	1402.1	1600	2243376
formwork/falsework	m2	11235	140	1572900
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	1920	30	57600

Total 10500284

Section Cut and Cover  
 Length of section: 150 m Section 3

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	55687.5	m3	
concrete=	1356.75	m3	
rebar=	162.8	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	9885	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	1650	m2	

**Newfoundland Fixed Link Pre-feasibility Study**  
**South Approach**  
**Bored Highway Tunnel**

**Date:** 8-Jun-04  
**Calculations by:** ANW  
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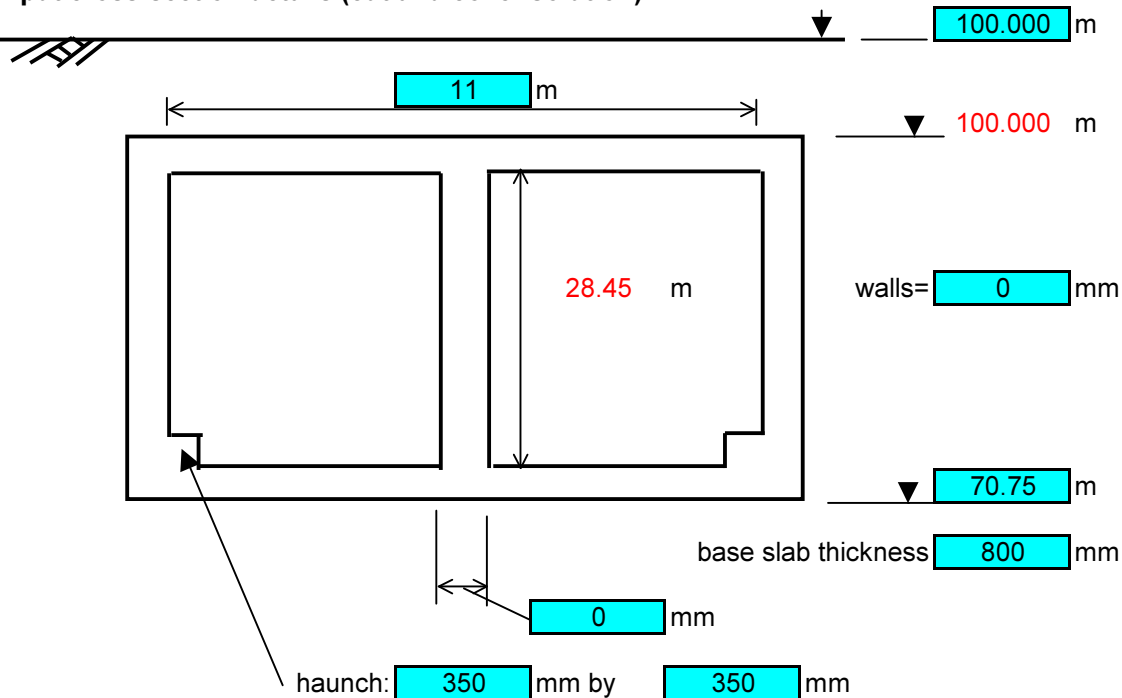
**Calculated costs**

Item	Unit	Quantity	Rate	Cost
excavation	m3	55687.5	60	3341250
concrete	m3	1356.75	190.0	257782.5
rebar	tonnes	162.8	1600	260496
formwork/falsework	m2	9885	140	1383900
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	1650	30	49500

Total 5292929

Section Cut and Cover  
 Length of section: 150 m Section 4

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	48262.5	m3	
concrete=	1356.75	m3	
rebar=	162.8	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	8535	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	1650	m2	



**Newfoundland Fixed Link Pre-feasibility Study**  
**South Approach**  
**Bored Highway Tunnel**

**Date:** 8-Jun-04  
**Calculations by:** ANW  
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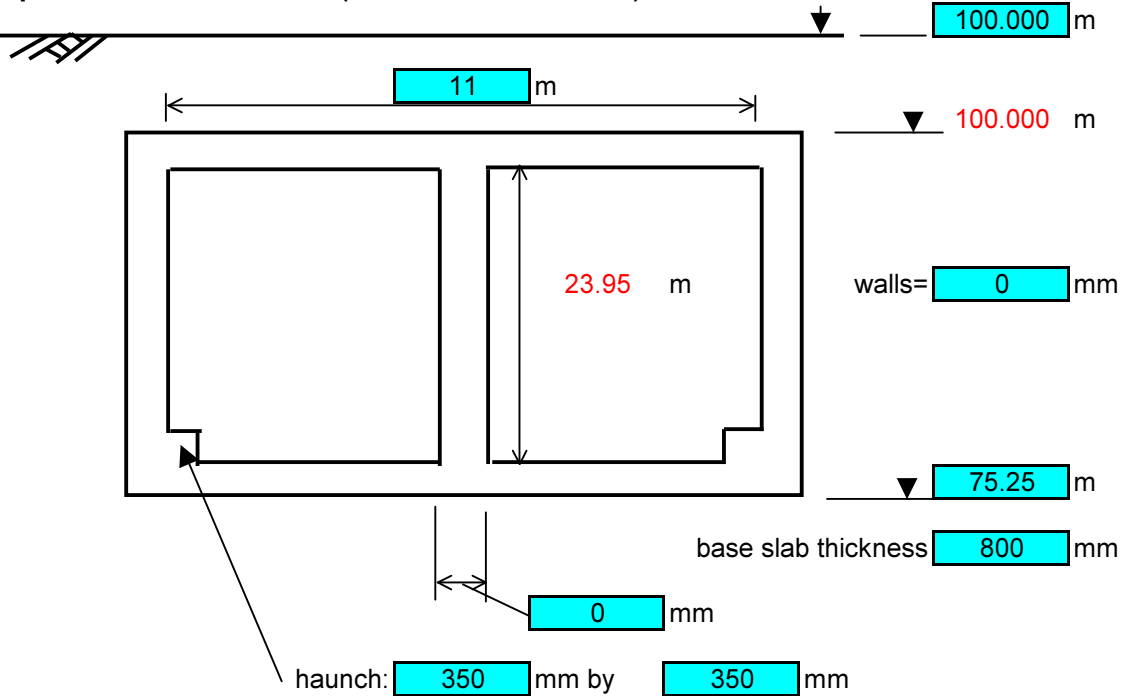
**Calculated costs**

Item	Unit	Quantity	Rate	Cost
excavation	m3	48262.5	60	2895750
concrete	m3	1356.75	190.0	257782.5
rebar	tonnes	162.8	1600	260496
formwork/falsework	m2	8535	140	1194900
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	1650	30	49500

Total 4658429

Section Cut and Cover  
 Length of section: 150 m Section 5

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	40837.5	m3	
concrete=	1356.75	m3	
rebar=	162.8	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	7185	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	7425.0	m2	
backfill=	0	m3	
surface reinstatement=	1650	m2	

**Newfoundland Fixed Link Pre-feasibility Study**  
**South Approach**  
**Bored Highway Tunnel**

**Date:** 8-Jun-04  
**Calculations by:** ANW  
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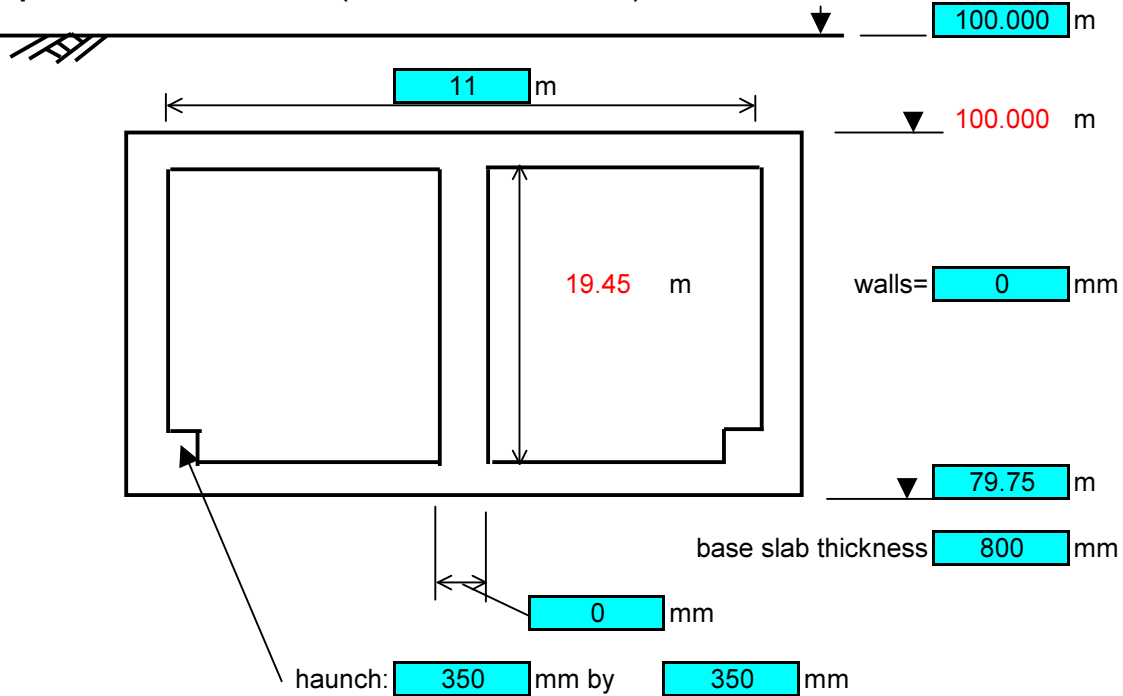
**Calculated costs**

Item	Unit	Quantity	Rate	Cost
excavation	m3	40837.5	60	2450250
concrete	m3	1356.75	190.0	257782.5
rebar	tonnes	162.8	1600	260496
formwork/falsework	m2	7185	140	1005900
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	7425.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	1650	30	49500

Total 4023929

Section Cut and Cover  
 Length of section: 150 m Section 6

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	33412.5	m3	
concrete=	1356.75	m3	
rebar=	162.8	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	5835	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	6075.0	m2	
backfill=	0	m3	
surface reinstatement=	1650	m2	

**Newfoundland Fixed Link Pre-feasibility Study**  
**South Approach**  
**Bored Highway Tunnel**

**Date:** 8-Jun-04  
**Calculations by:** ANW  
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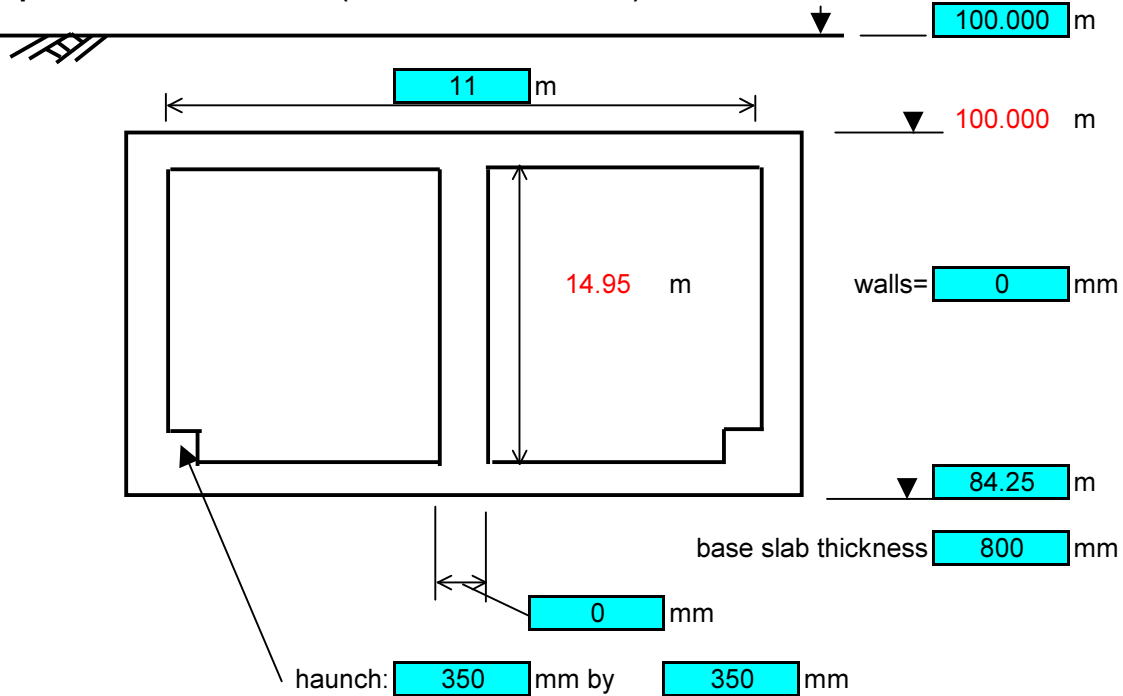
**Calculated costs**

Item	Unit	Quantity	Rate	Cost
excavation	m3	33412.5	60	2004750
concrete	m3	1356.75	190.0	257782.5
rebar	tonnes	162.8	1600	260496
formwork/falsework	m2	5835	140	816900
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	6075.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	1650	30	49500

Total 3389429

Section Cut and Cover  
 Length of section: 150 m Section 7

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	25987.5	m3	
concrete=	1356.75	m3	
rebar=	162.8	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	4485	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	4725.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	1650	m2	

**Newfoundland Fixed Link Pre-feasibility Study**  
**South Approach**  
**Bored Highway Tunnel**

**Date:** 8-Jun-04  
**Calculations by:** ANW  
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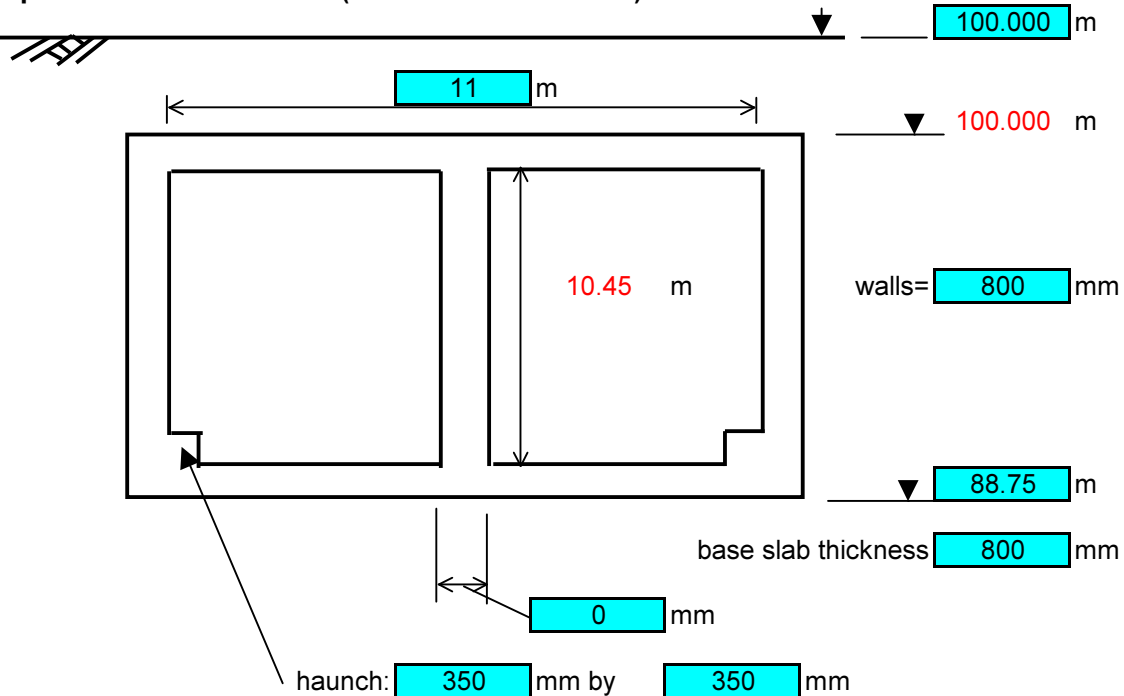
**Calculated costs**

Item	Unit	Quantity	Rate	Cost
excavation	m3	25987.5	60	1559250
concrete	m3	1356.75	190.0	257782.5
rebar	tonnes	162.8	1600	260496
formwork/falsework	m2	4485	140	627900
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	4725.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	1650	30	49500

Total 2754929

Section Cut and Cover  
 Length of section: 150 m Section 8

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	21262.5	m3	
concrete=	4056.75	m3	
rebar=	486.8	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	3135	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	3375.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	1890	m2	



**Newfoundland Fixed Link Pre-feasibility Study**  
**South Approach**  
**Bored Highway Tunnel**

**Date:** 8-Jun-04  
**Calculations by:** ANW  
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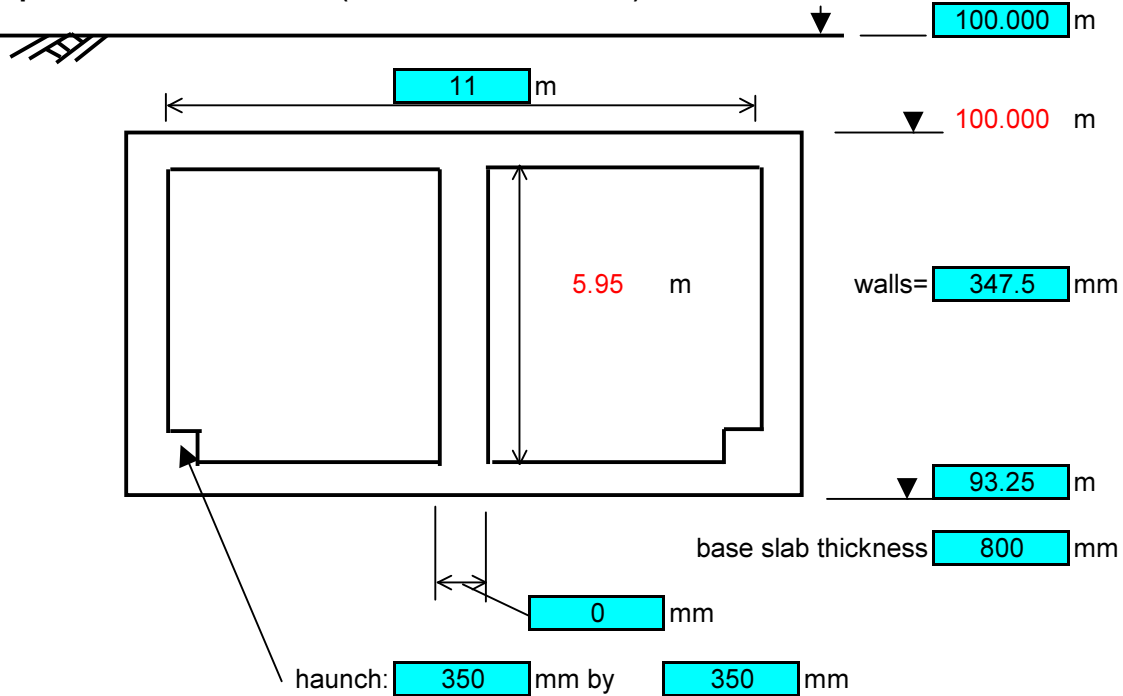
**Calculated costs**

Item	Unit	Quantity	Rate	Cost
excavation	m3	21262.5	60	1275750
concrete	m3	4056.75	190.0	770782.5
rebar	tonnes	486.8	1600	778896
formwork/falsework	m2	3135	140	438900
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	3375.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	1890	30	56700

Total 3321029

Section Cut and Cover  
 Length of section: 150 m Section 9

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	11841.2	m3	
concrete=	2060.438	m3	
rebar=	247.3	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	1785	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	2025.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	1754.25	m2	

**Newfoundland Fixed Link Pre-feasibility Study**  
**South Approach**  
**Bored Highway Tunnel**

**Date:** 8-Jun-04  
**Calculations by:** ANW  
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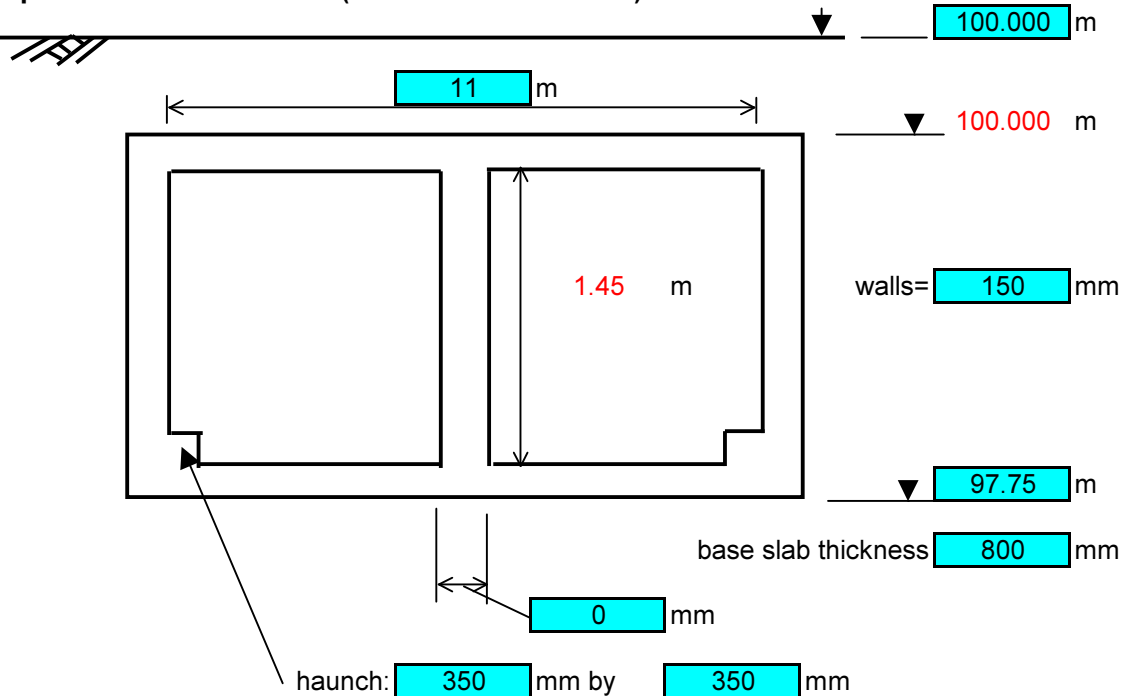
**Calculated costs**

Item	Unit	Quantity	Rate	Cost
excavation	m3	11841.2	60	710471.3
concrete	m3	2060.438	190.0	391483.1
rebar	tonnes	247.3	1600	395604
formwork/falsework	m2	1785	140	249900
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	2025.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	1754.25	30	52627.5

Total 1800086

Section Cut and Cover  
 Length of section: 150 m Section 10

Input cross-section details (cut and cover solution)



Calculated Quantities

excavation=	3813.8	m3	
concrete=	1458	m3	
rebar=	175.0	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	435	m2	
SP&L<=4.6m deep	675.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	1695	m2	

**Newfoundland Fixed Link Pre-feasibility Study**  
**South Approach**  
**Bored Highway Tunnel**

**Date:** 8-Jun-04  
**Calculations by:** ANW  
**Page 2 of 2**

**Calculated costs**

Item	Unit	Quantity	Rate	Cost
excavation	m3	3813.8	60	228825
concrete	m3	1458	190.0	277020
rebar	tonnes	175.0	1600	279936
formwork/falsework	m2	435	140	60900
SP&L<=4.6m deep	m2	675.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	1695	30	50850

Total 897531

**Newfoundland Fixed Link Pre-feasibility Study**  
**South Approach**  
**Bored Highway Tunnel**

**Date:** 8-Jun-04  
**Calculations by:** ANW

**Summary of Costs**

Markup for adjacent 0 %

<b>Section</b>	<b>Cost</b>
1	11671814
2	10500284
3	5292929
4	4658429
5	4023929
6	3389429
7	2754929
8	3321029
9	1800086
10	897531
Sub-total	<u>39536811</u>

Newfoundland Fixed Link  
Highway IT Option  
Tunnel Lighting Costs

Fraser River Project - 2x3 lane tunnels

For 1550 m length of Theo Van Kooten calculated the tunnel lighting cost as follows:

732	m of threshold lighting costs \$	661231.22	1260	lights
818	m of interior lighting costs \$	73151.75	139	lights
1550	m of nighttime circuit costs \$	126767.31	241	lights
1640	lights cost \$	117280.47	to instal	
1550	m of conduit costs	101424.99		
		<u>1079855.74</u>	*	<div>2</div>
				= \$ 2,159,711


Prorating for Newfoundland - assuming \*50% for single lane tunnel

for 

20300

 m length of tunnel

732	m of threshold lighting costs \$	661231.22	1260	lights
19568	m of interior lighting costs \$	1749918.6	3326	lights
20300	m of nighttime circuit costs \$	1660242.83	3157	lights
7743	lights cost \$	553721.15	to instal	
20300	m of conduit costs	1328340.19		
		<u>5953454.03</u>	*	<div>0.5</div>
				= \$ 2,976,727

 <b>Hatch Mott MacDonald</b>	<b>Newfoundland Fixed Link Pre-feasibility - Immersed Tube Highway Tunnel - Cost Summary</b>	
<b>ITEM</b>	<b>UNIT</b>	
MOBILIZATION & DEMOBILIZATION	LS	7,536,834
FABRICATION FACILITIES LEASE	LS	52,309,783
TUNNEL ELEMENT FABRICATION	LS	927,970,027
TUNNEL ELEMENT FINISHES	LS	94,194,981
MARINE DREDGE & BACKFILL	LS	743,334,442
UNIT TRANSPORT, PLACEMENT & CLOSURE	LS	247,961,957
NORTH DRILL AND BLAST TUNNEL	LS	69,969,983
NORTH APPROACH STRUCTURES	LS	5,533,384
SOUTH APPROACH STRUCTURES	LS	39,536,811
NORTH VENTILATION ADIT	LS	18,149,867
SOUTH VENTILATION ADIT	LS	0
ROAD FINISHES	LS	3,170,000
TUNNEL DRAINAGE	LS	7,370,000
NORTH VEHICLE HOLDING AREA	LS	6,960,000
SOUTH VEHICLE HOLDING AREA	LS	4,260,000
UTILITY DIVERSIONS	LS	1,000,000
MONITORING	LS	1,000,000
<b>SUBTOTAL CIVIL</b>		<b>\$2,230,258,068</b>
<b>CIVIL CONTINGENCIES</b>		
CONTINGENCY	40%	\$892,103,227
<b>TOTAL CIVIL</b>		<b>\$3,122,361,295</b>
<b>M&amp;E AND FINISHING WORK</b>		
VENTILATION EQUIPMENT	LS	\$6,000,000
VENTILATION BUILDINGS x 2	LS	\$2,000,000
FIRE SUPPRESSION SYSTEM	LS	\$4,000,000
CONTROL CENTRE	LS	\$4,000,000
SIGNALLING	LS	\$0
LIGHTING	LS	\$2,976,727
CCTV SYSTEM	LS	\$1,077,800
GAS DETECTION	LS	\$913,500
SUBSTATION, GENERATORS, UPS	LS	\$4,202,000
<b>SUBTOTAL M&amp;E AND FINISHING</b>		<b>\$25,170,027</b>
<b>CONTINGENCIES</b>	20%	\$5,034,005
<b>TOTAL M&amp;E AND FINISHING</b>		<b>\$30,204,032</b>
<b>TOTAL CIVIL, M&amp;E AND FINISHING</b>		<b>\$3,152,565,328</b>
<b>ALLOWANCES</b>		
CONTRACTOR OH	15%	\$472,884,799
CONTRACTOR PROFIT	15%	\$472,884,799
<b>CONSTRUCTION TOTAL</b>		<b>\$4,099,000,000</b>
<b>PRE-CONSTRUCTION AND SUPERVISION</b>		
FEASIBILITY STUDY	LS	\$11,000,000
ENVIRONMENTAL ASSESSMENT	LS	\$4,000,000
DESIGN	5%	\$204,950,000
CONSTRUCTION MANAGEMENT	10%	\$409,900,000
OWNERS COSTS	2%	\$81,980,000
<b>PRE-CONSTRUCTION TOTAL</b>		<b>\$711,830,000</b>
<b>GRAND TOTAL</b>		<b>\$4,810,830,000</b>





**Hatch Mott  
MacDonald**

**Strait of Belle Isle Crossing**

**Preliminary Immersed Tube Tunnel Cost Estimate - Road Tunnel**

<i>Item</i>	<i>Unit</i>	<i>Quantity</i>	<i>Rate</i>	<i>Total</i>
<b>General Details</b>				
Tunnel Length	18,000	metres		
Tunnel Element Length	150	metres	No. Elements =	120
The cross section of the tunnel element varies across three ventilation zones.				
Zone 1 from stations 0 to 1+800, and 16+200 to 18+000	3,600	metres	24	elements
Zone 2 from stations 1+800 to 6+150, and 11+850 to 16+200	8,700	metres	58	elements
Zone 3 from stations 6+150 to 11+850	5,700	metres	38	elements
<b>1 Miscellaneous</b>				
Mobilisation/demobilisation @ 3% of subtotal structure cost	ls	1	\$5,547,109.65	\$5,547,110
Fabrication facility lease (2 facilities assumed @ 5.5 yrs each)	year	11	\$3,500,000.00	\$38,500,000
<b>2 Tunnel Element Fabrication - Zone 1</b>				
<b>Concrete</b>				
Structural grade 4,000 psi placed by pump - slab on grade	m <sup>3</sup>	94,968	\$157.32	\$14,940,366
Structural grade 4,000 psi placed by pump - elevated slab	m <sup>3</sup>	80,640	\$169.62	\$13,678,157
Structural grade 4,000 psi placed by pump - walls	m <sup>3</sup>	58,572	\$175.31	\$10,268,257
External Protection Layer, 2,500 psi, placed by pump	m <sup>3</sup>	10,746	\$153.34	\$1,647,792
Keyed control joints transverse (at 20m centres approx)	m	10,161	\$13.25	\$134,633
Keyed control joints longitudinal (2 total at base/wall junction)	m	7,200	\$13.25	\$95,400
Curing, sprayed membrane, internal surfaces only	m	210,600	\$1.32	\$277,992
<b>Formwork</b>				
Walls, multiple use forms	m <sup>2</sup>	146,700	\$78.92	\$11,577,564
Elevated Slab, multiple use forms	m <sup>2</sup>	61,920	\$74.27	\$4,598,798
<b>Reinforcement: grade 60 high yield</b>				
Wall & Slab reinforcing, 150 kg/m <sup>3</sup>	tonnes	35,127	\$1,501.87	\$52,756,187
Bending, cutting & splicing	tonnes	35,127	\$270.44	\$9,499,746
<b>Waterproofing Membrane</b>				
Steel skin plate, A36, 6 mm thick	tonnes	19,143	\$3,132.11	\$59,957,982
Shear connectors, 150 mm x 12 mm, including stud welding	each	812,880	\$0.10	\$81,288
Automated Welding	m	91,044	\$14.86	\$1,352,914
<b>Tunnel Joints</b>				
Structural Steel End Frames (2/element)				
Embedded steel beams, 180 kg/m	tonnes	480	\$2,709.04	\$1,300,339
Front plates, 20 mm thick	tonnes	216	\$3,132.11	\$676,536
Gina fabrication, installation	each	24	\$29,128.00	\$699,072
Omega fabrication, installation & testing	each	24	\$36,693.00	\$880,632
Joint concrete, shear keys, cover plates etc.	each	24	\$20,000.00	\$480,000
<b>Page Total</b>				<b>\$228,950,765</b>



**Hatch Mott  
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**Strait of Belle Isle Crossing**

**Preliminary Immersed Tube Tunnel Cost Estimate - Road Tunnel**

Item	Unit	Quantity	Rate	Total
<b>Total Brought Forward</b>				<b>\$228,950,765</b>
<b>Temporary Works Items (Per Element)</b>				
Structural Steel Bulkheads (2/element)				
Support Columns, 250 kg/m	tonnes	936	\$2,709.04	\$2,535,661
Skin plate, 12 mm thick	tonnes	480	\$3,132.11	\$1,503,413
Plate stiffening angle, 18 kg/m	tonnes	168	\$3,174.03	\$533,237
Embedded perimeter angle, 18 kg/m	tonnes	96	\$3,174.03	\$304,707
Welding	m	22,656	\$14.86	\$336,668
Field Welding Premium	m	22,656	\$40.06	\$907,599
Misc. Structural Steel				
Alignment & pulling brackets etc., 5 tonnes per element	tonnes	120	\$3,132.11	\$375,853
Ballast Tanks (2/element)				
Steel support columns, 100 kg/m	tonnes	672	\$2,709.04	\$1,820,475
Timber lagging, 150 mm deep	m <sup>2</sup>	10,776	\$60.40	\$650,870
Membrane liner	m <sup>2</sup>	10,776	\$27.84	\$300,004
<b>3 Internal Structural &amp; Civil Finish Works - Zone 1</b>				
<b>Ballast</b>				
Road ballast concrete, 2,500 psi, placed by chute	m <sup>3</sup>	18,810	\$140.06	\$2,634,529
Road ballast reinforcement: welded wire fabric 6 x 6 x #4, 2.8kg/m <sup>2</sup>	m <sup>2</sup>	25,200	\$9.36	\$235,872
Deduct in excess of 4.5 tonnes	tonne	66	-\$41.01	-\$2,707
Emergency corridor sand/cement mix for HVDC cables	m <sup>3</sup>	4,410	\$140.06	\$617,665
<b>Precast Divider for Emergency Egress Corridor &amp; Vent Duct</b>				
Panel fabrication, 8" thick, including reinforcement & lifting points	m <sup>2</sup>	50,490	\$196.98	\$9,945,520
Panel setting, based upon max panel weight of 6 tons.	each	3,600	\$285.70	\$1,028,520
Seal and caulk panels	m	14,400	\$5.48	\$78,912
Sprayed fireproofing for precast panels	m <sup>2</sup>	50,490	\$20.77	\$1,048,677
<b>Roadway Surfacing</b>				
Surface treatment, prepare & clean surface	km	3.6	\$4,188.69	\$15,079
Bituminous surface course, 75 mm thick	m <sup>3</sup>	1,890	\$75.08	\$141,901
<b>4 Tunnel Element Fabrication - Zone 2</b>				
<b>Concrete</b>				
Structural grade 4,000 psi placed by pump - slab on grade	m <sup>3</sup>	169,563	\$157.32	\$26,675,651
Structural grade 4,000 psi placed by pump - elevated slab	m <sup>3</sup>	149,205	\$169.62	\$25,308,152
Structural grade 4,000 psi placed by pump - walls	m <sup>3</sup>	106,401	\$175.31	\$18,653,159
External Protection Layer, 2,500 psi, placed by pump	m <sup>3</sup>	20,384	\$153.34	\$3,125,698
Keyed control joints transverse (at 20m centres approx)	m <sup>2</sup>	20,097	\$13.25	\$266,285
Keyed control joints longitudinal (2 total at base/wall junction)	m	17,400	\$13.25	\$230,550
Curing, sprayed membrane, internal surfaces only	m	337,125	\$1.32	\$445,005
<b>Page Total</b>				<b>\$328,667,722</b>



**Hatch Mott  
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**Strait of Belle Isle Crossing**

**Preliminary Immersed Tube Tunnel Cost Estimate - Road Tunnel**

<i>Item</i>	<i>Unit</i>	<i>Quantity</i>	<i>Rate</i>	<i>Total</i>
<b>Total Brought Forward</b>				<b>\$328,667,722</b>
<b>Formwork</b>				
Walls, multiple use forms	m <sup>2</sup>	241,860	\$78.92	\$19,087,591
Elevated Slab, multiple use forms	m <sup>2</sup>	117,885	\$74.27	\$8,755,319
<b>Reinforcement: grade 60 high yield</b>				
Wall & Slab reinforcing, 200 kg/m <sup>3</sup>	tonnes	85,034	\$1,501.87	\$127,709,713
Bending, cutting & splicing	tonnes	85,034	\$270.44	\$22,996,541
<b>Waterproofing Membrane</b>				
Steel skin plate, A36, 6 mm thick	tonnes	19,140	\$3,132.11	\$59,948,585
Shear connectors, 150 mm x 12 mm, including stud welding	each	1,642,560	\$0.10	\$164,256
Automated Welding	m	186,528	\$14.86	\$2,771,806
<b>Tunnel Joints</b>				
Structural Steel End Frames (2/element)				
Embedded steel beams, 180 kg/m	tonnes	986	\$2,709.04	\$2,671,113
Front plates, 20 mm thick	tonnes	464	\$3,132.11	\$1,453,299
Gina fabrication, installation	each	58	\$24,355.00	\$1,412,590
Omega fabrication, installation & testing	each	58	\$30,680.00	\$1,779,440
Joint concrete, shear keys, cover plates etc.	each	58	\$20,000.00	\$1,160,000
<b>Temporary Works Items (Per Element)</b>				
Structural Steel Bulkheads (2/element)				
Support Columns, 250 kg/m	tonnes	1,682	\$2,709.04	\$4,556,605
Skin plate, 12 mm thick	tonnes	870	\$3,132.11	\$2,724,936
Plate stiffening angle, 18 kg/m	tonnes	348	\$3,174.03	\$1,104,562
Embedded perimeter angle, 18 kg/m	tonnes	116	\$3,174.03	\$368,187
Welding	m	77,024	\$14.86	\$1,144,577
Field Welding Premium	m	77,024	\$40.06	\$3,085,581
Misc. Structural Steel				
Alignment & pulling brackets etc., 5 tonnes per element	tonnes	290	\$3,132.11	\$908,312
Ballast Tanks (2/element)				
Steel support columns, 100 kg/m	tonnes	1,508	\$2,709.04	\$4,085,232
Timber lagging, 150 mm deep	m <sup>2</sup>	24,360	\$60.40	\$1,471,344
Membrane liner	m <sup>2</sup>	24,360	\$27.84	\$678,182
<b>5 Internal Structural &amp; Civil Finish Works - Zone 2</b>				
<b>Ballast</b>				
Road ballast concrete, 2,500 psi, placed by chute	m <sup>3</sup>	36,540	\$140.06	\$5,117,792
Road ballast reinforcement: welded wire fabric 6 x 6 x #4, 2.8kg/m <sup>2</sup>	m <sup>2</sup>	60,900	\$9.36	\$570,024
Deduct in excess of 4.5 tonnes	tonne	166	-\$41.01	-\$6,808
Emergency corridor sand/cement mix for HVDC cables	m <sup>3</sup>	10,658	\$140.06	\$1,492,689
<b>Page Total</b>				<b>\$605,879,194</b>



**Hatch Mott  
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***Strait of Belle Isle Crossing***

***Preliminary Immersed Tube Tunnel Cost Estimate - Road Tunnel***

<i>Item</i>	<i>Unit</i>	<i>Quantity</i>	<i>Rate</i>	<i>Total</i>
<b><i>Total Brought Forward</i></b>				<b><i>\$605,879,194</i></b>
<b><i>Precast Divider for Emergency Egress Corridor</i></b>				
Panel fabrication, 8" thick, including reinforcement & lifting points	m <sup>2</sup>	137,460	\$196.98	\$27,076,871
Panel setting, based upon max panel weight of 6 tons.	each	13,050	\$285.70	\$3,728,385
Seal and caulk panels	m	52,200	\$5.48	\$286,056
Sprayed fireproofing for precast panels	m <sup>2</sup>	167,040	\$20.77	\$3,469,421
<b><i>Roadway Surfacing</i></b>				
Surface treatment, prepare & clean surface	km	8.7	\$4,188.69	\$36,442
Bituminous surface course, 75 mm thick	m3	4,568	\$75.08	\$342,928
<b><i>6 Tunnel Element Fabrication - Zone 3</i></b>				
<b><i>Concrete</i></b>				
Structural grade 4,000 psi placed by pump - slab on grade	m <sup>3</sup>	71,193	\$157.32	\$11,200,083
Structural grade 4,000 psi placed by pump - elevated slab	m <sup>3</sup>	58,767	\$169.62	\$9,968,059
Structural grade 4,000 psi placed by pump - walls	m <sup>3</sup>	55,475	\$175.31	\$9,725,366
External Protection Layer, 2,500 psi, placed by pump	m <sup>3</sup>	9,320	\$153.34	\$1,429,052
Keyed control joints transverse (at 20m centres approx)	m <sup>2</sup>	10,616	\$13.25	\$140,665
Keyed control joints longitudinal (2 total at base/wall junction)	m	11,400	\$13.25	\$151,050
Curing, sprayed membrane, internal surfaces only	m	169,005	\$1.32	\$223,087
<b><i>Formwork</i></b>				
Walls, multiple use forms	m <sup>2</sup>	152,190	\$78.92	\$12,010,835
Elevated Slab, multiple use forms	m <sup>2</sup>	52,440	\$74.27	\$3,894,719
<b><i>Reinforcement: grade 60 high yield</i></b>				
Wall & Slab reinforcing, 150 kg/m <sup>3</sup>	tonnes	27,815	\$1,501.87	\$41,774,946
Bending, cutting & splicing	tonnes	27,815	\$270.44	\$7,522,366
<b><i>Waterproofing Membrane</i></b>				
Steel skin plate, A36, 6 mm thick	tonnes	9,975	\$3,132.11	\$31,242,797
Shear connectors, 150 mm x 12 mm, including stud welding	each	424,650	\$0.10	\$42,465
Automated Welding	m	99,465	\$14.86	\$1,478,050
<b><i>Tunnel Joints</i></b>				
Structural Steel End Frames (2/element)				
Embedded steel beams, 180 kg/m	tonnes	504	\$2,709.04	\$1,365,031
Front plates, 20 mm thick	tonnes	222	\$3,132.11	\$696,268
Gina fabrication, installation	each	38	\$19,221.00	\$730,398
Omega fabrication, installation & testing	each	38	\$24,213.00	\$920,094
Joint concrete, shear keys, cover plates etc.	each	38	\$20,000.00	\$760,000
<b><i>Page Total</i></b>				<b><i>\$776,094,627</i></b>



**Hatch Mott  
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**Strait of Belle Isle Crossing**

**Preliminary Immersed Tube Tunnel Cost Estimate - Road Tunnel**

<i>Item</i>	<i>Unit</i>	<i>Quantity</i>	<i>Rate</i>	<i>Total</i>
<b>Total Brought Forward</b>				<b>\$776,094,627</b>
<b>Temporary Works Items (Per Element)</b>				
Structural Steel Bulkheads (2/element)				
Support Columns, 250 kg/m	tonnes	749	\$2,709.04	\$2,027,987
Skin plate, 12 mm thick	tonnes	371	\$3,132.11	\$1,160,447
Plate stiffening angle, 18 kg/m	tonnes	129	\$3,174.03	\$410,085
Embedded perimeter angle, 18 kg/m	tonnes	42	\$3,174.03	\$132,674
Welding	m	18,392	\$14.86	\$273,305
Field Welding Premium	m	18,392	\$40.06	\$736,784
Misc. Structural Steel				
Alignment & pulling brackets etc., 5 tonnes per element	tonnes	190	\$3,132.11	\$595,101
Ballast Tanks (2/element)				
Steel support columns, 100 kg/m	tonnes	836	\$2,709.04	\$2,264,757
Timber lagging, 150 mm deep	m <sup>2</sup>	13,543	\$60.40	\$818,009
Membrane liner	m <sup>2</sup>	13,543	\$27.84	\$377,043
<b>7 Internal Structural &amp; Civil Finish Works - Zone 3</b>				
<b>Ballast</b>				
Road ballast concrete, 2,500 psi, placed by chute	m <sup>3</sup>	17,813	\$140.06	\$2,494,819
Road ballast reinforcement: welded wire fabric 6 x 6 x #4, 2.8kg/m <sup>2</sup>	m <sup>2</sup>	39,900	\$9.36	\$373,464
Deduct in excess of 4.5 tonnes	tonne	107	-\$41.01	-\$4,388
Emergency corridor sand/cement mix for HVDC cables	m <sup>3</sup>	3,563	\$140.06	\$498,964
<b>Precast Divider for Emergency Egress Corridor</b>				
Panel fabrication, 8" thick, including reinforcement & lifting points	m <sup>2</sup>	32,063	\$196.98	\$6,315,671
Panel setting, based upon max panel weight of 6 tons.	each	2,850	\$285.70	\$814,245
Seal and caulk panels	m	11,400	\$5.48	\$62,472
Sprayed fireproofing for precast panels	m <sup>2</sup>	32,063	\$20.77	\$665,938
<b>Roadway Surfacing</b>				
Surface treatment, prepare & clean surface	km	5.7	\$4,188.69	\$23,876
Bituminous surface course, 75 mm thick	m <sup>3</sup>	2,993	\$75.08	\$224,677
<b>8 Tunnel Transport &amp; Placement</b>				
Element Transport: tug rental etc.	each	120	\$500,000.00	\$60,000,000
Element placement: barge/pontoons, divers, survey etc.	each	120	\$1,000,000.00	\$120,000,000
<b>Tunnel Closure</b>				
Underwater joint completion	each	1	\$2,500,000.00	\$2,500,000
<b>Page Total</b>				<b>\$978,860,556</b>



**Hatch Mott  
MacDonald**

***Strait of Belle Isle Crossing***

***Preliminary Immersed Tube Tunnel Cost Estimate - Road Tunnel***

<i>Item</i>	<i>Unit</i>	<i>Quantity</i>	<i>Rate</i>	<i>Total</i>
<b><i>Total Brought Forward</i></b>				<b><i>\$978,860,556</i></b>
<b><i>9 Marine Operation</i></b>				
<b><i>Dredging</i></b>				
Mobilization/Demobilization per season, 6 seasons, 2 vessels	each	24	\$150,000.00	\$3,600,000
Stage 1 bulk dredging of material	m3	5,255,299	\$84.00	\$441,445,116
Stage 2 fine tolerance dredging & additional trench cleaning	m3	788,295	\$43.00	\$33,896,685
<b><i>Foundation and Backfill</i></b>				
Bedded sand foundation	m3	263,385	\$35.00	\$9,218,475
Selected locking fill	m3	298,955	\$35.00	\$10,463,425
Backfill	m3	416,616	\$35.00	\$14,581,560
Rock armor protection	m3	664,488	\$51.00	\$33,888,888
<b><i>Subtotal Structure Cost</i></b>				<b><i>\$1,525,954,705</i></b>
Tunnel MEP Systems	Is	10 % of structure cost		\$152,595,470
Rail Systems	Is	15 % of structure cost		\$228,893,206
Contingency on Tunnel Costs	Is	30% of subtotal structure cost		\$457,786,411
<b><i>"Soft" Costs</i></b>				
Engineers design & construction supervision fee	Is	10% of construction cost		\$236,522,979
<b><i>Estimated Construction Cost</i></b>				<b><i>\$2,601,752,772</i></b>
<b><i>Estimated Construction Cost per linear metre</i></b>				<b><i>\$144,542</i></b>

## Newfoundland Fixed Link Pre-feasibility Study South Vehicle Holding Area

Area= 300 m by 600 m

### Earthworks

Assume 0 m depth cleared over entire area

Spoil excavation and removal @ \$ 30 /m3

Earthworks= 0

### Surface

Assume surface @ 20 /m2

Surface= 3,600,000

### Buildings etc.

Public facilities building @	80000	See CJT estimate
Site maintenance building @	220000	See CJT estimate
Fire engines @	360000	See CJT estimate

Total cost 4,260,000



## Detailed Cost Estimate Report

<b>Project:</b>	Newfoundland Fixed Link Pre-feasibility Study	<b>Project Number:</b>	213789
<b>Estimate Description:</b>	Set-up TBM	<b>Parent Estimate ID:</b>	1563
<b>Tunnel Name:</b>	Single Highway Bored	<b>Project Phase:</b>	Conceptual
<b>Construction Activity:</b>	Erect TBM Only	<b>Geology Type:</b>	Not Applicable
<b>Tunnel Technique:</b>	EPB TBM - Precast segmental	<b>Estimate Date:</b>	May 31, 2004
<b>Estimate Definition ID:</b>	2631	<b>Tunnel Characteristics ID:</b>	842

### Tunnel Characteristics

**Finished Diameter:** 11 m

### Activity Details

**Shift Arrangement** 3 - 8 hour shifts x 7 days per week

**Duration of Activity** 4.5 Weeks

**Total Number of Shifts** 94.5

Resource Name	Unit Rate	UOM	Unit Quantity	Resource Quantity	Total
<b>Labor</b>					
Pit boss	52.29	\$/hr	756.00	1.00	39,531
Tunnel miner	48.89	\$/hr	756.00	2.00	73,922
Shaft bottom	48.44	\$/hr	756.00	3.00	109,862
Tunnel fitter	49.34	\$/hr	756.00	1.00	37,301
Tunnel electrician	49.34	\$/hr	756.00	1.00	37,301
Shaft top	47.99	\$/hr	756.00	1.00	36,280
Crane operator	49.34	\$/hr	756.00	2.00	74,602
Surface laborer	47.99	\$/hr	756.00	1.00	36,280
Equipment laborer	48.44	\$/hr	756.00	1.00	36,621
				<b>13.00</b>	<b>\$481,701</b>
<b>Plant</b>					
Loco	5,000.00	\$/wk	4.50	1.00	22,500
Muck cars & grout cars	1,900.00	\$/wk	4.50	6.00	51,300
Flat cars	310.00	\$/wk	4.50	2.00	2,790
Transformers & switchgear - LV	750.00	\$/wk	4.50	1.00	3,375
Small tools	2,600.00	\$/wk	4.50	1.00	11,700
Shaft crane	9,000.00	\$/wk	4.50	1.00	40,500
Erection crane	10,000.00	\$/wk	4.50	1.00	45,000
Compressors	950.00	\$/wk	4.50	1.00	4,275
Generators	2,000.00	\$/wk	4.50	1.00	9,000
Transformers & switchgear - HV	5,200.00	\$/wk	4.50	1.00	23,400
Loaders	2,300.00	\$/wk	4.50	1.00	10,350
					<b>\$224,190</b>
<b>Consumables</b>					
Electrical power	0.00	\$/kwh	756.00	300.00	0
Gas oil	0.00	\$/L	0.00	1.00	0

**Estimate Definition ID:** 2631

**Estimated by:**

**Printed by:** whit2782, 8/16/04 11:40:07 AM

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**Checked by:**



Resource Name	Unit Rate	UOM	Unit Quantity	Resource Quantity	Total
Lubrication materials	0.00	\$/wk	4.50	1.00	0
Filters etc.	0.00	\$/wk	4.50	1.00	0
Hydraulic oil	0.00	\$/L	0.00	1.00	0
Other consumables	0.00	\$/wk	4.50	1.00	0
					\$0
<b>Materials</b>					
Temporary materials	2,000.00	\$/wk	4.50	1.00	9,000
Thrust frame	5,000.00	\$/wk	4.50	1.00	22,500
					\$31,500
<b>Total Estimated Cost:</b>					\$737,391



## Detailed Cost Estimate Report

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**Project:** Newfoundland Fixed Link Pre-feasibility Study  
**Estimate Description:** Tunnel drive  
**Tunnel Name:** Single Highway Bored  
**Construction Activity:** TBM Tunneling  
**Tunnel Technique:** EPB TBM - Precast segmental  
**Estimate Definition ID:** 2632

**Project Number:** 213789  
**Parent Estimate ID:** 1559  
**Project Phase:** Conceptual  
**Geology Type:** Not Applicable  
**Estimate Date:** May 31, 2004  
**Tunnel Characteristics ID:** 842

### Tunnel Characteristics

**Tunnel Length:** 19,991 m  
**Finished Diameter:** 11 m  
**Initial Support Type:** Pre-cast concrete segments  
**Initial Support Thickness:** 0 m  
**Final Lining Thickness:** 0.55 m  
**Grout Thickness:** 0.125 m

### Theoretical Excavation Volumes

**Total Neat Excavation:** 2,394,738 Cubic Metres  
**Initial Lining Volume:** 0 Cubic Metres  
**Final Lining Volume:** 398,959 Cubic Metres  
**Theoretical Grout Volume:** 95,972 Cubic Metres

### Normal Excavation/Support Cycle

**Excavation Cycle Length:** 1.5 Metres  
**Excavate:** 28 Minutes  
**Erect Support:** 36 Minutes  
**Extend Services:** 0 Minutes  
**Total Cycle Time:** 64 Minutes

### Difficult Excavation/Support Cycle

**Length of Difficult Excavation:** 1400 Metres  
**Excavate:** 92 Minutes  
**Erect Support:** 74 Minutes  
**Extend Services:** 0 Minutes  
**Total Cycle Time:** 166 Minutes

### Reduction Factors

**Machine availability:** 80 %  
**Back up efficiency:** 55 %  
**Planned maintenance:** 5 %  
**Learning curve efficiency:** 40 %  
**Learning curve duration time:** 8 Weeks

**Learning Curve Rate:** 5.6 m/day  
**Experienced Advance Rate:** 14.1 m/day  
**Difficult Advance Rate:** 5.4 m/day

### TBM Skidding Through Excavation

**Duration of skidding:** 0 Weeks  
**Length of skidding:** 0 Metres

### Advance Rate and Shift Details

**Shift Arrangement:** 3 - 8 hour shifts x 7 days per week  
**Avg. Drive Advance per Shift:** 4.14 Metres  
**Avg. Drive Advance per Day:** 12 Metres  
**Avg. Drive Advance per Week:** 87 Metres  
**Duration of Tunneling (Incl. Skid):** 229.83 Weeks  
**Total number of shifts (Incl. Skid):** 4,827

	Metres	Days
<b>Learning Curve Drive:</b>	316	56
<b>Experienced Drive:</b>	18,275	1,295
<b>Difficult Drive:</b>	1,400	257
<b>Skidding Portion:</b>	0	0

Resource Name	Unit Rate	UOM	Unit Quantity	Resource Quantity	Total
<b>Labor</b>					
Pit boss	52.29	\$/hr	38,615.00	1.00	2,019,178
Working foreman	52.29	\$/hr	38,615.00	2.00	4,038,357
Tunnel miner	48.89	\$/hr	38,615.00	3.00	5,663,662
Tunnel laborer	48.44	\$/hr	38,615.00	4.00	7,482,042
Loco driver	49.34	\$/hr	38,615.00	4.00	7,621,056
Shaft bottom	48.44	\$/hr	38,615.00	1.00	1,870,511
TBM operator	49.34	\$/hr	38,615.00	1.00	1,905,264
Tunnel fitter	49.34	\$/hr	38,615.00	1.00	1,905,264
Tunnel electrician	49.34	\$/hr	38,615.00	1.00	1,905,264
Shaft top	47.99	\$/hr	38,615.00	2.00	3,706,268
Crane operator	49.34	\$/hr	38,615.00	1.00	1,905,264
Surface laborer	47.99	\$/hr	38,615.00	4.00	7,412,535
Equipment laborer	48.44	\$/hr	38,615.00	4.00	7,482,042
				<b>29.00</b>	<b>\$54,916,708</b>
<b>Plant</b>					
TBM	300,000.00	\$/m2	119.79	0.80	28,749,600
TBM backup	1,430,000.00	\$/Nr	1.00	1.00	1,430,000
Loco	5,000.00	\$/wk	229.83	4.00	4,596,600
Muck cars & grout cars	1,900.00	\$/wk	229.83	56.00	24,453,912
Flat cars	310.00	\$/wk	229.83	8.00	569,978
Manriders	310.00	\$/wk	229.83	2.00	142,495
Track	130.00	\$/m	19,991.00	1.00	2,598,830
Air pipe	30.00	\$/m	19,991.00	1.00	599,730
Water pipe	25.00	\$/m	19,991.00	1.00	499,775
Pump main	50.00	\$/m	19,991.00	1.00	999,550
Cabling	80.00	\$/m	19,991.00	1.00	1,599,280
Lighting	30.00	\$/m	19,991.00	1.00	599,730
Vent ducting	30.00	\$/m	19,991.00	1.00	599,730
Grout mixers	7,100.00	\$/wk	229.83	1.00	1,631,793
Grout pumps	3,400.00	\$/wk	229.83	1.00	781,422
Grout hoses & pipes	196.00	\$/wk	229.83	2.00	90,093
Transformers & switchgear - LV	750.00	\$/wk	229.83	2.00	344,745
Small tools	2,600.00	\$/wk	229.83	1.00	597,558
Shaft crane	9,000.00	\$/wk	229.83	1.00	2,068,470
Compressors	950.00	\$/wk	229.83	1.00	218,339
Low pressure C/A system	3,800.00	\$/wk	229.83	1.00	873,354
Pipework and controls	655.00	\$/wk	229.83	2.00	301,077
Generators	2,000.00	\$/wk	229.83	1.00	459,660
Transformers & switchgear - HV	5,200.00	\$/wk	229.83	1.00	1,195,116
Surface fans	800.00	\$/wk	229.83	2.00	367,728
Loaders	2,300.00	\$/wk	229.83	2.00	1,057,218
Other surface plant	2,600.00	\$/wk	229.83	1.00	597,558

Resource Name	Unit Rate	UOM	Unit Quantity	Resource Quantity	Total
Tunnel C/A system	40,000.00	\$/wk	229.83	1.00	9,193,200
					\$87,216,541
<b>Consumables</b>					
Electrical power	0.10	\$/kwh	38,615.00	3,000.00	11,584,500
Gas oil	0.45	\$/L	48,000.00	1.00	21,600
Lubrication materials	90.00	\$/wk	229.83	1.00	20,685
TBM spares, cutters	250.00	\$/m	19,991.00	1.00	4,997,750
Filters etc.	300.00	\$/wk	229.83	1.00	68,949
Hydraulic oil	0.90	\$/L	32,000.00	1.00	28,800
Other consumables	160.00	\$/wk	229.83	1.00	36,773
Tail seal grease	100.00	\$/m	19,991.00	1.00	1,999,100
					\$18,758,157
<b>Materials</b>					
Concrete lining rings	13,211.47	\$/Nr	13,328.00	1.00	176,082,407
Gaskets	110.00	\$/m	19,991.00	1.00	2,199,010
Bolts	12.00	\$/Nr	1,765.00	30.00	635,400
Grout	145.00	\$/m3	95,972.00	1.00	13,915,940
Grout plugs	0.50	\$/Nr	1,765.00	7.00	6,178
Packers	10.00	\$/Nr	3,633.00	12.00	435,960
Temporary materials	2,250.00	\$/wk	229.83	1.00	517,118
Other materials	0.00	\$/t	0.00	1.00	0
					\$193,792,012
<b>Subcontracts</b>					
Soil disposal	20.00	\$/m3	2,394,738.00	1.50	71,842,140
					\$71,842,140
<b>Total Estimated Cost:</b>					\$426,525,558
<b>Total Estimated Cost per Metre:</b>					\$21,336
<b>Total Estimated Cost per Week:</b>					\$1,855,833
<b>Total Estimated Cost per Shift:</b>					\$88,364



## Detailed Cost Estimate Report

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<b>Project:</b>	Newfoundland Fixed Link Pre-feasibility Study	<b>Project Number:</b>	213789
<b>Estimate Description:</b>	Maintain TBM	<b>Parent Estimate ID:</b>	1561
<b>Tunnel Name:</b>	Single Highway Bored	<b>Project Phase:</b>	Conceptual
<b>Construction Activity:</b>	TBM Maintenance	<b>Geology Type:</b>	Not Applicable
<b>Tunnel Technique:</b>	EPB TBM - Precast segmental	<b>Estimate Date:</b>	May 31, 2004
<b>Estimate Definition ID:</b>	2633	<b>Tunnel Characteristics ID:</b>	842

### Tunnel Characteristics

**Finished Diameter:** 11 m

### Activity Details

**Shift Arrangement** 1 - 6 hour shifts x 1 days per week

**Duration of Activity** 229 Weeks

**Total Number of Shifts** 229

Resource Name	Unit Rate	UOM	Unit Quantity	Resource Quantity	Total
<b>Labor</b>					
Working foreman	52.29	\$/hr	1,374.00	1.50	107,770
Loco driver	49.34	\$/hr	1,374.00	1.50	101,690
Shaft bottom	48.44	\$/hr	1,374.00	1.50	99,835
TBM operator	49.34	\$/hr	1,374.00	1.50	101,690
Tunnel fitter	49.34	\$/hr	1,374.00	1.50	101,690
Tunnel electrician	49.34	\$/hr	1,374.00	1.50	101,690
Shaft top	47.99	\$/hr	1,374.00	1.50	98,907
Surface laborer	47.99	\$/hr	1,374.00	1.50	98,907
				<b>12.00</b>	<b>\$812,178</b>
<b>Consumables</b>					
Electrical power	0.10	\$/kwh	1,374.00	600.00	82,440
Gas oil	0.45	\$/L	0.00	1.00	0
Other consumables	0.00	\$/wk	229.00	1.00	0
					<b>\$82,440</b>
<b>Materials</b>					
Temporary materials	200.00	\$/wk	229.00	1.00	45,800
Other materials	0.00	\$/t	0.00	1.00	0
					<b>\$45,800</b>

**Total Estimated Cost:** \$940,418



## Detailed Cost Estimate Report

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<b>Project:</b>	Newfoundland Fixed Link Pre-feasibility Study	<b>Project Number:</b>	213789
<b>Estimate Description:</b>	Clean tunnel	<b>Parent Estimate ID:</b>	1562
<b>Tunnel Name:</b>	Single Highway Bored	<b>Project Phase:</b>	Conceptual
<b>Construction Activity:</b>	Tunnel Clean Up	<b>Geology Type:</b>	Not Applicable
<b>Tunnel Technique:</b>	EPB TBM - Precast segmental	<b>Estimate Date:</b>	May 21, 2004
<b>Estimate Definition ID:</b>	2634	<b>Tunnel Characteristics ID:</b>	842

### Tunnel Characteristics

<b>Tunnel Length:</b>	19,991 m
<b>Finished Diameter:</b>	11 m (Circular Tunnels)
<b>Excavated Cross Section:</b>	0 m2 (Non-circular Tunnels)
<b>Excavated Perimeter:</b>	0 m (Non-circular Tunnels)

### Productivity Cycle

<b>Section Length</b>	30 Metres
<b>Vent Line Removal Time</b>	120 Minutes
<b>Track Removal Time</b>	60 Minutes
<b>Temp Lighting Removal Time</b>	60 Minutes
<b>Clean Up Time</b>	120 Minutes
<b>Total Cycle Time</b>	360 Minutes

### Reduction Factors

<b>Learning Curve Efficiency:</b>	50 %
<b>Back Up Efficiency:</b>	80 %
<b>Learning Curve Duration:</b>	1 Weeks

### Shift Details

<b>Shift Arrangement:</b>	3 - 8 hour shifts x 7 days per week
<b>Avg. Advance per Shift:</b>	31.45 Metres
<b>Avg. Advance per Week:</b>	661 Metres
<b>Total number of hours:</b>	5,086

### Clean Up Productivity Data

	<u>Average Advance</u>	<u>Drive Length</u>	<u>Drive Duration</u>		
<b>Learning Curve Portion:</b>	48.0 m/day	336 Metres	21 Shifts	7 Days	1.00 Weeks
<b>Experienced Drive Portion:</b>	96.0 m/day	19,655 Metres	614 Shifts	205 Days	29.25 Weeks
<b>Total:</b>	94.4 m/day	19,991 Metres	636 Shifts	212 Days	30.25 Weeks

Resource Name	Unit Rate	UOM	Unit Quantity	Resource Quantity	Total
<b>Labor</b>					
Tunnel laborer	48.44	\$/hr	5,086.00	6.00	1,478,195
Shaft bottom	48.44	\$/hr	5,086.00	1.00	246,366
Shaft top	47.99	\$/hr	5,086.00	1.00	244,077
Crane operator	49.34	\$/hr	5,086.00	1.00	250,943
				<b>9.00</b>	<b>\$2,219,581</b>
<b>Plant</b>					
Transformers & switchgear - LV	750.00	\$/wk	30.25	1.00	22,688

Estimate Definition ID: 2634

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Resource Name	Unit Rate	UOM	Unit Quantity	Resource Quantity	Total
Man hoists	2,600.00	\$/wk	30.25	1.00	78,650
Shaft crane	9,000.00	\$/wk	30.25	1.00	272,250
Compressors	950.00	\$/wk	30.25	1.00	28,738
Loaders	2,260.00	\$/wk	30.25	1.00	68,365
Other surface plant	2,600.00	\$/wk	30.25	1.00	78,650
Bobcat	500.00	\$/wk	30.25	1.00	15,125
					\$564,465
<b>Consumables</b>					
Electrical power	0.10	\$/kwh	5,086.00	200.00	101,720
					\$101,720

**Total Estimated Cost:** \$2,885,766  
**Total Estimated Cost per Metre:** \$144  
**Total Estimated Cost per Week:** \$95,402  
**Total Estimated Cost per Shift:** \$4,539



## Detailed Cost Estimate Report

<b>Project:</b>	Newfoundland Fixed Link Pre-feasibility Study	<b>Project Number:</b>	213789
<b>Estimate Description:</b>	Remove TBM	<b>Parent Estimate ID:</b>	1564
<b>Tunnel Name:</b>	Single Highway Bored	<b>Project Phase:</b>	Preliminary
<b>Construction Activity:</b>	TBM Removal	<b>Geology Type:</b>	Not Applicable
<b>Tunnel Technique:</b>	EPB TBM - Precast segmental	<b>Estimate Date:</b>	May 21, 2004
<b>Estimate Definition ID:</b>	2635	<b>Tunnel Characteristics ID:</b>	842

### Tunnel Characteristics

**Finished Diameter:** 11 m

### Activity Details

**Shift Arrangement** 3 - 8 hour shifts x 7 days per week

**Duration of Activity** 2.2 Weeks

**Total Number of Shifts** 46.2

Resource Name	Unit Rate	UOM	Unit Quantity	Resource Quantity	Total
<b>Labor</b>					
Pit boss	52.29	\$/hr	370.00	1.00	19,347
Tunnel miner	48.89	\$/hr	370.00	3.00	54,268
Shaft bottom	48.44	\$/hr	370.00	2.00	35,846
Tunnel fitter	49.34	\$/hr	370.00	1.00	18,256
Tunnel electrician	49.34	\$/hr	370.00	1.00	18,256
Shaft top	47.99	\$/hr	370.00	2.00	35,513
Crane operator	49.34	\$/hr	370.00	2.00	36,512
Surface laborer	47.99	\$/hr	370.00	2.00	35,513
Equipment laborer	48.44	\$/hr	370.00	1.00	17,923
				<b>15.00</b>	<b>\$271,432</b>
<b>Plant</b>					
Loco	5,000.00	\$/wk	2.20	1.00	11,000
Muck cars & grout cars	1,900.00	\$/wk	2.20	6.00	25,080
Flat cars	310.00	\$/wk	2.20	4.00	2,728
Manriders	310.00	\$/wk	2.20	1.00	682
Booster fans	800.00	\$/wk	2.20	1.00	1,760
Transformers & switchgear - LV	750.00	\$/wk	2.20	1.00	1,650
Other plant	1,400.00	\$/wk	2.20	1.00	3,080
Man hoists	2,000.00	\$/wk	2.20	1.00	4,400
Shaft crane	9,000.00	\$/wk	2.20	1.00	19,800
50T Crane	3,000.00	\$/wk	2.20	1.00	6,600
TBM Crane	15,000.00	\$/wk	2.20	1.00	33,000
Compressors	950.00	\$/wk	2.20	1.00	2,090
Transformers & switchgear - HV	5,200.00	\$/wk	2.20	1.00	11,440
Surface fans	800.00	\$/wk	2.20	1.00	1,760
					<b>\$125,070</b>

**Estimate Definition ID:** 2635

**Estimated by:**

**Printed by:** whit2782, 8/16/04 11:42:02 AM

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**Checked by:**



Resource Name	Unit Rate	UOM	Unit Quantity	Resource Quantity	Total
<b>Consumables</b>					
Electrical power	0.00	\$/kwh	370.00	600.00	0
Gas oil	0.40	\$/L	15.00	1,000.00	6,000
Lubrication materials	0.00	\$/wk	2.20	1.00	0
Filters etc.	0.00	\$/wk	2.20	1.00	0
Hydraulic oil	0.00	\$/L	0.00	1.00	0
Other consumables	500.00	\$/wk	2.20	1.00	1,100
					\$7,100
<b>Materials</b>					
Temporary materials	500.00	\$/wk	2.20	1.00	1,100
Thrust frame	0.00	\$/wk	2.20	1.00	0
					\$1,100
<b>General Supplies</b>					
Small tools	700.00	\$/wk	2.20	1.00	1,540
					\$1,540
<b>Total Estimated Cost:</b>					\$406,242

## Initialisation

**Project:** Newfoundland Fixed Link Pre-feasibility Study

**Section:** North Approach

**Option:** Bored Highway Tunnel

**Date:** 8-Jun-04

**Calculations by:** ANW

Surface gradient  %

+ sloping same way as track/road  
- sloping against track/road

Track/Road Gradient  %

Ground elevation  
at portal  m

Bottom of slab  
elevation at portal  m

Total length= 328.5714 m

Total Cost=\$ 5.9 M

**UNIT RATES**

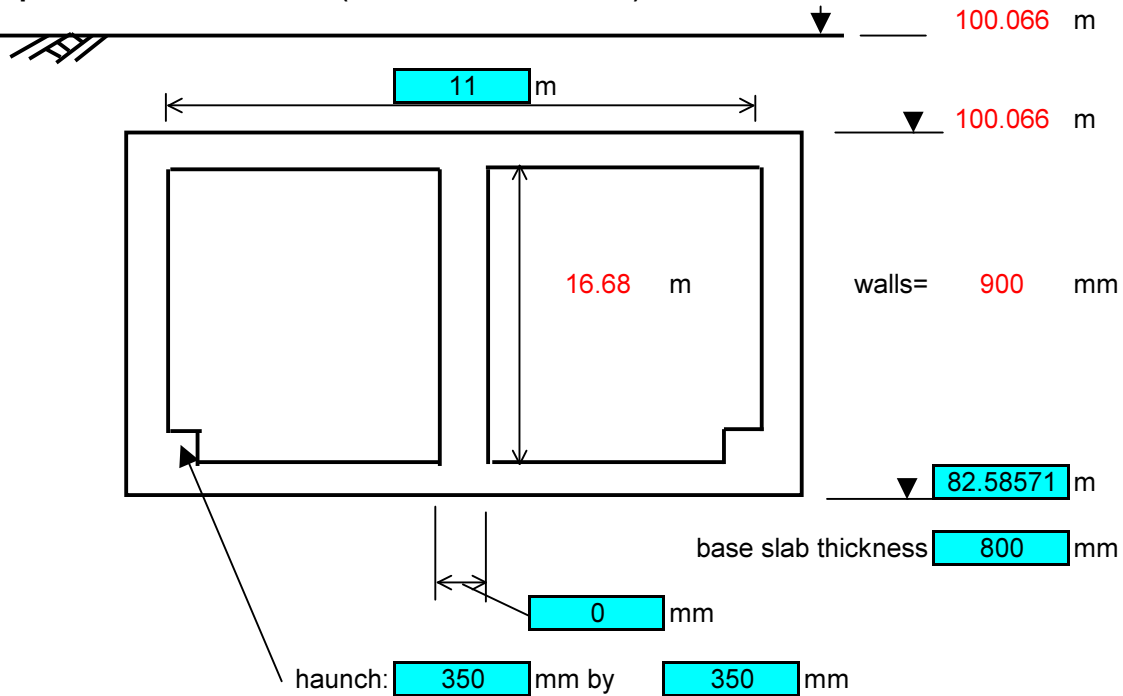
**Materials**

<b>Item</b>	<b>unit</b>	<b>Rate</b>
excavation	m3	60
concrete	m3	190
rebar	tonnes	1600
formwork/falsework	m2	140
SP&L<=4.6m deep	m2	0
4.6<SP&L<=6.7m deep	m2	0
6.7<SP&L<=10.6m deep	m2	0
10.6<SP&L<=13.7m deep	m2	0
13.7<SP&L<=16.8m deep	m2	0
16.8<SP&L<=20.0m deep	m2	0
20<SP&L<=25m deep	m2	0
backfill + compact	m3	40
surface reinstatement	m2	30

Section Cut and Cover  
Length of section: 32.85714 m

Section 1

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	7351.6	m3	
concrete=	1331.01	m3	
rebar=	159.7	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	1096.114	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	1148.7	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	420.5714	m2	

**Newfoundland Fixed Link Pre-feasibility Study**  
**North Approach**  
**Bored Highway Tunnel**

**Date:** 8-Jun-04  
**Calculations by:** ANW  
**Page 2 of 2**

**Calculated costs**

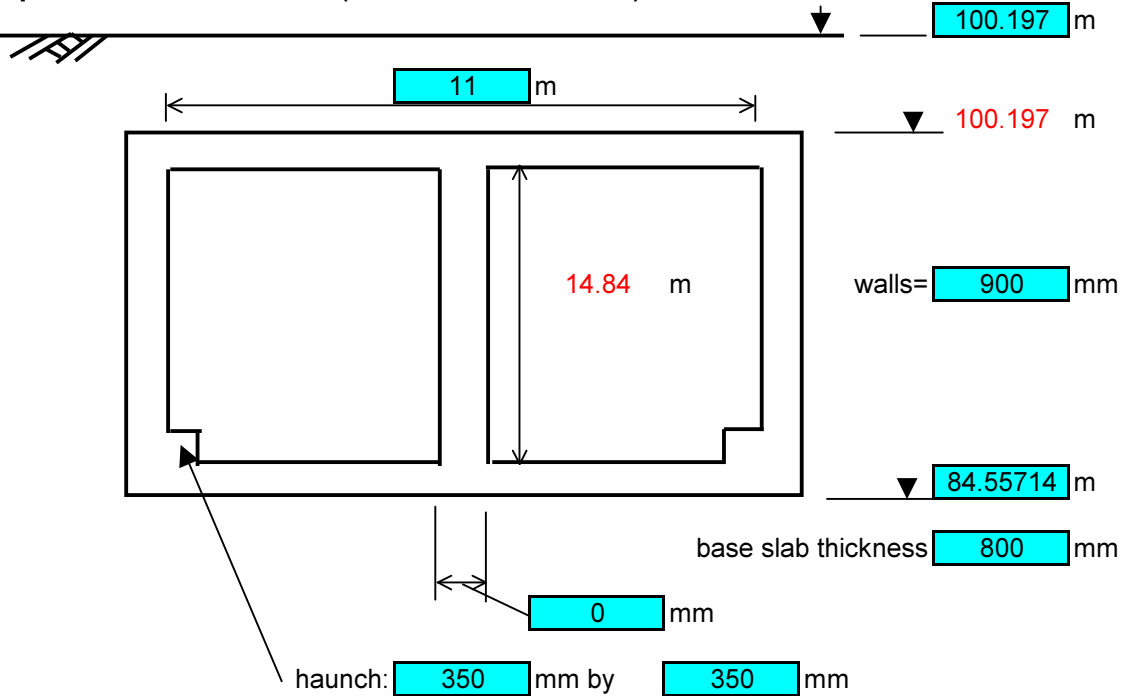
Item	Unit	Quantity	Rate	Cost
excavation	m3	7351.6	60	441095.3
concrete	m3	1331.01	190.0	252891.9
rebar	tonnes	159.7	1600	255553.9
formwork/falsework	m2	1096.114	140	153456
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	1148.7	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	420.5714	30	12617.14

Total 1115614

Section Cut and Cover  
 Length of section: 32.85714 m

Section 2

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	6577.7	m3	
concrete=	1222.187	m3	
rebar=	146.7	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	975.2	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	1027.8	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	420.5714	m2	

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**Calculated costs**

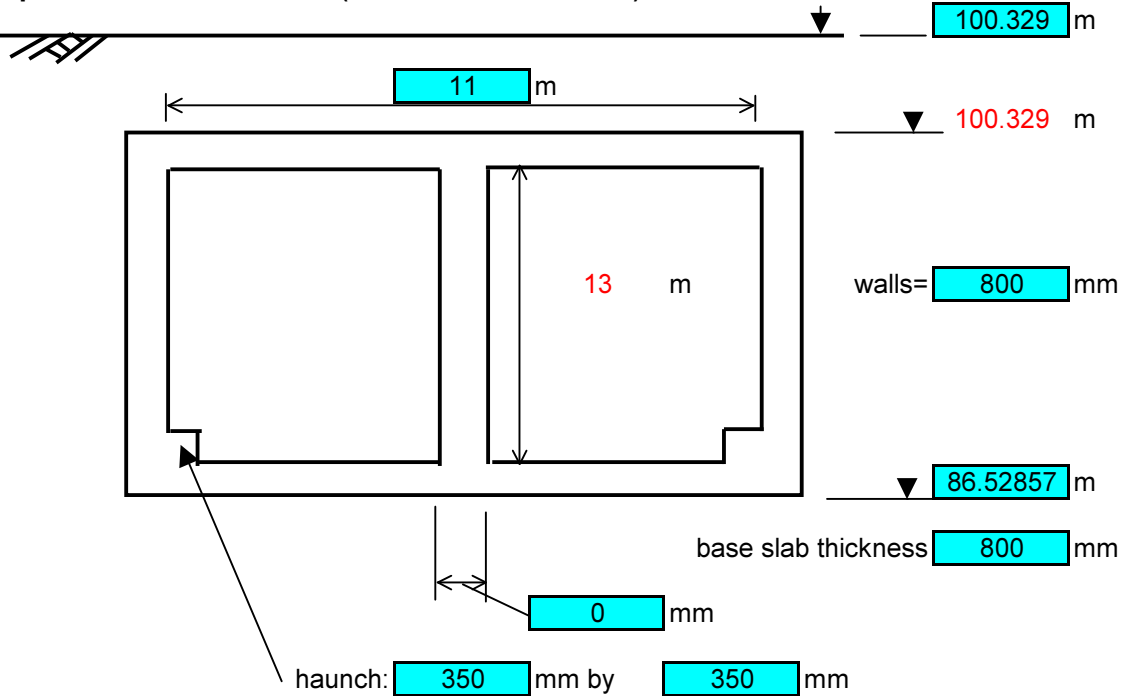
Item	Unit	Quantity	Rate	Cost
excavation	m3	6577.7	60	394664.2
concrete	m3	1222.187	190.0	232215.6
rebar	tonnes	146.7	1600	234659.9
formwork/falsework	m2	975.2	140	136528
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	1027.8	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	420.5714	30	12617.14

Total 1010685

Section Cut and Cover  
Length of section: 32.85714 m

Section 3

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	5713.2	m3	
concrete=	1022.679	m3	
rebar=	122.7	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	854.2857	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	906.9	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	414	m2	



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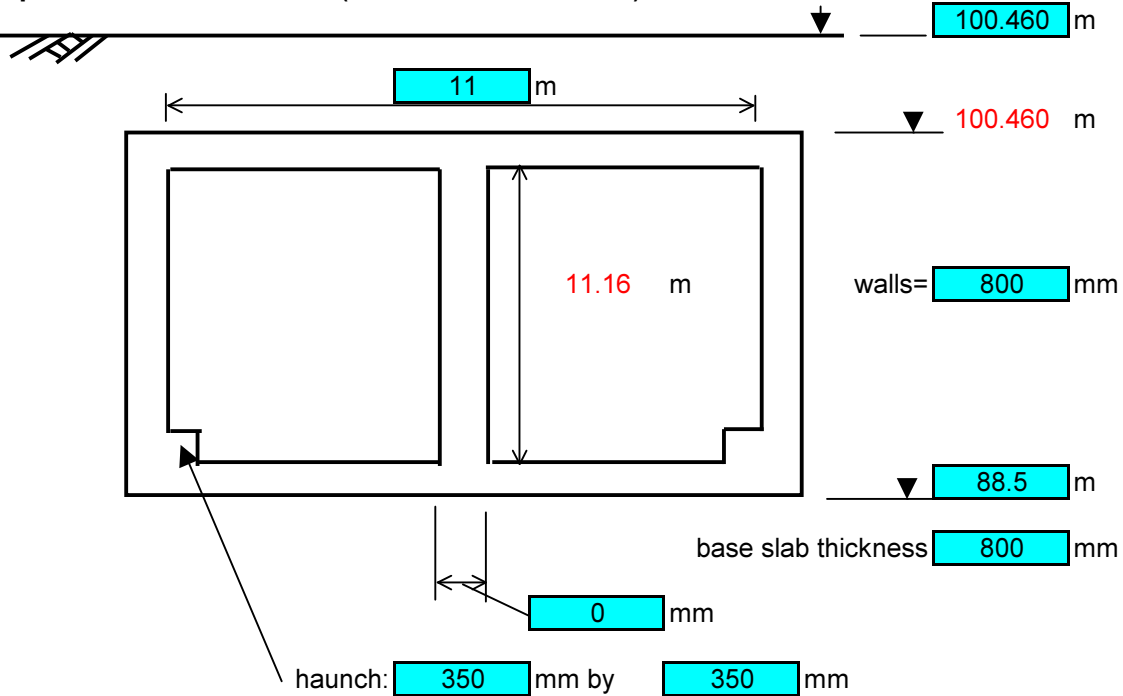
**Calculated costs**

Item	Unit	Quantity	Rate	Cost
excavation	m3	5713.2	60	342792
concrete	m3	1022.679	190.0	194308.9
rebar	tonnes	122.7	1600	196354.3
formwork/falsework	m2	854.2857	140	119600
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	906.9	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	414	30	12420

Total 865475.2

Section Cut and Cover  
 Length of section: 32.85714 m  
 Section 4

Input cross-section details (cut and cover solution)



Calculated Quantities

excavation=	4951.4	m3	
concrete=	925.9471	m3	
rebar=	111.1	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	733.3714	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	785.9	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	414	m2	

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**Calculated costs**

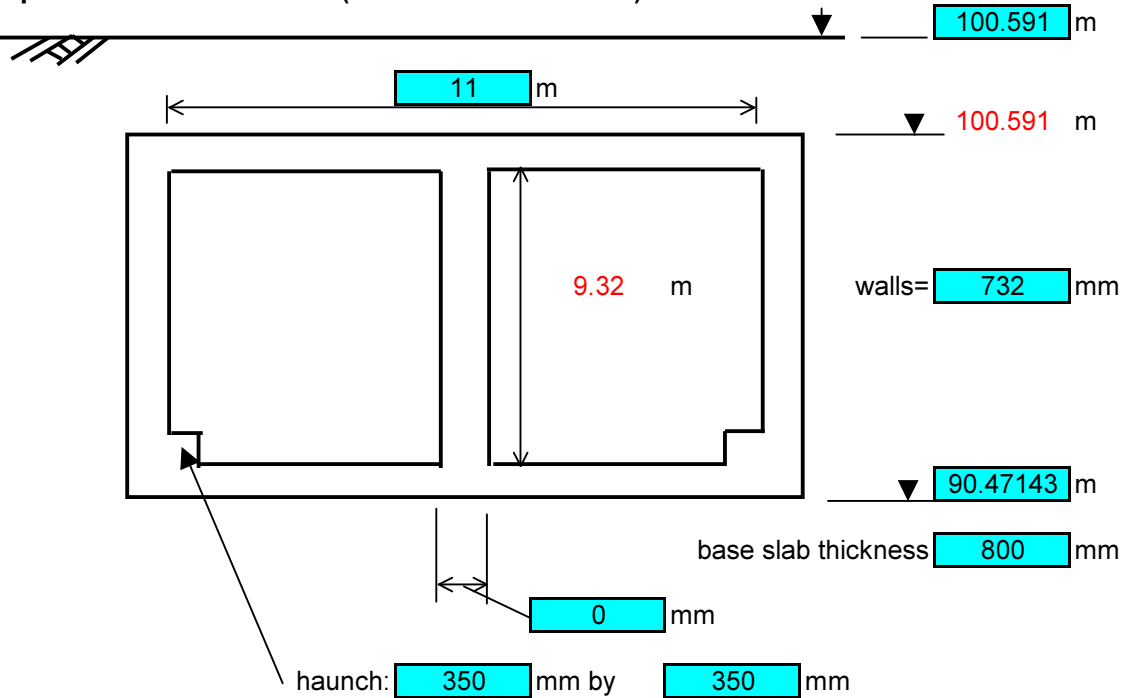
Item	Unit	Quantity	Rate	Cost
excavation	m3	4951.4	60	297086.4
concrete	m3	925.9471	190.0	175930
rebar	tonnes	111.1	1600	177781.9
formwork/falsework	m2	733.3714	140	102672
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	785.9	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	414	30	12420

Total 765890.2

Section Cut and Cover  
 Length of section: 32.85714 m

Section 5

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	4144.5	m3	
concrete=	783.9938	m3	
rebar=	94.1	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	612.4571	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	665.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	409.5314	m2	

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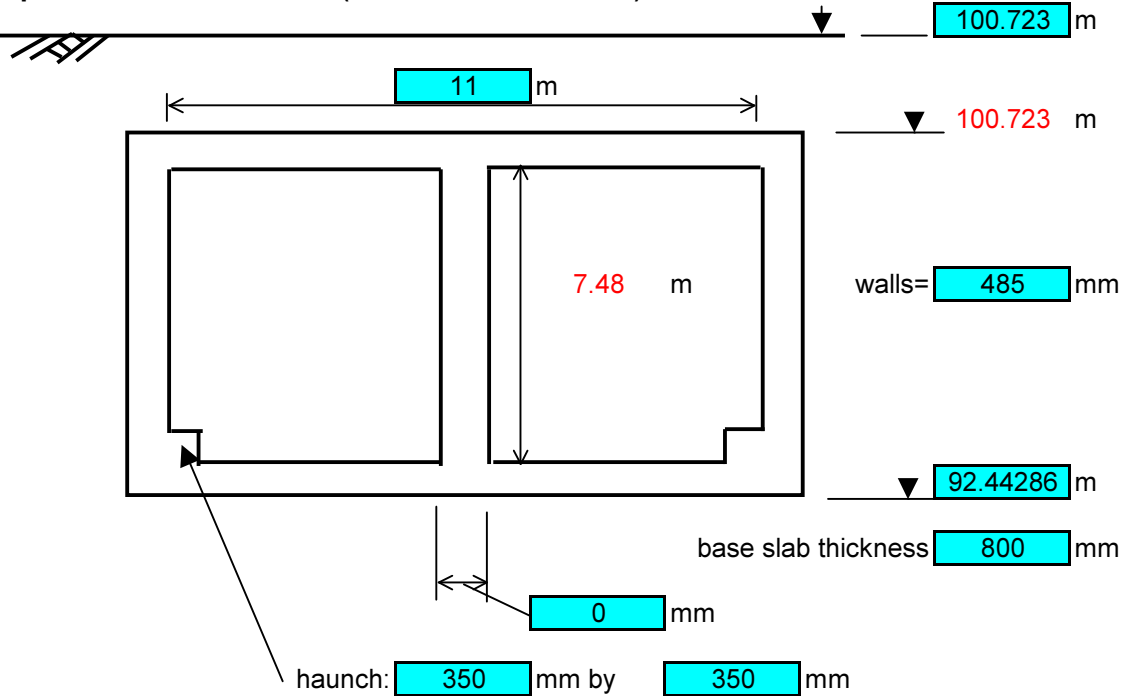
**Calculated costs**

Item	Unit	Quantity	Rate	Cost
excavation	m3	4144.5	60	248667.5
concrete	m3	783.9938	190.0	148958.8
rebar	tonnes	94.1	1600	150526.8
formwork/falsework	m2	612.4571	140	85744
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	665.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	409.5314	30	12285.94

Total 646183

Section Cut and Cover  
 Length of section: 32.85714 m Section 6

Input cross-section details (cut and cover solution)



Calculated Quantities

excavation=	3256.5	m3	
concrete=	561.0883	m3	
rebar=	67.3	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	491.5429	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	544.1	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	393.3	m2	

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**Calculated costs**

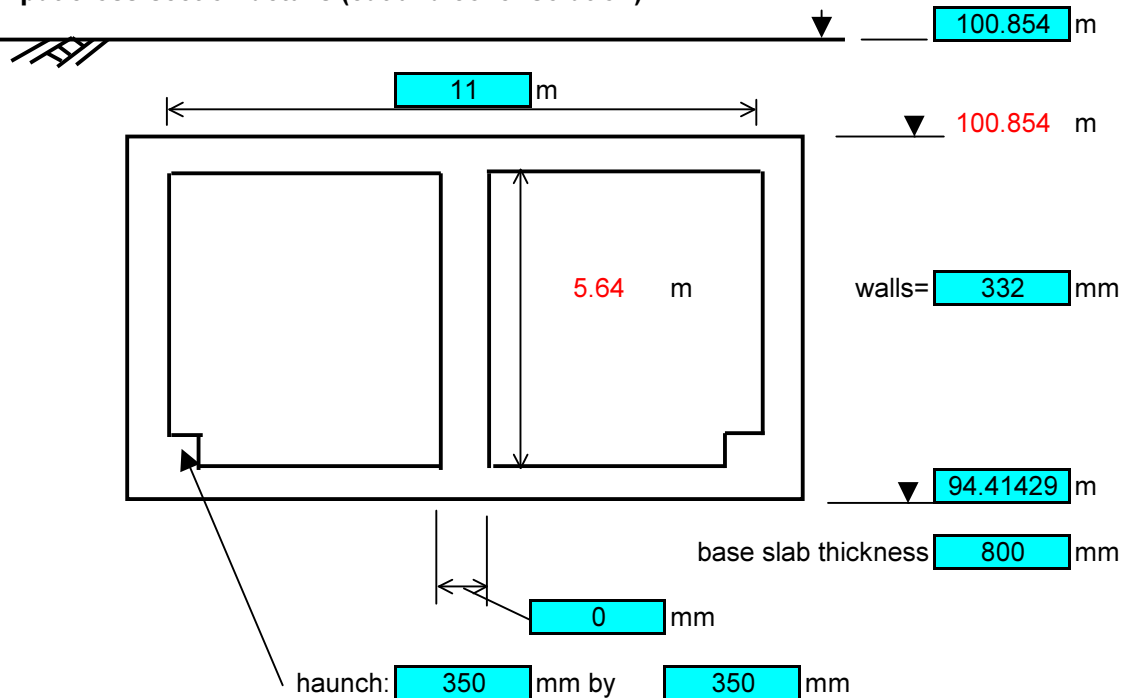
Item	Unit	Quantity	Rate	Cost
excavation	m3	3256.5	60	195391.4
concrete	m3	561.0883	190.0	106606.8
rebar	tonnes	67.3	1600	107729
formwork/falsework	m2	491.5429	140	68816
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	544.1	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	393.3	30	11799

Total 490342.2

Section Cut and Cover  
Length of section: 32.85714 m

Section 7

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	2468.1	m3	
concrete=	437.6953	m3	
rebar=	52.5	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	370.6286	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	423.2	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	383.2457	m2	



**Calculated costs**

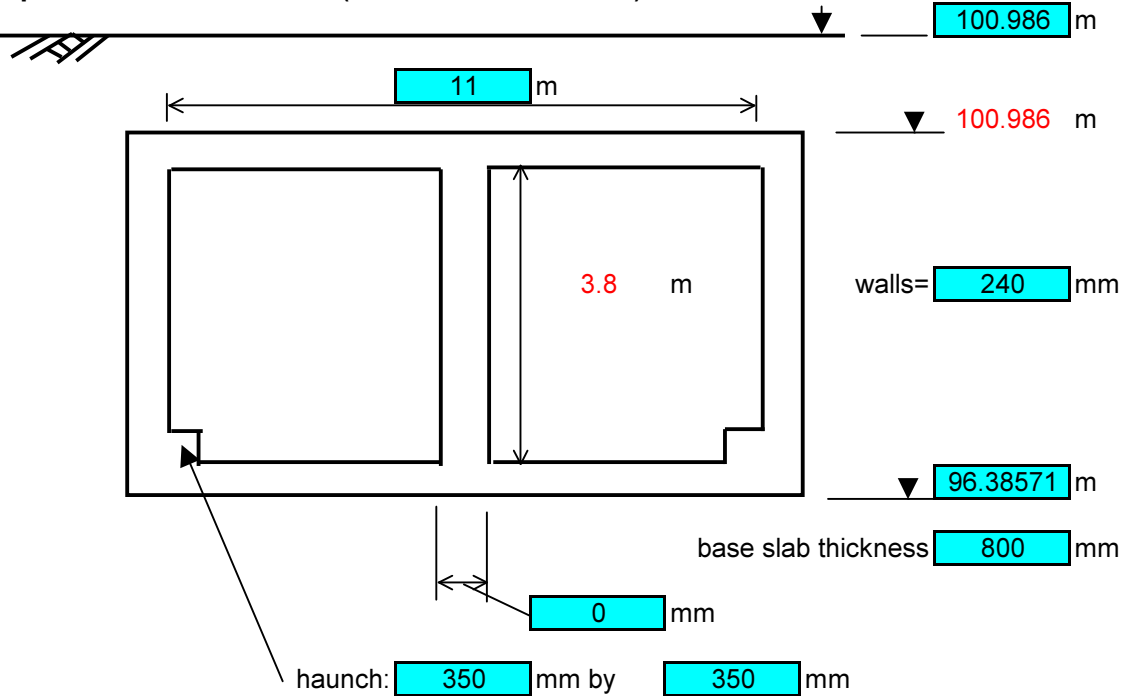
Item	Unit	Quantity	Rate	Cost
excavation	m3	2468.1	60	148086.1
concrete	m3	437.6953	190.0	83162.1
rebar	tonnes	52.5	1600	84037.49
formwork/falsework	m2	370.6286	140	51888
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	423.2	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	383.2457	30	11497.37

Total 378671.1

Section Cut and Cover  
 Length of section: 32.85714 m

Section 8

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	1735.1	m3	
concrete=	369.7414	m3	
rebar=	44.4	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	249.7143	m2	
SP&L<=4.6m deep	302.3	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	377.2	m2	

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**Calculated costs**

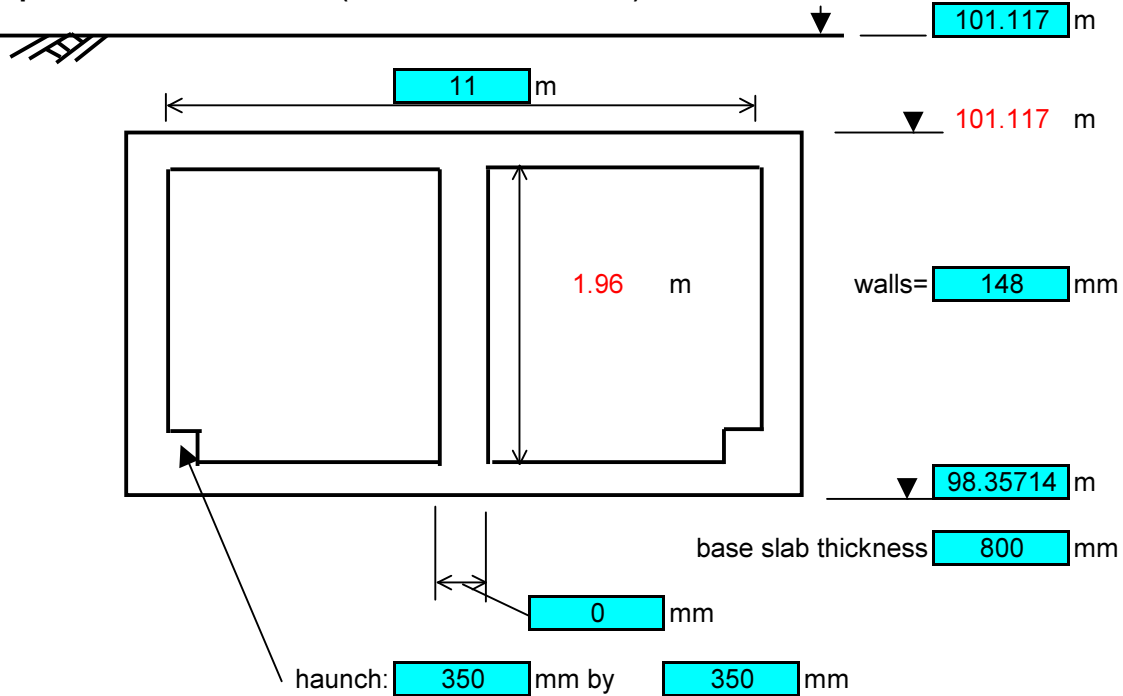
Item	Unit	Quantity	Rate	Cost
excavation	m3	1735.1	60	104107.2
concrete	m3	369.7414	190.0	70250.87
rebar	tonnes	44.4	1600	70990.35
formwork/falsework	m2	249.7143	140	34960
SP&L<=4.6m deep	m2	302.3	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	377.2	30	11316

Total 291624.4

Section Cut and Cover  
Length of section: 32.85714 m

Section 9

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	1024.4	m3	
concrete=	324.0358	m3	
rebar=	38.9	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	128.8	m2	
SP&L<=4.6m deep	181.4	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	371.1543	m2	

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**Calculated costs**

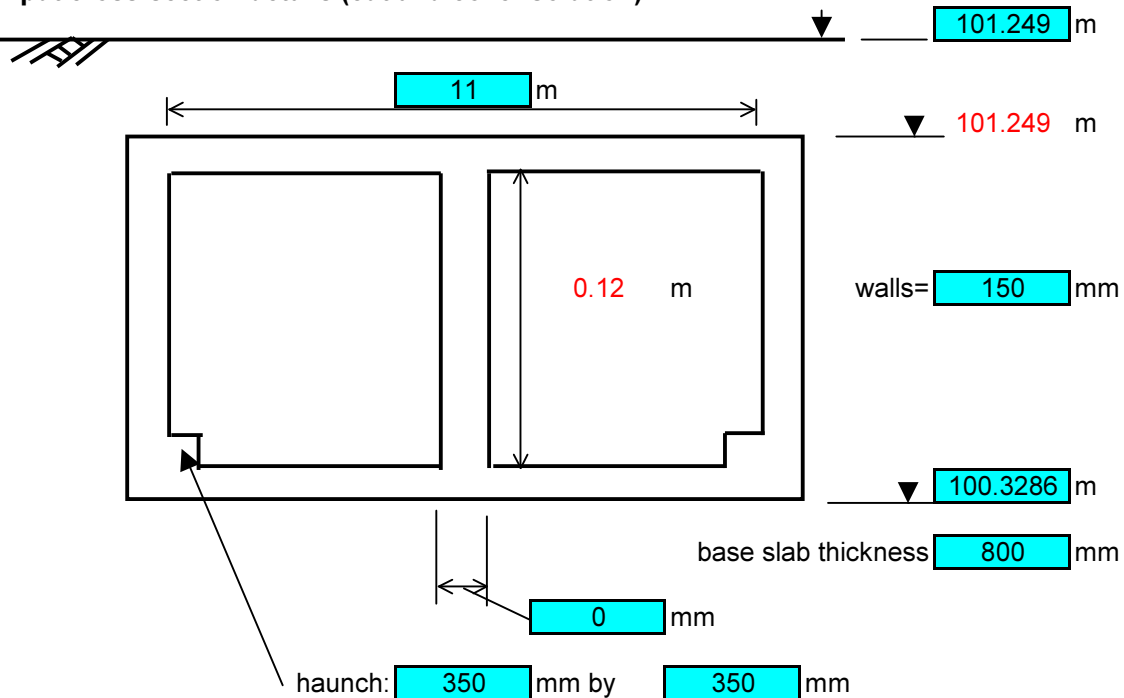
Item	Unit	Quantity	Rate	Cost
excavation	m3	1024.4	60	61463.15
concrete	m3	324.0358	190.0	61566.81
rebar	tonnes	38.9	1600	62214.88
formwork/falsework	m2	128.8	140	18032
SP&L<=4.6m deep	m2	181.4	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	371.1543	30	11134.63

Total 214411.5

Section Cut and Cover  
Length of section: 32.85714 m

Section 10

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	341.6	m3	
concrete=	306.2614	m3	
rebar=	36.8	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	7.885714	m2	
SP&L<=4.6m deep	60.5	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	371.2857	m2	

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**Calculated costs**

Item	Unit	Quantity	Rate	Cost
excavation	m3	341.6	60	20494.97
concrete	m3	306.2614	190.0	58189.67
rebar	tonnes	36.8	1600	58802.19
formwork/falsework	m2	7.885714	140	1104
SP&L<=4.6m deep	m2	60.5	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	371.2857	30	11138.57

Total 149729.4

**Newfoundland Fixed Link Pre-feasibility Study**  
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**Summary of Costs**

Markup for adjacent 0 %

<b>Section</b>	<b>Cost</b>
1	1115614
2	1010685
3	865475.2
4	765890.2
5	646183
6	490342.2
7	378671.1
8	291624.4
9	214411.5
10	149729.4
Sub-total	<u>5928626</u>



## Initialisation

**Project:** Newfoundland Fixed Link Pre-feasibility Study

**Section:** South Approach

**Option:** Bored Highway Tunnel

**Date:** 8-Jun-04

**Calculations by:** ANW

Surface gradient  %

+ sloping same way as track/road  
- sloping against track/road

Track/Road Gradient  %

Ground elevation  
at portal  m

Bottom of slab  
elevation at portal  m

Total length= 337.6147 m

Total Cost=\$ 6.1 M

**Newfoundland Fixed Link Pre-feasibility Study**  
**South Approach**  
**Bored Highway Tunnel**

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**Calculations by:** ANW

**UNIT RATES**

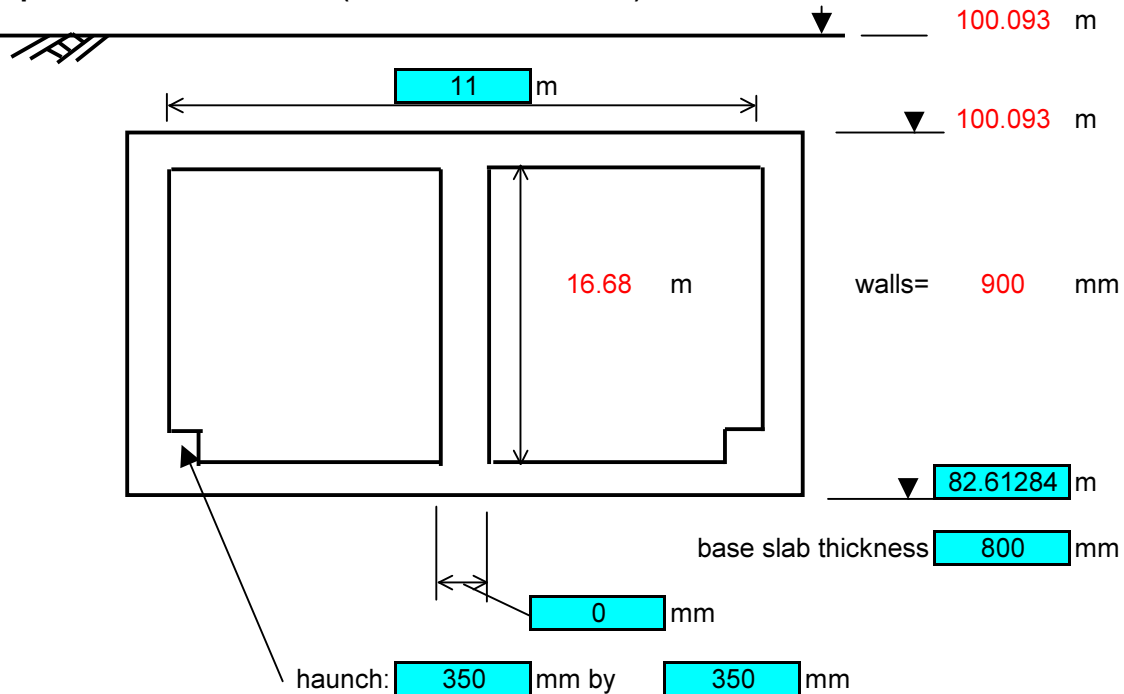
**Materials**

Item	unit	Rate
excavation	m3	60
concrete	m3	190
rebar	tonnes	1600
formwork/falsework	m2	140
SP&L<=4.6m deep	m2	0
4.6<SP&L<=6.7m deep	m2	0
6.7<SP&L<=10.6m deep	m2	0
10.6<SP&L<=13.7m deep	m2	0
13.7<SP&L<=16.8m deep	m2	0
16.8<SP&L<=20.0m deep	m2	0
20<SP&L<=25m deep	m2	0
backfill + compact	m3	40
surface reinstatement	m2	30

Section Cut and Cover  
Length of section: 33.76147 m

Section 1

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	7553.9	m3	
concrete=	1367.643	m3	
rebar=	164.1	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	1126.283	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	1180.3	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	432.1468	m2	

**Newfoundland Fixed Link Pre-feasibility Study**  
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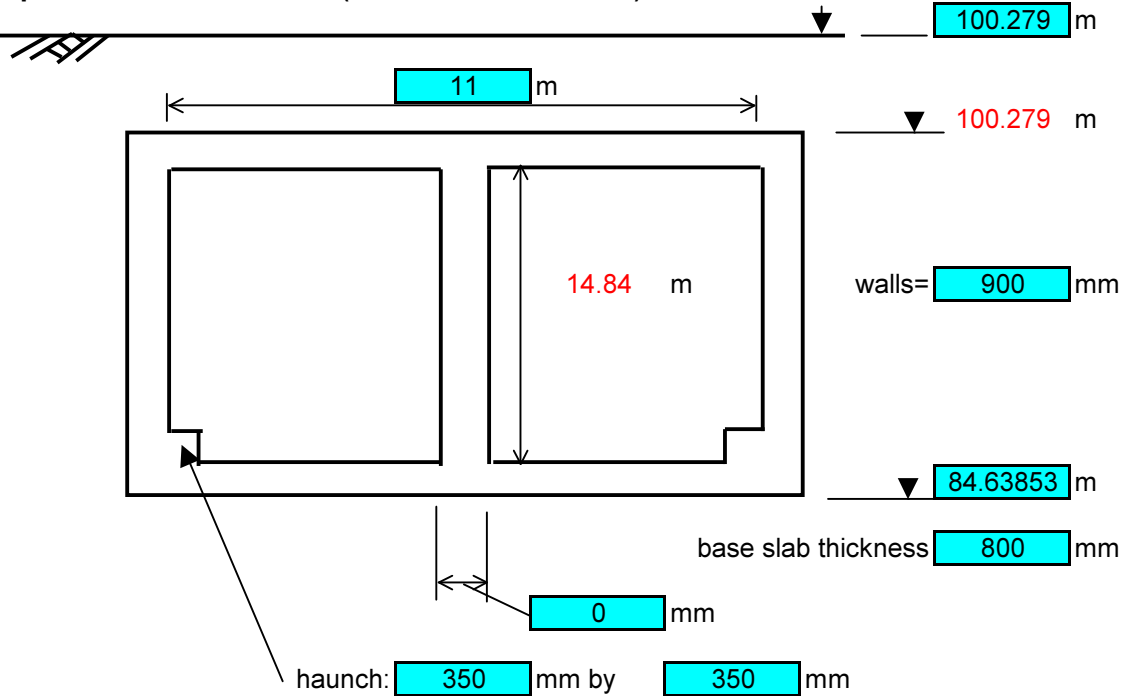
**Calculated costs**

Item	Unit	Quantity	Rate	Cost
excavation	m3	7553.9	60	453235.6
concrete	m3	1367.643	190.0	259852.2
rebar	tonnes	164.1	1600	262587.5
formwork/falsework	m2	1126.283	140	157679.6
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	1180.3	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	432.1468	30	12964.4

Total 1146319

Section Cut and Cover  
 Length of section: 33.76147 m Section 2

Input cross-section details (cut and cover solution)



Calculated Quantities

excavation=	6758.8	m3	
concrete=	1255.825	m3	
rebar=	150.7	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	1002.04	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	1056.1	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	432.1468	m2	

**Newfoundland Fixed Link Pre-feasibility Study**  
**South Approach**  
**Bored Highway Tunnel**

**Date:** 8-Jun-04  
**Calculations by:** ANW  
**Page 2 of 2**

**Calculated costs**

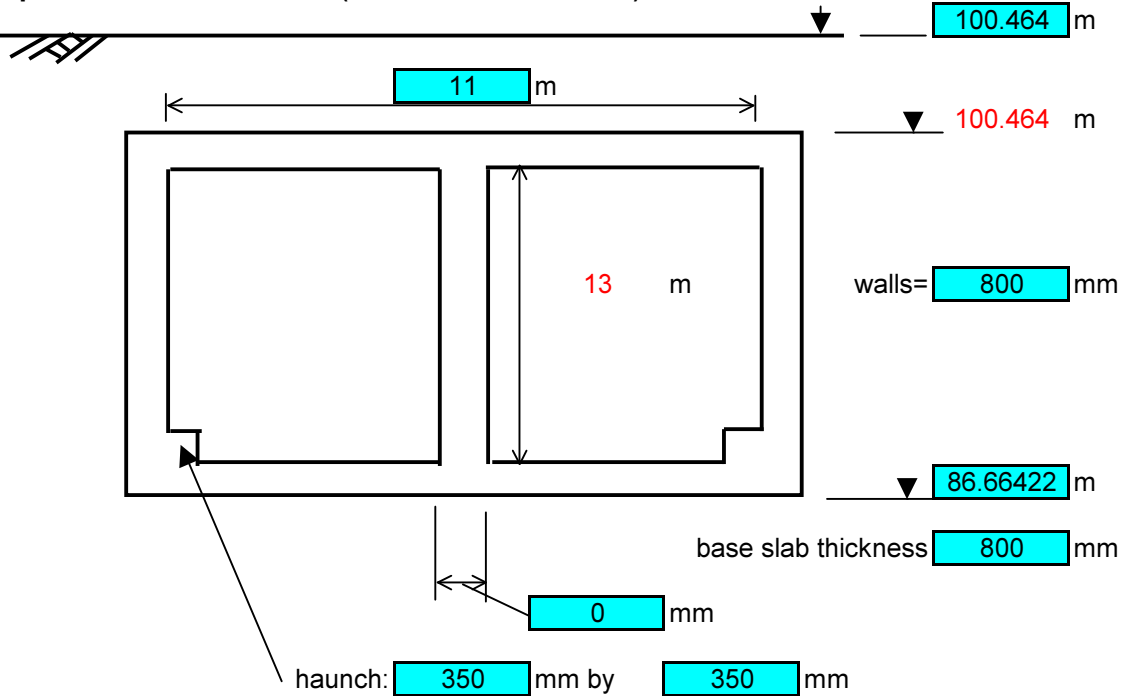
Item	Unit	Quantity	Rate	Cost
excavation	m3	6758.8	60	405526.5
concrete	m3	1255.825	190.0	238606.8
rebar	tonnes	150.7	1600	241118.5
formwork/falsework	m2	1002.04	140	140285.7
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	1056.1	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	432.1468	30	12964.4

Total 1038502

Section Cut and Cover  
 Length of section: 33.76147 m

Section 3

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	5870.4	m3	
concrete=	1050.826	m3	
rebar=	126.1	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	877.7982	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	931.8	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	425.3945	m2	

**Newfoundland Fixed Link Pre-feasibility Study**  
**South Approach**  
**Bored Highway Tunnel**

**Date:** 8-Jun-04  
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**Page 2 of 2**

**Calculated costs**

Item	Unit	Quantity	Rate	Cost
excavation	m3	5870.4	60	352226.6
concrete	m3	1050.826	190.0	199656.9
rebar	tonnes	126.1	1600	201758.5
formwork/falsework	m2	877.7982	140	122891.7
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	931.8	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	425.3945	30	12761.83

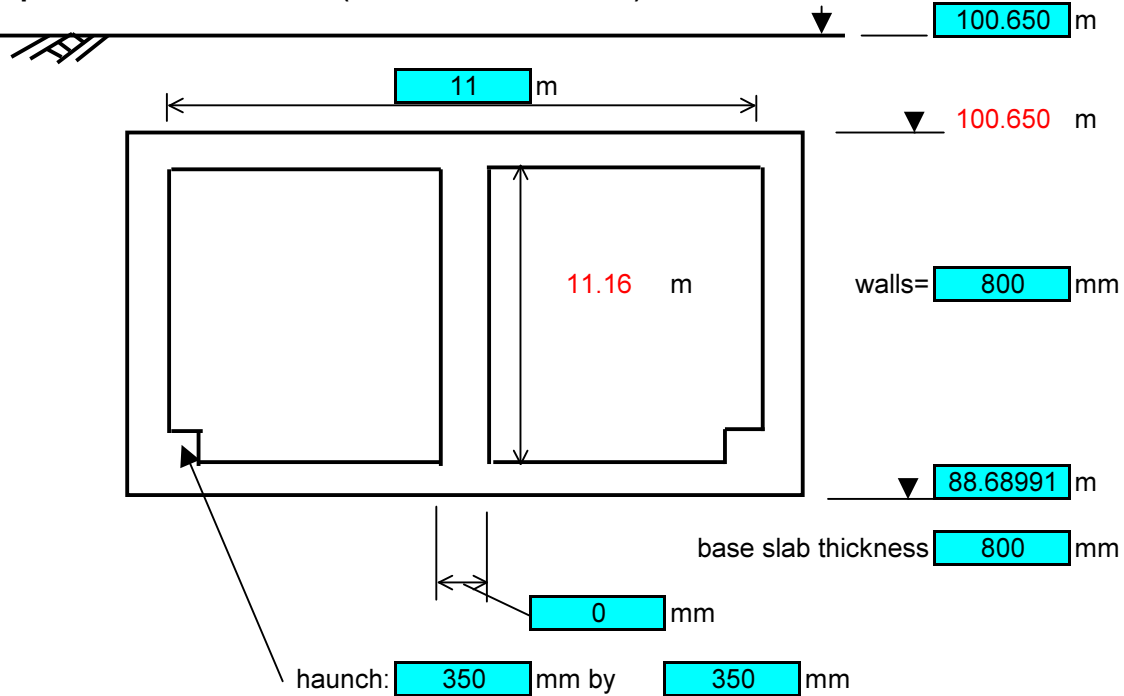
Total 889295.6



Section Cut and Cover  
 Length of section: 33.76147 m

Section 4

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	5087.7	m3	
concrete=	951.4319	m3	
rebar=	114.2	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	753.556	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	807.6	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	425.3945	m2	

**Newfoundland Fixed Link Pre-feasibility Study**  
**South Approach**  
**Bored Highway Tunnel**

**Date:** 8-Jun-04  
**Calculations by:** ANW  
**Page 2 of 2**

**Calculated costs**

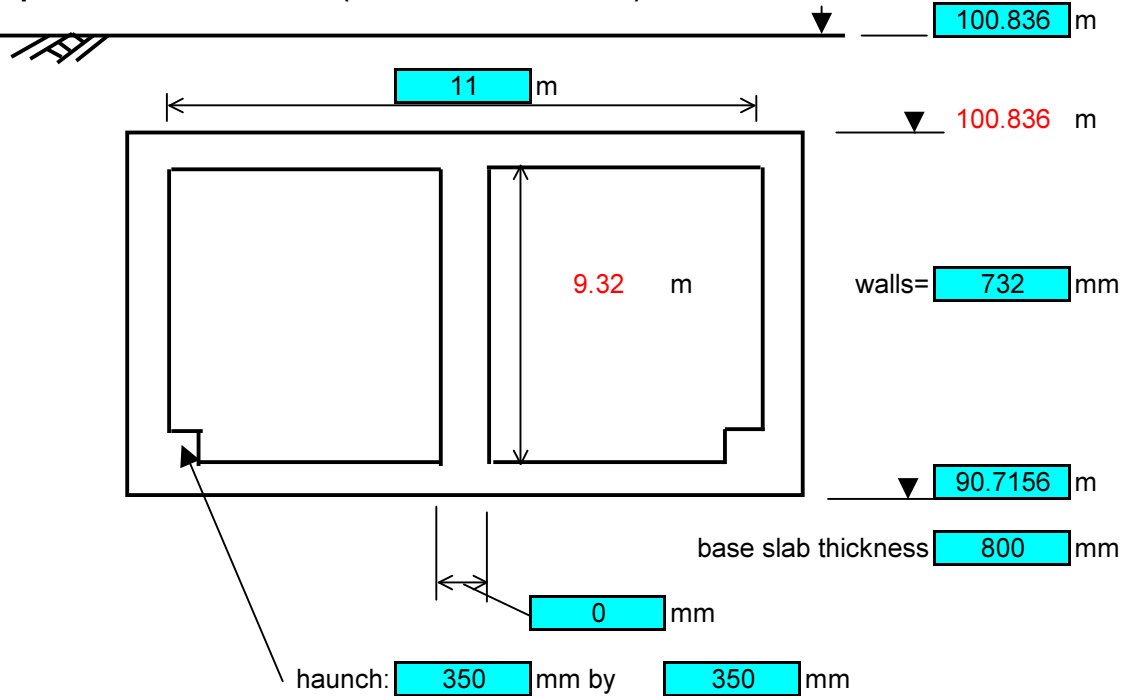
Item	Unit	Quantity	Rate	Cost
excavation	m3	5087.7	60	305263.1
concrete	m3	951.4319	190.0	180772.1
rebar	tonnes	114.2	1600	182674.9
formwork/falsework	m2	753.556	140	105497.8
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	807.6	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	425.3945	30	12761.83

Total 786969.8

Section Cut and Cover  
Length of section: 33.76147 m

Section 5

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	4258.5	m3	
concrete=	805.5716	m3	
rebar=	96.7	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	629.3138	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	683.3	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	420.8029	m2	

**Newfoundland Fixed Link Pre-feasibility Study**  
**South Approach**  
**Bored Highway Tunnel**

**Date:** 8-Jun-04  
**Calculations by:** ANW  
**Page 2 of 2**

**Calculated costs**

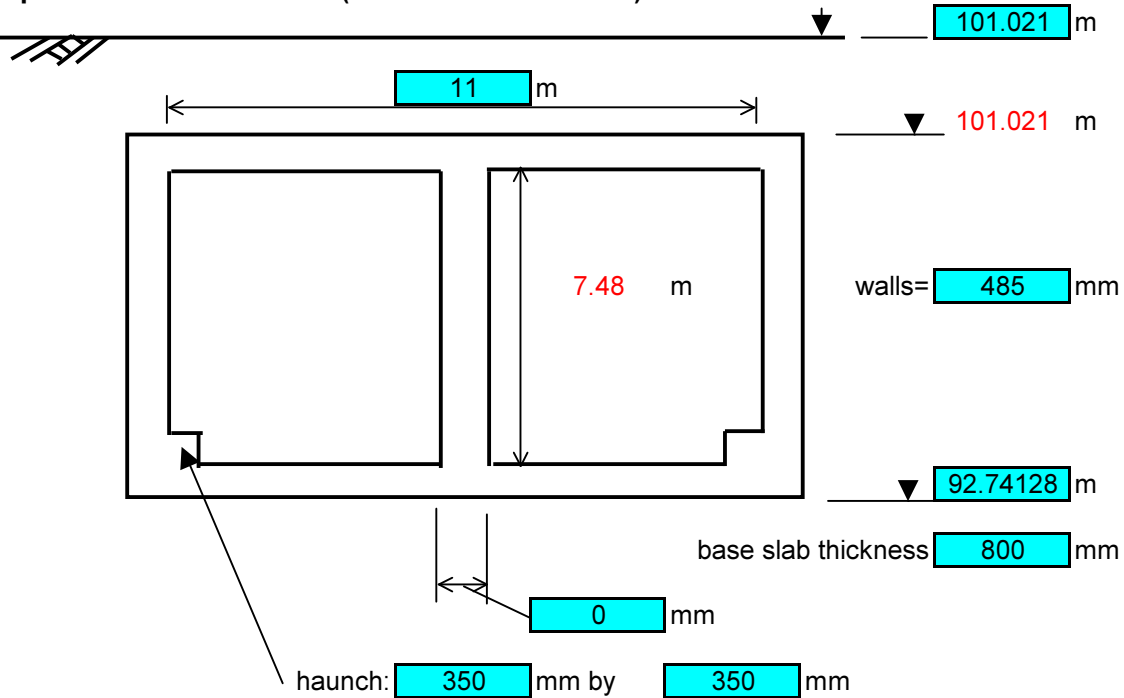
Item	Unit	Quantity	Rate	Cost
excavation	m3	4258.5	60	255511.5
concrete	m3	805.5716	190.0	153058.6
rebar	tonnes	96.7	1600	154669.7
formwork/falsework	m2	629.3138	140	88103.93
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	683.3	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	420.8029	30	12624.09

Total 663967.9

Section Cut and Cover  
 Length of section: 33.76147 m

Section 6

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	3346.2	m3	
concrete=	576.5311	m3	
rebar=	69.2	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	505.0716	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	559.1	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	404.1248	m2	

**Newfoundland Fixed Link Pre-feasibility Study**  
**South Approach**  
**Bored Highway Tunnel**

**Date:** 8-Jun-04  
**Calculations by:** ANW  
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**Calculated costs**

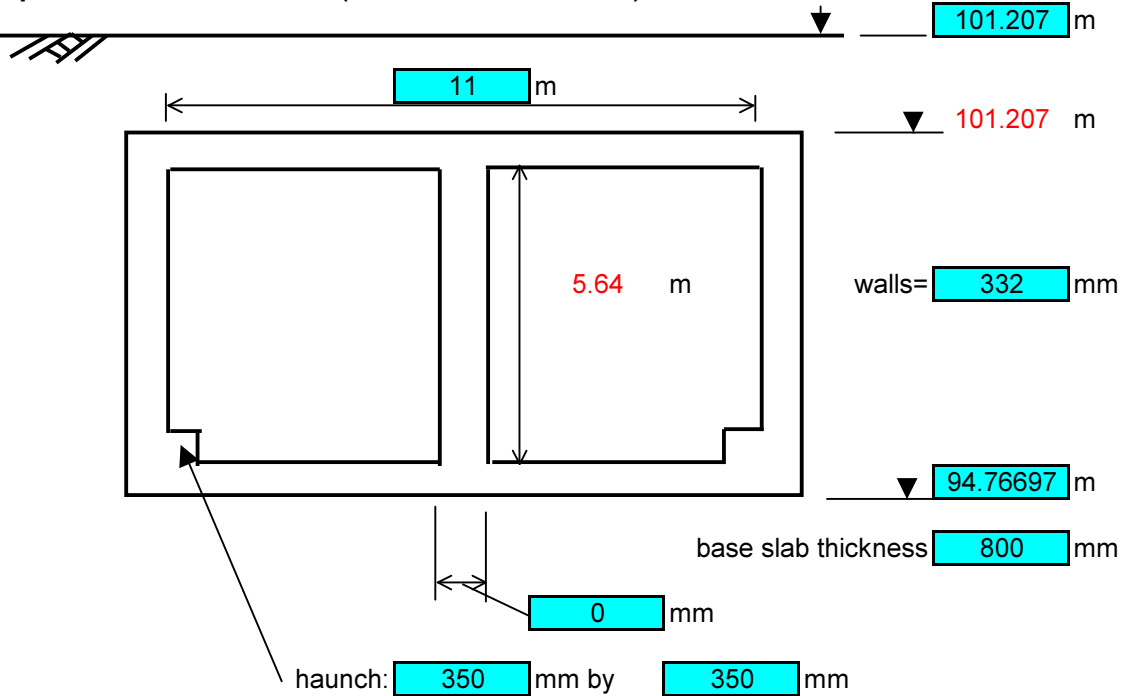
Item	Unit	Quantity	Rate	Cost
excavation	m3	3346.2	60	200769.2
concrete	m3	576.5311	190.0	109540.9
rebar	tonnes	69.2	1600	110694
formwork/falsework	m2	505.0716	140	70710.02
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	559.1	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	404.1248	30	12123.74

Total 503837.8

Section Cut and Cover  
 Length of section: 33.76147 m

Section 7

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	2536.0	m3	
concrete=	449.7419	m3	
rebar=	54.0	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	380.8294	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	434.8	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	393.7938	m2	

**Newfoundland Fixed Link Pre-feasibility Study**  
**South Approach**  
**Bored Highway Tunnel**

**Date:** 8-Jun-04  
**Calculations by:** ANW  
**Page 2 of 2**

**Calculated costs**

Item	Unit	Quantity	Rate	Cost
excavation	m3	2536.0	60	152161.9
concrete	m3	449.7419	190.0	85450.96
rebar	tonnes	54.0	1600	86350.45
formwork/falsework	m2	380.8294	140	53316.11
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	434.8	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	393.7938	30	11813.81

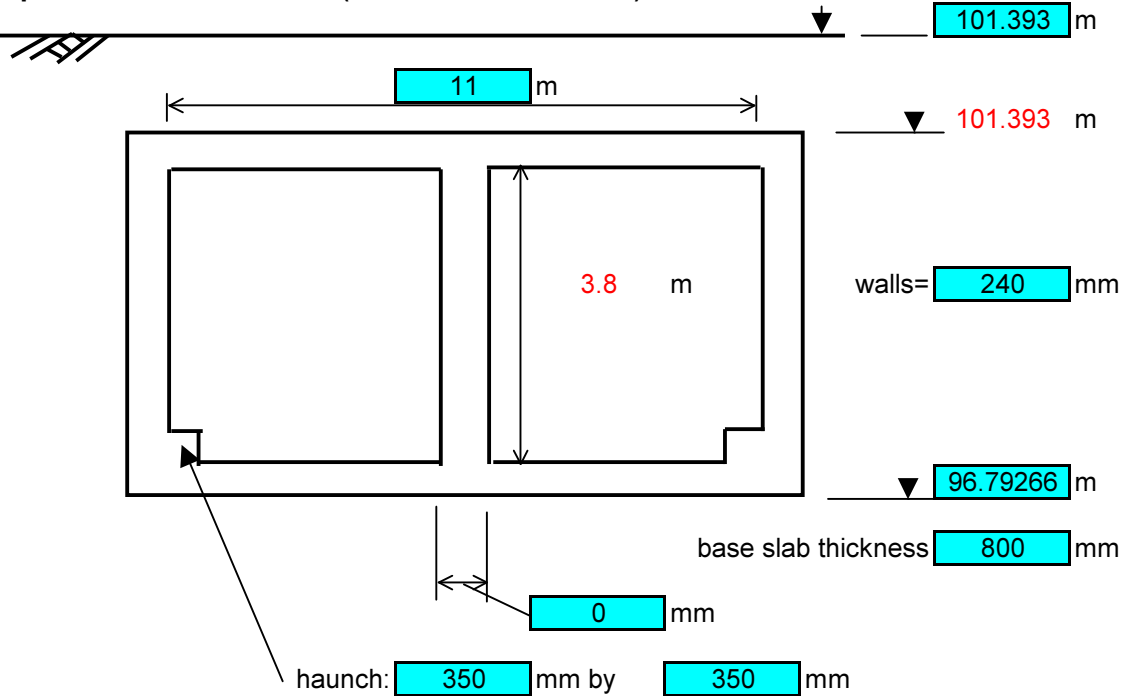
Total 389093.2



Section Cut and Cover  
 Length of section: 33.76147 m

Section 8

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	1782.9	m3	
concrete=	379.9178	m3	
rebar=	45.6	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	256.5872	m2	
SP&L<=4.6m deep	310.6	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	387.5817	m2	

**Newfoundland Fixed Link Pre-feasibility Study**  
**South Approach**  
**Bored Highway Tunnel**

**Date:** 8-Jun-04  
**Calculations by:** ANW  
**Page 2 of 2**

**Calculated costs**

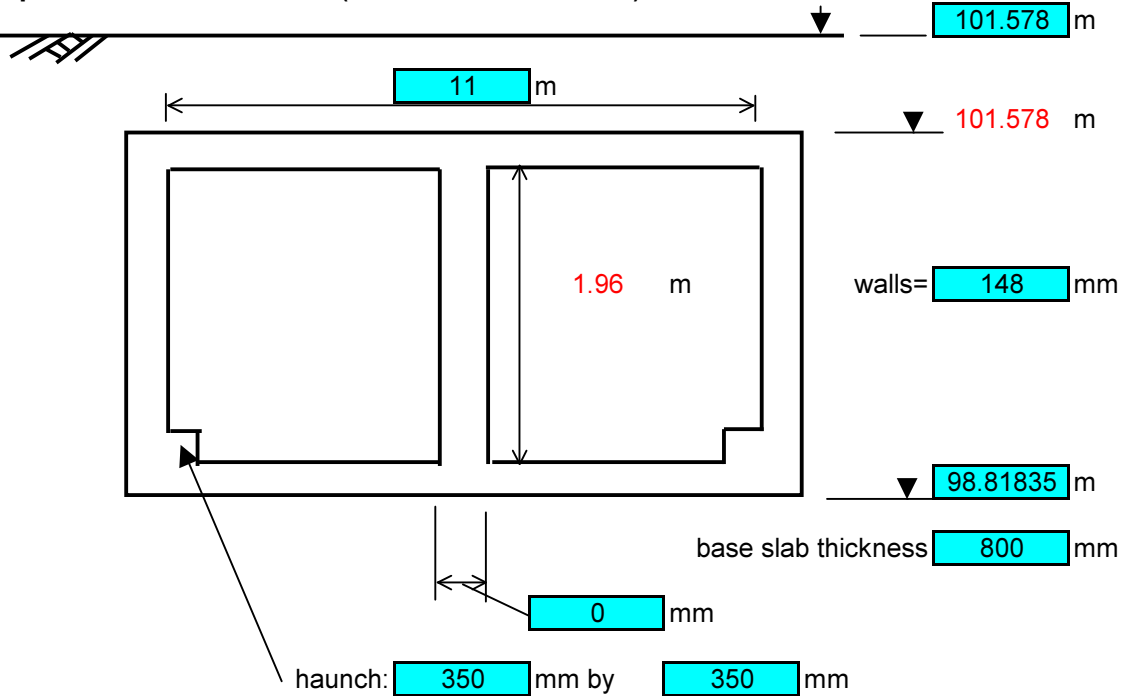
Item	Unit	Quantity	Rate	Cost
excavation	m3	1782.9	60	106972.5
concrete	m3	379.9178	190.0	72184.38
rebar	tonnes	45.6	1600	72944.22
formwork/falsework	m2	256.5872	140	35922.2
SP&L<=4.6m deep	m2	310.6	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	387.5817	30	11627.45

Total 299650.8

Section Cut and Cover  
Length of section: 33.76147 m

Section 9

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	1052.6	m3	
concrete=	332.9542	m3	
rebar=	40.0	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	132.345	m2	
SP&L<=4.6m deep	186.4	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	381.3695	m2	

**Newfoundland Fixed Link Pre-feasibility Study**  
**South Approach**  
**Bored Highway Tunnel**

**Date:** 8-Jun-04  
**Calculations by:** ANW  
**Page 2 of 2**

**Calculated costs**

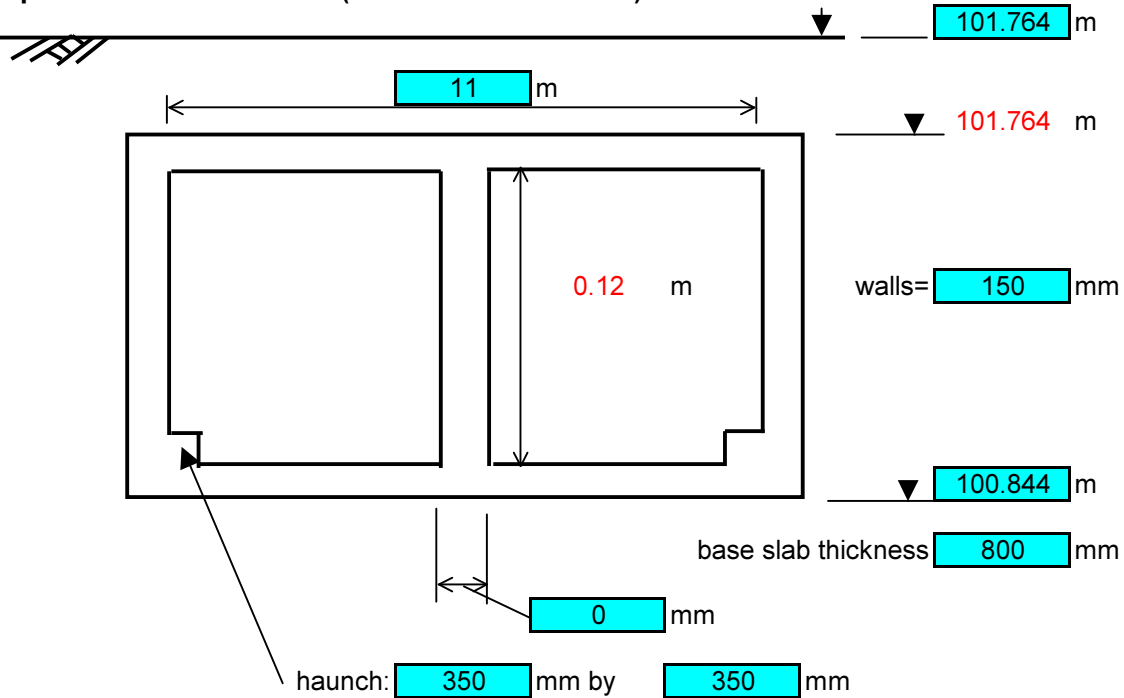
Item	Unit	Quantity	Rate	Cost
excavation	m3	1052.6	60	63154.8
concrete	m3	332.9542	190.0	63261.31
rebar	tonnes	40.0	1600	63927.22
formwork/falsework	m2	132.345	140	18528.29
SP&L<=4.6m deep	m2	186.4	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	381.3695	30	11441.09

Total 220312.7

Section Cut and Cover  
 Length of section: 33.76147 m

Section 10

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	351.0	m3	
concrete=	314.6906	m3	
rebar=	37.8	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	8.102752	m2	
SP&L<=4.6m deep	62.1	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	381.5046	m2	

**Newfoundland Fixed Link Pre-feasibility Study**  
**South Approach**  
**Bored Highway Tunnel**

**Date:** 8-Jun-04  
**Calculations by:** ANW  
**Page 2 of 2**

**Calculated costs**

Item	Unit	Quantity	Rate	Cost
excavation	m3	351.0	60	21059.05
concrete	m3	314.6906	190.0	59791.22
rebar	tonnes	37.8	1600	60420.6
formwork/falsework	m2	8.102752	140	1134.385
SP&L<=4.6m deep	m2	62.1	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	381.5046	30	11445.14

Total 153850.4

**Newfoundland Fixed Link Pre-feasibility Study**  
**South Approach**  
**Bored Highway Tunnel**

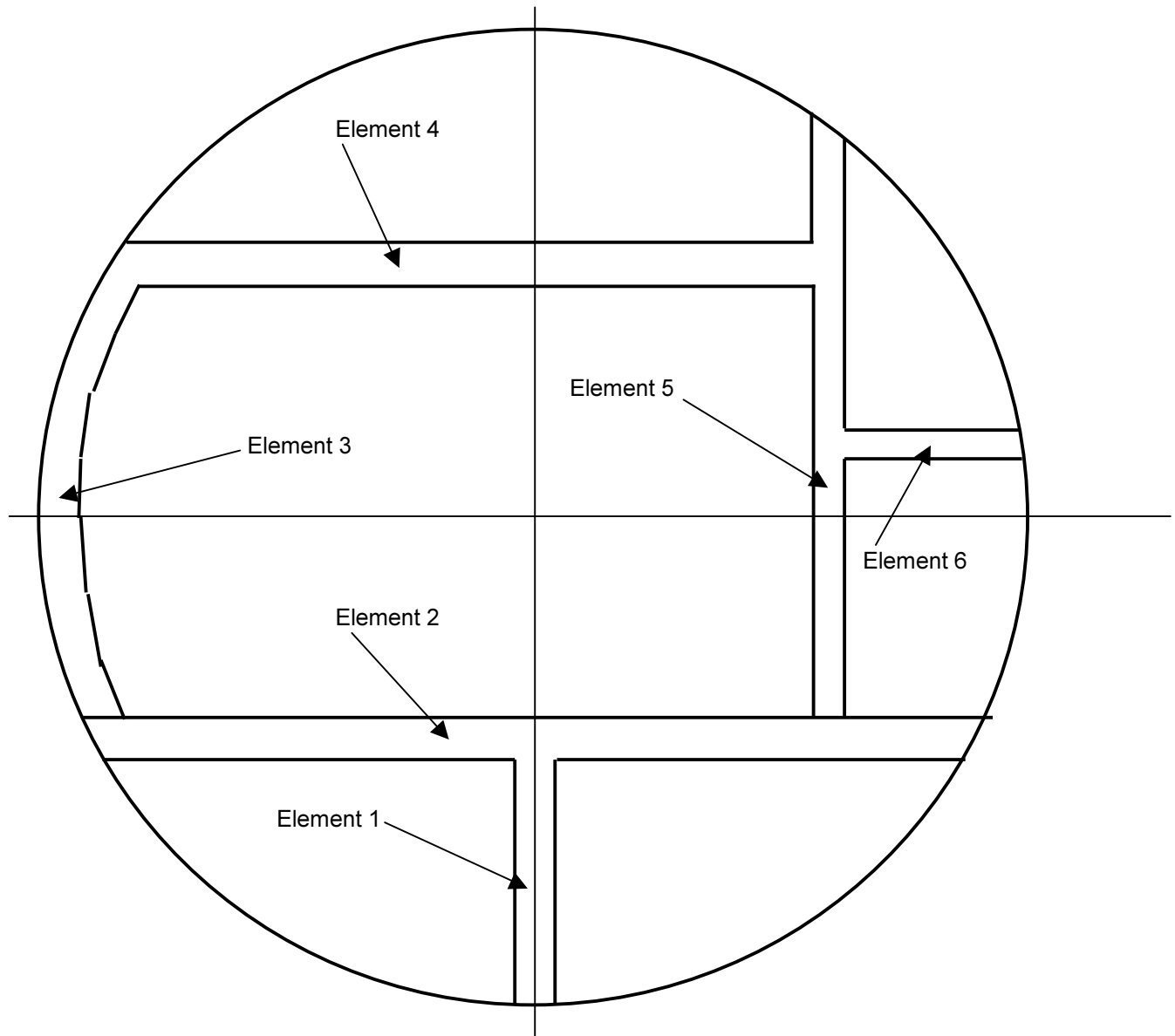
**Date:** 8-Jun-04  
**Calculations by:** ANW

**Summary of Costs**

Markup for adjacent 0 %

<b>Section</b>	<b>Cost</b>
1	1146319
2	1038502
3	889295.6
4	786969.8
5	663967.9
6	503837.8
7	389093.2
8	299650.8
9	220312.7
10	153850.4
Sub-total	<u>6091799</u>

Tunnel length= 20248 m



Assumed tunnel cross section



**Page 2 of 2**  
**Date:** June 07, 2004  
**Calculation by:** A.White

## Concrete

Element	Nr.	L(m)	b(m)	d(m)	Concrete Qty(m3)	Rebar Qty(m3)
1	1	20248	0.5	2.5	25310	3037.2
2	1	20248	9.4	0.5	95166	11419.9
3	1	20248	0.3	4.8	29157	3498.9
4	1	20248	7.5	0.5	75930	9111.6
5	1	20248	0.3	6.6	40091	4810.9
6	1	20248	2.1	0.3	12756	1530.7
					<u>278410</u> m3	<u>21989</u> t

Element	Nr.	L(m)	d(m)	Faces	Area(m2)
1	1	20248	2.5	2	101240
2	2	20248	8.5	1	172108
3	1	20248	4.8	1	97190.4
4	2	20248	7	1	141736
5	2	20248	6.6	2	267273.6
6	1	20248	2.1	1	42520.8
					<hr/> 822068.8 m2

Concrete	m3	190
Formwork	m2	140
Reinforcement	t	1600

Concrete	m3	278410 m3	at	190	=	52,897,900
Formwork	m2	822069 m2	at	140	=	115,089,632
Reinforcement	t	21989 t	at	1600	=	35,182,925
					\$	<u>203,170,457</u>

**Main Electrical Components for Novaroute  
Newfoundland Fixed Link  
Single TBM Bored Highway Tunnel Option**

Length of each tunnel= 19991 m  
Tunnel width= 9.5 m

Number of tunnels= 1

Item	Component	Unit	Qty	Unit Cost	Total Cost
	<b>Lighting</b>				
	Threshold + transition (1st 700m)	m2	7280	315	2293200
	Interior (balance)	m2	183264.5	120.00	21991740
<b>Lighting subtotal</b>					0
	<b>Substations, generators, UPS</b>				
	Substations	Ea	2	1337000	2674000
	Emergency generator	Ea	1	955000	955000
	UPS (Battery system)	Ea	1	573000	573000
<b>Substations, generators, UPS subtotal</b>					4202000
	<b>CCTV system</b>				
	Cameras (every 60m)	Each	333	3100	1032300
	Control station	Each	1	30000	30000
<b>CCTV system subtotal</b>					1062300
	<b>Provide power for gas detection, ventilation etc.</b>				
	Power provision	m	19991	45	899595
<b>Power subtotal</b>					899595
	<b>Lane control system</b>				
	Fibre optic display (every 200m)	Each	99	12500	0
<b>Lane control system subtotal</b>					0

Lighting costed elsewhere

Total Electrical 6163895

Newfoundland Fixed Link  
Pre-feasibility Study  
TBM Bored Highway Tunnel Option  
Tunnel Lighting Costs

Fraser River Project - 2x3 lane tunnels

For 1550 m length of Theo Van Kooten calculated the tunnel lighting cost as follows:

732	m of threshold lighting costs \$	661231.22	1260	lights		
818	m of interior lighting costs \$	73151.75	139	lights		
1550	m of nighttime circuit costs \$	126767.31	241	lights		
1640	lights cost \$	117280.47	to instal			
1550	m of conduit costs	101424.99				
		<u>1079855.74</u>	*	2	= \$	2,159,711

Prorating for Newfoundland - assuming \*50% for single lane tunnel

for 19991 m length of tunnel

732	m of threshold lighting costs \$	661231.22	1260	lights		
19259	m of interior lighting costs \$	1722285.5	3273	lights		
19991	m of nighttime circuit costs \$	1634971.16	3109	lights		
7642	lights cost \$	546498.39	to instal			
19991	m of conduit costs	1308120.63				
		<u>5873106.91</u>	*	0.5	= \$	2,936,553

**Newfoundland Fixed Link Pre-feasibility Study**  
**TBM Bored Highway Tunnel - North Vent Adit**  
**Tunnel Final Liner Cost Estimate**

Tunnel length= 600 m  
 Liner cross section area= 5.47 m<sup>2</sup>

**Shift pattern**

Shifts	Hours	Days
3	8	5

Advance rate= 30 m/day

Rebar ratio= 0.12 t/m<sup>3</sup> of concrete

Concrete supply=\$ 135 /m<sup>3</sup>

Rebar supply=\$ 900 /t

Initial form set-up time= 4 weeks

**Durations**

Number of days= 40 days  
 Number of hours= 960 hours  
 Number of weeks= 8 weeks

**Labour**

Crew size 15  
 Average labour rate \$ 47 /hour

Total labour cost=\$ 676,800

**Equipment**

Form \$ 1000000  
 Weekly cost of other equipment \$ 15000 (see TED 2370)

Total equipment cost=\$ 1,120,000

**Materials**

Concrete= 3279.8227 m<sup>3</sup>  
 Rebar= 393.57873

Concrete cost=\$ 442,776  
 Rebar cost=\$ 354,221

Total material cost=\$ 796,997

**Cost Summary**

Labour 676,800  
 Equipment 1,120,000  
 Materials 796,997  
 Total 2,593,797

**Newfoundland Fixed Link Pre-feasibility Study**  
**TBM Bored Highway Tunnel - North Vent Adit**  
**Tunnel Drill and Blast Cost Estimate**

Drill & blast excavation @ \$ 250 /m3

Tunnel length= 600 m

Tunnel excavated diameter= 6.5 m

Excavated volume= 19909.8 m3

Excavation cost=\$ 4,977,461

**Newfoundland Fixed Link Pre-feasibility Study**  
**TBM Bored Highway Tunnel - North Vent Adit Shaft**  
**Tunnel Drill and Blast Cost Estimate**

shaft excavated diameter= 5.5 m  
 depth= 100 m  
 shaft final diameter= 6.1 m

From graph

unlined shaft cost=\$ 17000 /m

**Quantities**

Concrete Base= 24 m3  
 Shotcrete= 173 m3  
 Rockbolts= 1728 m2  
 final cast in place liner= 547 m3

**Direct Costs**

				\$ - Cost
shaft excavation etc.	100	*	17000	1700000
Concrete Base	24	*	150	3564
Shotcrete	173	*	500	86394
Rockbolts	1728	*	10	17279
liner	547	*	600	327982 (includes steel & forms)
Total Direct Cost=				<u>2135219</u>

**Newfoundland Fixed Link Pre-feasibility Study**  
**TBM Bored Highway Tunnel**  
**TBM Bored Option - North Vent Adit**

D&B Excavation	4,977,461
Liner	2,593,797
Shaft	<u>2,135,219</u>
	<u>9,706,476</u>

**Newfoundland Fixed Link Pre-feasibility Study**  
**TBM Bored Highway Tunnel - South Vent Adit**  
**Tunnel Final Liner Cost Estimate**

Tunnel length= 2000 m  
 Liner cross section area= 5.47 m<sup>2</sup>

**Shift pattern**

Shifts	Hours	Days
3	8	5

Advance rate= 30 m/day

Rebar ratio= 0.12 t/m<sup>3</sup> of concrete

Concrete supply=\$ 135 /m<sup>3</sup>

Rebar supply=\$ 900 /t

Initial form set-up time= 4 weeks

**Durations**

Number of days= 87 days  
 Number of hours= 2080 hours  
 Number of weeks= 17 weeks

**Labour**

Crew size 15  
 Average labour rate \$ 47 /hour

Total labour cost=\$ 1,466,400

**Equipment**

Form \$ 1000000  
 Weekly cost of other equipment \$ 15000 (see TED 2370)

Total equipment cost=\$ 1,260,000

**Materials**

Concrete= 10932.742 m<sup>3</sup>  
 Rebar= 1311.9291  
 Concrete cost=\$ 1,475,920  
 Rebar cost=\$ 1,180,736

Total material cost=\$ 2,656,656

**Cost Summary**

Labour 1,466,400  
 Equipment 1,260,000  
 Materials 2,656,656  
 Total 5,383,056



**Newfoundland Fixed Link Pre-feasibility Study**  
**TBM Bored Highway Tunnel - South Vent Adit**  
**Tunnel Drill and Blast Cost Estimate**

Drill & blast excavation @ \$ 250 /m<sup>3</sup>

Tunnel length= 2000 m

Tunnel excavated diameter= 6.5 m

Excavated volume= 66366.1 m<sup>3</sup>

Excavation cost=\$ 16,591,536

**Newfoundland Fixed Link Pre-feasibility Study**  
**TBM Bored Highway Tunnel - South Vent Adit Shaft**  
**Tunnel Drill and Blast Cost Estimate**

shaft excavated diameter= 5.5 m  
 depth= 0 m  
 shaft final diameter= 6.1 m

From graph

unlined shaft cost=\$ 17000 /m

**Quantities**

Concrete Base= 24 m3  
 Shotcrete= 0 m3  
 Rockbolts= 0 m2  
 final cast in place liner= 0 m3

**Direct Costs**

				\$ - Cost	
shaft excavation etc.	0	*	17000	0	
Concrete Base	24	*	150	3564	
Shotcrete	0	*	500	0	
Rockbolts	0	*	10	0	
liner	0	*	600	0	(includes steel & forms)
Total Direct Cost=				<u>3564</u>	

5)

**Newfoundland Fixed Link Pre-feasibility Study**  
**TBM Bored Highway Tunnel**  
**TBM Bored Option - South Vent Adit**

D&B Excavation	16,591,536
Liner	5,383,056
Shaft	3,564
	<u>21,978,156</u>

**Newfoundland Fixed Link Pre-feasibility Study**  
**Tunnel Drainage**  
**Bored Highway Tunnel**  
**Drainage Costs**

**Page 1 of 1**  
**Calculation by:** ANW  
**Date:** Jun.08, 2004

**Sump Sizing**

Assume inflow to tunnel of  litres/m2/24hours

Tunnel length=  m  
Tunnel diameter=  m

24 hour inflow= 1995697 litres = 1996 m3  
assume same again for firefighting= 1996 m3

Required sump capacity= 3991 m3

Assumed sump diameter=  m  
Assumed number of sump structures=  m

Required length of each sump= 71 m

**Piping**

Assume 300 mm diameter steel pipe connecting each sump to the portal areas  
Number of pipes=   
Assume sumps located at 1/3 and 2/3 of tunnel length

Total length of piping= 14300 m

**Rates**

Sump construction-\$ 17795 /m of sump  
Pipe-\$ 265 /m of pipe  
Pipe installation labour -\$ 29 /m of pipe (assume 6 man crew installing 100m/day)  
Pipe installation equipment-\$ 10 /m of pipe (assume \$1000/day for equipment)  
Pumps-\$ 125000 /pump

**Costs**

Item	Unit	Qty	Rate	\$-Cost
Sump construction	m	142	17795	2,526,890
Pipe	m	14300	265	3,789,500
Pipe installation	m	14300	29	411,840
Equipment	m	14300	10	143,000
Pumps	Nr	4	125000	500,000
			<b>Total</b>	<b><u>7,371,230</u></b>

**Newfoundland Fixed Link Pre-feasibility Study**  
**Highway Tunnel Options**  
**South Vehicle Holding Area**

Area= 300 m by 600 m

**Earthworks**

Assume 0.5 m depth cleared over entire area

Spoil excavation and removal @ \$ 30 /m<sup>3</sup>

Earthworks= 2,700,000

**Surface**


Assume surface @ 20 /m<sup>2</sup>

Surface= 3,600,000

**Buildings etc.**

Public facilities building @	80000	See CJT estimate
Site maintenance building @	220000	See CJT estimate
Fire engines @	360000	See CJT estimate

Total cost **6,960,000**

 <div>Hatch Mott MacDonald</div>	Newfoundland Fixed Link Pre-feasibility - TBM Bored Highway Tunnel - Cost Summary	
BORED TUNNEL CONSTRUCTION COSTS		
ITEM	UNIT	MAIN TUNNEL
MOBILIZATION & DEMOBILIZATION	LS	8,000,000
TUNNELLING	LS	429,709,000
TUNNEL FINISHES	LS	203,170,000
NORTH APPROACH STRUCTURES	LS	5,920,000
SOUTH APPROACH STRUCTURES	LS	6,090,000
NORTH VENTILATION ADIT	LS	9,706,476
SOUTH VENTILATION ADIT	LS	21,978,156
ROAD FINISHES	LS	2,581,875
NORTH VEHICLE HOLDING AREA	LS	6,960,000
SOUTH VEHICLE HOLDING AREA	LS	4,260,000
TUNNEL DRAINAGE	LS	7,370,000
UTILITY DIVERSIONS	LS	1,000,000
MONITORING	LS	1,000,000
SUBTOTAL CIVIL		\$707,745,508
CIVIL CONTINGENCIES		
CONTINGENCY	40%	\$283,098,203
TOTAL CIVIL		\$990,843,711
M&E AND FINISHING WORK		
VENTILATION EQUIPMENT	LS	\$6,000,000
VENTILATION BUILDINGS x 2	LS	\$2,000,000
FIRE SUPPRESSION SYSTEM	LS	\$4,000,000
CONTROL CENTRE	LS	\$4,000,000
SIGNALLING	LS	\$0
LIGHTING	LS	\$2,936,553
CCTV SYSTEM	LS	\$30,000
GAS DETECTION	LS	\$890,000
SUBSTATION, GENERATORS, UPS	LS	\$570,000
SUBTOTAL M&E AND FINISHING		\$20,426,553
CONTINGENCIES	20%	\$4,085,311
TOTAL M&E AND FINISHING		\$24,511,864
TOTAL CIVIL, M&E AND FINISHING		\$1,015,355,575
ALLOWANCES		
CONTRACTOR OH	15%	\$152,303,336
CONTRACTOR PROFIT	15%	\$152,303,336
CONSTRUCTION TOTAL		\$1,320,000,000
PRE-CONSTRUCTION AND SUPERVISION		
FEASIBILITY STUDY	LS	\$11,000,000
ENVIRONMENTAL ASSESSMENT	LS	\$4,000,000
DESIGN	5%	\$66,000,000
CONSTRUCTION MANAGEMENT	10%	\$132,000,000
OWNERS COSTS	2%	\$26,400,000
PRE-CONSTRUCTION TOTAL		\$239,400,000
GRAND TOTAL		\$1,559,400,000



## Newfoundland Fixed Link Pre-feasibility - TBM Bored Highway Tunnel - Civil Costs

ITEM	UNIT	QTY	RATE	TOTAL
MOBILIZATION	LS	1.00	\$8,000,000	\$8,000,000
TUNNELLING				
- Set-up TBM	LS	1.00	\$723,000	\$723,000
- Tunnel drive	LS	1.00	\$424,854,000	\$424,854,000
- TBM maintenance	LS	1.00	\$916,000	\$916,000
- Remove TBM	LS	1.00	\$398,000	\$398,000
- Clean tunnel	LS	1.00	\$2,818,000	\$2,818,000
- Structural finishes	LS	1.00	\$203,170,000	\$203,170,000
NORTH APPROACH STRUCTURES				
- cut and cover approach	LS	1.00	\$5,920,000	\$5,920,000
SOUTH APPROACH STRUCTURES				
- cut and cover approach	LS	1.00	\$6,090,000	\$6,090,000
END VENTILATION ADITs				
- south adit	LS	1.00	\$21,978,156	\$21,978,156
- north adit	LS	1.00	\$9,706,476	\$9,706,476
DRAINAGE				
Drainage sumps and piping	LS	1.00	\$7,370,000	\$7,370,000
ROAD FINISHES				
- bored tunnel	m2	124,943.75	\$20	\$2,498,875
- north approach	m2	2,075.00	\$20	\$41,000
- south approach	m2	2,100.00	\$20	\$42,000
SUB-TOTAL				\$694,525,508



**Newfoundland Fixed Link Pre-feasibility Study**  
**Drill & Blast Highway Tunnel - South Vehicle Holding Area**

Area= 300 m by 600 m

**Earthworks**

Assume 0 m depth cleared over entire area

Spoil excavation and removal @ \$ 30 /m3

Earthworks= 0

**Surface**

Assume surface @ 20 /m2

Surface= 3,600,000

**Buildings etc.**

Public facilities building @	80000	See CJT estimate
Site maintenance building @	220000	See CJT estimate
Fire engines @	360000	See CJT estimate

Total cost 4,260,000

**Newfoundland Fixed Link Pre-feasibility Study**  
**Drill and Blast Highway Tunnel - Zones 1, 3, and 5**  
**Tunnel Final Liner Cost Estimate**

Tunnel length= 6500 m  
 Liner cross section area= 15 m<sup>2</sup>

**Shift pattern**

Shifts	Hours	Days
3	8	5

Advance rate= 10 m/day

Rebar ratio= 0.12 t/m<sup>3</sup> of concrete

Concrete supply=\$ 135 /m<sup>3</sup>

Rebar supply=\$ 900 /t

Initial form set-up time= 4 weeks

**Durations**

Number of days= 670 days  
 Number of hours= 16080 hours  
 Number of weeks= 134 weeks

**Labour**

Crew size 30  
 Average labour rate \$ 47 /hour

Total labour cost=\$ 22,672,800

**Equipment**

Form \$ 1000000  
 Weekly cost of other equipment \$ 15000 (see TED 2370)

Total equipment cost=\$ 3,010,000

**Materials**

Concrete= 97500 m<sup>3</sup>  
 Rebar= 11700  
 Concrete cost=\$ 13,162,500  
 Rebar cost=\$ 10,530,000

Total material cost=\$ 23,692,500

**Cost Summary**

Labour 22,672,800  
 Equipment 3,010,000  
 Materials 23,692,500  
 Total 49,375,300

**Newfoundland Fixed Link Pre-feasibility Study**  
**Drill and Blast Highway Tunnel - Zones 1, 3, and 5**  
**Tunnel Final Liner Cost Estimate**

Tunnel length= 13748 m  
 Liner cross section area= 17.2 m<sup>2</sup>

**Shift pattern**

Shifts	Hours	Days
3	8	5

Advance rate= 10 m/day

Rebar ratio= 0.12 t/m<sup>3</sup> of concrete

Concrete supply=\$ 135 /m<sup>3</sup>

Rebar supply=\$ 900 /t

Initial form set-up time= 4 weeks

**Durations**

Number of days= 1395 days  
 Number of hours= 33475 hours  
 Number of weeks= 279 weeks

**Labour**

Crew size 30  
 Average labour rate \$ 40 /hour

Total labour cost=\$ 40,170,240

**Equipment**

Form \$ 1000000  
 Weekly cost of other equipment \$ 15000 (see TED 2370)

Total equipment cost=\$ 5,184,400

**Materials**

Concrete= 236465.6 m<sup>3</sup>  
 Rebar= 28375.872  
 Concrete cost=\$ 31,922,856  
 Rebar cost=\$ 25,538,285

Total material cost=\$ 57,461,141

**Cost Summary**

Labour 40,170,240  
 Equipment 5,184,400  
 Materials 57,461,141  
 Total 102,815,781

# Main Electrical Components for Novaroute

## Drill & Blast Highway Tunnel Option

Length of each tunnel= 20248 m

Number of tunnels= 1

Tunnel width= 9.5 m

Item	Component	Unit	Qty	Unit Cost	Total Cost
	<b>Lighting</b>				
	Threshold + transition (1st 700m)	m2	7280	315	2293200
	Interior (balance)	m2	185706	120.00	22284720
<b>Lighting subtotal</b>					0
	<b>Substations, generators, UPS</b>				
	Substations	Ea	2	1337000	2674000
	Emergency generator	Ea	1	955000	955000
	UPS (Battery system)	Ea	1	573000	573000
<b>Substations, generators, UPS subtotal</b>					4202000
	<b>CCTV system</b>				
	Cameras (every 60m)	Each	337	3100	1044700
	Control station	Each	1	30000	30000
<b>CCTV system subtotal</b>					1074700
	<b>Provide power for gas detection, ventilation etc.</b>				
	Power provision	m	20248	45	911160
<b>Power subtotal</b>					911160
	<b>Lane control system</b>				
	Fibre optic display (every 200m)	Each	101	12500	0
<b>Lane control system subtotal</b>					0

Lighting costed elsewhere

Total Electrical 6187860

## Initialisation

**Project:** Newfoundland Fixed Link Pre-feasibility Study

**Section:** North Approach

**Option:** D&B Highway Tunnel

**Date:** 8-Jun-04

**Calculations by:** ANW

Surface gradient  %

+ sloping same way as track/road  
- sloping against track/road

Track/Road Gradient  %

Ground elevation  
at portal  m

Bottom of slab  
elevation at portal  m

Total length= 587.8594 m

Total Cost=\$ 10.6 M

UNIT RATES

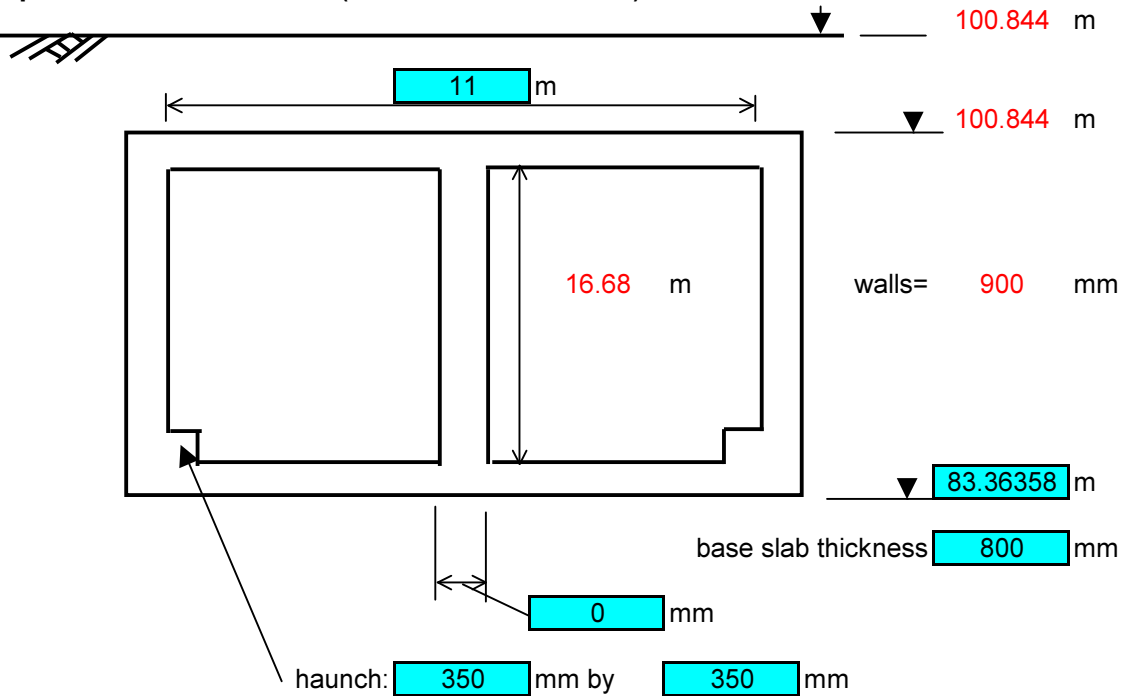
Materials

Item	unit	Rate
excavation	m3	60
concrete	m3	190
rebar	tonnes	1600
formwork/falsework	m2	140
SP&L<=4.6m deep	m2	0
4.6<SP&L<=6.7m deep	m2	0
6.7<SP&L<=10.6m deep	m2	0
10.6<SP&L<=13.7m deep	m2	0
13.7<SP&L<=16.8m deep	m2	0
16.8<SP&L<=20.0m deep	m2	0
20<SP&L<=25m deep	m2	0
backfill + compact	m3	40
surface reinstatement	m2	30

Section Cut and Cover  
Length of section: 58.78594 m

Section 1

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	13153.0	m3	
concrete=	2381.36	m3	
rebar=	285.8	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	1961.099	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	2055.2	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	752.4601	m2	

**Calculated costs**

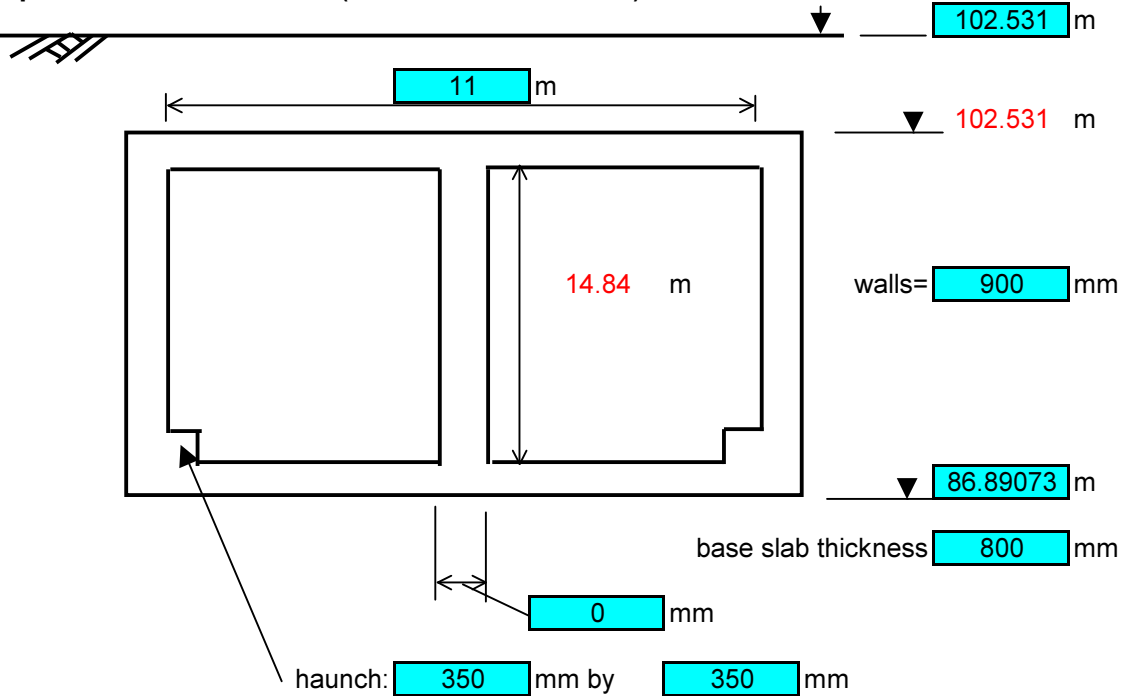
Item	Unit	Quantity	Rate	Cost
excavation	m3	13153.0	60	789180.1
concrete	m3	2381.36	190.0	452458.4
rebar	tonnes	285.8	1600	457221.1
formwork/falsework	m2	1961.099	140	274553.9
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	2055.2	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	752.4601	30	22573.8
			Total	<u>1995987</u>



Section Cut and Cover  
Length of section: 58.78594 m

Section 2

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	11768.5	m3	
concrete=	2186.661	m3	
rebar=	262.4	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	1744.767	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	1838.8	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	752.4601	m2	

**Calculated costs**

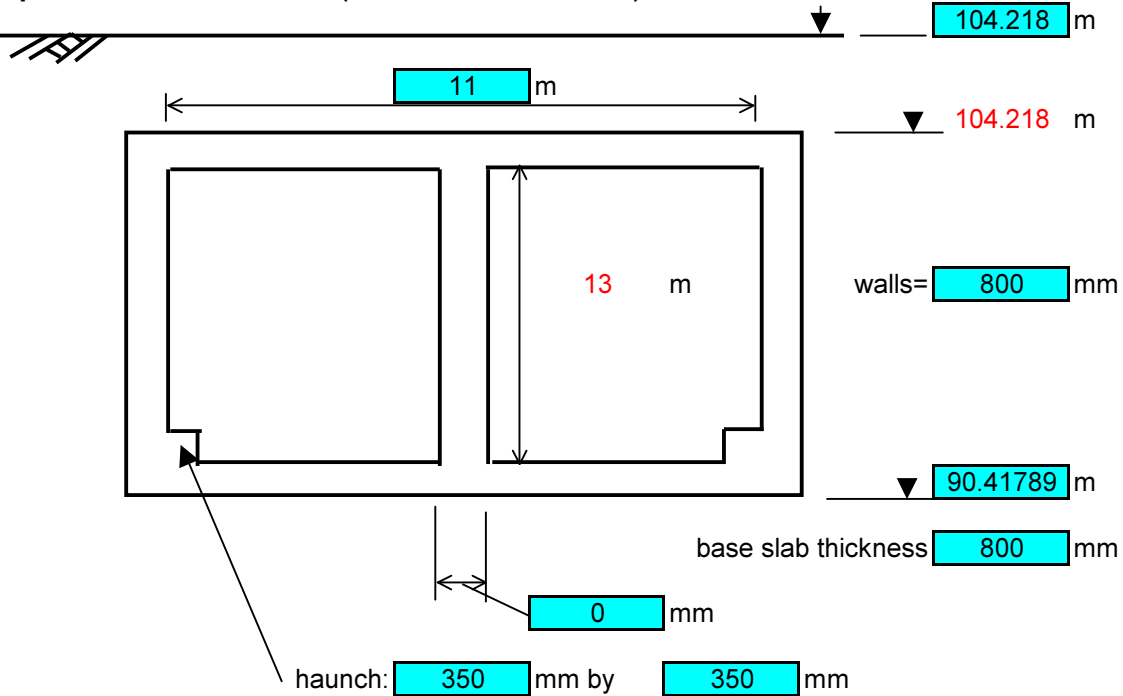
Item	Unit	Quantity	Rate	Cost
excavation	m3	11768.5	60	706108.5
concrete	m3	2186.661	190.0	415465.5
rebar	tonnes	262.4	1600	419838.9
formwork/falsework	m2	1744.767	140	244267.3
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	1838.8	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	752.4601	30	22573.8

Total 1808254

Section Cut and Cover  
Length of section: 58.78594 m

Section 3

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	10221.7	m3	
concrete=	1829.712	m3	
rebar=	219.6	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	1528.435	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	1622.5	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	740.7029	m2	

**Calculated costs**

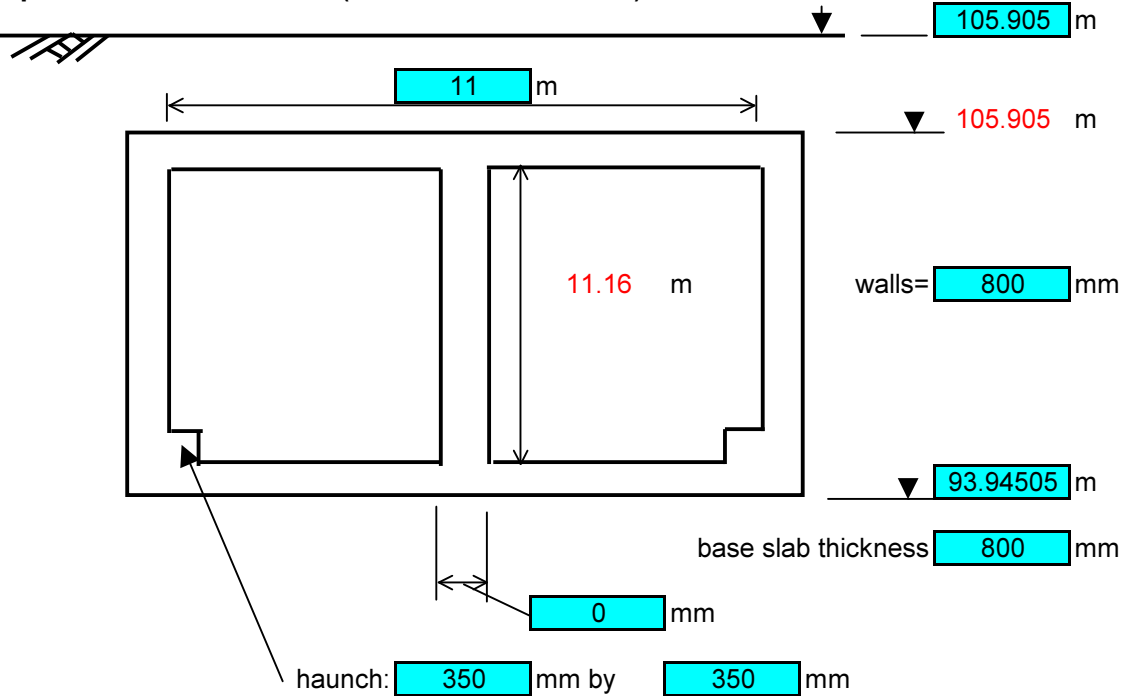
Item	Unit	Quantity	Rate	Cost
excavation	m3	10221.7	60	613302
concrete	m3	1829.712	190.0	347645.4
rebar	tonnes	219.6	1600	351304.8
formwork/falsework	m2	1528.435	140	213980.8
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	1622.5	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	740.7029	30	22221.09

Total 1548454

Section Cut and Cover  
Length of section: 58.78594 m

Section 4

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	8858.8	m3	
concrete=	1656.647	m3	
rebar=	198.8	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	1312.102	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	1406.2	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	740.7029	m2	

**Calculated costs**

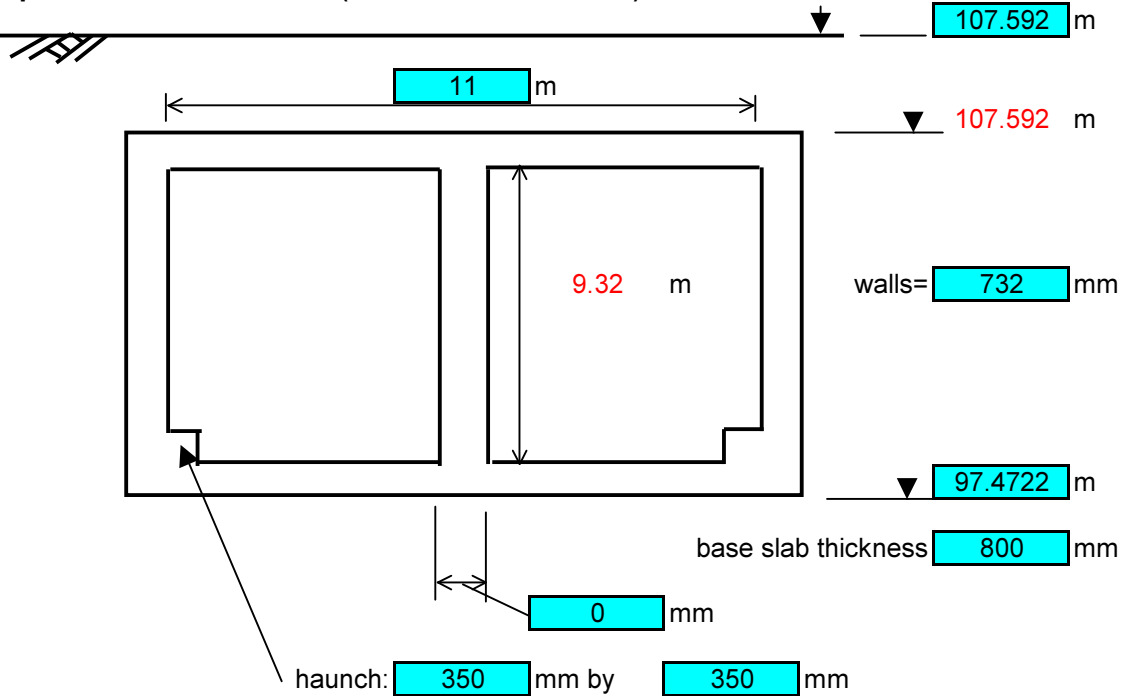
Item	Unit	Quantity	Rate	Cost
excavation	m3	8858.8	60	531528.4
concrete	m3	1656.647	190.0	314762.9
rebar	tonnes	198.8	1600	318076.2
formwork/falsework	m2	1312.102	140	183694.3
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	1406.2	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	740.7029	30	22221.09

Total 1370283

Section Cut and Cover  
 Length of section: 58.78594 m

Section 5

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	7415.0	m3	
concrete=	1402.673	m3	
rebar=	168.3	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	1095.77	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	1189.8	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	732.708	m2	

**Calculated costs**

Item	Unit	Quantity	Rate	Cost
excavation	m3	7415.0	60	444900.3
concrete	m3	1402.673	190.0	266507.8
rebar	tonnes	168.3	1600	269313.1
formwork/falsework	m2	1095.77	140	153407.8
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	1189.8	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	732.708	30	21981.24

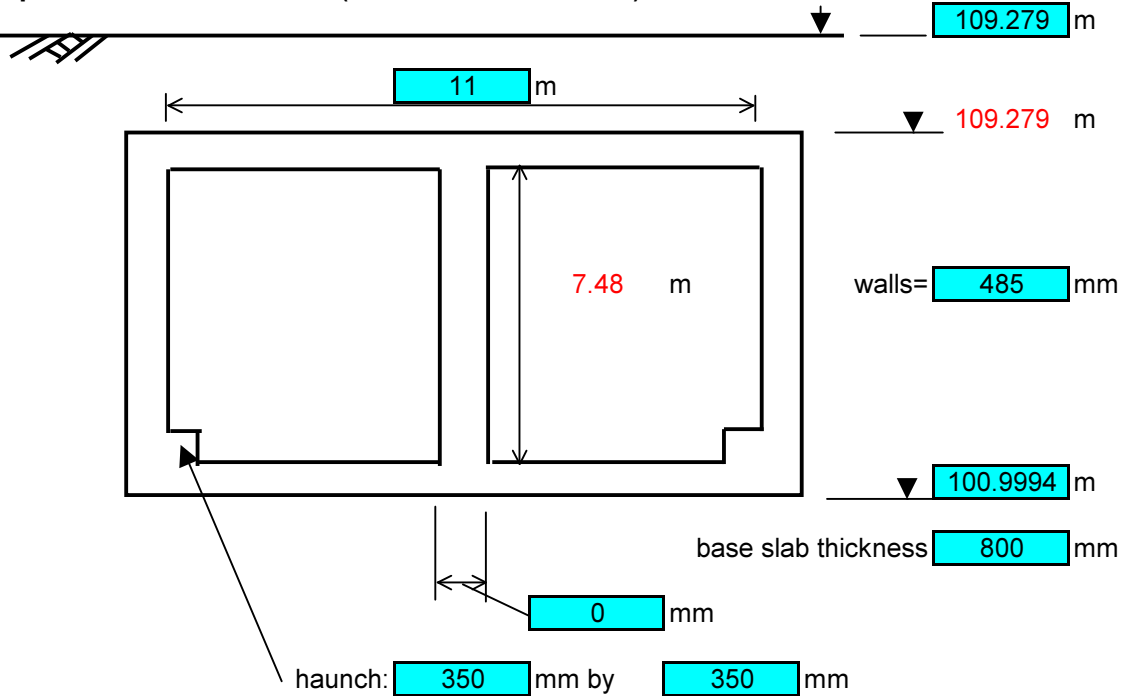
Total 1156110



Section Cut and Cover  
Length of section: 58.78594 m

Section 6

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	5826.4	m3	
concrete=	1003.864	m3	
rebar=	120.5	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	879.4377	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	973.5	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	703.6677	m2	

**Calculated costs**

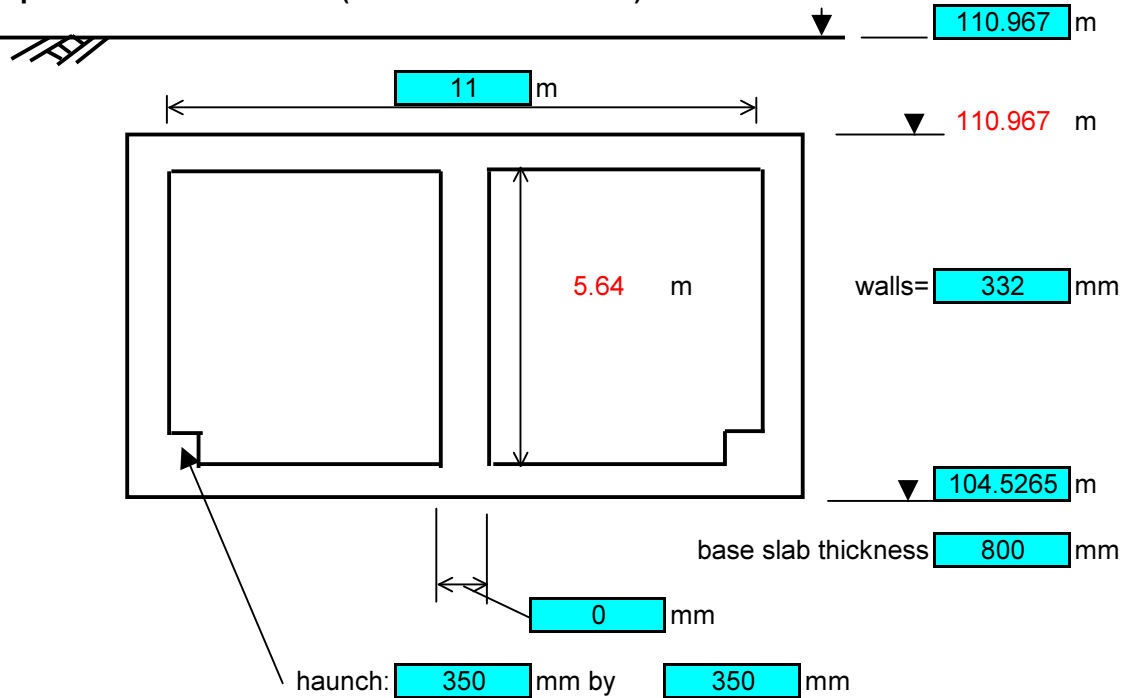
Item	Unit	Quantity	Rate	Cost
excavation	m3	5826.4	60	349582.1
concrete	m3	1003.864	190.0	190734.2
rebar	tonnes	120.5	1600	192741.9
formwork/falsework	m2	879.4377	140	123121.3
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	973.5	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	703.6677	30	21110.03

Total 877289.5

Section Cut and Cover  
Length of section: 58.78594 m

Section 7

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	4415.8	m3	
concrete=	783.0969	m3	
rebar=	94.0	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	663.1054	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	757.2	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	685.6792	m2	

**Calculated costs**

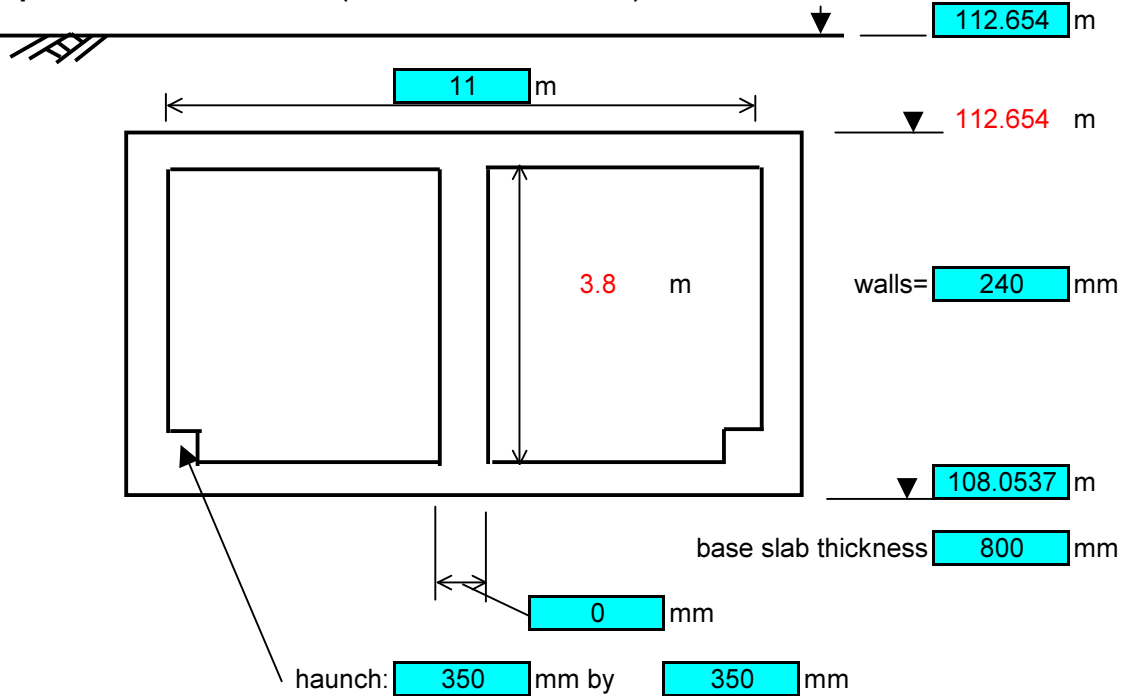
Item	Unit	Quantity	Rate	Cost
excavation	m3	4415.8	60	264946.5
concrete	m3	783.0969	190.0	148788.4
rebar	tonnes	94.0	1600	150354.6
formwork/falsework	m2	663.1054	140	92834.76
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	757.2	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	685.6792	30	20570.38

Total 677494.6

Section Cut and Cover  
Length of section: 58.78594 m

Section 8

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	3104.4	m3	
concrete=	661.5182	m3	
rebar=	79.4	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	446.7732	m2	
SP&L<=4.6m deep	540.8	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	674.8626	m2	

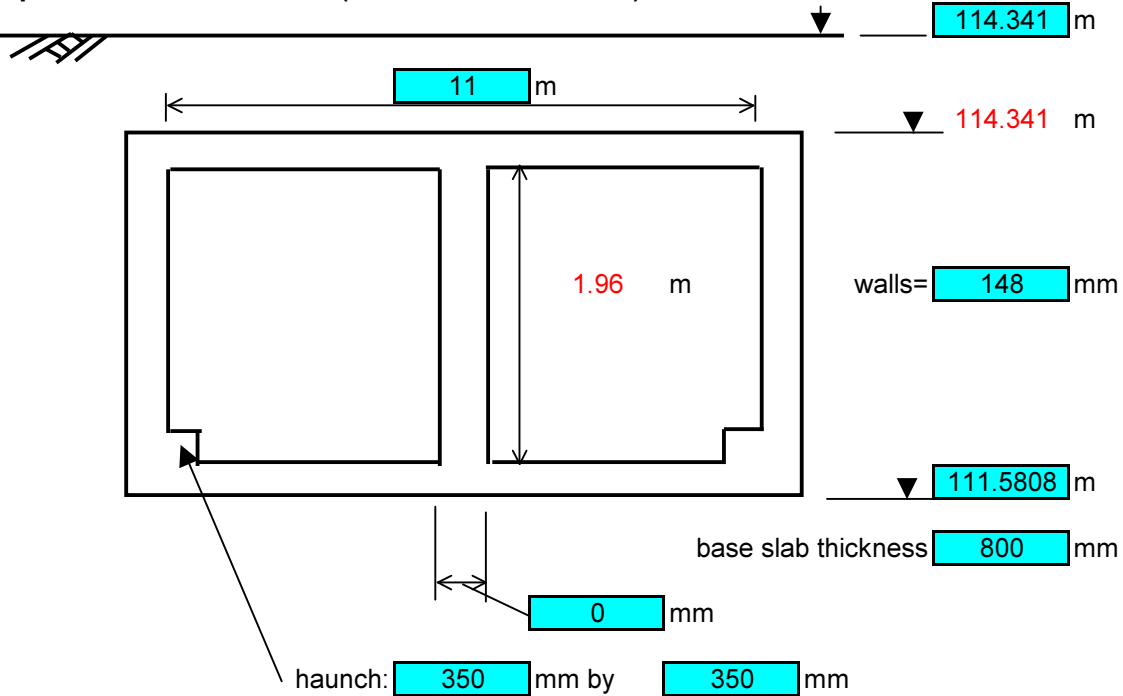
**Calculated costs**

Item	Unit	Quantity	Rate	Cost
excavation	m3	3104.4	60	186262.1
concrete	m3	661.5182	190.0	125688.5
rebar	tonnes	79.4	1600	127011.5
formwork/falsework	m2	446.7732	140	62548.24
SP&L<=4.6m deep	m2	540.8	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	674.8626	30	20245.88

Total 521756.2

Section Cut and Cover  
 Length of section: 58.78594 m Section 9

Input cross-section details (cut and cover solution)



Calculated Quantities

excavation=	1832.8	m3	
concrete=	579.7446	m3	
rebar=	69.6	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	230.4409	m2	
SP&L<=4.6m deep	324.5	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	664.046	m2	

**Calculated costs**

Item	Unit	Quantity	Rate	Cost
excavation	m3	1832.8	60	109966
concrete	m3	579.7446	190.0	110151.5
rebar	tonnes	69.6	1600	111311
formwork/falsework	m2	230.4409	140	32261.73
SP&L<=4.6m deep	m2	324.5	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	664.046	30	19921.38

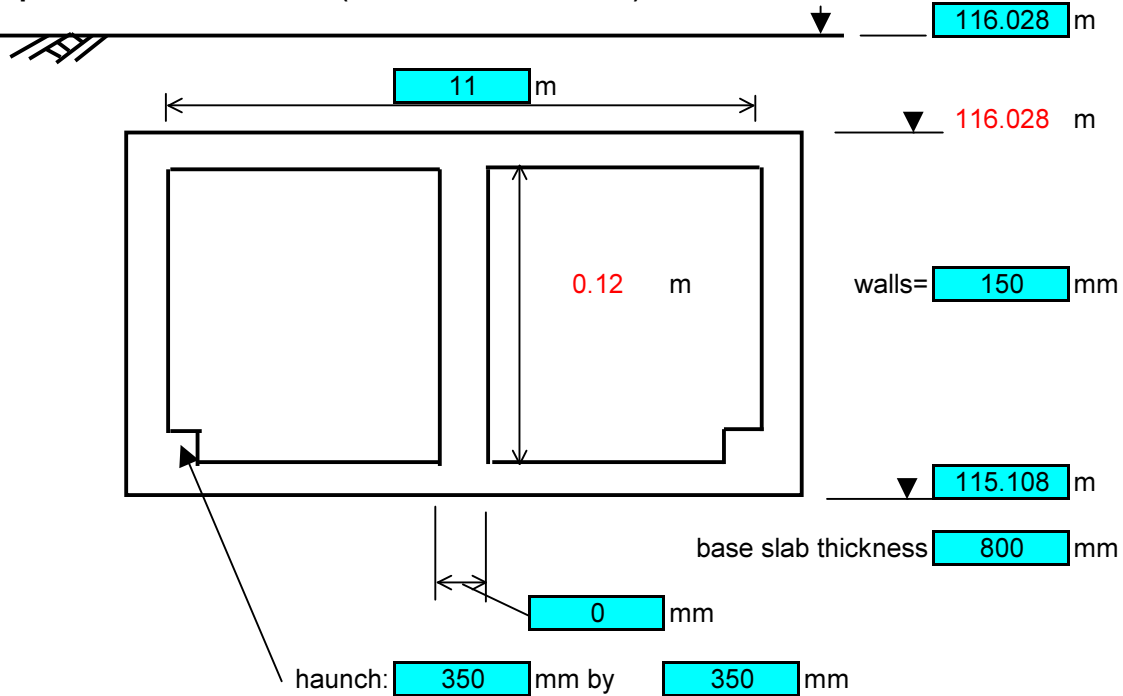
Total 383611.6



Section Cut and Cover  
 Length of section: 58.78594 m

Section 10

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	611.1	m3	
concrete=	547.9438	m3	
rebar=	65.8	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	14.10863	m2	
SP&L<=4.6m deep	108.2	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	664.2812	m2	

**Calculated costs**

Item	Unit	Quantity	Rate	Cost
excavation	m3	611.1	60	36668.32
concrete	m3	547.9438	190.0	104109.3
rebar	tonnes	65.8	1600	105205.2
formwork/falsework	m2	14.10863	140	1975.208
SP&L<=4.6m deep	m2	108.2	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	664.2812	30	19928.43

Total 267886.5

**Newfoundland Fixed Link Pre-feasibility Study**  
**North Approach**  
**D&B Highway Tunnel**

**Date:** 8-Jun-04  
**Calculations by:** ANW

**Summary of Costs**

Markup for adjacent 0 %

<b>Section</b>	<b>Cost</b>
1	1995987
2	1808254
3	1548454
4	1370283
5	1156110
6	877289.5
7	677494.6
8	521756.2
9	383611.6
10	267886.5
Sub-total	<u>10607127</u>

## Initialisation

**Project:** Newfoundland Fixed Link Pre-feasibility Study

**Section:** South Approach

**Option:** D&B Highway Tunnel

**Date:** 8-Jun-04

**Calculations by:** ANW

Surface gradient  %

+ sloping same way as track/road  
- sloping against track/road

Track/Road Gradient  %

Ground elevation  
at portal  m

Bottom of slab  
elevation at portal  m

Total length= 334.5455 m

Total Cost=\$ 6.0 M

**UNIT RATES**

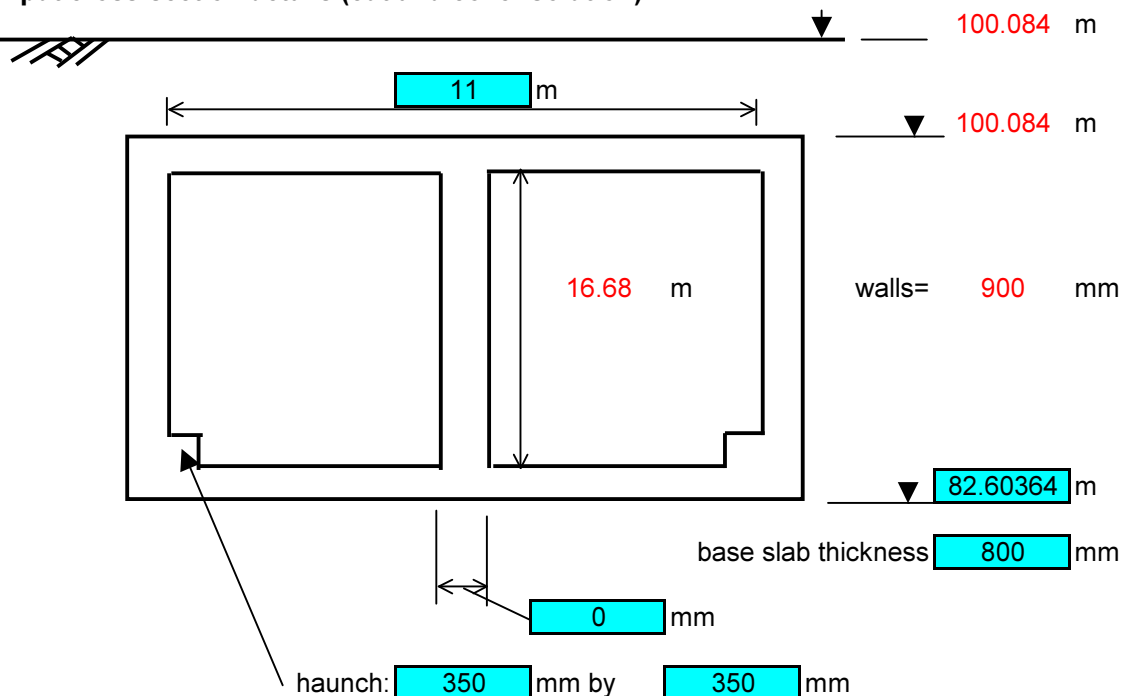
**Materials**

<b>Item</b>	<b>unit</b>	<b>Rate</b>
excavation	m3	60
concrete	m3	190
rebar	tonnes	1600
formwork/falsework	m2	140
SP&L<=4.6m deep	m2	0
4.6<SP&L<=6.7m deep	m2	0
6.7<SP&L<=10.6m deep	m2	0
10.6<SP&L<=13.7m deep	m2	0
13.7<SP&L<=16.8m deep	m2	0
16.8<SP&L<=20.0m deep	m2	0
20<SP&L<=25m deep	m2	0
backfill + compact	m3	40
surface reinstatement	m2	30

Section Cut and Cover  
Length of section: 33.45455 m

Section 1

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	7485.3	m3	
concrete=	1355.21	m3	
rebar=	162.6	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	1116.044	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	1169.6	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	428.2182	m2	

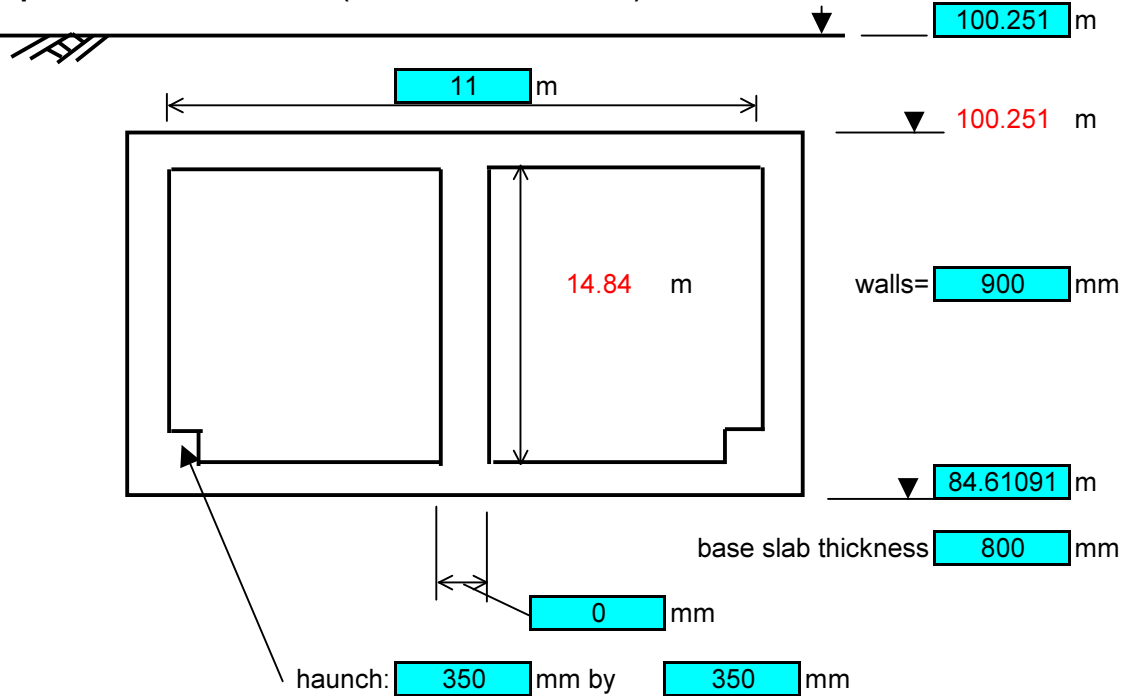
**Calculated costs**

Item	Unit	Quantity	Rate	Cost
excavation	m3	7485.3	60	449115.2
concrete	m3	1355.21	190.0	257489.9
rebar	tonnes	162.6	1600	260200.4
formwork/falsework	m2	1116.044	140	156246.1
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	1169.6	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	428.2182	30	12846.55

Total 1135898

Section Cut and Cover  
 Length of section: 33.45455 m Section 2

Input cross-section details (cut and cover solution)



Calculated Quantities

excavation=	6697.3	m3	
concrete=	1244.409	m3	
rebar=	149.3	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	992.9309	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	1046.5	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	428.2182	m2	



**Calculated costs**

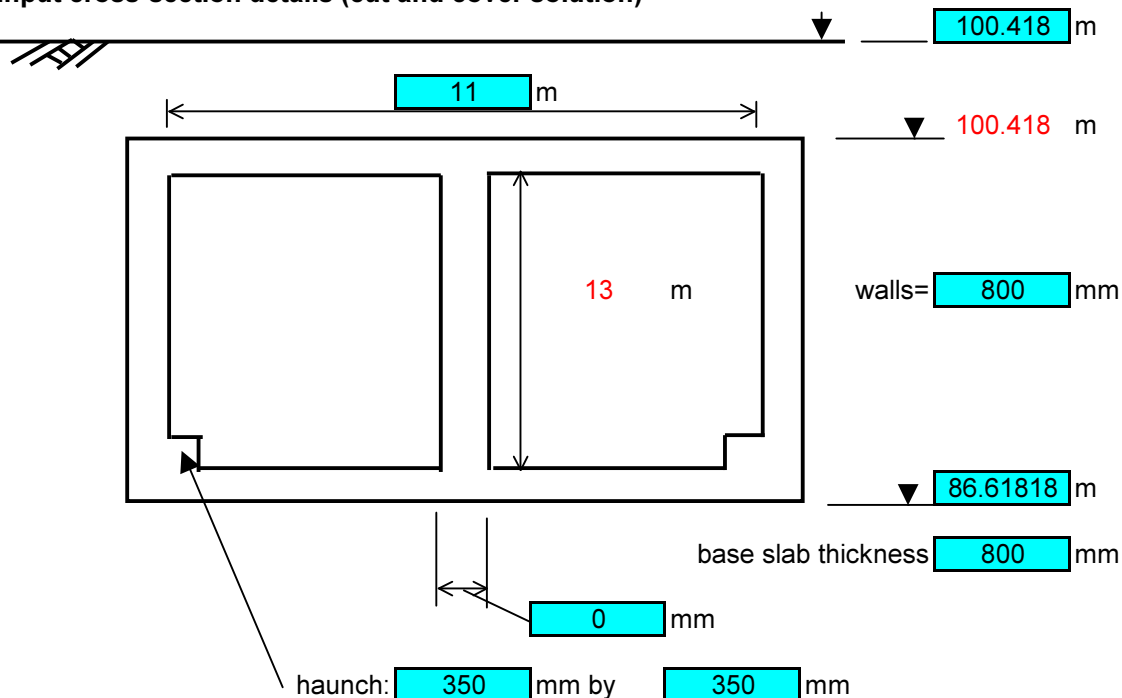
Item	Unit	Quantity	Rate	Cost
excavation	m3	6697.3	60	401839.9
concrete	m3	1244.409	190.0	236437.7
rebar	tonnes	149.3	1600	238926.5
formwork/falsework	m2	992.9309	140	139010.3
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	1046.5	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	428.2182	30	12846.55

Total 1029061

Section Cut and Cover  
Length of section: 33.45455 m

Section 3

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	5817.1	m3	
concrete=	1041.273	m3	
rebar=	125.0	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	869.8182	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	923.3	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	421.5273	m2	

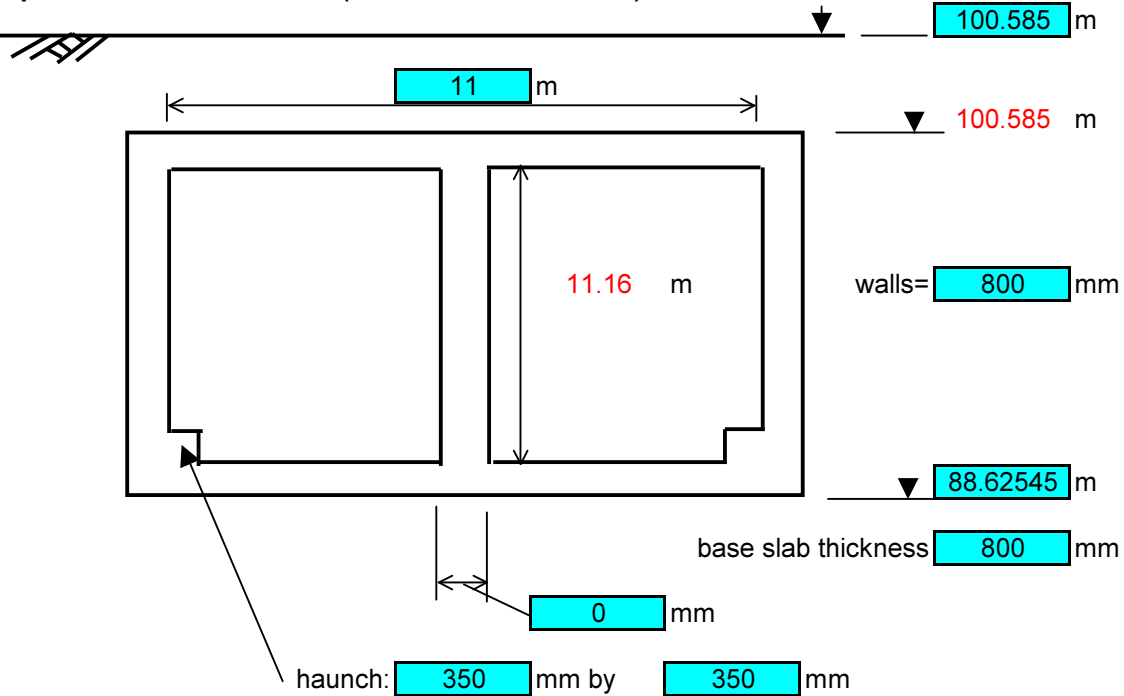
**Calculated costs**

Item	Unit	Quantity	Rate	Cost
excavation	m3	5817.1	60	349024.6
concrete	m3	1041.273	190.0	197841.8
rebar	tonnes	125.0	1600	199924.4
formwork/falsework	m2	869.8182	140	121774.5
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	923.3	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	421.5273	30	12645.82

Total 881211.1

Section Cut and Cover  
 Length of section: 33.45455 m Section 4

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	5041.5	m3	
concrete=	942.7825	m3	
rebar=	113.1	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	746.7055	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	800.2	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	421.5273	m2	

**Calculated costs**

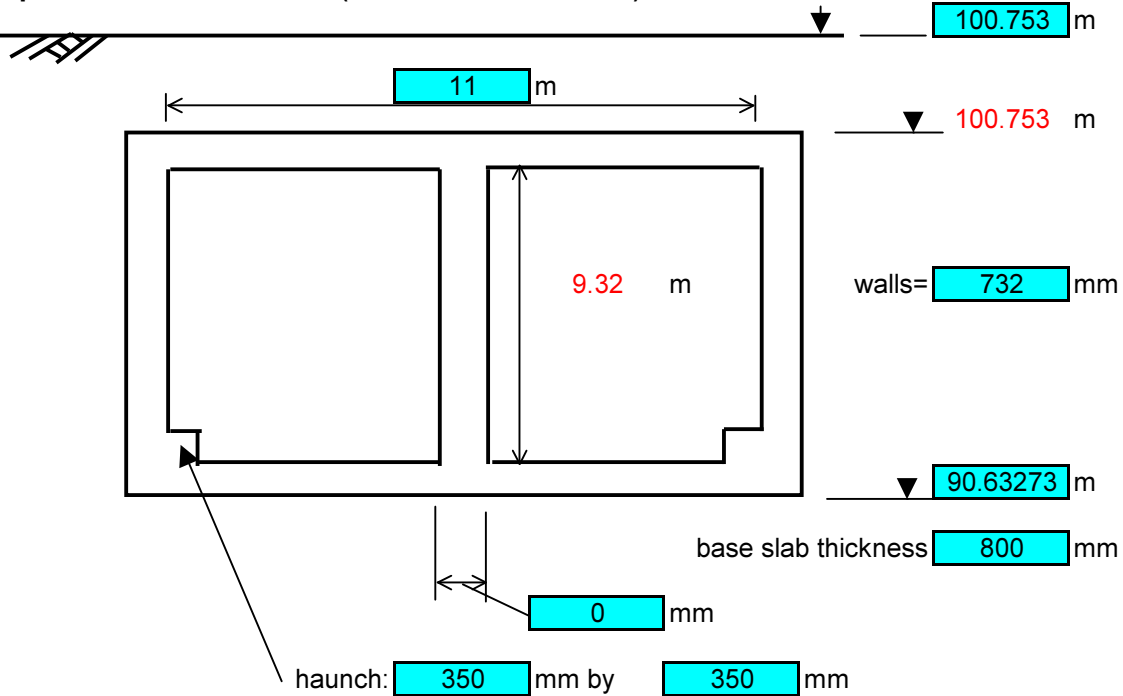
Item	Unit	Quantity	Rate	Cost
excavation	m3	5041.5	60	302488
concrete	m3	942.7825	190.0	179128.7
rebar	tonnes	113.1	1600	181014.2
formwork/falsework	m2	746.7055	140	104538.8
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	800.2	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	421.5273	30	12645.82

Total 779815.5

Section Cut and Cover  
 Length of section: 33.45455 m

Section 5

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	4219.8	m3	
concrete=	798.2482	m3	
rebar=	95.8	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	623.5927	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	677.1	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	416.9775	m2	

**Calculated costs**

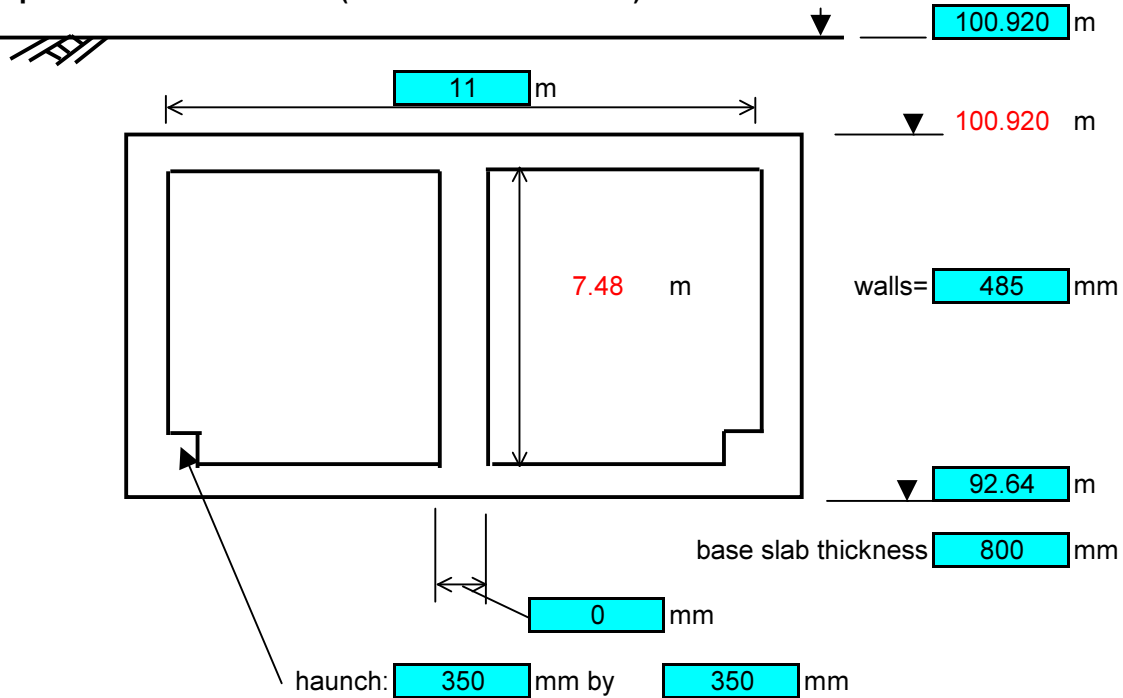
Item	Unit	Quantity	Rate	Cost
excavation	m3	4219.8	60	253188.7
concrete	m3	798.2482	190.0	151667.2
rebar	tonnes	95.8	1600	153263.7
formwork/falsework	m2	623.5927	140	87302.98
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	677.1	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	416.9775	30	12509.32

Total 657931.8

Section Cut and Cover  
Length of section: 33.45455 m

Section 6

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	3315.7	m3	
concrete=	571.2899	m3	
rebar=	68.6	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	500.48	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	554.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	400.4509	m2	



**Calculated costs**

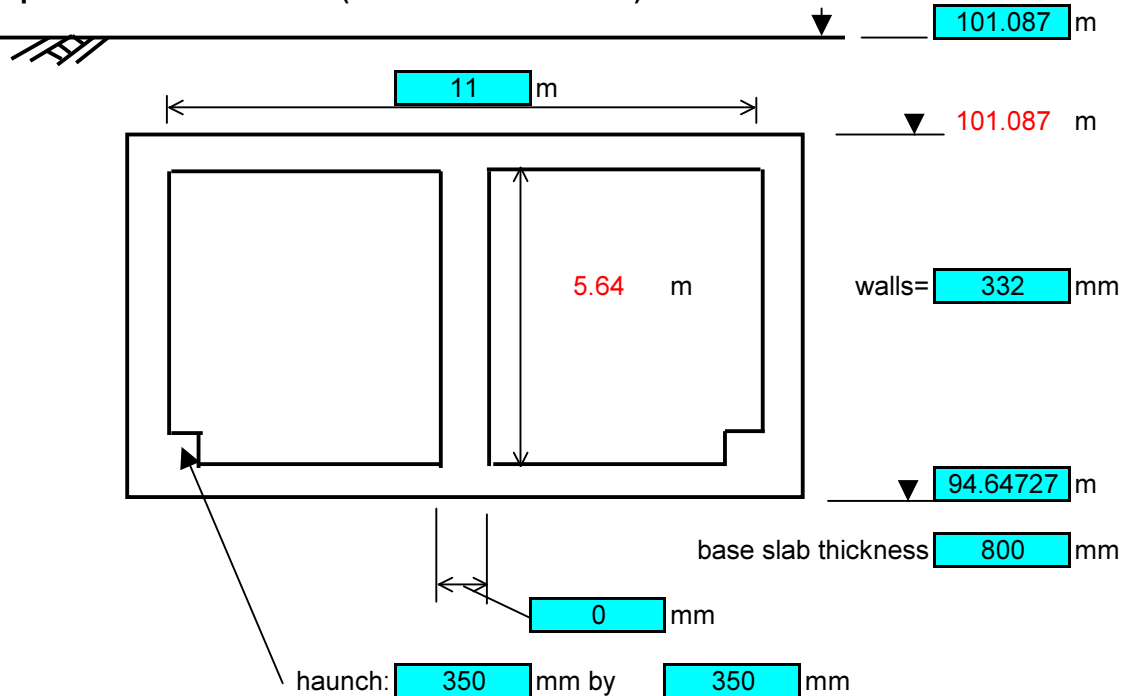
Item	Unit	Quantity	Rate	Cost
excavation	m3	3315.7	60	198944
concrete	m3	571.2899	190.0	108545.1
rebar	tonnes	68.6	1600	109687.7
formwork/falsework	m2	500.48	140	70067.2
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	554.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	400.4509	30	12013.53

Total 499257.5

Section Cut and Cover  
Length of section: 33.45455 m

Section 7

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	2513.0	m3	
concrete=	445.6534	m3	
rebar=	53.5	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	377.3673	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	430.9	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	390.2138	m2	

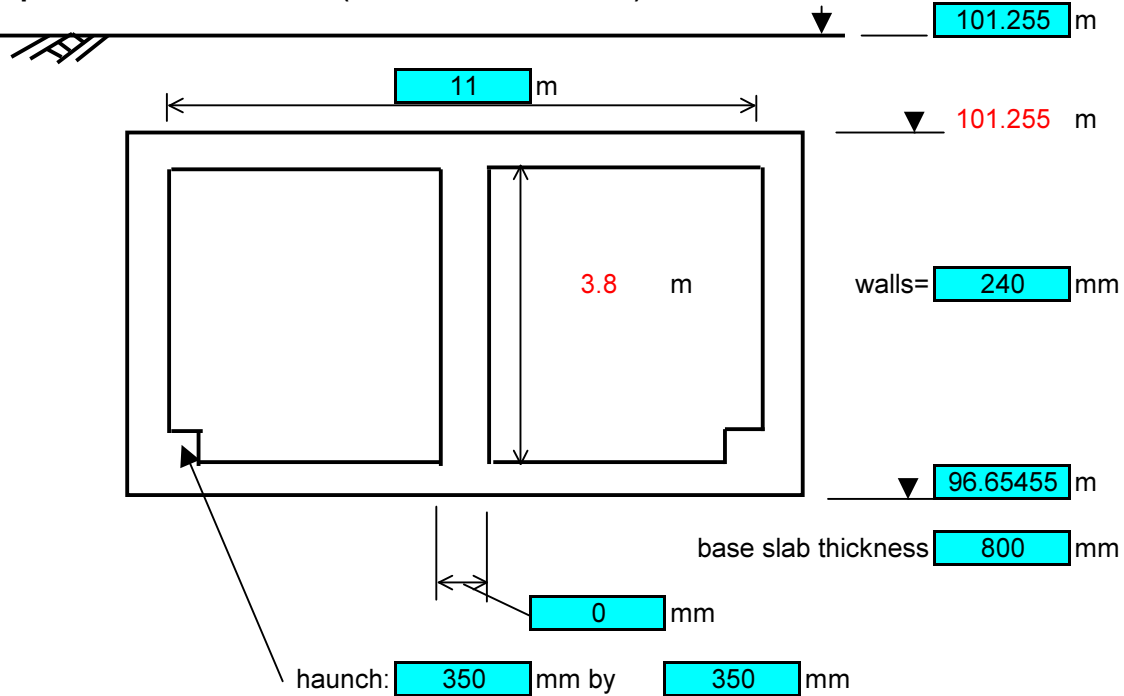
**Calculated costs**

Item	Unit	Quantity	Rate	Cost
excavation	m3	2513.0	60	150778.6
concrete	m3	445.6534	190.0	84674.14
rebar	tonnes	53.5	1600	85565.44
formwork/falsework	m2	377.3673	140	52831.42
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	430.9	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	390.2138	30	11706.41
Total				<u>385556</u>

Section Cut and Cover  
 Length of section: 33.45455 m

Section 8

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	1766.7	m3	
concrete=	376.464	m3	
rebar=	45.2	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	254.2545	m2	
SP&L<=4.6m deep	307.8	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	384.0582	m2	

**Calculated costs**

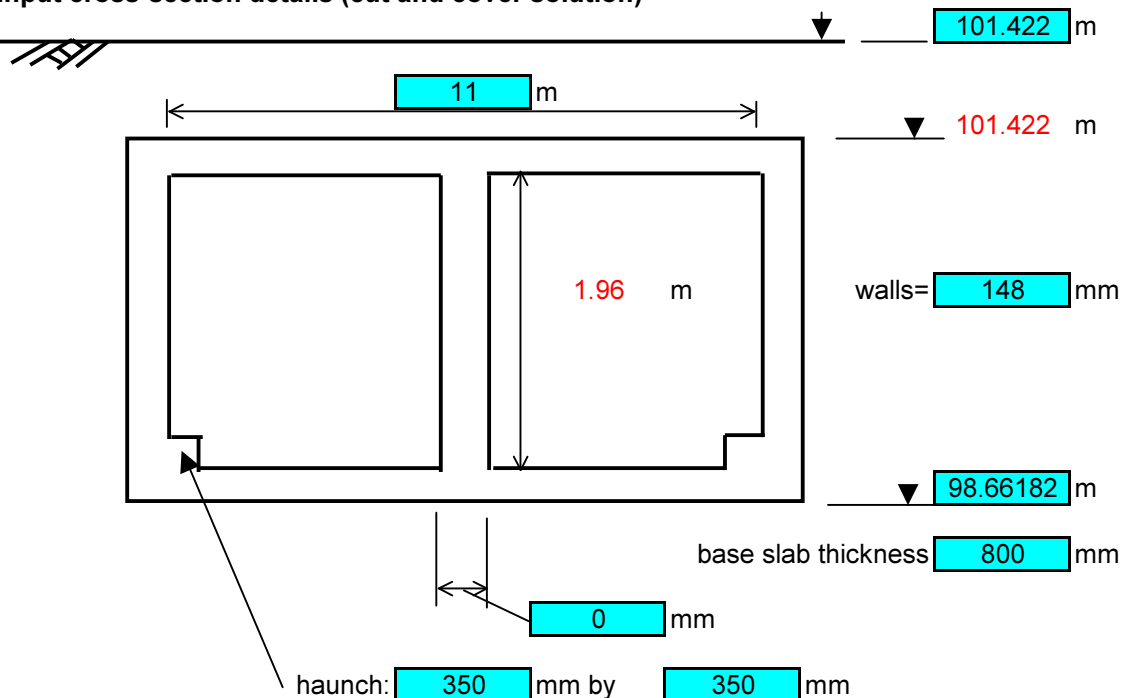
Item	Unit	Quantity	Rate	Cost
excavation	m3	1766.7	60	106000.1
concrete	m3	376.464	190.0	71528.16
rebar	tonnes	45.2	1600	72281.09
formwork/falsework	m2	254.2545	140	35595.64
SP&L<=4.6m deep	m2	307.8	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	384.0582	30	11521.75

Total 296926.7

Section Cut and Cover  
Length of section: 33.45455 m

Section 9

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	1043.0	m3	
concrete=	329.9274	m3	
rebar=	39.6	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	131.1418	m2	
SP&L<=4.6m deep	184.7	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	377.9025	m2	

**Calculated costs**

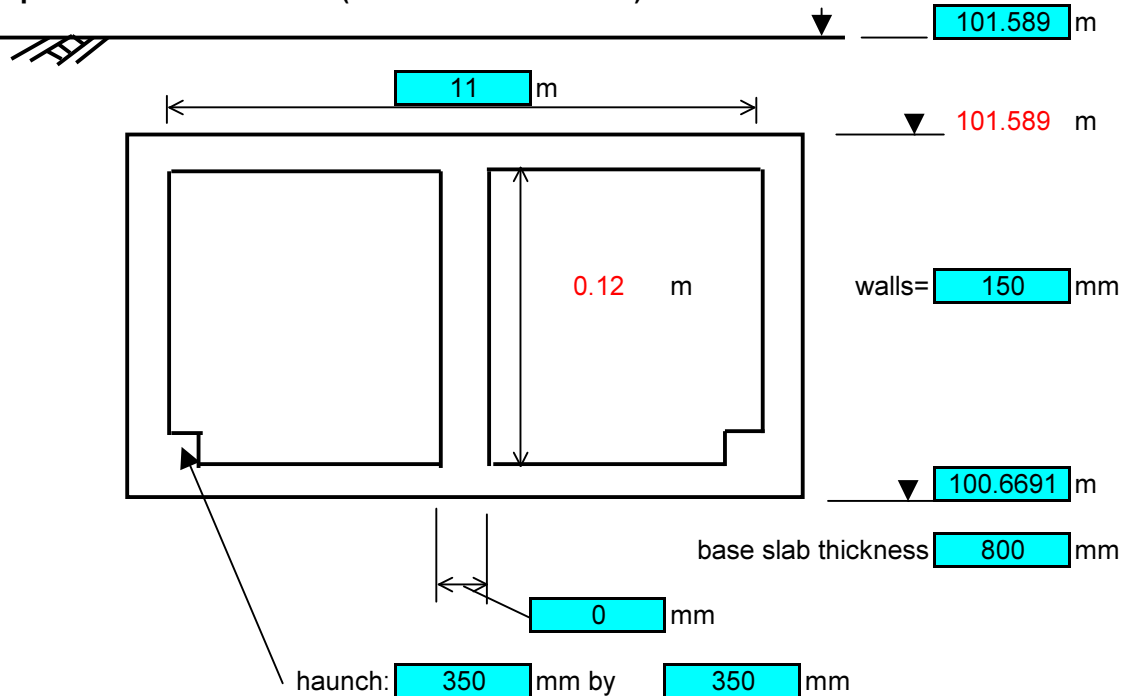
Item	Unit	Quantity	Rate	Cost
excavation	m3	1043.0	60	62580.66
concrete	m3	329.9274	190.0	62686.2
rebar	tonnes	39.6	1600	63346.06
formwork/falsework	m2	131.1418	140	18359.85
SP&L<=4.6m deep	m2	184.7	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	377.9025	30	11337.08

Total 218309.9

Section Cut and Cover  
Length of section: 33.45455 m

Section 10

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	347.8	m3	
concrete=	311.8298	m3	
rebar=	37.4	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	8.029091	m2	
SP&L<=4.6m deep	61.6	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	378.0364	m2	



**Calculated costs**

Item	Unit	Quantity	Rate	Cost
excavation	m3	347.8	60	20867.61
concrete	m3	311.8298	190.0	59247.67
rebar	tonnes	37.4	1600	59871.33
formwork/falsework	m2	8.029091	140	1124.073
SP&L<=4.6m deep	m2	61.6	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	378.0364	30	11341.09

Total 152451.8

**Newfoundland Fixed Link Pre-feasibility Study**  
**South Approach**  
**D&B Highway Tunnel**

**Date:** 8-Jun-04  
**Calculations by:** ANW

**Summary of Costs**

Markup for adjacent 0 %

<b>Section</b>	<b>Cost</b>
1	1135898
2	1029061
3	881211.1
4	779815.5
5	657931.8
6	499257.5
7	385556
8	296926.7
9	218309.9
10	152451.8
Sub-total	<u>6036419</u>

**Newfoundland Fixed Link Pre-feasibility Study**  
**Highway Tunnel - North Vent Adit**  
**Tunnel Final Liner Cost Estimate**

Tunnel length= 600 m  
 Liner cross section area= 5.47 m<sup>2</sup>

**Shift pattern**

Shifts	Hours	Days
3	8	5

Advance rate= 30 m/day

Rebar ratio= 0.12 t/m<sup>3</sup> of concrete

Concrete supply=\$ 135 /m<sup>3</sup>

Rebar supply=\$ 900 /t

Initial form set-up time= 4 weeks

**Durations**

Number of days= 40 days  
 Number of hours= 960 hours  
 Number of weeks= 8 weeks

**Labour**

Crew size 15  
 Average labour rate \$ 47 /hour

Total labour cost=\$ 676,800

**Equipment**

Form \$ 1000000  
 Weekly cost of other equipment \$ 15000 (see TED 2370)

Total equipment cost=\$ 1,120,000

**Materials**

Concrete= 3279.8227 m<sup>3</sup>  
 Rebar= 393.57873  
 Concrete cost=\$ 442,776  
 Rebar cost=\$ 354,221

Total material cost=\$ 796,997

**Cost Summary**

Labour 676,800  
 Equipment 1,120,000  
 Materials 796,997  
 Total 2,593,797

**Newfoundland Fixed Link Pre-feasibility Study**  
**Highway Tunnel - North Vent Adit**  
**Tunnel Drill and Blast Cost Estimate**

Drill & blast excavation @ \$ 250 /m<sup>3</sup>

Tunnel length= 600 m

Tunnel excavated diameter= 6.5 m

Excavated volume= 19909.8 m<sup>3</sup>

Excavation cost=\$ 4,977,461

**Newfoundland Fixed Link Pre-feasibility Study**  
**Highway Tunnel - North Vent Adit Shaft**  
**Tunnel Drill and Blast Cost Estimate**

shaft excavated diameter= 5.5 m  
 depth= 100 m  
 shaft final diameter= 6.1 m

From graph

unlined shaft cost=\$ 17000 /m

**Quantities**

Concrete Base= 24 m3  
 Shotcrete= 173 m3  
 Rockbolts= 1728 m2  
 final cast in place liner= 547 m3

**Direct Costs**

				\$ - Cost	
shaft excavation etc.	100	*	17000	1700000	
Concrete Base	24	*	150	3564	
Shotcrete	173	*	500	86394	
Rockbolts	1728	*	10	17279	
liner	547	*	600	327982	(includes steel & forms)
Total Direct Cost=				<u>2135219</u>	

**Newfoundland Fixed Link Pre-feasibility Study**  
**Highway Tunnel - North Vent Adit**  
**Summary**

D&B Excavation	4,977,461
Liner	2,593,797
Shaft	<u>2,135,219</u>
	<u>9,706,476</u>

**Newfoundland Fixed Link Pre-feasibility Study**  
**Highway Tunnel - South Vent Adit**  
**Tunnel Final Liner Cost Estimate**

Tunnel length= 2000 m  
 Liner cross section area= 5.47 m<sup>2</sup>

**Shift pattern**

Shifts	Hours	Days
3	8	5

Advance rate= 30 m/day

Rebar ratio= 0.12 t/m<sup>3</sup> of concrete

Concrete supply=\$ 135 /m<sup>3</sup>

Rebar supply=\$ 900 /t

Initial form set-up time= 4 weeks

**Durations**

Number of days= 87 days  
 Number of hours= 2080 hours  
 Number of weeks= 17 weeks

**Labour**

Crew size 15  
 Average labour rate \$ 47 /hour

Total labour cost=\$ 1,466,400

**Equipment**

Form \$ 1000000  
 Weekly cost of other equipment \$ 15000 (see TED 2370)

Total equipment cost=\$ 1,260,000

**Materials**

Concrete= 10932.742 m<sup>3</sup>  
 Rebar= 1311.9291  
 Concrete cost=\$ 1,475,920  
 Rebar cost=\$ 1,180,736

Total material cost=\$ 2,656,656

**Cost Summary**

Labour 1,466,400  
 Equipment 1,260,000  
 Materials 2,656,656  
 Total 5,383,056

**Newfoundland Fixed Link Pre-feasibility Study**  
**Highway Tunnel - South Vent Adit**  
**Tunnel Drill and Blast Cost Estimate**

Drill & blast excavation @ \$ 250 /m3

Tunnel length= 2000 m

Tunnel excavated diameter= 6.5 m

Excavated volume= 66366.1 m3

Excavation cost=\$ 16,591,536



**Newfoundland Fixed Link Pre-feasibility Study**  
**Highway Tunnel - South Vent Adit Shaft**  
**Tunnel Drill and Blast Cost Estimate**

shaft excavated diameter=

5.5

m

depth=

0

m

shaft final diameter=

6.1

m

From graph

unlined shaft cost=\$

17000

/m

**Quantities**

Concrete Base=

24

m3

Shotcrete=

0

m3

Rockbolts=

0

m2

final cast in place liner=

0

m3

**Direct Costs**

				\$ - Cost	
shaft excavation etc.	0	*	17000	0	
Concrete Base	24	*	150	3564	
Shotcrete	0	*	500	0	
Rockbolts	0	*	10	0	
liner	0	*	600	0	(includes steel & forms
Total Direct Cost=				<u>3564</u>	

5)

**Newfoundland Fixed Link Pre-feasibility Study**  
**Highway Tunnel - South Vent Adit**  
**Summary**

D&B Excavation	16,591,536
Liner	5,383,056
Shaft	3,564
	<u>21,978,156</u>

Newfoundland Fixed Link  
Drill & Blast Highway Tunnel  
Tunnel Lighting Cost

Fraser River Project - 2x3 lane tunnels

For 1550 m length of Theo Van Kooten calculated the tunnel lighting cost as follows:

732	m of threshold lighting costs \$	661231.22	1260	lights		
818	m of interior lighting costs \$	73151.75	139	lights		
1550	m of nighttime circuit costs \$	126767.31	241	lights		
1640	lights cost \$	117280.47	to instal			
1550	m of conduit costs	101424.99				
		<u>1079855.74</u>	*	2	= \$	2,159,711

Prorating for Newfoundland - assuming \*50% for single lane tunnel

for 20248 m length of tunnel

732	m of threshold lighting costs \$	661231.22	1260	lights		
19516	m of interior lighting costs \$	1745268.4	3317	lights		
20248	m of nighttime circuit costs \$	1655990.00	3149	lights		
7726	lights cost \$	552505.43	to instal			
20248	m of conduit costs	1324937.55				
		<u>5939932.60</u>	*	0.5	= \$	2,969,966

**Newfoundland Fixed Link Pre-feasibility Study**  
**Drill & Blast Highway Tunnel - North Vehicle Holding Area**

Area= 300 m by 600 m

**Earthworks**

Assume 0.5 m depth cleared over entire area

Spoil excavation and removal @ \$ 30 /m3

Earthworks= 2,700,000

**Surface**

Assume surface @ 20 /m2

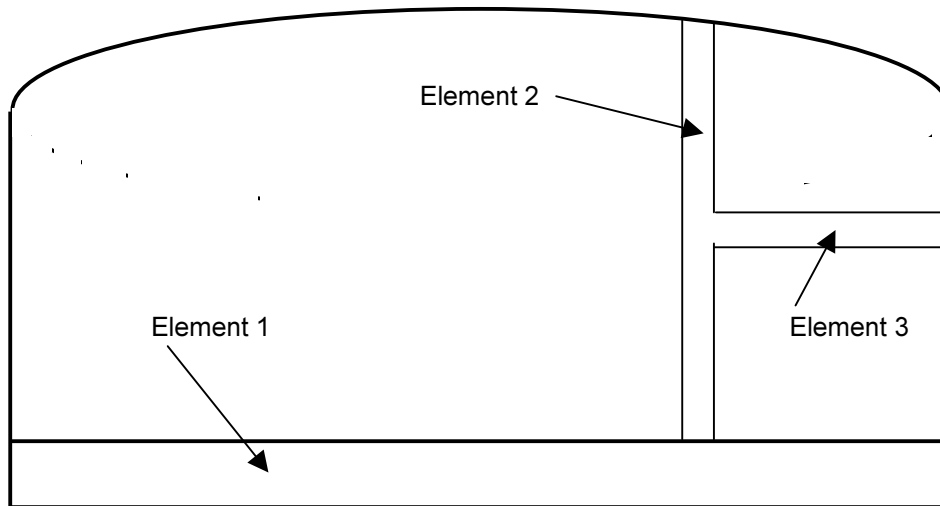
Surface= 3,600,000

**Buildings etc.**

Public facilities building @	80000	See CJT estimate
Site maintenance building @	220000	See CJT estimate
Fire engines @	360000	See CJT estimate

Total cost 6,960,000

Tunnel length= 6500 m

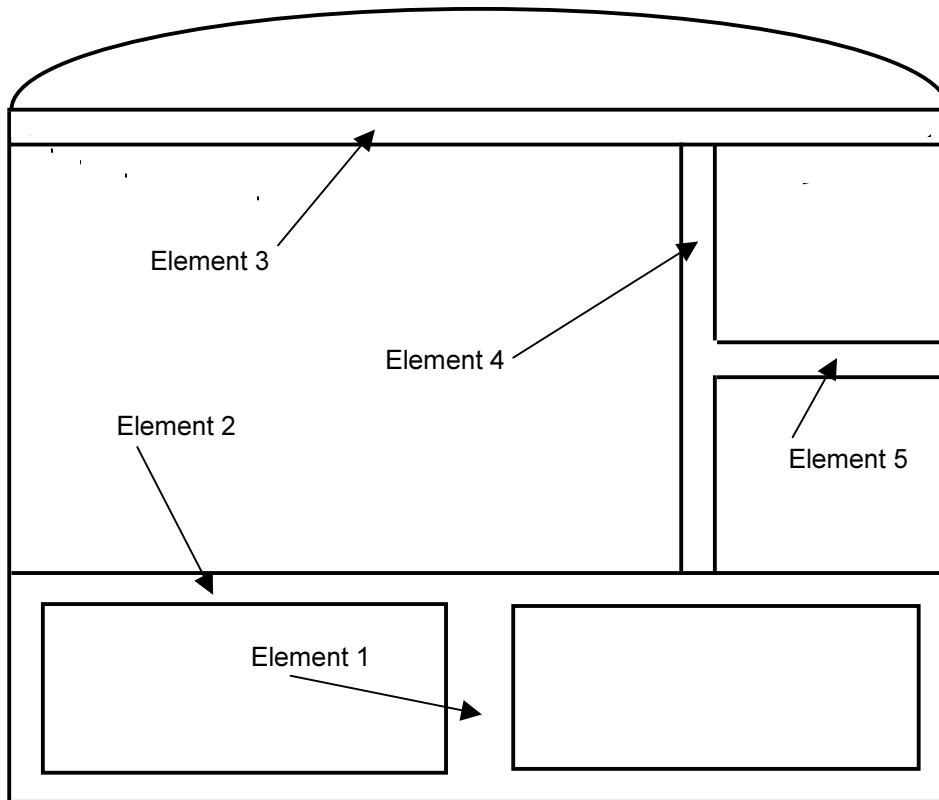


Assumed tunnel cross section  
Zones 1, 3, and 5

**Page 2 of 2**  
**Date:** June 07, 2004  
**Calculation by:** A.White

Concrete	m3	14040	m3	at	190	=	2667600
Formwork	m2	81900	m2	at	140	=	11466000
Reinforcement	t	421	t	at	1600	=	673920
					\$		<u>14807520</u>

Tunnel length= 13748 m



Assumed tunnel cross section  
Zones 1, 3, and 5



**Newfoundland Fixed Link Pre-feasibility Study**  
**Cost Estimating**  
**Single Lane Drill & Blast Highway Tunnel**  
**Tunnel Structural Finishes**

**Page 2 of 2**  
**Date:** June 07, 2004  
**Calculation by:** A.White

**Quantity Take-off**

<b>Concrete</b>					<b>Concrete</b>	<b>Rebar</b>
<b>Element</b>	<b>Nr.</b>	<b>L(m)</b>	<b>b(m)</b>	<b>d(m)</b>	<b>Qty(m3)</b>	<b>Qty(m3)</b>
1	1	13748	0.5	1.5	10311	1237.3
2	1	13748	9	0.5	61866	7423.9
3	1	13748	8.6	0.5	59116	7094.0
4	1	13748	0.3	5	20622	2474.6
5	1	13748	1.8	0.3	7423.9	890.9
					<u>159339</u> m3	<u>10459</u> t

**Formwork/falsework**

<b>Element</b>	<b>Nr.</b>	<b>L(m)</b>	<b>d(m)</b>	<b>Faces</b>	<b>Area(m2)</b>
1	1	13748	1.5	2	41244
2	2	13748	8.5	1	116858
3	1	13748	8.6	1	118232.8
4	1	13748	5	2	137480
5	1	13748	1.8	1	24746.4
					<u>438561.2</u> m2

**Rates**

Concrete	m3	190
Formwork	m2	140
Reinforcement	t	1600

**Costs**

Concrete	m3	159339 m3	at	190	=	30274471
Formwork	m2	438561 m2	at	140	=	61398568
Reinforcement	t	10459 t	at	1600	=	16735165
					\$	<u>108408204</u>

680.360656

**Newfoundland Fixed Link**  
**Drill & Blast Highway Tunnel - Tunnel Finishes**  
**Cost Summary**

	<b>Zones</b>	<b>Zones</b>	<b>Total</b>	
	<b>1, 3, and 5</b>	<b>2 and 4</b>		
Concrete	2,667,600	30,274,471	32,942,071	
Formwork	11,466,000	61,398,568	72,864,568	
Reinforcement	673,920	16,735,165	17,409,085	
			<u>123,215,724</u>	710.6714

<b>BORED TUNNEL CONSTRUCTION COSTS</b>		
<b>ITEM</b>	<b>UNIT</b>	<b>MAIN TUNNEL</b>
MOBILIZATION & DEMOBILIZATION	LS	8,000,000
DRILL & BLAST TUNNELLING	LS	461,565,738
TUNNEL LINER	LS	152,191,081
TUNNEL FINISHES	LS	123,215,724
NORTH APPROACH STRUCTURES	LS	10,607,127
SOUTH APPROACH STRUCTURES	LS	6,036,419
NORTH VENTILATION ADIT	LS	9,706,476
SOUTH VENTILATION ADIT	LS	21,978,156
ROAD FINISHES	LS	2,646,625
TUNNEL DRAINAGE	LS	7,370,000
NORTH VEHICLE HOLDING AREA	LS	6,960,000
SOUTH VEHICLE HOLDING AREA	LS	4,260,000
UTILITY DIVERSIONS	LS	1,000,000
MONITORING	LS	1,000,000
<b>SUBTOTAL CIVIL</b>		<b>\$816,537,346</b>
<b>CIVIL CONTINGENCIES</b>		
CONTINGENCY	40%	\$326,614,939
<b>TOTAL CIVIL</b>		<b>\$1,143,152,285</b>
<b>M&amp;E AND FINISHING WORK</b>		
VENTILATION EQUIPMENT	LS	\$6,000,000
VENTILATION BUILDINGS x 2	LS	\$2,000,000
FIRE SUPPRESSION SYSTEM	LS	\$4,000,000
CONTROL CENTRE	LS	\$4,000,000
SIGNALLING	LS	\$0
LIGHTING	LS	\$2,969,966
CCTV SYSTEM	LS	\$1,074,700
GAS DETECTION	LS	\$911,160
SUBSTATION, GENERATORS, UPS	LS	\$4,202,000
<b>SUBTOTAL M&amp;E AND FINISHING</b>		<b>\$25,157,826</b>
<b>CONTINGENCIES</b>	20%	\$5,031,565
<b>TOTAL M&amp;E AND FINISHING</b>		<b>\$30,189,392</b>
<b>TOTAL CIVIL, M&amp;E AND FINISHING</b>		<b>\$1,173,341,676</b>
<b>ALLOWANCES</b>		
CONTRACTOR OH	15%	\$176,001,251
CONTRACTOR PROFIT	15%	\$176,001,251
<b>CONSTRUCTION TOTAL</b>		<b>\$1,526,000,000</b>
<b>PRE-CONSTRUCTION AND SUPERVISION</b>		
FEASIBILITY STUDY	LS	\$11,000,000
ENVIRONMENTAL ASSESSMENT	LS	\$4,000,000
DESIGN	5%	\$76,300,000
CONSTRUCTION MANAGEMENT	10%	\$152,600,000
OWNERS COSTS	2%	\$30,520,000
<b>PRE-CONSTRUCTION TOTAL</b>		<b>\$274,420,000</b>
<b>GRAND TOTAL</b>		<b>\$1,800,420,000</b>



Detailed Cost Estimate Report

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Project: Newfoundland Fixed Link Study

Project Number: 213789

Estimate Description: Prefeasibility Level

Project Phase: Prefeasibility Design

Estimate Date: June 11 2004

# Newfoundland Fixed Link Study

## Prefeasibility Level

213789

Prefeasibility Design

June 11 2004

STRUCTION AND SUPERVISION



### Detailed Cost Estimate Report

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<b>Project:</b>	<b>Newfoundland Fixed Link Study</b>	<b>Project Number:</b>	<b>213789</b>
<b>Estimate Description:</b>	<b>Prefeasibility Level</b>	<b>Parent Estimate ID:</b>	<b>V-300</b>
<b>Tunnel Name:</b>	<b>Highway Tunnel - Single Lane - Down Drive</b>	<b>Project Phase:</b>	<b>Prefeasibility Design</b>
<b>Construction Activity:</b>	<b>Excavation (Drill &amp; Blast) &amp; Initial Support</b>	<b>Geology Type:</b>	<b>Poor to Fair Sediments &amp; Volcanics</b>
<b>Estimate Definition ID:</b>	<b>V-317</b>	<b>Estimate Date:</b>	<b>June 11 2004</b>

<u>Tunnel Characteristics</u>				<u>Shift Details</u>	
<b>Tunnel Length:</b>	<b>6,500.0</b>	m		<b>Shift Arrangement:</b>	<b>3.0</b> Shifts / Day
<b>Design Width:</b>	<b>10.9</b>	m			<b>8.0</b> Hours / Shift
<b>Design Wall Height (Ave.)</b>	<b>4.5</b>	m			<b>7.0</b> Days / Week
<b>Design Wall to Roof:</b>	<b>3.7</b>			<u>Drill, Charge, Blast, Vent &amp; Mucking Details</u>	
<b>Design Max Height :</b>	<b>8.2</b>	m		<b>Survey Tunnel / Holes / Map:</b>	<b>30.0</b> Min / Cycle
<b>Ave Tunnel Overbreak:</b>	<b>20.0</b>	cm		<b>Drilling Blast Holes:</b>	
<b>Tunnel Face Area:</b>	<b>86.8</b> (Includes Overbreak)	m <sup>2</sup>		<b>Hole Length:</b>	<b>3.9</b> m / Hole
<b>Crown Perimeter:</b>	<b>15.1</b> (Includes Overbreak)	m		<b>Perim. Blast Hole Spacing:</b>	<b>0.50</b> m
<b>Wall &amp; Crown Perimeter:</b>	<b>24.5</b> (Includes Overbreak)	m		<b>Interior Blast Hole Spacing:</b>	<b>1.25</b> m
<b>Wall &amp; Crown Area:</b>	<b>159,433</b> (Includes Overbreak)	m <sup>2</sup>		<b>No. Perimeter Holes:</b>	<b>49</b> No.
<b>Neat Tunnel Excav. Vol.:</b>	<b>564,086</b> (Includes Overbreak)	m <sup>3</sup>		<b>No. Interior Area Holes:</b>	<b>55.5</b> No.
<b>Re-Muck / Pull-Out Bays:</b>				<b>No. Blast Initiation Holes:</b>	<b>15</b> No.
<b>Bay Length:</b>	<b>10.0</b>	m		<b>Number of Drillholes / Blast:</b>	<b>120</b> Blastholes / Blast
<b>Spacing Bttn Bays:</b>	<b>1000.0</b>	m		<b>Blast Hole / Face Area Ratio:</b>	<b>1.38</b> Holes / m <sup>2</sup>
<b>Number of Bays:</b>	<b>6</b>	No.		<b>Typical / Check Ratio:</b>	<b>1.26</b> Holes / m <sup>2</sup>
<b>Total Length of Bays:</b>	<b>60.0</b>	m		<b>Drill Eqpt Set-Up Time:</b>	<b>40</b> min / Set-up
<b>Neat Excavation Vol.:</b>	<b>5,207</b>	m <sup>3</sup>		<b>Drill Penetration Rate:</b>	<b>0.30</b> m / Min
<b>Total Tunnel Volume:</b>	<b>569,293</b>	m <sup>3</sup>			<b>18</b> m/hour
<b>Muck Bulking Factor:</b>	<b>1.6</b>	Ratio		<b># of Drills or Booms:</b>	<b>6.0</b> No.
<b>Bulked Tunnel Volume:</b>	<b>910,869</b> (Loose Muck Volume)	m <sup>3</sup>		<b>Charging &amp; Blasting:</b>	
<u>Primary Mucking Production Details</u>				<b>Prime &amp; Load Rate / Hole:</b>	<b>2.50</b> min / Blasthole
(Activity to remove blast muck from face to conveyor & muck cars)				<b>Prep &amp; Hook-up Time:</b>	<b>40.0</b> min / Set-up
<b>Muck Volume / Blast:</b>	<b>458.2</b>	m <sup>3</sup>		<b>Total No. Blasts / Tunnel:</b>	<b>1988</b> No.
<b>Mucking Volume / Trip:</b>	<b>5.00</b>	m <sup>3</sup>		<b>Net Blast Break Length:</b>	<b>3.3</b> m / Blast
<b>Bucket Fill Factor (%):</b>	<b>90.0</b>	%		<b>Blast &amp; Ventilation Time:</b>	<b>1.0</b> Hours
<b>Number of Trips:</b>	<b>102</b>	No.		<u>Pre-Excavation Grouting Details</u>	
<b>Ave. Dist. to Load:</b>	<b>35.0</b> (Ave Distance One Way)	m		<b>% Tunnel to be Grouted:</b>	<b>12.0</b> %
<b>Ave. Tramming Speed:</b>	<b>8.0</b>	km/hr		<b>Tunnel Length to Grout:</b>	<b>780</b> m
<b>Load, Dump, Manoever:</b>	<b>1.0</b> (Time per Trip)	Min		<b>Grout Hole Length:</b>	<b>7.0</b> m
<b>Face Cleanup / Blast:</b>	<b>15.0</b>	Min		<b>No. of Grouting Applications:</b>	<b>111</b> No.
<b>Mucking Time:</b>	<b>2.8</b>	Hours		<b>Perim. Grout Holes Spacing:</b>	<b>1.50</b> m
<b>Mucking Rate:</b>	<b>161.5</b>	m <sup>3</sup> / Hour		<b># Perim. Grout Holes:</b>	<b>16</b> Holes / Grout Cycle
<u>Tunnel Support Class Details</u>				<b>Drilling Penetration Rate:</b>	<b>50</b> m/hour
<b>Class I - No Support:</b>	<b>0.0</b> (%)	0	(m)	<b>No. of Drill Booms:</b>	<b>2</b> No.
<b>Class II - Spot Bolts:</b>	<b>0.0</b> (%)	0	(m)	<b>Drilling Time per Cycle:</b>	<b>128</b> Min
<b>Class III - Crown Only:</b>	<b>40.0</b> (%)	2,600	(m)	<b>Grout Eqpt. Set-Up Time:</b>	<b>1.0</b> Hours / Grout Cycle
<b>Class IV - Full Pattern:</b>	<b>50.0</b> (%)	3,250	(m)	<b>No. of Holes Grouted at Once:</b>	<b>2</b> Hoses
<b>Class V - Steel Sets:</b>	<b>10.0</b> (%)	650	(m)	<b>Grouting Injection Rate:</b>	<b>10</b> min / Drillhole
<b>Total</b>	<b>100.0</b>	6,500	(m)	<b>Full Grout Cycle Time:</b>	<b>66.0</b> Hours
<u>Initial Shotcrete Support Details</u>				<u>Steel Set Installation Details</u>	
<b>Support Arc Length:</b>	<b>24.5</b>	m		<b>Steel Set Spacing:</b>	<b>1.0</b> m
<b>Thickness:</b>	<b>25.0</b>	mm		<b>Total No. Sets / Tunnel:</b>	<b>650</b> No.
<b>Volume / Round:</b>	<b>2.3</b>	m <sup>3</sup>		<b>Ave. Installation Time / Set:</b>	<b>3.0</b> Hours
<b>Time:</b>	<b>0.8</b> (Includes Scaling & Equip Set-up)	Hours		<b>Total Installation Time:</b>	<b>1,950</b> Hours

<u>Wiremesh Installation Details</u>			<u>Rockbolt Support Class Details</u>		
Install Rate:	100	m <sup>2</sup> / Hour		(Bolts Per Row)	(Bolts Per Support Class)
Total Install Time:	1,757.7	Hours	Class I:	0	0
Ave. Install Time:	53.1	Min	Class II:	0.0	0
Overlap:	5	%	Class III:	9	15,600
Net Applied Area:	159,433 (Assume Class V only)	m <sup>2</sup>	Class IV:	21	45,500
Area with Overlap:	175,775	m <sup>2</sup>	Class V:	0	0
			Total:		61,100
<u>Final Shotcrete Support Class Details</u>			<u>Face Scaling</u>		
Shotcrete Thickness:			Scaling Time:	20.0	min / Blast
Classes I and II:	0	mm	<u>Rockbolt Installation Details</u>		
Class III:	0	mm	Rockbolt Length:	3.0	m
Classes IV:	50	mm	Row Spacing:	1.5	m
Class V:	100	mm	No. Rockbolts Required:	61,100	No.
Support Arc Length:			Ave. Bolts / Round:	31.0	Bolts / Blast
Class I:	0.0	m	Drilled Length / Round:	93	m
Class II:	0.0	m	Total Drilling Length:	183,300	m
Class III:	0.0	m	Drill Penetration Rate:	1.5	m / Min
Class IV:	24.5	m	# of Drills / Booms Used:	3	No.
Class V:	24.5	m	Ave. Drilling Time / Round:	20.7	Min
<u>Initial and Final Shotcrete Application Details</u>			Bolt Install Rate	2.0	Min / Bolt
Net Volume:	5,580	m <sup>3</sup>	Ave. Bolt Install Time:	62.0	Min
Rebound / Waste:	15	%	Drill Set-Up Time:	10.0	Min
Final Layer Volume:	6,417	m <sup>3</sup>	Total Bolt Drill/Install Time:	92.7	Min
No. of Applications:	1142 (Required Per Bench)	No.	<u>Drainhole Details</u>		
Ave. Vol. / Application:	5.6	m <sup>3</sup>	Drainhole Spacing:	3.0	m
Surface Prep Time:	10.0	Min	Drainhole Length:	1.1	m
Total Surface Prep Time:	11,424	Min	Total Area:	79,716.4	m <sup>2</sup>
Application Rate:	24.0	m <sup>3</sup> / Hour	Total Drainholes:	8,857.4	# / Per Tunnel
Total Application Time:	16,043	Min	Total Length:	9,743.1	m
Eqpt. Setup Time:	20.0	Min	Note: Activity carried out concurrent with other activities.		
Total Setup Time:	22,848	Min	<u>Duration of Tunneling:</u>		
Eqpt. Remove Time:	10.0 (Required Per Application)	Min	Pre-Exc. Grouting Time =	7,349.2	Hours
Total Remove Time:	11,424	Min	Drilling Time =	9,932.2	Hours
Total Shotcreting Time:	61,740 (For Final Shotcrete Layer)	Min	Charge, Blast, Vent Time =	13,244.3	Hours
Equivalent Time / Blast:	31.1	Min / Cycle	Primary Mucking Time =	5,641.7	Hours
<u>Secondary Mucking Details</u>			Scaling Time =	1,988.2	Hours
Req'd during Tunneling:	No (No if loaded directly into trucks in tunnel)		Survey / Map Time =	993.9	Hours
Ave. LHD Tram Speed:	0.0	km / hour	Install Steel Sets Time =	1,950.0	Hours
<u>Wick Drain Installation Details</u>			Initial Shotcreting Time =	1,518.0	Hours
Drain Spacing:	0.0	m	Install Services Time =	993.9	Hours
Installation Time / Row:	0.0	Hours / Drain	Rockbolting (of % Critical) =	921.6	Hours
<u>Average Tunneling Productivity Cycle Details</u>			Non-Productive Time =	993.9	Hours
Equiv. Pre-Exc. Grouting:	3.7	Hours	Total Time =	45,527.0	Hours
Drilling:	5.0	Hours		62.5	Months
Charging:	5.7	Hours	(Critical Path Tunneling Activities Only)	271.0	Weeks
Blast & Venting:	1.0	Hours		1,897.0	Days
Mucking:	2.8	Hours	<u>Other Concurrent Tunneling Activities</u>		
Scaling:	0.3	Hours	Rockbolting (of % Not Critical) =	2,150.4	Hours
Surveying / Mapping:	0.5	Hours	Wiremesh Installation =	1,757.7	Hours
Initial Shotcreting:	0.8	Hours	Final Shotcreting Time =	0.5	Hours
Install Services:	0.5 (Equiv. Time Per Cycle)	Hours	Drilling Drainholes =	6,495.4	Hours
Non-Productive Time:	0.5 (Travel in/out, Break)	Hours	Secondary Mucking =	0.0	Hours
			Wick Drain Installation =	0.0	Hours
Include Rockbolting:	Yes (Yes / No, as part of Cycle Time)		<u>Overall Advance Rate:</u>		
If yes, % of Support Req'd:	30 (% Req'd During Cycle for Poorer Ground)			3.4	m / Day
Rockbolting:	0.5	Hours		297.4	m <sup>3</sup> / Day
Total Cycle Time:	21.3	Hours			

Resource Type	Resource Name	Unit Rate	Unit	Quantity	Resource Quantity	Total
<b>Labor</b>						
	Miner - Shift Boss	50.68	\$/hr	45,527.0	2.00	4,614,616.40
	Miner - Operator - Journeyman	47.84	\$/hr	45,527.0	11.00	23,958,126.82
	Miner - Foreman	50.68	\$/hr	45,527.0	3.00	6,921,924.60
	Miner - Laborer - Journeyman	47.40	\$/hr	45,527.0	5.00	10,789,898.25
	Miner - Laborer - Apprentice	45.00	\$/hr	45,527.0	5.00	10,243,574.29
	Tunnel Electrician - Journeyman	47.84	\$/hr	45,527.0	4.00	8,712,046.12
					30.00	65,240,186.47
<b>Plant</b>						
	Cable - Fans & Pumps - High Voltage	120.00	\$/m	6,500.0	0.20	156,000.00
	Cable - Lights / Controls - Low Voltage	10.00	\$/m	6,500.0	0.80	52,000.00
	Compressor	121.77	\$/wk	271.0	1.00	33,000.00
	Conveyor - Heading Muck Loading	4,774.09	\$/wk	271.0	1.00	1,293,750.00
	Drill - Jack-Leg	77.49	\$/wk	271.0	4.00	84,000.00
	Drill Jumbo - Rail Mounted - 2 Boom	968.66	\$/wk	271.0	1.00	262,500.00
	Drill Jumbo - Rail Mounted - 6 Boom	2,767.59	\$/wk	271.0	1.00	750,000.00
	Excavator - Rail Mounted	304.43	\$/wk	271.0	1.00	82,500.00
	Generator - Back-Up - 500KW	290.60	\$/wk	271.0	1.00	78,750.00
	Generator - Working - 1000KW	2,169.79	\$/wk	271.0	1.00	588,000.00
	Grout Plant-Consol-D&B-Pump, Hoses	182.66	\$/wk	271.0	1.00	49,500.00
	Lighting (Including Consumables)	7.50	\$/m	6,500.0	1.00	48,750.00
	Locomotive - Diesel - 16T	5,000.00	\$/wk	271.0	4.00	5,419,880.58
	LHD Loader - D&B Tunnel	928.53	\$/wk	271.0	1.00	251,625.00
	Manlift / Platform - Rail Mounted	405.91	\$/wk	271.0	1.00	110,000.00
	Pipe - 50mm (Water Supply)	7.50	\$/m	6,500.0	1.00	48,750.00
	Pipe - 100mm (Air Supply)	15.00	\$/m	6,500.0	1.00	97,500.00
	Pipe - 150mm (DeWatering)	25.00	\$/m	3,250.0	1.00	81,250.00
	Pipe - 250mm (Dewater)	70.00	\$/m	3,250.0	1.00	227,500.00
	Pipe - Dewatering Clamps (<=200mm)	7.00	\$/m	6,500.0	1.00	45,500.00
	Pumps - Dewatering - Tunnel - 50HP	93.16	\$/wk	135.5	15.00	189,337.50
	Rail - 80 lb/yd - Used	101.54	\$/m	13,400.0	0.60	816,369.23
	Rail - California Switch Gear	75,000.00	\$/Nr	1.0	3.00	225,000.00
	Rail Car - Flat	50,000.00	\$/Nr	1.0	3.00	150,000.00
	Rail Car - Man Rider	50,000.00	\$/Nr	1.0	1.00	50,000.00
	Rail Car - Muck Cars	1,900.00	\$/wk	271.0	18.00	9,267,995.79
	Rail Car - Muck Car Tipping System	75,000.00	\$/Nr	1.0	1.00	75,000.00
	Shotcrete Machine - Rail Mounted	445.58	\$/wk	271.0	1.00	120,750.00
	Shotcrete Machine - Tire Mounted	721.42	\$/wk	271.0	2.00	391,000.00
	Small Tools	200.00	\$/wk	271.0	1.00	54,198.81
	Tie Plates, Splice Bars, Bolts	150,000.00	LS	1.0	1.00	150,000.00
	Ties - Wooden - Untreated - 7" x 9" x 40"	23.00	\$/m	6,500.0	1.00	149,500.00
	Transformers & Switchgear - High Voltage	202.96	\$/wk	271.0	1.00	55,000.00
	Transformers-Switchgear-Low Voltage	101.48	\$/wk	271.0	1.00	27,500.00
	Ventilation Duct - Rigid	110.00	\$/m	6,500.0	1.00	715,000.00
	Ventilation Fans - 75HP	57.29	\$/wk	271.0	7.00	108,675.00
	Welder (Plant)	6.37	\$/wk	271.0	1.00	1,725.00
						22,307,806.90

Resource Type	Resource Name	Unit Rate	Unit	Quantity	Resource Quantity	Total
<b>Consumables</b>						
	Bits, Powder and Caps - Blasting	15.00	\$/m3	569,293.2	1.00	8,539,397.71
	Bits - (Drainholes & Rockbolts)	5.00	\$/m	193,043.1	1.00	965,215.55
	Drill Jumbo Maintenance	100.00	\$/hr	9,466.3	1.00	946,630.96
	Electricity - Tunnel Heading Conveyor	0.22	\$/kwh	150	496.97	16,400.00
	Electricity - Fans & Lighting	0.22	\$/kwh	411	22,763.50	2,058,237.70
	Electricity - Jumbo	0.22	\$/kwh	75	9,466.31	156,194.11
	Electricity - Pumps Dewatering	0.22	\$/kwh	559	31,868.90	3,921,164.59
	Lubricants	2,500.00	\$/wk	271.0	1.00	677,485.07
	Fuels & Lubricants	5,000.00	\$/wk	271.0	1.00	1,354,970.14
	Other Consumables	1,500.00	\$/wk	271.0	1.00	406,491.04
						<b>\$ 19,042,186.89</b>
<b>Materials</b>						
	Grout - Consolidation	50.00	\$/m3	2,000.0	1.00	100,000.00
	Other Materials	2,000.00	\$/wk	271.0	1.00	541,988.06
	Rock Bolts - No.10 - 3.0m - (Non-Galv)	40.00	\$/Nr	61,100	1.00	2,444,000.00
	Shotcrete	180.00	\$/m3	6,417.2	1.00	1,155,090.08
	Steel Sets - W10 x 65	152.75	\$/m	650	24.53	2,435,334.84
	Synthetic Wick Drains	5.00	\$/m	0	1.00	-
	WWF mesh	5.50	\$/m2	175,775	1.00	966,760.17
						<b>\$ 6,576,412.98</b>
<b>Subcontracts</b>						
	Tunnel Muck - Misc Surface Handling	20.00	\$/m3	910,869.09	1.00	18,217,381.78
						<b>\$ 18,217,381.78</b>
					<b>Total Estimated Cost: \$ 131,383,975.02</b>	
					<b>Per Meter:</b>	<b>\$ 20,212.92</b>
					<b>Per m<sup>3</sup>:</b>	<b>\$ 230.78</b>





### Detailed Cost Estimate Report

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<b>Project:</b>	<b>Newfoundland Fixed Link Study</b>	<b>Project Number:</b>	<b>213789</b>
<b>Estimate Description:</b>	<b>Prefeasibility Level</b>	<b>Parent Estimate ID:</b>	<b>V-300</b>
<b>Tunnel Name:</b>	<b>Highway Tunnel - Zones 1,2,4,&amp;5 - Up Drive</b>	<b>Project Phase:</b>	<b>Prefeasibility Design</b>
<b>Construction Activity:</b>	<b>Excavation (Drill &amp; Blast) &amp; Initial Support</b>	<b>Geology Type:</b>	<b>Poor to Fair Sediments &amp; Volcanics</b>
<b>Estimate Definition ID:</b>	<b>V-318</b>	<b>Estimate Date:</b>	<b>June 11 2004</b>

<u>Tunnel Characteristics</u>			<u>Shift Details</u>	
<b>Tunnel Length:</b>	<b>13,748.0</b>	m	<b>Shift Arrangement:</b>	<b>3.0</b> Shifts / Day
<b>Design Width:</b>	<b>10.0</b>	m		<b>8.0</b> Hours / Shift
<b>Design Wall Height (Ave.)</b>	<b>9.0</b>	m		<b>7.0</b> Days / Week
<b>Design Wall to Roof:</b>	<b>3.0</b>		<u>Drill, Charge, Blast, Vent &amp; Mucking Details</u>	
<b>Design Max Height :</b>	12.0	m	<b>Survey Tunnel / Holes / Map:</b>	<b>30.0</b> Min / Cycle
<b>Ave Tunnel Overbreak:</b>	<b>20.0</b>	cm	<b>Drilling Blast Holes:</b>	
<b>Tunnel Face Area:</b>	120.0 (Includes Overbreak)	m <sup>2</sup>	<b>Hole Length:</b>	<b>3.9</b> m / Hole
<b>Crown Perimeter:</b>	13.4 (Includes Overbreak)	m	<b>Perim. Blast Hole Spacing:</b>	<b>0.50</b> m
<b>Wall &amp; Crown Perimeter:</b>	31.8 (Includes Overbreak)	m	<b>Interior Blast Hole Spacing:</b>	<b>1.25</b> m
<b>Wall &amp; Crown Area:</b>	436,972 (Includes Overbreak)	m <sup>2</sup>	<b>No. Perimeter Holes:</b>	64 No.
<b>Neat Tunnel Excav. Vol.:</b>	1,649,458 (Includes Overbreak)	m <sup>3</sup>	<b>No. Interior Area Holes:</b>	76.8 No.
<b>Re-Muck / Pull-Out Bays:</b>			<b>No. Blast Initiation Holes:</b>	16 No.
<b>Bay Length:</b>	<b>10.0</b>	m	<b>Number of Drillholes / Blast:</b>	156 Blastholes / Blast
<b>Spacing Bttn Bays:</b>	<b>1000.0</b>	m	<b>Blast Hole / Face Area Ratio:</b>	1.30 Holes / m <sup>2</sup>
<b>Number of Bays:</b>	13	No.	<b>Typical / Check Ratio:</b>	<b>1.05</b> Holes / m <sup>2</sup>
<b>Total Length of Bays:</b>	130.0	m	<b>Drill Eqpt Set-Up Time:</b>	<b>40</b> min / Set-up
<b>Neat Excavation Vol.:</b>	15,597	m <sup>3</sup>	<b>Drill Penetration Rate:</b>	<b>0.30</b> m / Min
<b>Total Tunnel Volume:</b>	1,665,055	m <sup>3</sup>		18 m/hour
<b>Muck Bulking Factor:</b>	<b>1.6</b>	Ratio	<b># of Drills or Booms:</b>	<b>6.0</b> No.
<b>Bulked Tunnel Volume:</b>	2,664,089 (Loose Muck Volume)	m <sup>3</sup>	<b>Charging &amp; Blasting:</b>	
<u>Primary Mucking Production Details</u>			<b>Prime &amp; Load Rate / Hole:</b>	<b>2.50</b> min / Blasthole
(Activity to remove blast muck from face to conveyor & muck cars)			<b>Prep &amp; Hook-up Time:</b>	<b>40.0</b> min / Set-up
<b>Muck Volume / Blast:</b>	633.5	m <sup>3</sup>	<b>Total No. Blasts / Tunnel:</b>	4205 No.
<b>Mucking Volume / Trip:</b>	<b>5.00</b>	m <sup>3</sup>	<b>Net Blast Break Length:</b>	<b>3.3</b> m / Blast
<b>Bucket Fill Factor (%):</b>	<b>90.0</b>	%	<b>Blast &amp; Ventilation Time:</b>	<b>1.0</b> Hours
<b>Number of Trips:</b>	141	No.	<u>Pre-Excavation Grouting Details</u>	
<b>Ave. Dist. to Load:</b>	<b>35.0</b> (Ave Distance One Way)	m	<b>% Tunnel to be Grouted:</b>	<b>12.0</b> %
<b>Ave. Tramming Speed:</b>	<b>8.0</b>	km/hr	<b>Tunnel Length to Grout:</b>	1650 m
<b>Load, Dump, Manoever:</b>	<b>1.0</b> (Time per Trip)	Min	<b>Grout Hole Length:</b>	<b>7.0</b> m
<b>Face Cleanup / Blast:</b>	<b>15.0</b>	Min	<b>No. of Grouting Applications:</b>	236 No.
<b>Mucking Time:</b>	3.8	Hours	<b>Perim. Grout Holes Spacing:</b>	<b>1.50</b> m
<b>Mucking Rate:</b>	165.5	m <sup>3</sup> / Hour	<b># Perim. Grout Holes:</b>	21 Holes / Grout Cycle
<u>Tunnel Support Class Details</u>			<b>Drilling Penetration Rate:</b>	<b>50</b> m/hour
<b>Class I - No Support:</b>	<b>0.0</b> (%)	0 (m)	<b>No. of Drill Booms:</b>	<b>2</b> No.
<b>Class II - Spot Bolts:</b>	<b>0.0</b> (%)	0 (m)	<b>Drilling Time per Cycle:</b>	350 Min
<b>Class III - Crown Only:</b>	<b>40.0</b> (%)	5,499 (m)	<b>Grout Eqpt. Set-Up Time:</b>	<b>1.0</b> Hours / Grout Cycle
<b>Class IV - Full Pattern:</b>	<b>50.0</b> (%)	6,874 (m)	<b>No. of Holes Grouted at Once:</b>	<b>2</b> Hoses
<b>Class V - Steel Sets:</b>	<b>10.0</b> (%)	<b>1,375</b> (m)	<b>Grouting Injection Rate:</b>	<b>10</b> min / Drillhole
<b>Total</b>	100.0	13,748 (m)	<b>Full Grout Cycle Time:</b>	85.2 Hours
<u>Initial Shotcrete Support Details</u>			<u>Steel Set Installation Details</u>	
<b>Support Arc Length:</b>	<b>31.8</b>	m	<b>Steel Set Spacing:</b>	<b>1.0</b> m
<b>Thickness:</b>	<b>25.0</b>	mm	<b>Total No. Sets / Tunnel:</b>	1,375 No.
<b>Volume / Round:</b>	3.0	m <sup>3</sup>	<b>Ave. Installation Time / Set:</b>	<b>3.0</b> Hours

<b>Time:</b>	0.8	(Includes Scaling & Equip Set-up)	Hours	<b>Total Installation Time:</b>	4,124	Hours
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<u>Wiremesh Installation Details</u>			<u>Rockbolt Support Class Details</u>		
Install Rate:	100	m <sup>2</sup> / Hour	(Bolts Per Row)	(Bolts Per m)	(Bolts Per Support Class)
Total Install Time:	4,817.6	Hours	Class I:	0.0	0
Ave. Install Time:	68.7	Min	Class II:	0.0	0
Overlap:	5	%	Class III:	4.0	21,997
Net Applied Area:	436,972 (Assume Class V only)	m <sup>2</sup>	Class IV:	10.0	68,740
Area with Overlap:	481,762	m <sup>2</sup>	Class V:	0.0	0
<u>Final Shotcrete Support Class Details</u>			Total:		90,737
Shotcrete Thickness:			<u>Face Scaling</u>		
Classes I and II:	0	mm	Scaling Time:	20.0	min / Blast
Class III:	0	mm	<u>Rockbolt Installation Details</u>		
Classes IV:	50	mm	Rockbolt Length:	3.0	m
Class V:	100	mm	Row Spacing:	1.5	m
Support Arc Length:			No. Rockbolts Required:	90,737	No.
Class I:	0.0	m	Ave. Bolts / Round:	21.8	Bolts / Blast
Class II:	0.0	m	Drilled Length / Round:	65	m
Class III:	0.0	m	Total Drilling Length:	272,210	m
Class IV:	31.8	m	Drill Penetration Rate:	1.5	m / Min
Class V:	31.8	m	# of Drills / Booms Used:	3	No.
<u>Initial and Final Shotcrete Application Details</u>			Ave. Drilling Time / Round:	14.5	Min
Net Volume:	15,294	m <sup>3</sup>	Bolt Install Rate	2.0	Min / Bolt
Rebound / Waste:	15	%	Ave. Bolt Install Time:	43.6	Min
Final Layer Volume:	17,588	m <sup>3</sup>	Drill Set-Up Time:	10.0	Min
No. of Applications:	2416 (Required Per Bench)	No.	Total Bolt Drill/Install Time:	68.1	Min
Ave. Vol. / Application:	7.3	m <sup>3</sup>	<u>Drainhole Details</u>		
Surface Prep Time:	10.0	Min	Drainhole Spacing:	3.0	m
Total Surface Prep Time:	24,163	Min	Drainhole Length:	1.1	m
Application Rate:	24.0	m <sup>3</sup> / Hour	Total Area:	218,486.1	m <sup>2</sup>
Total Application Time:	43,970	Min	Total Drainholes:	24,276.2	# / Per Tunnel
Eqpt. Setup Time:	20.0	Min	Total Length:	26,703.9	m
Total Setup Time:	48,326	Min	Note: Activity carried out concurrent with other activities.		
Eqpt. Remove Time:	10.0 (Required Per Application)	Min	<u>Duration of Tunneling:</u>		
Total Remove Time:	24,163	Min	Pre-Exc. Grouting Time =	20,072.8	Hours
Total Shotcreting Time:	140,623 (For Final Shotcrete Layer)	Min	Drilling Time =	26,567.2	Hours
Equivalent Time / Blast:	33.4	Min / Cycle	Charge, Blast, Vent Time =	34,428.6	Hours
<u>Secondary Mucking Details</u>			Primary Mucking Time =	16,098.5	Hours
Req'd during Tunneling:	No (No if loaded directly into trucks in tunnel)		Scaling Time =	4,205.8	Hours
Ave. LHD Tram Speed:	0.0	km / hour	Survey / Map Time =	2,102.7	Hours
<u>Wick Drain Installation Details</u>			Install Steel Sets Time =	4,124.4	Hours
Drain Spacing:	0.0	m	Initial Shotcreting Time =	3,332.0	Hours
Installation Time / Row:	0.0	Hours / Drain	Install Services Time =	2,102.7	Hours
<u>Average Tunneling Productivity Cycle Details</u>			Rockbolting (of % Critical) =	1,431.5	Hours
Equiv. Pre-Exc. Grouting:	4.8	Hours	Non-Productive Time =	2,102.7	Hours
Drilling:	6.3	Hours	Total Time =	116,569.1	Hours
Charging:	7.2	Hours		160.1	Months
Blast & Venting:	1.0	Hours	(Critical Path Tunneling Activities Only)	693.9	Weeks
Mucking:	3.8	Hours		4,857.0	Days
Scaling:	0.3	Hours	<u>Other Concurrent Tunneling Activities</u>		
Surveying / Mapping:	0.5	Hours	Rockbolting (of % Not Critical) =	3,340.3	Hours
Initial Shotcreting:	0.8	Hours	Wiremesh Installation =	4,817.6	Hours
Install Services:	0.5 (Equiv. Time Per Cycle)	Hours	Final Shotcreting Time =	0.6	Hours
Non-Productive Time:	0.5 (Travel in/out, Break)	Hours	Drilling Drainholes =	17,802.6	Hours
Include Rockbolting:	Yes (Yes / No, as part of Cycle Time)		Secondary Mucking =	0.0	Hours
If yes, % of Support Req'd:	30 (% Req'd During Cycle for Poorer Ground)		Wick Drain Installation =	0.0	Hours
Rockbolting:	0.3	Hours	<u>Overall Advance Rate:</u>		
Total Cycle Time:	26.1	Hours		2.8	m / Day
				339.6	m <sup>3</sup> / Day

Resource Type	Resource Name	Unit Rate	Unit	Quantity	Resource Quantity	Total
<b>Labor</b>						
	Miner - Shift Boss	50.68	\$/hr	116,569.1	2.00	11,815,445.90
	Miner - Operator - Journeyman	47.84	\$/hr	116,569.1	11.00	61,343,333.16
	Miner - Foreman	50.68	\$/hr	116,569.1	3.00	17,723,168.85
	Miner - Laborer - Journeyman	47.40	\$/hr	116,569.1	5.00	27,626,881.19
	Miner - Laborer - Apprentice	45.00	\$/hr	116,569.1	5.00	26,228,051.76
	Tunnel Electrician - Journeyman	47.84	\$/hr	116,569.1	4.00	22,306,666.60
					30.00	167,043,547.46
<b>Plant</b>						
	Cable - Fans & Pumps - High Voltage	120.00	\$/m	13,748.0	0.20	329,952.00
	Cable - Lights / Controls - Low Voltage	10.00	\$/m	13,748.0	0.80	109,984.00
	Compressor	121.77	\$/wk	693.9	1.00	84,494.50
	Conveyor - Heading Muck Loading	4,774.09	\$/wk	693.9	1.00	3,312,568.54
	Drill - Jack-Leg	77.49	\$/wk	693.9	4.00	215,076.91
	Drill Jumbo - Rail Mounted - 2 Boom	968.66	\$/wk	693.9	1.00	672,115.36
	Drill Jumbo - Rail Mounted - 3 Boom	2,767.59	\$/wk	693.9	1.00	1,920,329.59
	Excavator - Rail Mounted	304.43	\$/wk	693.9	1.00	211,236.26
	Generator - Back-Up - 500KW	290.60	\$/wk	693.9	1.00	201,634.61
	Generator - Working - 1000KW	2,169.79	\$/wk	693.9	1.00	1,505,538.40
	Grout Plant-Consol-D&B-Pump, Hoses	182.66	\$/wk	693.9	1.00	126,741.75
	Lighting (Including Consumables)	7.50	\$/m	13,748.0	1.00	103,110.00
	Locomotive - Diesel - 16T	5,000.00	\$/wk	693.9	4.00	13,877,276.07
	LHD Loader - D&B Tunnel	928.53	\$/wk	693.9	1.00	644,270.58
	Manlift / Platform - Rail Mounted	405.91	\$/wk	693.9	1.00	281,648.34
	Pipe - 50mm (Water Supply)	7.50	\$/m	13,748.0	1.00	103,110.00
	Pipe - 100mm (Air Supply)	15.00	\$/m	13,748.0	1.00	206,220.00
	Rail - 80 lb/yd - Used	101.54	\$/m	27,896.0	0.60	1,699,510.15
	Rail - California Switch Gear	75,000.00	\$/Nr	1.0	3.00	225,000.00
	Rail Car - Flat	50,000.00	\$/Nr	1.0	3.00	150,000.00
	Rail Car - Man Rider	50,000.00	\$/Nr	1.0	1.00	50,000.00
	Rail Car - Muck Cars	1,900.00	\$/wk	693.9	18.00	23,730,142.07
	Rail Car - Muck Car Tipping System	75,000.00	\$/Nr	1.0	1.00	75,000.00
	Shotcrete Machine - Rail Mounted	445.58	\$/wk	693.9	1.00	309,173.06
	Shotcrete Machine - Tire Mounted	721.42	\$/wk	693.9	2.00	1,001,131.83
	Small Tools	200.00	\$/wk	693.9	1.00	138,772.76
	Tie Plates, Splice Bars, Bolts	150,000.00	LS	1.0	1.00	150,000.00
	Ties - Wooden - Untreated - 7" x 9" x 40"	23.00	\$/m	13,748.0	1.00	316,204.00
	Transformers & Switchgear - High Voltage	202.96	\$/wk	693.9	1.00	140,824.17
	Transformers-Switchgear-Low Voltage	101.48	\$/wk	693.9	1.00	70,412.09
	Ventilation Duct - Rigid	110.00	\$/m	13,748.0	1.00	1,512,280.00
	Ventilation Fans - 75HP	57.29	\$/wk	693.9	7.00	278,255.76
	Welder (Plant)	6.37	\$/wk	693.9	1.00	4,416.76
						53,756,429.56
<b>Consumables</b>						
	Bits, Powder and Caps - Blasting	15.00	\$/m3	1,665,055.4	1.00	24,975,830.85
	Bits - (Drainholes & Rockbolts)	5.00	\$/m	298,914.3	1.00	1,494,571.27
	Drill Jumbo Maintenance	100.00	\$/hr	25,266.3	1.00	2,526,627.68
	Electricity - Tunnel Heading Conveyor	0.22	\$/kwh	150	1,051.36	34,695.00
	Electricity - Fans & Lighting	0.22	\$/kwh	433	58,284.56	5,548,807.71
	Electricity - Jumbo	0.22	\$/kwh	75	25,266.28	416,893.57
	Lubricants	2,500.00	\$/wk	693.9	1.00	1,734,659.51
	Fuels & Lubricants	5,000.00	\$/wk	693.9	1.00	3,469,319.02
	Other Consumables	1,500.00	\$/wk	693.9	1.00	1,040,795.70

Resource Type	Resource Name	Unit Rate	Unit	Quantity	Resource Quantity	Total
						\$ 41,242,200.30

Resource Type	Resource Name	Unit Rate	Unit	Quantity	Resource Quantity	Total
<b>Materials</b>						
	Grout - Consolidation	50.00	\$/m3	2,000.0	1.00	100,000.00
	Other Materials	2,000.00	\$/wk	693.9	1.00	1,387,727.61
	Rock Bolts - No. 10 - 3.0m - (Non-Galv)	40.00	\$/Nr	90,737	1.00	3,629,472.00
	Shotcrete	180.00	\$/m3	17,588.1	1.00	3,165,863.32
	Steel Sets - W10 x 65	152.75	\$/m	1,375	31.78	6,674,749.78
	Synthetic Wick Drains	5.00	\$/m	0	1.00	-
	WWF mesh	5.50	\$/m2	481,762	1.00	2,649,689.95
						\$ 14,857,812.70
<b>Subcontracts</b>						
	Tunnel Muck - Miscel Surface Handling	20.00	\$/m3	2,664,088.62	1.00	53,281,772.48
						\$ 53,281,772.48

**Total Estimated Cost: \$ 330,181,762.51**

**Per Meter: \$ 24,016.71**

**Per m³: \$ 198.30**

**Newfoundland Fixed Link  
Bridge Option  
Cost Estimate**

**Unit Costs**

Suspension Bridge	\$	5,000	/m2	(Rate includes piers & deck)
Substructure Piers Protection	\$	260,000,000	/pier	

**Quantities**

Bridge length=	16,000	m
Bridge width=	10	m
Bridge Area=	160,000	m2
Bridge Piers	8	Nr.

**Construction Costs**

	Unit	Qty	\$-Rate	\$ - Cost
Suspension Bridge	m2	160,000	5,000	800,000,000
Substructure Piers Protection	Ea	8	260,000,000	2,080,000,000
			Sub-total	2,880,000,000
			25% Contingency	720,000,000
			<b>Total</b>	<b>3,600,000,000</b>

**Pre-Construction and Supervision**

	Unit	Qty	\$-Rate	\$ - Cost
Feasibility Study	LS	1	11,000,000	11,000,000
Environmental Assessment	LS	1	4,000,000	4,000,000
Design	5%	1	180,000,000	180,000,000
Construction Management	10%	1	360,000,000	360,000,000
Owners Costs	2%	1	72,000,000	72,000,000
				<b>627,000,000</b>

**GRAND TOTAL** **4,227,000,000**

**Newfoundland Fixed Link  
Bridge/Causeway Option  
Cost Estimate**

**Page 1 of 2**

**Unit Costs**

Suspension Bridge	\$	5,000	/m2	
Bridge Approach	\$	2,500	/m2	
Substructure Piers Protection	\$	260,000,000	/pier	
Fill from shore	\$	15	/m3	
Fill from barge	\$	50	/m3	
Large armour stone from shore	\$	100	/m3	wave zone armour stone
Large armour stone from barge	\$	200	/m3	wave zone armour stone
Small armour stone from shore	\$	50	/m3	iceberg zone armour stone
Small armour stone from barge	\$	100	/m3	iceberg zone armour stone

**Quantities**

*Bridge*

Bridge length= 4,000 m  
Bridge width= 10 m

Bridge Area= 40,000 m2

*Approach*

Approach length= 1,000 m  
Approach width= 10 m

Approach area= 10,000 m2

*Piers*

Bridge Piers 2 Nr.

*Rockfill from shore*

Section	Length(m)	Top Width(m)	Slope (1:X)	Average Embankment Depth(m)	Calculated Volume (m3)
1	3800	15	1.8	90	60,534,000
3	4700	15	1.8	90	74,871,000
Total rockfill from shore					135,405,000 m3

*Rockfill from barge*

Section	Length(m)	Top Width(m)	Slope (1:X)	Average Embankment Depth(m)	Calculated Volume (m3)
2	5600	15	1.8	80	71,232,000
Total rockfill from barge					71,232,000 m3

*Large armour stone from shore*

Section	Length(m)	Wave Protection Depth(m)	Armour Thickness(m)	Slope (1:X)	Calculated Volume (m3)
1	3800	20	2.2	1.8	688,572
3	4700	20	2.2	1.8	851,655
Large armour stone from shore					1,540,226 m3



**Newfoundland Fixed Link  
Bridge/Causeway Option  
Cost Estimate**

**Page 2 of 2**

**Quantities contd.**

*Large armour stone from barge*

Section	Length(m)	Wave Protection Depth(m)	Armour Thickness(m)	Slope (1:X)	Calculated Volume (m3)
2	5600	20	2.2	1.8	1,014,737
Large armour stone from barge					1,014,737 m3

*Small armour stone from shore*

Section	Length(m)	Iceberg Protection Depth(m)	Armour Thickness(m)	Slope (1:X)	Calculated Volume (m3)
1	3800	60	1	1.8	938,961
3	4700	60	1	1.8	1,161,347
Small armour stone from shore					2,100,309 m3

*Small armour stone from barge*

Section	Length(m)	Wave Protection Depth(m)	Armour Thickness(m)	Slope (1:X)	Calculated Volume (m3)
2	5600	50	1	1.8	1,153,111
Small armour stone from barge					1,118,000 m3

**Construction Costs**

	Unit	Qty	\$-Rate	\$ - Cost
Suspension Bridge	m2	40,000	5,000	200,000,000
Bridge approaches	m2	10,000	2,500	25,000,000
Substructure Piers Protection	Ea	2	260,000,000	520,000,000
Causeway Fill from Shore	m3	135,405,000	15	2,031,075,000
Causeway Fill in Channel	m3	71,232,000	50	3,561,600,000
Large armour stone from shore	m3	1,540,226	100	154,022,627
Large armour stone from barge	m3	1,014,737	200	202,947,461
Small armour stone from shore	m3	2,100,309	50	105,015,427
Small armour stone from barge	m3	1,118,000	100	111,800,000
Sub-total				6,911,460,516
25% Contingency				1,727,865,129
<b>Total</b>				<b>8,639,325,645</b>

**Pre-Construction and Supervision**

	Unit	Qty	\$-Rate	\$ - Cost
Feasibility Study	LS	1	11,000,000	11,000,000
Environmental Assessment	LS	1	4,000,000	4,000,000
Design	5%	1	431,966,282	431,966,282
Construction Management	10%	1	863,932,564	863,932,564
Owners Costs	2%	1	172,786,513	172,786,513
				<b>1,483,685,360</b>

**GRAND TOTAL 10,123,011,004**

**Newfoundland Fixed Link Pre-feasibility Study**  
**Tunnel Drainage**  
**Bored Railway Tunnel**  
**Drainage Costs**

**Page 1 of 1**  
**Calculation by:** ANW  
**Date:** June 8, 2004

**Sump Sizing**

Assume inflow to tunnel of  litres/m<sup>2</sup>/24hours

Tunnel length=  m  
Tunnel diameter=  m

24 hour inflow= 1237002 litres = 1237 m<sup>3</sup>  
assume same again for firefighting= 1237 m<sup>3</sup>

Required sump capacity= 2474 m<sup>3</sup>

Assumed sump diameter=  m  
Assumed number of sump structures=  m

Required length of each sump= 44 m

**Piping**

Assume 300 mm diameter steel pipe connecting each sump to the portal areas  
Number of pipes=   
Assume sumps located at 1/3 and 2/3 of tunnel length


Total length of piping= 18967 m

**Rates**

Sump construction-\$ 17795 /m of sump  
Pipe-\$ 265 /m of pipe  
Pipe installation labour -\$ 29 /m of pipe (assume 6 man crew installing 100m/day)  
Pipe installation equipment-\$ 10 /m of pipe (assume \$1000/day for equipment)  
Pumps-\$ 125000 /pump

**Costs**

Item	Unit	Qty	Rate	\$-Cost
Sump construction	m	88	17795	1,565,960
Pipe	m	18967	265	5,026,167
Pipe installation	m	18967	29	546,240
Equipment	m	18967	10	189,667
Pumps	Nr	4	125000	500,000
<b>Total</b>				<u><b>7,828,033</b></u>

 Hatch Mott MacDonald		Newfoundland Fixed Link Pre-feasibility - TBM Bored Railway Tunnel - Cost Summary	
BORED TUNNEL CONSTRUCTION COSTS			
ITEM	UNIT	MAIN TUNNEL	
MOBILIZATION & DEMOBILIZATION	LS	8,000,000	
TUNNELLING	LS	356,357,000	
TUNNEL FINISHES	LS	75,539,979	
NORTH APPROACH STRUCTURES	LS	7,770,000	
SOUTH APPROACH STRUCTURES	LS	8,150,000	
RAIL TRACK	LS	13,923,100	
TUNNEL DRAINAGE	LS	7,820,000	
UTILITY DIVERSIONS	LS	1,000,000	
MONITORING	LS	1,000,000	
SUBTOTAL CIVIL		\$479,560,079	
CIVIL CONTINGENCIES			
CONTINGENCY	40%	\$191,824,032	
TOTAL CIVIL		\$671,384,111	
M&E, ROLLING STOCK, RAIL HARDWARE AND FINISHING WORK			
ROLLING STOCK, TERMINALS, OCS, ETC	LS	\$48,000,000	
VENTILATION EQUIPMENT	LS	\$3,000,000	
VENTILATION SHAFTS AND BUILDINGS x 2	LS	\$0	
FIRE SUPPRESSION SYSTEM	LS	\$2,000,000	
CONTROL CENTRE	LS	\$1,000,000	
SIGNALLING	LS	\$1,000,000	
LIGHTING	LS	\$1,000,000	
CCTV SYSTEM	LS	\$0	
GAS DETECTION	LS	\$900,000	
SUBSTATION, GENERATORS, UPS	LS	\$2,000,000	
SUBTOTAL M&E AND FINISHING		\$58,900,000	
CONTINGENCIES	20%	\$11,780,000	
TOTAL M&E AND FINISHING		\$70,680,000	
TOTAL CIVIL, M&E AND FINISHING		\$742,064,111	
ALLOWANCES			
CONTRACTOR OH	15%	\$111,309,617	
CONTRACTOR PROFIT	15%	\$111,309,617	
CONSTRUCTION TOTAL		\$965,000,000	
PRE-CONSTRUCTION AND SUPERVISION			
FEASIBILITY STUDY	LS	\$11,000,000	
ENVIRONMENTAL ASSESSMENT	LS	\$4,000,000	
DESIGN	5%	\$48,250,000	
CONSTRUCTION MANAGEMENT	10%	\$96,500,000	
OWNERS COSTS	2%	\$19,300,000	
PRE-CONSTRUCTION TOTAL		\$179,050,000	
GRAND TOTAL		\$1,144,050,000	



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Newfoundland Fixed Link Pre-feasibility - TBM Bored Railway Tunnel -  
Civil Costs

ITEM	UNIT	QTY	RATE	TOTAL
MOBILIZATION	LS	1.00	\$8,000,000	\$8,000,000
TUNNELLING				
- TBM launch shaft	LS	1.00	\$0	\$0
- Set-up TBM	LS	1.00	\$737,000	\$737,000
- Tunnel drive	LS	1.00	\$350,470,000	\$350,470,000
- TBM maintenance	LS	1.00	\$960,000	\$960,000
- Remove TBM	LS	1.00	\$406,000	\$406,000
- Clean tunnel	LS	1.00	\$3,784,000	\$3,784,000
- Structural finishes	LS	1.00	\$75,539,979	\$75,539,979
- TBM reception shaft	LS	1.00	\$0	\$0
NORTH APPROACH STRUCTURES				
- Cut and cover approach	LS	1.00	\$7,770,000	\$7,770,000
SOUTH APPROACH STRUCTURES				
- cut and cover approach	LS	1.00	\$8,150,000	\$8,150,000
DRAINAGE				
Drainage sumps and piping	LS	1.00	\$7,820,000	\$7,820,000
RAIL TRACK				
- bored tunnel	m2	40,050.00	\$20	\$801,000
- north approach	m2	31,150.00	\$20	\$623,000
- south approach	m2	1,602.00	\$30	\$48,060
SUB-TOTAL				\$465,109,039



## Detailed Cost Estimate Report

<b>Project:</b>	Newfoundland Fixed Link Pre-feasibility Study	<b>Project Number:</b>	213789
<b>Estimate Description:</b>	Set-up TBM	<b>Parent Estimate ID:</b>	1563
<b>Tunnel Name:</b>	Single Rail Bored	<b>Project Phase:</b>	Conceptual
<b>Construction Activity:</b>	Erect TBM Only	<b>Geology Type:</b>	Not Applicable
<b>Tunnel Technique:</b>	EPB TBM - Precast segmental	<b>Estimate Date:</b>	May 31, 2004
<b>Estimate Definition ID:</b>	2636	<b>Tunnel Characteristics ID:</b>	843

### Tunnel Characteristics

**Finished Diameter:** 7.5 m

### Activity Details

**Shift Arrangement** 3 - 8 hour shifts x 7 days per week

**Duration of Activity** 4.5 Weeks

**Total Number of Shifts** 94.5

Resource Name	Unit Rate	UOM	Unit Quantity	Resource Quantity	Total
<b>Labor</b>					
Pit boss	52.29	\$/hr	756.00	1.00	39,531
Tunnel miner	48.89	\$/hr	756.00	2.00	73,922
Shaft bottom	48.44	\$/hr	756.00	3.00	109,862
Tunnel fitter	49.34	\$/hr	756.00	1.00	37,301
Tunnel electrician	49.34	\$/hr	756.00	1.00	37,301
Shaft top	47.99	\$/hr	756.00	1.00	36,280
Crane operator	49.34	\$/hr	756.00	2.00	74,602
Surface laborer	47.99	\$/hr	756.00	1.00	36,280
Equipment laborer	48.44	\$/hr	756.00	1.00	36,621
				<b>13.00</b>	<b>\$481,701</b>
<b>Plant</b>					
Loco	5,000.00	\$/wk	4.50	1.00	22,500
Muck cars & grout cars	1,900.00	\$/wk	4.50	6.00	51,300
Flat cars	310.00	\$/wk	4.50	2.00	2,790
Transformers & switchgear - LV	750.00	\$/wk	4.50	1.00	3,375
Small tools	2,600.00	\$/wk	4.50	1.00	11,700
Shaft crane	9,000.00	\$/wk	4.50	1.00	40,500
Erection crane	10,000.00	\$/wk	4.50	1.00	45,000
Compressors	950.00	\$/wk	4.50	1.00	4,275
Generators	2,000.00	\$/wk	4.50	1.00	9,000
Transformers & switchgear - HV	5,200.00	\$/wk	4.50	1.00	23,400
Loaders	2,300.00	\$/wk	4.50	1.00	10,350
					<b>\$224,190</b>
<b>Consumables</b>					
Electrical power	0.00	\$/kwh	756.00	300.00	0
Gas oil	0.00	\$/L	0.00	1.00	0

**Estimate Definition ID:** 2636

**Estimated by:**

**Printed by:** whit2782, 8/16/04 11:42:50 AM

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**Checked by:**

Resource Name	Unit Rate	UOM	Unit Quantity	Resource Quantity	Total
Lubrication materials	0.00	\$/wk	4.50	1.00	0
Filters etc.	0.00	\$/wk	4.50	1.00	0
Hydraulic oil	0.00	\$/L	0.00	1.00	0
Other consumables	0.00	\$/wk	4.50	1.00	0
					\$0
<b>Materials</b>					
Temporary materials	2,000.00	\$/wk	4.50	1.00	9,000
Thrust frame	5,000.00	\$/wk	4.50	1.00	22,500
					\$31,500
<b>Total Estimated Cost:</b>					\$737,391



### Detailed Cost Estimate Report

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**Project:** Newfoundland Fixed Link Pre-feasibility Study  
**Estimate Description:** Tunnel drive  
**Tunnel Name:** Single Rail Bored  
**Construction Activity:** TBM Tunneling  
**Tunnel Technique:** EPB TBM - Precast segmental  
**Estimate Definition ID:** 2637

**Project Number:** 213789  
**Parent Estimate ID:** 1559  
**Project Phase:** Conceptual  
**Geology Type:** Not Applicable  
**Estimate Date:** May 21, 2004  
**Tunnel Characteristics ID:** 843

#### Tunnel Characteristics

**Tunnel Length:** 26,322 m  
**Finished Diameter:** 7.5 m  
**Initial Support Type:** Pre-cast concrete segments  
**Initial Support Thickness:** 0 m  
**Final Lining Thickness:** 0.35 m  
**Grout Thickness:** 0.1 m

#### Theoretical Excavation Volumes

**Total Neat Excavation:** 1,458,703 Cubic Metres  
**Initial Lining Volume:** 0 Cubic Metres  
**Final Lining Volume:** 227,199 Cubic Metres  
**Theoretical Grout Volume:** 68,635 Cubic Metres

#### Normal Excavation/Support Cycle

**Excavation Cycle Length:** 1.5 Metres  
**Excavate:** 24 Minutes  
**Erect Support:** 27 Minutes  
**Extend Services:** 0 Minutes  
**Total Cycle Time:** 51 Minutes

#### Difficult Excavation/Support Cycle

**Length of Difficult Excavation:** 1400 Metres  
**Excavate:** 73 Minutes  
**Erect Support:** 54 Minutes  
**Extend Services:** 0 Minutes  
**Total Cycle Time:** 127 Minutes

#### Reduction Factors

**Machine availability:** 80 %  
**Back up efficiency:** 55 %  
**Planned maintenance:** 5 %  
**Learning curve efficiency:** 40 %  
**Learning curve duration time:** 8 Weeks

**Learning Curve Rate:** 7.1 m/day  
**Experienced Advance Rate:** 17.7 m/day  
**Difficult Advance Rate:** 7.1 m/day

#### TBM Skidding Through Excavation

**Duration of skidding:** 0 Weeks  
**Length of skidding:** 0 Metres

#### Advance Rate and Shift Details

**Shift Arrangement:** 3 - 8 hour shifts x 7 days per week  
**Avg. Drive Advance per Shift:** 5.36 Metres  
**Avg. Drive Advance per Day:** 16 Metres  
**Avg. Drive Advance per Week:** 112 Metres  
**Duration of Tunneling (Incl. Skid):** 234.04 Weeks  
**Total number of shifts (Incl. Skid):** 4,915

	Metres	Days
<b>Learning Curve Drive:</b>	397	56
<b>Experienced Drive:</b>	24,525	1,385
<b>Difficult Drive:</b>	1,400	197
<b>Skidding Portion:</b>	0	0

Resource Name	Unit Rate	UOM	Unit Quantity	Resource Quantity	Total
<b>Labor</b>					
Pit boss	52.29	\$/hr	39,322.00	1.00	2,056,147
Working foreman	52.29	\$/hr	39,322.00	2.00	4,112,295
Tunnel miner	48.89	\$/hr	39,322.00	3.00	5,767,358
Tunnel laborer	48.44	\$/hr	39,322.00	4.00	7,619,031
Loco driver	49.34	\$/hr	39,322.00	5.00	9,700,737
Shaft bottom	48.44	\$/hr	39,322.00	1.00	1,904,758
TBM operator	49.34	\$/hr	39,322.00	1.00	1,940,147
Tunnel fitter	49.34	\$/hr	39,322.00	1.00	1,940,147
Tunnel electrician	49.34	\$/hr	39,322.00	1.00	1,940,147
Shaft top	47.99	\$/hr	39,322.00	2.00	3,774,126
Crane operator	49.34	\$/hr	39,322.00	1.00	1,940,147
Surface laborer	47.99	\$/hr	39,322.00	4.00	7,548,251
Equipment laborer	48.44	\$/hr	39,322.00	4.00	7,619,031
				<b>30.00</b>	<b>\$57,862,323</b>
<b>Plant</b>					
TBM	300,000.00	\$/m2	55.42	0.80	13,300,800
TBM backup	1,430,000.00	\$/Nr	1.00	1.00	1,430,000
Loco	5,000.00	\$/wk	234.04	5.00	5,851,000
Muck cars & grout cars	1,900.00	\$/wk	234.04	35.00	15,563,660
Flat cars	310.00	\$/wk	234.04	10.00	725,524
Manriders	310.00	\$/wk	234.04	2.00	145,105
Track	130.00	\$/m	26,322.00	1.00	3,421,860
Air pipe	30.00	\$/m	26,322.00	1.00	789,660
Water pipe	25.00	\$/m	26,322.00	1.00	658,050
Pump main	50.00	\$/m	26,322.00	1.00	1,316,100
Cabling	80.00	\$/m	26,322.00	1.00	2,105,760
Lighting	30.00	\$/m	26,322.00	1.00	789,660
Vent ducting	30.00	\$/m	26,322.00	1.00	789,660
Grout mixers	7,100.00	\$/wk	234.04	1.00	1,661,684
Grout pumps	3,400.00	\$/wk	234.04	1.00	795,736
Grout hoses & pipes	196.00	\$/wk	234.04	2.00	91,744
Transformers & switchgear - LV	750.00	\$/wk	234.04	2.00	351,060
Small tools	2,600.00	\$/wk	234.04	1.00	608,504
Shaft crane	9,000.00	\$/wk	234.04	1.00	2,106,360
Compressors	950.00	\$/wk	234.04	1.00	222,338
Low pressure C/A system	3,800.00	\$/wk	234.04	1.00	889,352
Pipework and controls	655.00	\$/wk	234.04	2.00	306,592
Generators	2,000.00	\$/wk	234.04	1.00	468,080
Transformers & switchgear - HV	5,200.00	\$/wk	234.04	1.00	1,217,008
Surface fans	800.00	\$/wk	234.04	2.00	374,464
Loaders	2,300.00	\$/wk	234.04	2.00	1,076,584
Other surface plant	2,600.00	\$/wk	234.04	1.00	608,504



Resource Name	Unit Rate	UOM	Unit Quantity	Resource Quantity	Total
Tunnel C/A system	40,000.00	\$/wk	234.04	1.00	9,361,600
					\$67,026,449
<b>Consumables</b>					
Electrical power	0.10	\$/kwh	39,322.00	3,000.00	11,796,600
Gas oil	0.45	\$/L	48,000.00	1.00	21,600
Lubrication materials	90.00	\$/wk	234.04	1.00	21,064
TBM spares, cutters	250.00	\$/m	26,322.00	1.00	6,580,500
Filters etc.	300.00	\$/wk	234.04	1.00	70,212
Hydraulic oil	0.90	\$/L	32,000.00	1.00	28,800
Other consumables	160.00	\$/wk	234.04	1.00	37,446
Tail seal grease	100.00	\$/m	26,322.00	1.00	2,632,200
					\$21,188,422
<b>Materials</b>					
Concrete lining rings	8,300.31	\$/Nr	17,548.00	1.00	145,653,824
Gaskets	130.00	\$/m	26,322.00	1.00	3,421,860
Bolts	12.00	\$/Nr	1,765.00	30.00	635,400
Grout	145.00	\$/m3	68,635.00	1.00	9,952,075
Grout plugs	0.50	\$/Nr	1,765.00	7.00	6,178
Packers	10.00	\$/Nr	3,633.00	12.00	435,960
Temporary materials	2,250.00	\$/wk	234.04	1.00	526,590
Other materials	0.00	\$/t	0.00	1.00	0
					\$160,631,886
<b>Subcontracts</b>					
Soil disposal	20.00	\$/m3	1,458,703.00	1.50	43,761,090
					\$43,761,090
<b>Total Estimated Cost:</b>					\$350,470,170
<b>Total Estimated Cost per Metre:</b>					\$13,315
<b>Total Estimated Cost per Week:</b>					\$1,497,491
<b>Total Estimated Cost per Shift:</b>					\$71,302



## Detailed Cost Estimate Report

<b>Project:</b>	Newfoundland Fixed Link Pre-feasibility Study	<b>Project Number:</b>	213789
<b>Estimate Description:</b>	Maintain TBM	<b>Parent Estimate ID:</b>	1561
<b>Tunnel Name:</b>	Single Rail Bored	<b>Project Phase:</b>	Conceptual
<b>Construction Activity:</b>	TBM Maintenance	<b>Geology Type:</b>	Not Applicable
<b>Tunnel Technique:</b>	EPB TBM - Precast segmental	<b>Estimate Date:</b>	May 21, 2004
<b>Estimate Definition ID:</b>	2638	<b>Tunnel Characteristics ID:</b>	843

### Tunnel Characteristics

**Finished Diameter:** 7.5 m

### Activity Details

**Shift Arrangement** 1 - 6 hour shifts x 1 days per week

**Duration of Activity** 234 Weeks

**Total Number of Shifts** 234

Resource Name	Unit Rate	UOM	Unit Quantity	Resource Quantity	Total
<b>Labor</b>					
Working foreman	52.29	\$/hr	1,404.00	1.50	110,123
Loco driver	49.34	\$/hr	1,404.00	1.50	103,910
Shaft bottom	48.44	\$/hr	1,404.00	1.50	102,015
TBM operator	49.34	\$/hr	1,404.00	1.50	103,910
Tunnel fitter	49.34	\$/hr	1,404.00	1.50	103,910
Tunnel electrician	49.34	\$/hr	1,404.00	1.50	103,910
Shaft top	47.99	\$/hr	1,404.00	1.50	101,067
Surface laborer	47.99	\$/hr	1,404.00	1.50	101,067
				<b>12.00</b>	<b>\$829,911</b>
<b>Consumables</b>					
Electrical power	0.10	\$/kwh	1,404.00	600.00	84,240
Gas oil	0.45	\$/L	0.00	1.00	0
Other consumables	0.00	\$/wk	234.00	1.00	0
					<b>\$84,240</b>
<b>Materials</b>					
Temporary materials	200.00	\$/wk	234.00	1.00	46,800
Other materials	0.00	\$/t	0.00	1.00	0
					<b>\$46,800</b>
<b>Total Estimated Cost:</b>					<b>\$960,951</b>



### Detailed Cost Estimate Report

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<b>Project:</b>	Newfoundland Fixed Link Pre-feasibility Study	<b>Project Number:</b>	213789
<b>Estimate Description:</b>	Clean tunnel	<b>Parent Estimate ID:</b>	1562
<b>Tunnel Name:</b>	Single Rail Bored	<b>Project Phase:</b>	Conceptual
<b>Construction Activity:</b>	Tunnel Clean Up	<b>Geology Type:</b>	Not Applicable
<b>Tunnel Technique:</b>	EPB TBM - Precast segmental	<b>Estimate Date:</b>	May 21, 2004
<b>Estimate Definition ID:</b>	2639	<b>Tunnel Characteristics ID:</b>	843

#### Tunnel Characteristics

<b>Tunnel Length:</b>	26,322 m
<b>Finished Diameter:</b>	7.5 m (Circular Tunnels)
<b>Excavated Cross Section:</b>	0 m2 (Non-circular Tunnels)
<b>Excavated Perimeter:</b>	0 m (Non-circular Tunnels)

#### Productivity Cycle

<b>Section Length</b>	30 Metres
<b>Vent Line Removal Time</b>	120 Minutes
<b>Track Removal Time</b>	60 Minutes
<b>Temp Lighting Removal Time</b>	60 Minutes
<b>Clean Up Time</b>	120 Minutes
<b>Total Cycle Time</b>	360 Minutes

#### Reduction Factors

<b>Learning Curve Efficiency:</b>	50 %
<b>Back Up Efficiency:</b>	80 %
<b>Learning Curve Duration:</b>	1 Weeks

#### Shift Details

<b>Shift Arrangement:</b>	3 - 8 hour shifts x 7 days per week
<b>Avg. Advance per Shift:</b>	31.58 Metres
<b>Avg. Advance per Week:</b>	664 Metres
<b>Total number of hours:</b>	6,669

#### Clean Up Productivity Data

	<u>Average Advance</u>	<u>Drive Length</u>	<u>Drive Duration</u>		
<b>Learning Curve Portion:</b>	48.0 m/day	336 Metres	21 Shifts	7 Days	1.00 Weeks
<b>Experienced Drive Portion:</b>	96.0 m/day	25,986 Metres	812 Shifts	271 Days	38.67 Weeks
<b>Total:</b>	94.8 m/day	26,322 Metres	834 Shifts	278 Days	39.67 Weeks

Resource Name	Unit Rate	UOM	Unit Quantity	Resource Quantity	Total
<b>Labor</b>					
Tunnel laborer	48.44	\$/hr	6,668.00	6.00	1,937,988
Shaft bottom	48.44	\$/hr	6,668.00	1.00	322,998
Shaft top	47.99	\$/hr	6,668.00	1.00	319,997
Crane operator	49.34	\$/hr	6,668.00	1.00	328,999
				<b>9.00</b>	<b>\$2,909,982</b>
<b>Plant</b>					
Transformers & switchgear - LV	750.00	\$/wk	39.67	1.00	29,753

Estimate Definition ID: 2639

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Resource Name	Unit Rate	UOM	Unit Quantity	Resource Quantity	Total
Man hoists	2,600.00	\$/wk	39.67	1.00	103,142
Shaft crane	9,000.00	\$/wk	39.67	1.00	357,030
Compressors	950.00	\$/wk	39.67	1.00	37,687
Loaders	2,260.00	\$/wk	39.67	1.00	89,654
Other surface plant	2,600.00	\$/wk	39.67	1.00	103,142
Bobcat	500.00	\$/wk	39.67	1.00	19,835
					\$740,242
<b>Consumables</b>					
Electrical power	0.10	\$/kwh	6,668.00	200.00	133,360
					\$133,360

**Total Estimated Cost:** \$3,783,584  
**Total Estimated Cost per Metre:** \$144  
**Total Estimated Cost per Week:** \$95,377  
**Total Estimated Cost per Shift:** \$4,539



### Detailed Cost Estimate Report

<b>Project:</b>	Newfoundland Fixed Link Pre-feasibility Study	<b>Project Number:</b>	213789
<b>Estimate Description:</b>	Remove TBM	<b>Parent Estimate ID:</b>	1564
<b>Tunnel Name:</b>	Single Rail Bored	<b>Project Phase:</b>	Conceptual
<b>Construction Activity:</b>	TBM Removal	<b>Geology Type:</b>	Not Applicable
<b>Tunnel Technique:</b>	EPB TBM - Precast segmental	<b>Estimate Date:</b>	May 21, 2004
<b>Estimate Definition ID:</b>	2640	<b>Tunnel Characteristics ID:</b>	843

#### Tunnel Characteristics

**Finished Diameter:** 7.5 m

#### Activity Details

**Shift Arrangement** 3 - 8 hour shifts x 7 days per week

**Duration of Activity** 2.2 Weeks

**Total Number of Shifts** 46.2

Resource Name	Unit Rate	UOM	Unit Quantity	Resource Quantity	Total
<b>Labor</b>					
Pit boss	52.29	\$/hr	370.00	1.00	19,347
Tunnel miner	48.89	\$/hr	370.00	3.00	54,268
Shaft bottom	48.44	\$/hr	370.00	2.00	35,846
Tunnel fitter	49.34	\$/hr	370.00	1.00	18,256
Tunnel electrician	49.34	\$/hr	370.00	1.00	18,256
Shaft top	47.99	\$/hr	370.00	2.00	35,513
Crane operator	49.34	\$/hr	370.00	2.00	36,512
Surface laborer	47.99	\$/hr	370.00	2.00	35,513
Equipment laborer	48.44	\$/hr	370.00	1.00	17,923
				<b>15.00</b>	<b>\$271,432</b>
<b>Plant</b>					
Loco	5,000.00	\$/wk	2.20	1.00	11,000
Muck cars & grout cars	1,900.00	\$/wk	2.20	6.00	25,080
Flat cars	310.00	\$/wk	2.20	4.00	2,728
Manriders	310.00	\$/wk	2.20	1.00	682
Booster fans	800.00	\$/wk	2.20	1.00	1,760
Transformers & switchgear - LV	750.00	\$/wk	2.20	1.00	1,650
Other plant	1,400.00	\$/wk	2.20	1.00	3,080
Man hoists	2,000.00	\$/wk	2.20	1.00	4,400
Shaft crane	9,000.00	\$/wk	2.20	1.00	19,800
50T Crane	3,000.00	\$/wk	2.20	1.00	6,600
TBM Crane	15,000.00	\$/wk	2.20	1.00	33,000
Compressors	950.00	\$/wk	2.20	1.00	2,090
Transformers & switchgear - HV	5,200.00	\$/wk	2.20	1.00	11,440
Surface fans	800.00	\$/wk	2.20	1.00	1,760
					<b>\$125,070</b>

**Estimate Definition ID:** 2640

**Estimated by:**

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Resource Name	Unit Rate	UOM	Unit Quantity	Resource Quantity	Total
<b>Consumables</b>					
Electrical power	0.00	\$/kwh	370.00	600.00	0
Gas oil	0.40	\$/L	15.00	1,000.00	6,000
Lubrication materials	0.00	\$/wk	2.20	1.00	0
Filters etc.	0.00	\$/wk	2.20	1.00	0
Hydraulic oil	0.00	\$/L	0.00	1.00	0
Other consumables	500.00	\$/wk	2.20	1.00	1,100
					\$7,100
<b>Materials</b>					
Temporary materials	500.00	\$/wk	2.20	1.00	1,100
Thrust frame	0.00	\$/wk	2.20	1.00	0
					\$1,100
<b>General Supplies</b>					
Small tools	700.00	\$/wk	2.20	1.00	1,540
					\$1,540
<b>Total Estimated Cost:</b>					\$406,242



## Detailed Cost Estimate Report

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<b>Project:</b>	NFLink	<b>Project Number:</b>	213789
<b>Estimate Description:</b>	Liner production	<b>Parent Estimate ID:</b>	1596
<b>Tunnel Name:</b>	Single Rail Bored	<b>Project Phase:</b>	Conceptual
<b>Construction Activity:</b>	Precast Linings	<b>Geology Type:</b>	Not Applicable
<b>Tunnel Technique:</b>	EPB TBM - Precast segmental	<b>Estimate Date:</b>	June 01, 2004
<b>Estimate Definition ID:</b>	2642	<b>Tunnel Characteristics ID:</b>	843

### Tunnel Characteristics

<b>Tunnel Length:</b>	26,322 m
<b>Finished Diameter:</b>	7.5 m
<b>Final Lining Thickness:</b>	0.35 m

### Assumptions

#### A) Duration

	Maximum	Minimum	
<b>TBM Fabrication Time</b>	19	15	Months
<b>TBM Erection Time</b>	3	2	Months
<b>Tunneling Time</b>	86	81	Months
<b>Total</b>	<b>108</b>	<b>98</b>	Months
<b>Facility Setup Time</b>	6	5	Months
<b>Learning Curve/Shakedown Time</b>	1	1	Months
<b>Concrete Strength Gain Time</b>	1	1	Months
<b>Available Manufacturing Time</b>	<b>100</b>	<b>91</b>	Months

#### B) Production

<b>Allowance for Damage</b>	2 %
<b>Ring Length</b>	1.5 m
<b>Number of Rings Required</b>	17,899
<b>Production Rate Required</b>	49.2 Rings/Week
<b>Actual Production Rate Achieved</b>	50 Rings/Week

**Investment on plant, equipment and moulds**

\$5,000,000

<b>Initial Shakedown Time</b>	4 Weeks
<b>Production Time</b>	358.0 Weeks

	Shakedown Crew	Production / QC Crew
<b>Shifts per Day</b>	1	2
<b>Hours per Shift</b>	12	12
<b>Days per Week</b>	5	5

Number of Rings per Truck	1
Concrete	12.95 m3/ring
Reinforcing Steel	120 kg/m3
Dunnage Assumption	50 % of total required storage

C) Overheads	\$/Month	Months	Cost	
Project Manager Rate	7,000	97	679,000	
Plant Manager Rate	5,000	95	475,000	
Quality Manager Rate	5,000	93	465,000	
Secretary Rate	2,000	97	194,000	
Office Building Cost			150,000	
Office Equipment and Supplies Cost			0	
Finance Assume \$	1,000,000	97	485,000	
Financing @	6 %			
Head Office Support @	1 %		1,286,778	
Total Overhead Cost				\$3,734,778
Profit Margin			10 %	

Resource Name	Unit Rate	UOM	Unit Quantity	Resource Quantity	Total
<b>Labor</b>					
Shakedown crew	25.00	\$/hr	240.00	30.00	180,000
Production & QC crew	32.00	\$/hr	42,958.00	30.00	41,239,680
				<b>60.00</b>	\$41,419,680
<b>Consumables</b>					
Power	0.06	\$/kwh	43,198.00	1,020.00	2,643,718
Heating	0.11	\$/m2/wk	362.00	10,600.00	422,092
Steam curing	0.54	\$/m2/wk	362.00	2,000.00	390,960
Fuel	0.50	\$/L	362.00	3,000.00	543,000
Water	0.05	\$/L	231,743.00	100.00	1,158,715
					\$5,158,485
<b>Materials</b>					
Concrete	84.00	\$/m3	12.95	17,899.00	19,470,532
Rebar	1.00	\$/kg	1,554.00	17,899.00	27,815,046
Grout nozzles	3.00	\$/Nr	17,899.00	12.00	644,364
Lifting socket	10.00	\$/Nr	17,899.00	12.00	2,147,880
Bolt inserts	5.00	\$/Nr	17,899.00	12.00	1,073,940
Gaskets	100.00	\$/Nr	17,899.00	12.00	21,478,800
Dunnage	2.50	\$/m	18.00	8,949.00	402,705
Site preparation	10.00	\$/m2	12.32	8,949.00	1,102,517
					\$74,135,784

Estimate Definition ID: 2642

Estimated by: \_\_\_\_\_

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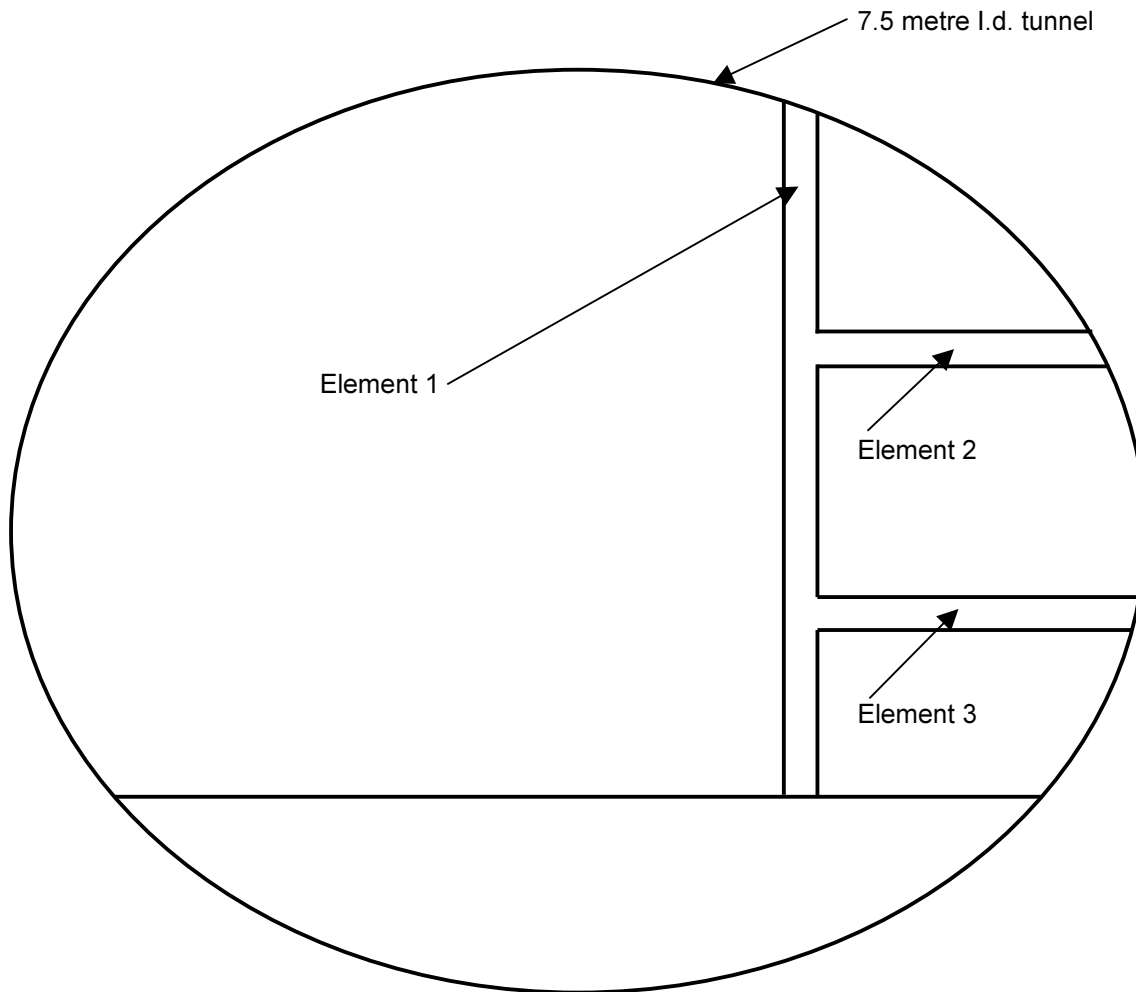
Page 2 of 3

Checked by: \_\_\_\_\_



Resource Name	Unit Rate	UOM	Unit Quantity	Resource Quantity	Total
<b>Subcontracts</b>					
Delivery	80.00	\$/hr	2.00	17,899.00	2,863,840
Testing	100,000.00	\$/Nr	1.00	1.00	100,000
					<hr/> \$2,963,840
					<hr/>
<b>Subtotal:</b>					\$123,677,789
<b>Investment on Plant:</b>					\$5,000,000
<b>Total Overhead Cost:</b>					\$3,734,778
<b>Subtotal:</b>					\$132,412,566
<b>Profit:</b>					\$13,241,257
					<hr/>
<b>Total Precast Lining Cost:</b>					<b>\$145,653,823</b>
					<hr/>
<b>Total Cost per Cubic Metre:</b>					<b>\$629</b>
<b>Total Cost per Ring:</b>					<b>\$8,138</b>

Tunnel length= 26320 m



Assumed tunnel cross section

Page 2 of 2  
Date: June 07, 2004  
Calculation by: A.White

Concrete	m3	65537	m3	at	190	=	12,451,992
Formwork	m2	373744	m2	at	140	=	52,324,160
Reinforcement	t	6727	t	at	1600	=	10,763,827
					\$		<u>75,539,979</u>

## Initialisation

**Project:** Newfoundland Fixed Link Pre-feasibility Study

**Section:** North Approach

**Option:** Bored Rail Tunnel

**Date:** 8-Jun-04

**Calculations by:** ANW

Surface gradient  %

+ sloping same way as track/road  
- sloping against track/road

Track/Road Gradient  %

Ground elevation  
at portal  m

Bottom of slab  
elevation at portal  m

Total length= 748.7091 m

Total Cost=\$ 7.8 M

**UNIT RATES**

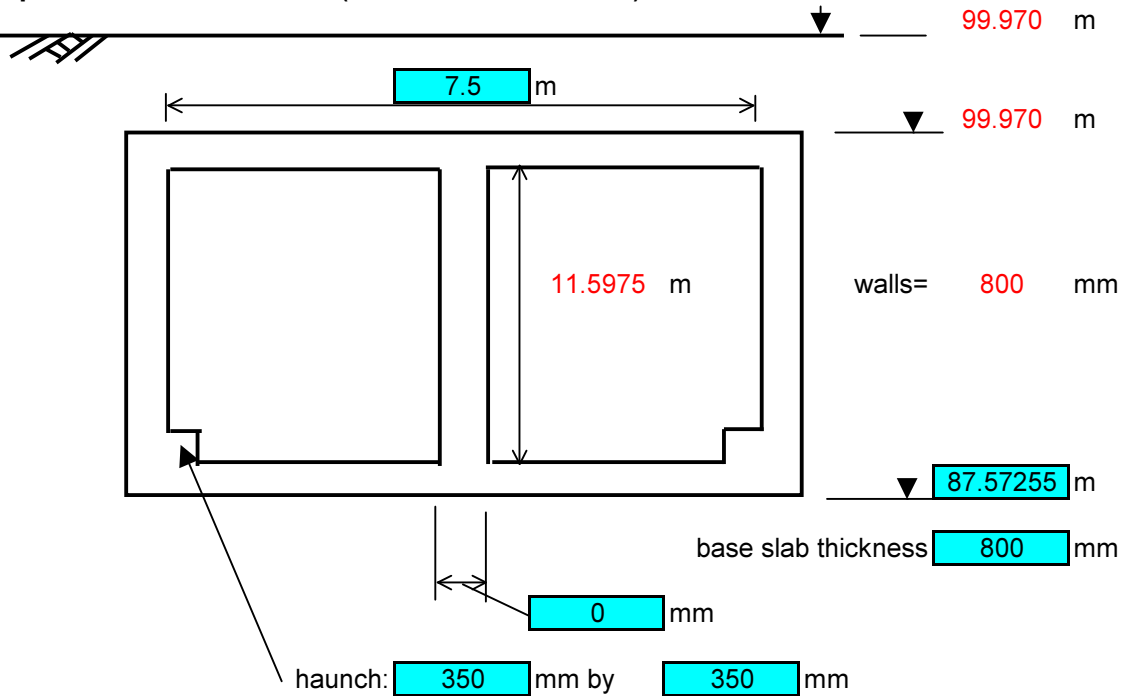
**Materials**

<b>Item</b>	<b>unit</b>	<b>Rate</b>
excavation	m3	60
concrete	m3	190
rebar	tonnes	1600
formwork/falsework	m2	140
SP&L<=4.6m deep	m2	0
4.6<SP&L<=6.7m deep	m2	0
6.7<SP&L<=10.6m deep	m2	0
10.6<SP&L<=13.7m deep	m2	0
13.7<SP&L<=16.8m deep	m2	0
16.8<SP&L<=20.0m deep	m2	0
20<SP&L<=25m deep	m2	0
backfill + compact	m3	40
surface reinstatement	m2	30

Section Cut and Cover  
Length of section: 74.87091 m

Section 1

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	8446.7	m3	
concrete=	1952.708	m3	
rebar=	234.3	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	1736.631	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	1856.4	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	681.3253	m2	

**Calculated costs**

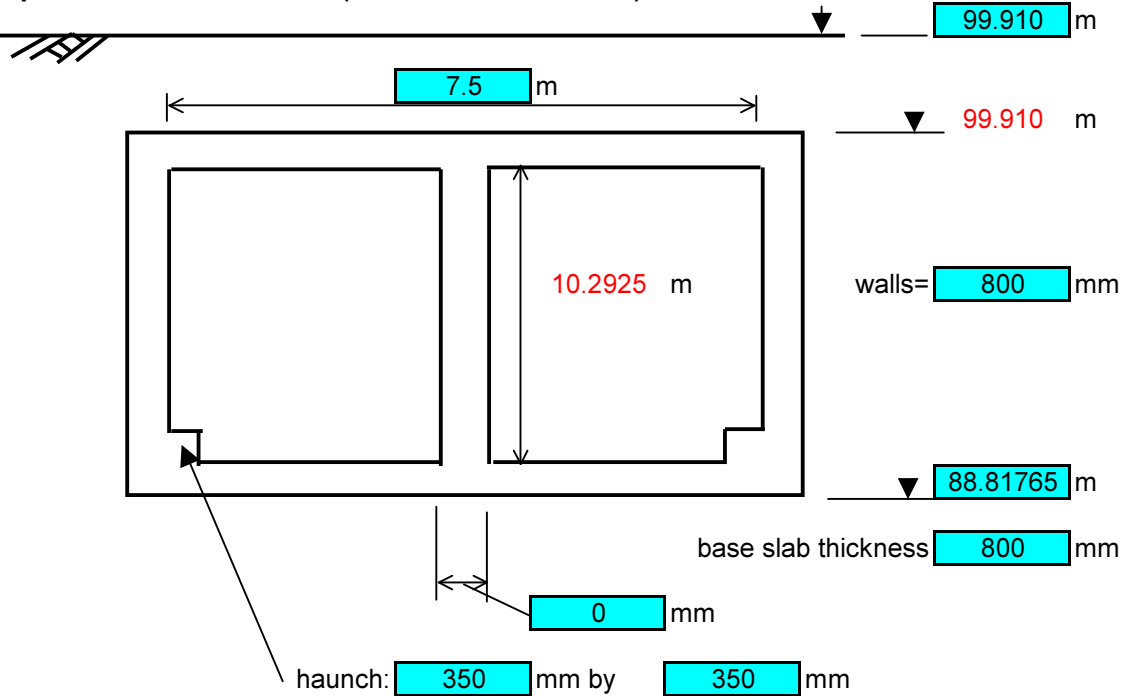
Item	Unit	Quantity	Rate	Cost
excavation	m3	8446.7	60	506803.8
concrete	m3	1952.708	190.0	371014.6
rebar	tonnes	234.3	1600	374920
formwork/falsework	m2	1736.631	140	243128.3
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	1856.4	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	681.3253	30	20439.76

Total 1516306

Section Cut and Cover  
Length of section: 74.87091 m

Section 2

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	7557.6	m3	
concrete=	1796.378	m3	
rebar=	215.6	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	1541.218	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	1661.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	681.3253	m2	



**Calculated costs**

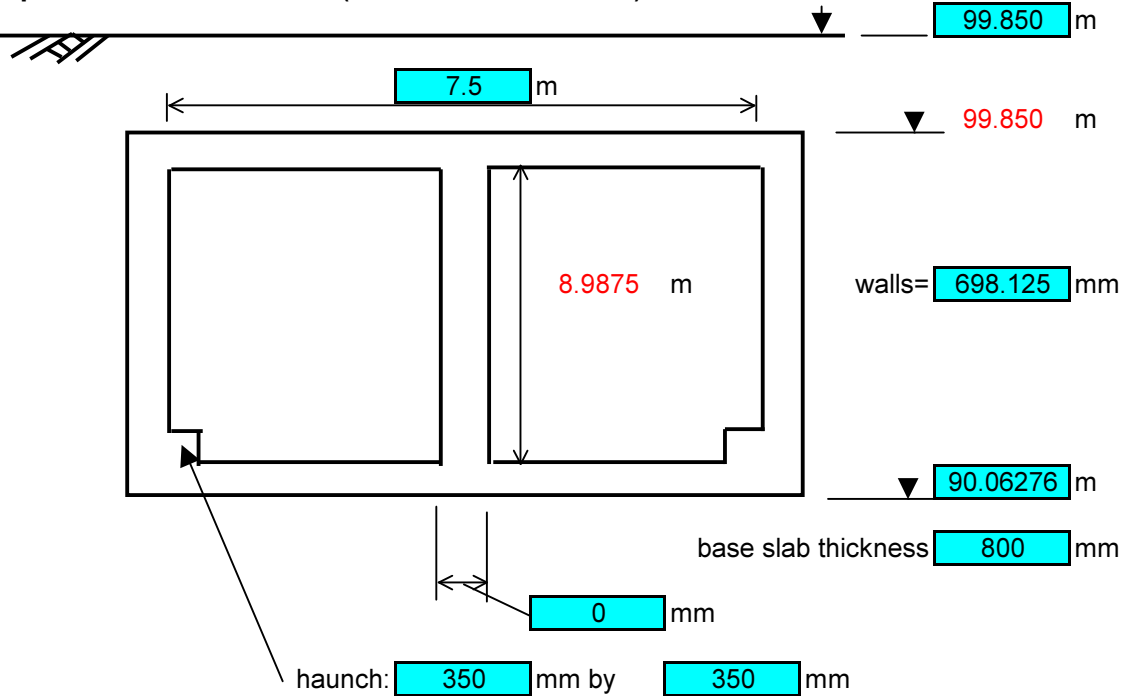
Item	Unit	Quantity	Rate	Cost
excavation	m3	7557.6	60	453456.1
concrete	m3	1796.378	190.0	341311.8
rebar	tonnes	215.6	1600	344904.5
formwork/falsework	m2	1541.218	140	215770.5
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	1661.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	681.3253	30	20439.76

Total 1375883

Section Cut and Cover  
Length of section: 74.87091 m

Section 3

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	6519.2	m3	
concrete=	1490.74	m3	
rebar=	178.9	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	1345.805	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	1465.6	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	666.0704	m2	

**Calculated costs**

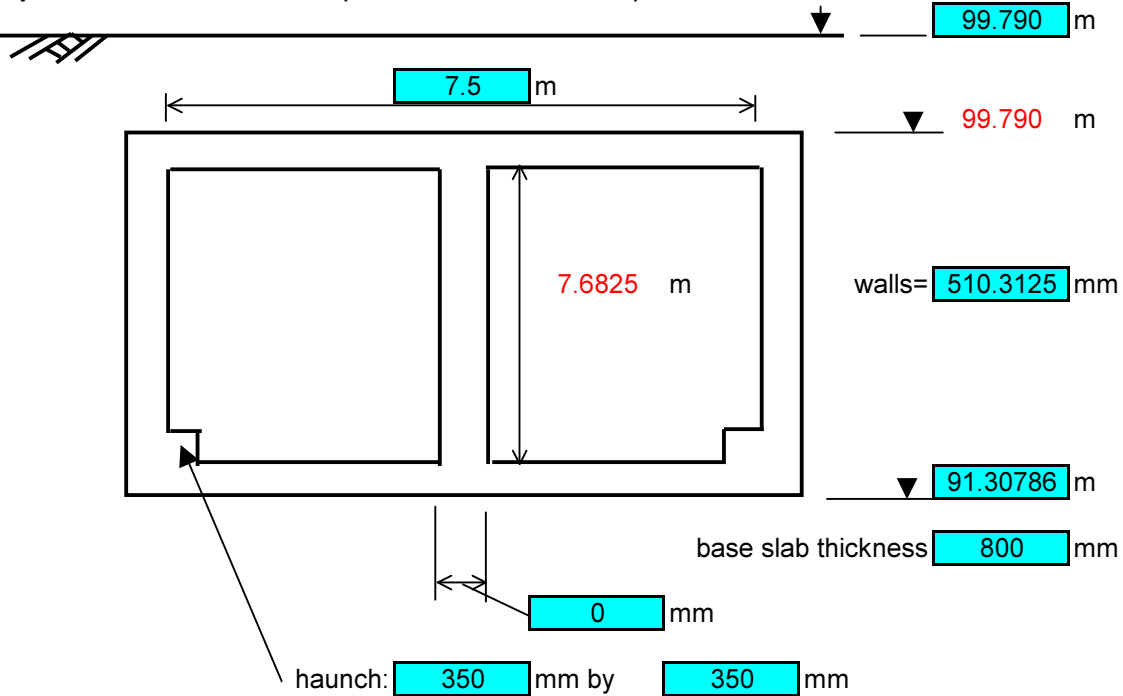
Item	Unit	Quantity	Rate	Cost
excavation	m3	6519.2	60	391149.8
concrete	m3	1490.74	190.0	283240.5
rebar	tonnes	178.9	1600	286222
formwork/falsework	m2	1345.805	140	188412.7
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	1465.6	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	666.0704	30	19982.11

Total 1169007

Section Cut and Cover  
Length of section: 74.87091 m

Section 4

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	5411.4	m3	
concrete=	1115.76	m3	
rebar=	133.9	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	1150.392	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	1270.2	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	637.947	m2	

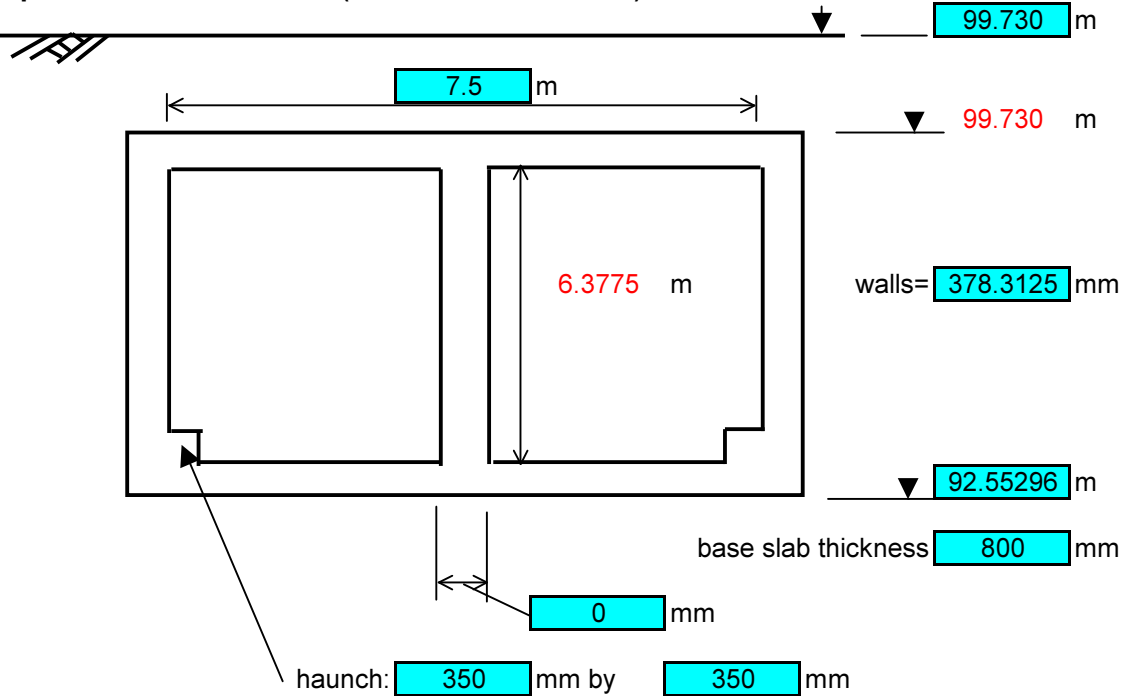
**Calculated costs**

Item	Unit	Quantity	Rate	Cost
excavation	m3	5411.4	60	324683.1
concrete	m3	1115.76	190.0	211994.4
rebar	tonnes	133.9	1600	214225.9
formwork/falsework	m2	1150.392	140	161054.8
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	1270.2	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	637.947	30	19138.41
Total				<u>931096.7</u>

Section Cut and Cover  
Length of section: 74.87091 m

Section 5

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	4437.0	m3	
concrete=	874.1685	m3	
rebar=	104.9	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	954.9785	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	1074.8	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	618.181	m2	

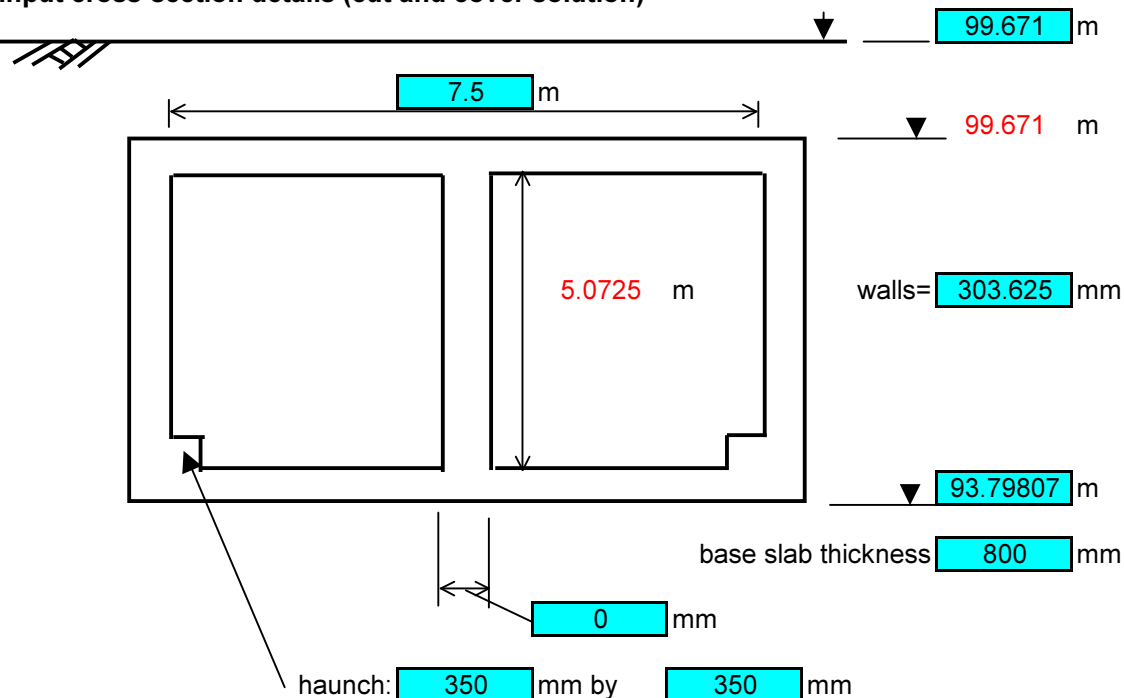
**Calculated costs**

Item	Unit	Quantity	Rate	Cost
excavation	m3	4437.0	60	266219.7
concrete	m3	874.1685	190.0	166092
rebar	tonnes	104.9	1600	167840.4
formwork/falsework	m2	954.9785	140	133697
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	1074.8	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	618.181	30	18545.43
Total				<u>752394.5</u>

Section Cut and Cover  
Length of section: 74.87091 m

Section 6

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	3564.6	m3	
concrete=	734.5642	m3	
rebar=	88.1	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	759.5654	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	879.4	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	606.9972	m2	



**Calculated costs**

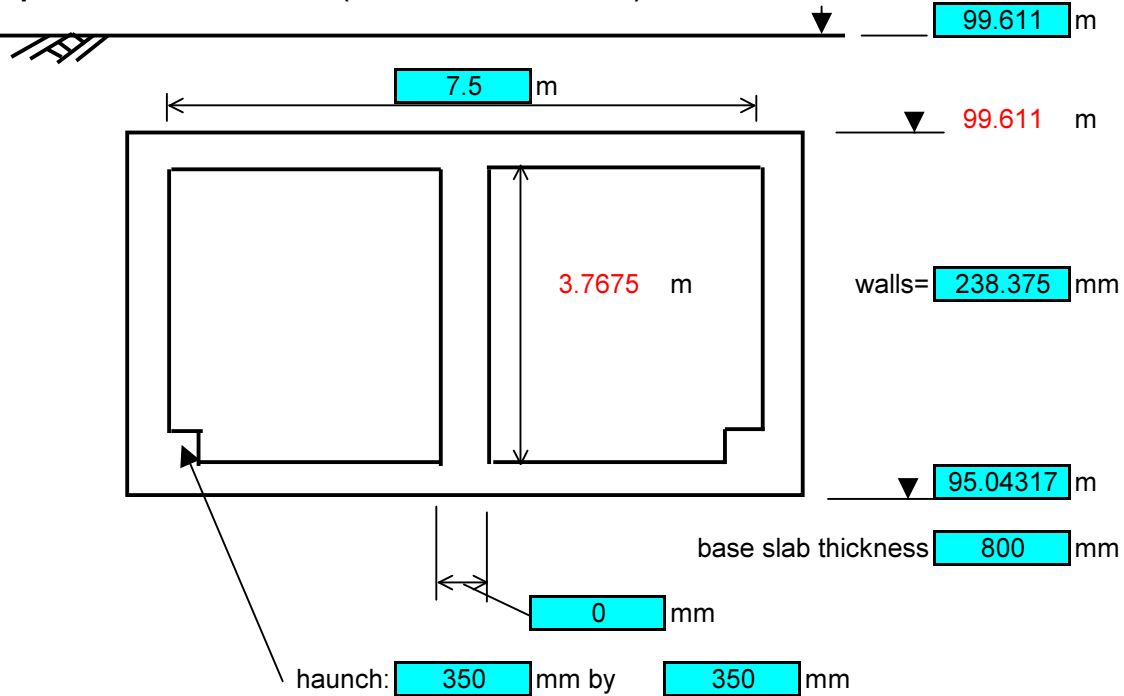
Item	Unit	Quantity	Rate	Cost
excavation	m3	3564.6	60	213875.5
concrete	m3	734.5642	190.0	139567.2
rebar	tonnes	88.1	1600	141036.3
formwork/falsework	m2	759.5654	140	106339.2
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	879.4	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	606.9972	30	18209.92

Total 619028.1

Section Cut and Cover  
Length of section: 74.87091 m

Section 7

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	2727.8	m3	
concrete=	630.6044	m3	
rebar=	75.7	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	564.1523	m2	
SP&L<=4.6m deep	683.9	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	597.2265	m2	

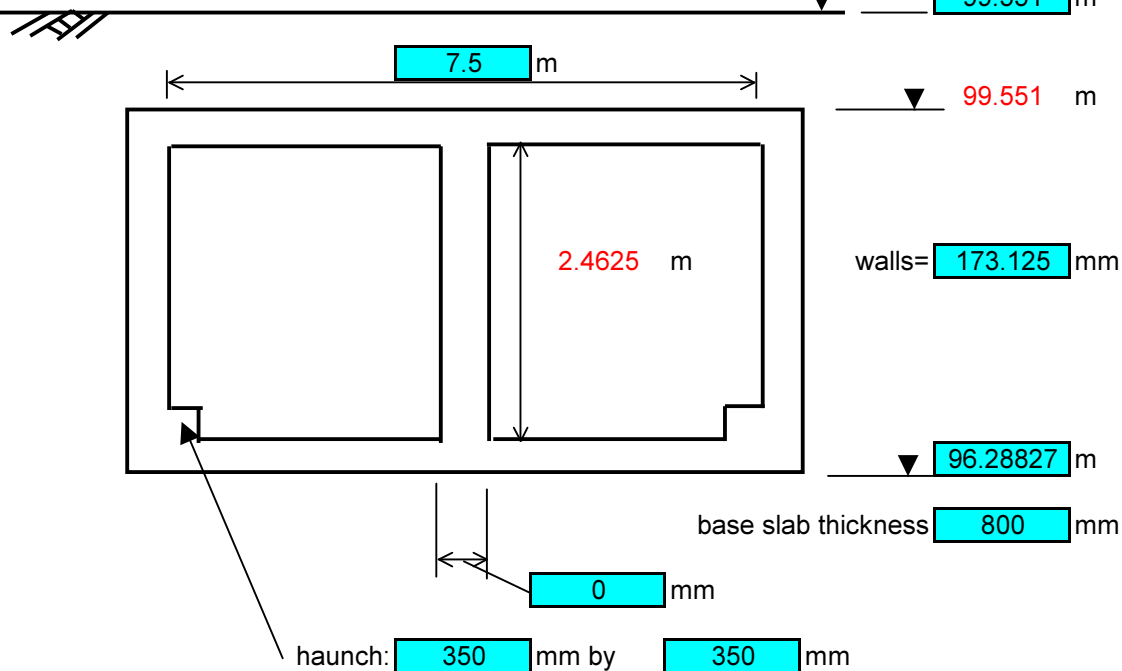
**Calculated costs**

Item	Unit	Quantity	Rate	Cost
excavation	m3	2727.8	60	163669.9
concrete	m3	630.6044	190.0	119814.8
rebar	tonnes	75.7	1600	121076
formwork/falsework	m2	564.1523	140	78981.33
SP&L<=4.6m deep	m2	683.9	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	597.2265	30	17916.8

Total 501458.9

## Section 8

99.551 m



excavation=	1916.6	m3	
concrete=	552.1461	m3	
rebar=	66.3	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	368.7392	m2	
SP&L<=4.6m deep	488.5	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	587.4559	m2	

**Calculated costs**

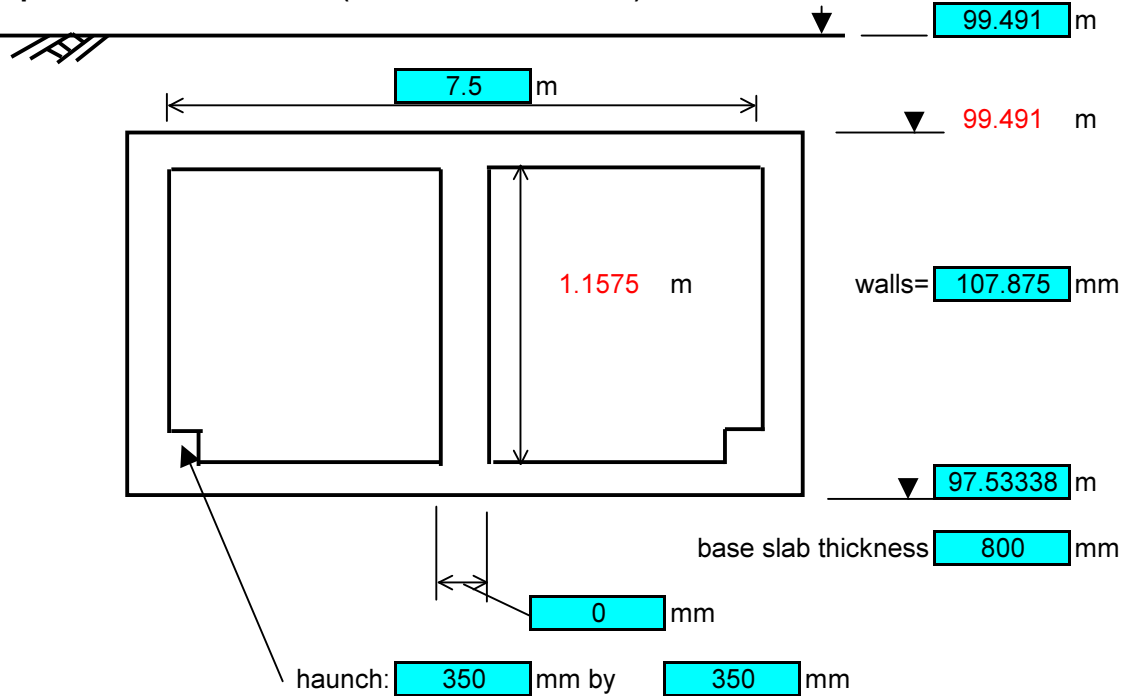
Item	Unit	Quantity	Rate	Cost
excavation	m3	1916.6	60	114994.5
concrete	m3	552.1461	190.0	104907.8
rebar	tonnes	66.3	1600	106012
formwork/falsework	m2	368.7392	140	51623.49
SP&L<=4.6m deep	m2	488.5	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	587.4559	30	17623.68

Total 395161.5

Section Cut and Cover  
Length of section: 74.87091 m

Section 9

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	1130.8	m3	
concrete=	499.1891	m3	
rebar=	59.9	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	173.3262	m2	
SP&L<=4.6m deep	293.1	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	577.6852	m2	

**Calculated costs**

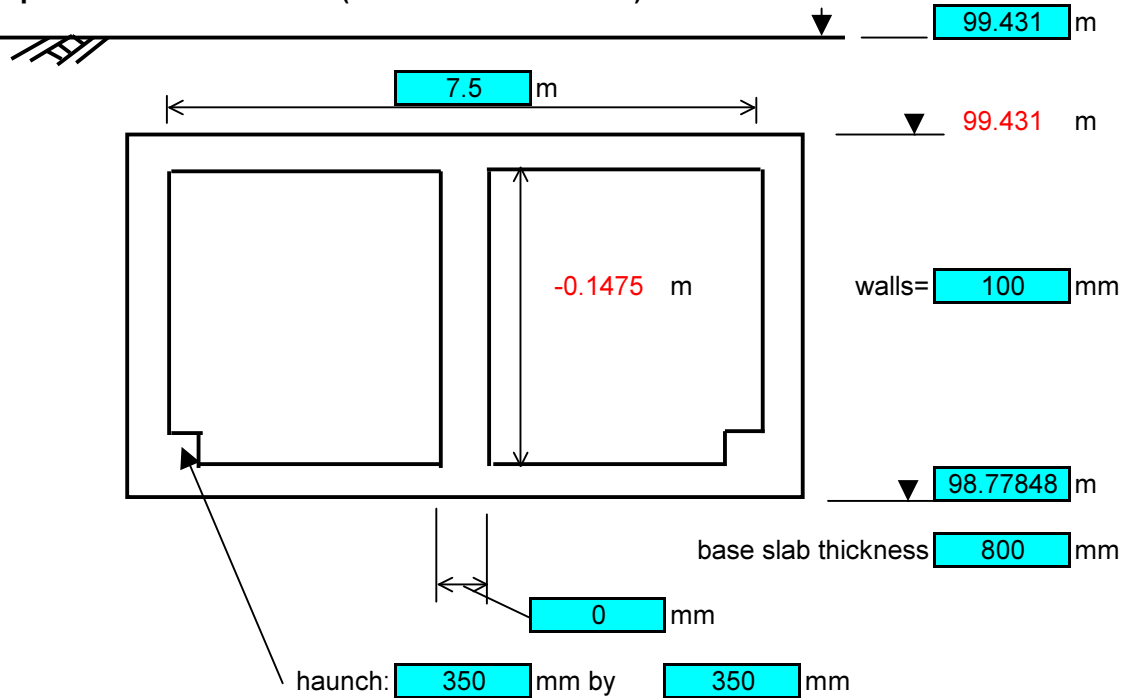
Item	Unit	Quantity	Rate	Cost
excavation	m3	1130.8	60	67849.13
concrete	m3	499.1891	190.0	94845.93
rebar	tonnes	59.9	1600	95844.31
formwork/falsework	m2	173.3262	140	24265.66
SP&L<=4.6m deep	m2	293.1	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	577.6852	30	17330.56

Total 300135.6

Section Cut and Cover  
Length of section: 74.87091 m

Section 10

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	376.2	m3	
concrete=	477.3395	m3	
rebar=	57.3	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	-22.08692	m2	
SP&L<=4.6m deep	97.7	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	576.506	m2	



**Calculated costs**

Item	Unit	Quantity	Rate	Cost
excavation	m3	376.2	60	22570.21
concrete	m3	477.3395	190.0	90694.51
rebar	tonnes	57.3	1600	91649.18
formwork/falsework	m2	-22.08692	140	-3092.169
SP&L<=4.6m deep	m2	97.7	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	576.506	30	17295.18

Total 219116.9

**Newfoundland Fixed Link Pre-feasibility Study**  
**North Approach**  
**Bored Rail Tunnel**

**Date:** 8-Jun-04  
**Calculations by:** ANW

**Summary of Costs**

Markup for adjacent 0 %

<b>Section</b>	<b>Cost</b>
1	1516306
2	1375883
3	1169007
4	931096.7
5	752394.5
6	619028.1
7	501458.9
8	395161.5
9	300135.6
10	<u>219116.9</u>
Sub-total	<u>7779588</u>



## Initialisation

**Project:** Newfoundland Fixed Link Pre-feasibility Study

**Section:** South Approach

**Option:** Bored Rail Tunnel

**Date:** 8-Jun-04

**Calculations by:** ANW

Surface gradient  %

+ sloping same way as track/road  
- sloping against track/road

Track/Road Gradient  %

Ground elevation  
at portal  m

Bottom of slab  
elevation at portal  m

Total length= 784.7264 m

Total Cost=\$ 8.2 M

**UNIT RATES**

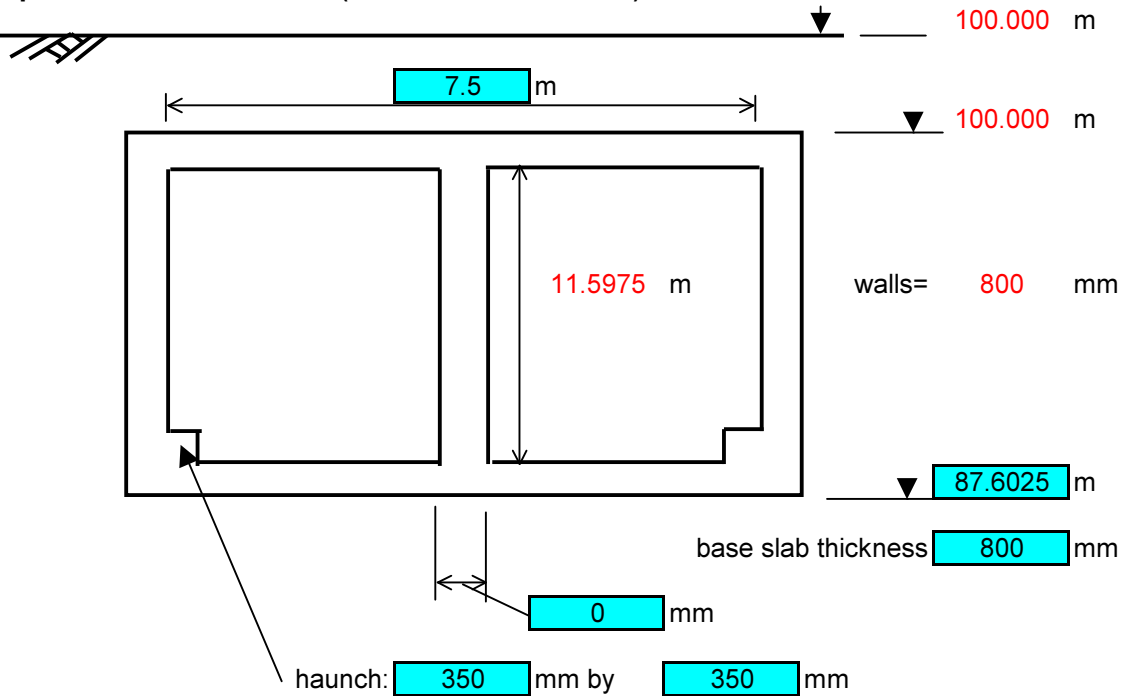
**Materials**

<b>Item</b>	<b>unit</b>	<b>Rate</b>
excavation	m3	60
concrete	m3	190
rebar	tonnes	1600
formwork/falsework	m2	140
SP&L<=4.6m deep	m2	0
4.6<SP&L<=6.7m deep	m2	0
6.7<SP&L<=10.6m deep	m2	0
10.6<SP&L<=13.7m deep	m2	0
13.7<SP&L<=16.8m deep	m2	0
16.8<SP&L<=20.0m deep	m2	0
20<SP&L<=25m deep	m2	0
backfill + compact	m3	40
surface reinstatement	m2	30

Section Cut and Cover  
Length of section: 78.47264 m

Section 1

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	8853.1	m3	
concrete=	2046.645	m3	
rebar=	245.6	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	1820.173	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	1945.7	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	714.101	m2	

**Calculated costs**

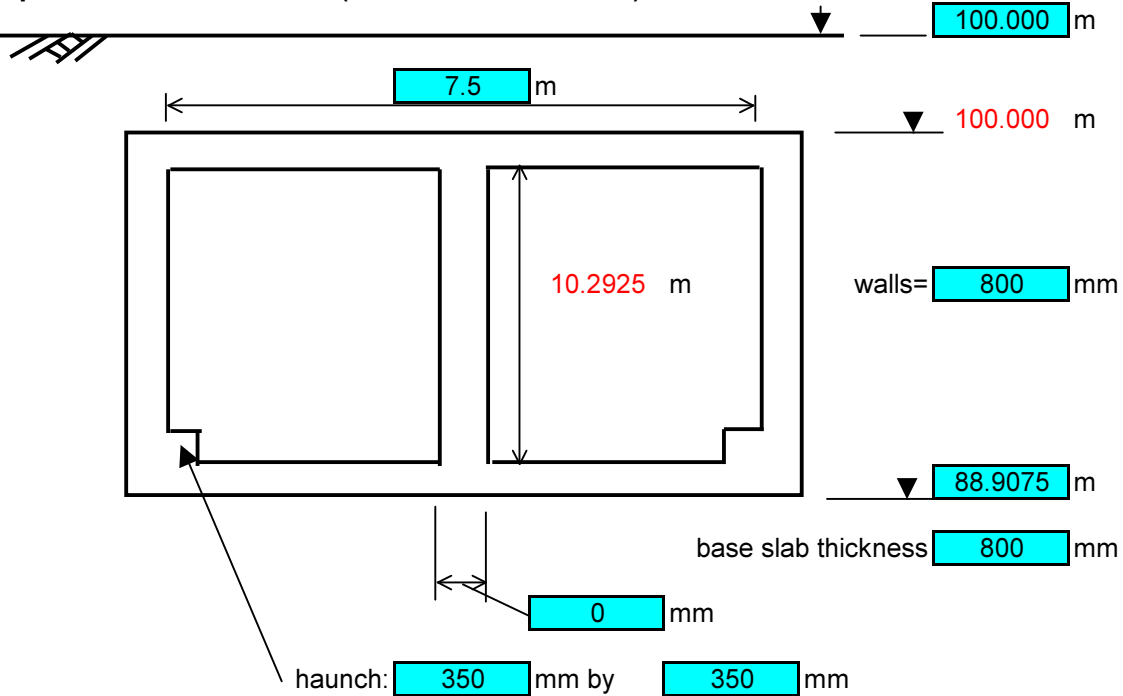
Item	Unit	Quantity	Rate	Cost
excavation	m3	8853.1	60	531184
concrete	m3	2046.645	190.0	388862.5
rebar	tonnes	245.6	1600	392955.8
formwork/falsework	m2	1820.173	140	254824.2
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	1945.7	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	714.101	30	21423.03

Total 1589250

Section Cut and Cover  
Length of section: 78.47264 m

Section 2

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	7921.2	m3	
concrete=	1882.794	m3	
rebar=	225.9	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	1615.359	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	1740.9	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	714.101	m2	



**Calculated costs**

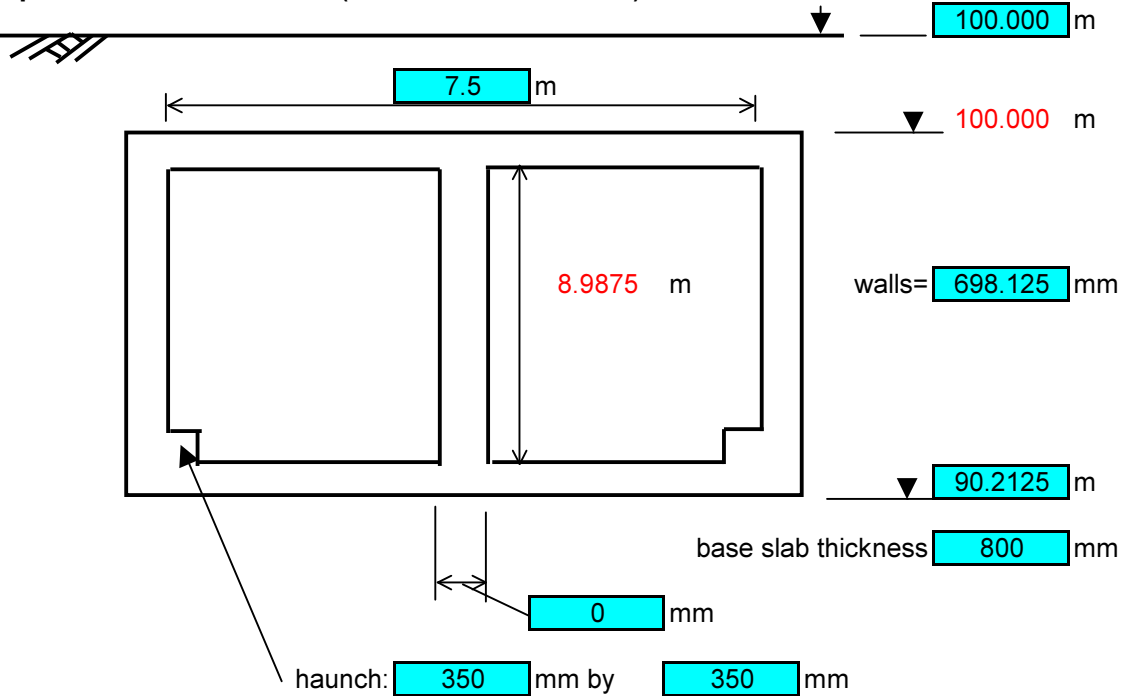
Item	Unit	Quantity	Rate	Cost
excavation	m3	7921.2	60	475269.9
concrete	m3	1882.794	190.0	357730.9
rebar	tonnes	225.9	1600	361496.5
formwork/falsework	m2	1615.359	140	226150.3
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	1740.9	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	714.101	30	21423.03

Total 1442071

Section Cut and Cover  
Length of section: 78.47264 m

Section 3

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	6832.8	m3	
concrete=	1562.453	m3	
rebar=	187.5	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	1410.546	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	1536.1	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	698.1122	m2	

**Calculated costs**

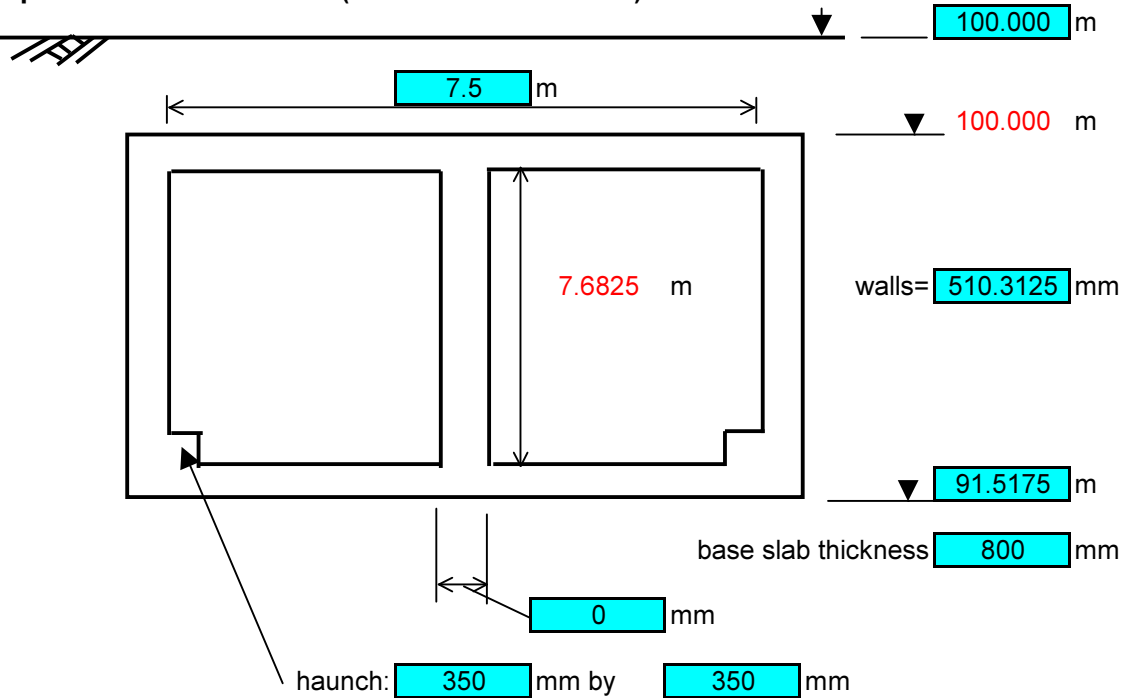
Item	Unit	Quantity	Rate	Cost
excavation	m3	6832.8	60	409966.4
concrete	m3	1562.453	190.0	296866
rebar	tonnes	187.5	1600	299990.9
formwork/falsework	m2	1410.546	140	197476.4
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	1536.1	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	698.1122	30	20943.37

Total 1225243

Section Cut and Cover  
Length of section: 78.47264 m

Section 4

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	5671.7	m3	
concrete=	1169.435	m3	
rebar=	140.3	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	1205.732	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	1331.3	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	668.6359	m2	

**Calculated costs**

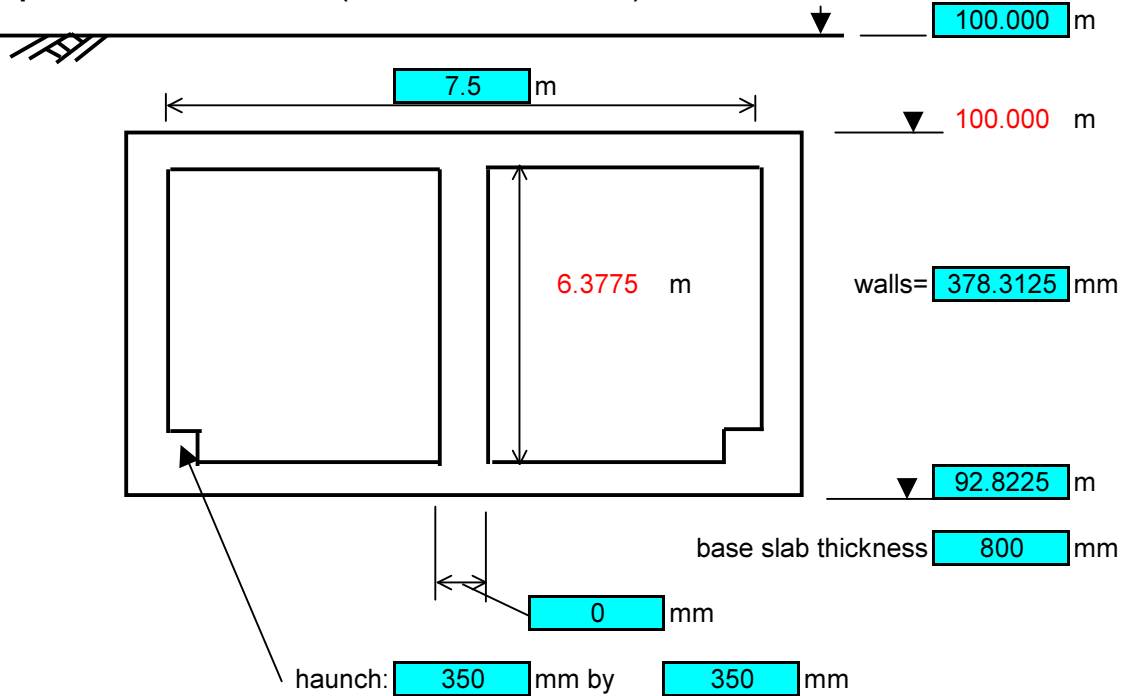
Item	Unit	Quantity	Rate	Cost
excavation	m3	5671.7	60	340302.3
concrete	m3	1169.435	190.0	222192.6
rebar	tonnes	140.3	1600	224531.5
formwork/falsework	m2	1205.732	140	168802.5
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	1331.3	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	668.6359	30	20059.08

Total 975887.9

Section Cut and Cover  
Length of section: 78.47264 m

Section 5

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	4650.4	m3	
concrete=	916.2211	m3	
rebar=	109.9	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	1000.919	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	1126.5	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	647.9192	m2	

**Calculated costs**

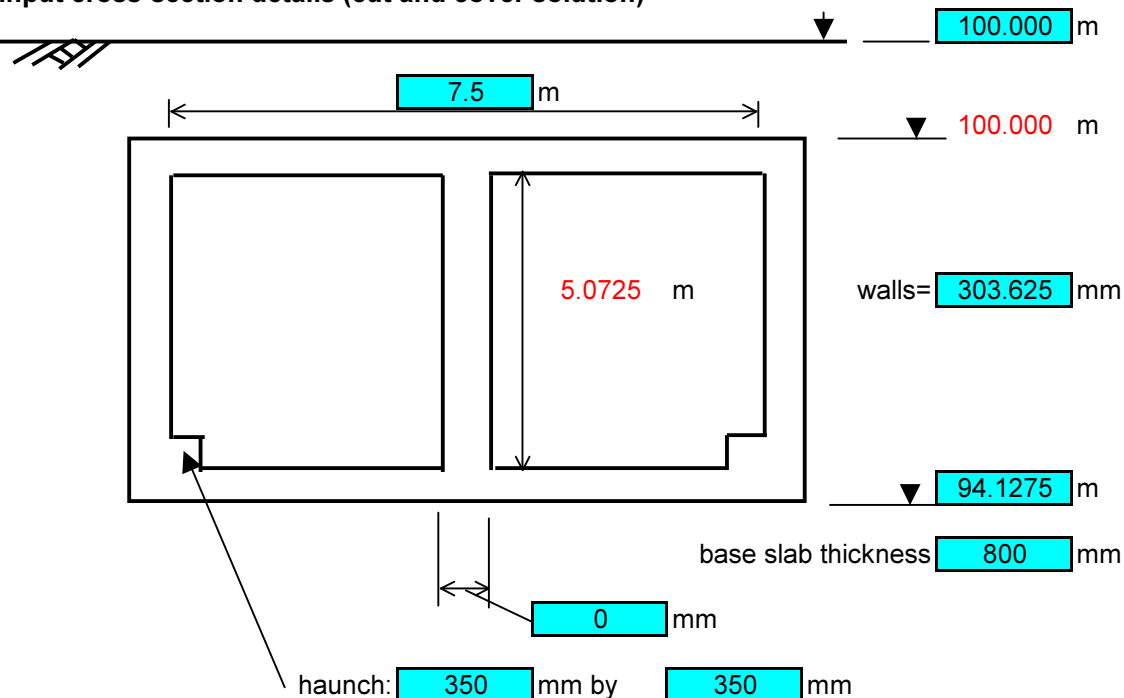
Item	Unit	Quantity	Rate	Cost
excavation	m3	4650.4	60	279026.4
concrete	m3	916.2211	190.0	174082
rebar	tonnes	109.9	1600	175914.5
formwork/falsework	m2	1000.919	140	140128.6
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	1126.5	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	647.9192	30	19437.57

Total 788589

Section Cut and Cover  
Length of section: 78.47264 m

Section 6

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	3736.1	m3	
concrete=	769.901	m3	
rebar=	92.4	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	796.1049	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	921.7	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	636.1973	m2	



**Newfoundland Fixed Link Pre-feasibility Study**  
**South Approach**  
**Bored Rail Tunnel**

**Date:** 8-Jun-04  
**Calculations by:** ANW  
**Page 2 of 2**

**Calculated costs**

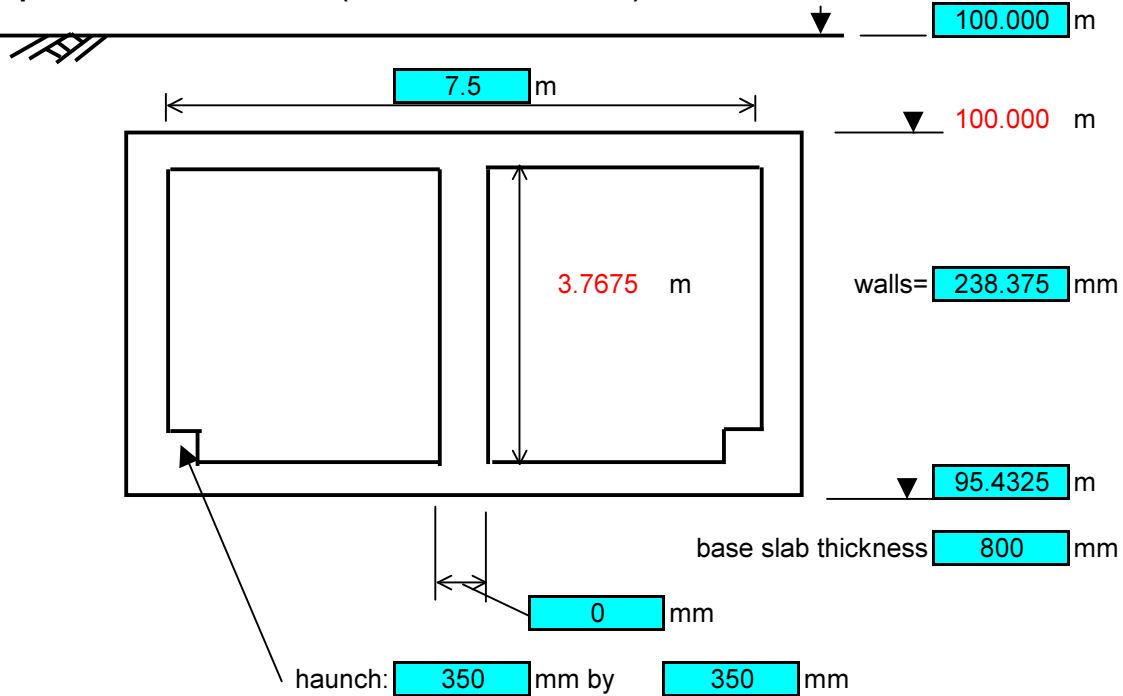
Item	Unit	Quantity	Rate	Cost
excavation	m3	3736.1	60	224164.1
concrete	m3	769.901	190.0	146281.2
rebar	tonnes	92.4	1600	147821
formwork/falsework	m2	796.1049	140	111454.7
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	921.7	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	636.1973	30	19085.92

Total 648806.9

Section Cut and Cover  
 Length of section: 78.47264 m

Section 7

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	2859.1	m3	
concrete=	660.9402	m3	
rebar=	79.3	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	591.2913	m2	
SP&L<=4.6m deep	716.8	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	625.9566	m2	

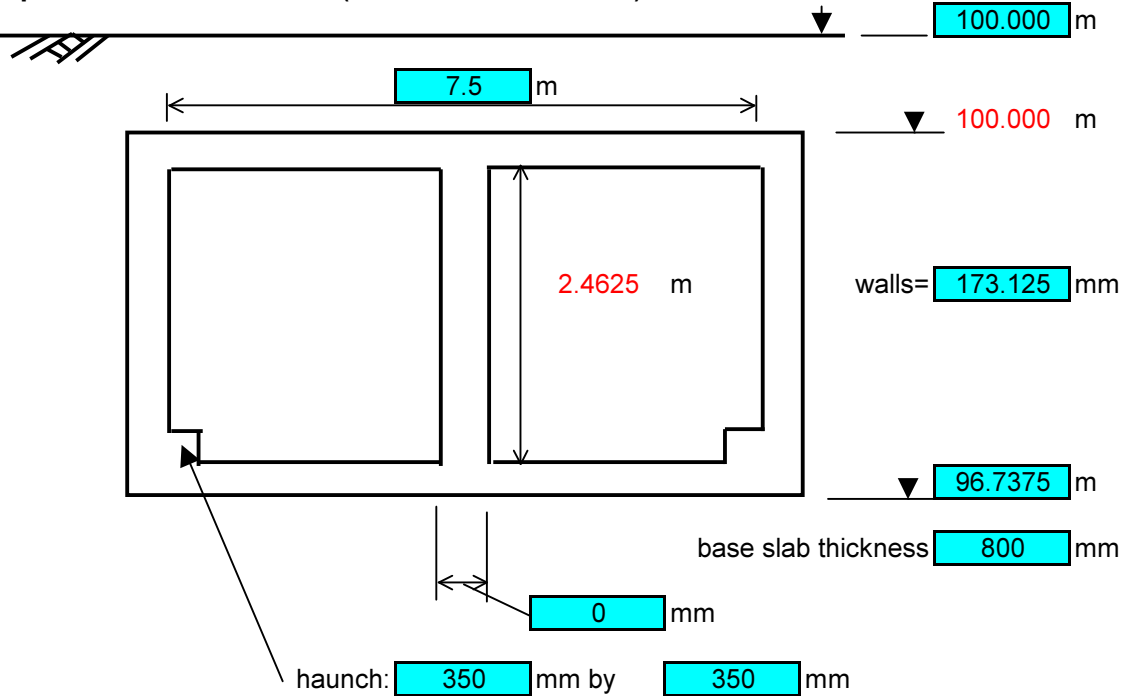
**Calculated costs**

Item	Unit	Quantity	Rate	Cost
excavation	m3	2859.1	60	171543.4
concrete	m3	660.9402	190.0	125578.6
rebar	tonnes	79.3	1600	126900.5
formwork/falsework	m2	591.2913	140	82780.79
SP&L<=4.6m deep	m2	716.8	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	625.9566	30	18778.7
Total				<u>525582</u>

Section Cut and Cover  
Length of section: 78.47264 m

Section 8

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	2008.8	m3	
concrete=	578.7075	m3	
rebar=	69.4	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	386.4778	m2	
SP&L<=4.6m deep	512.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	615.716	m2	

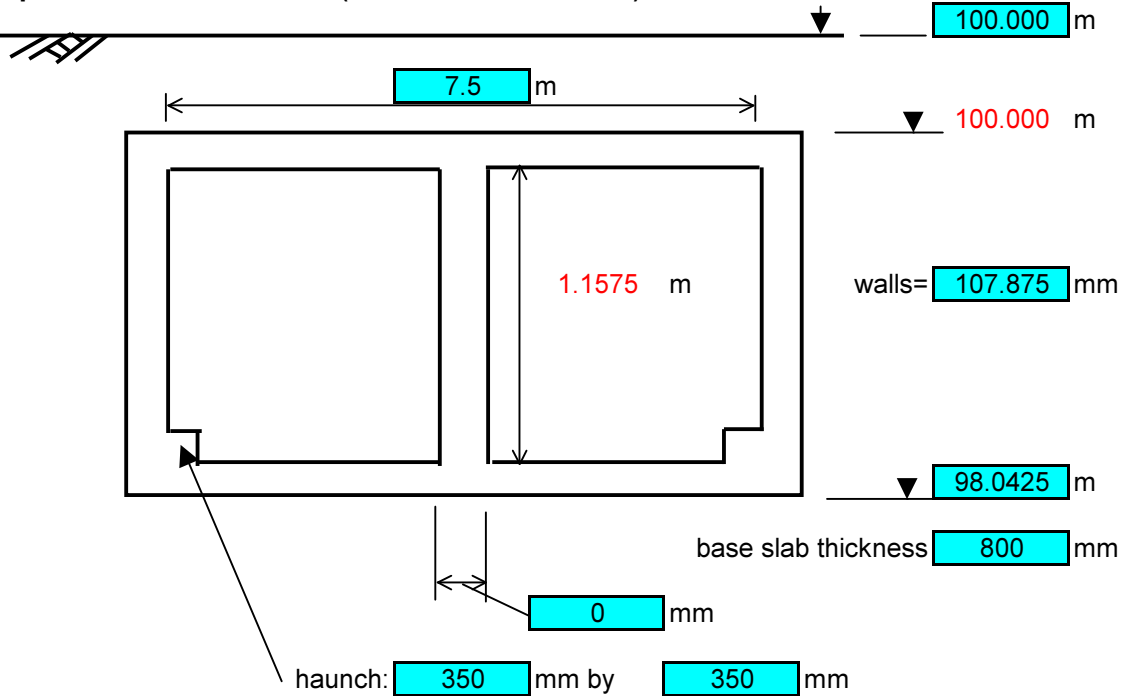
**Calculated costs**

Item	Unit	Quantity	Rate	Cost
excavation	m3	2008.8	60	120526.4
concrete	m3	578.7075	190.0	109954.4
rebar	tonnes	69.4	1600	111111.8
formwork/falsework	m2	386.4778	140	54106.89
SP&L<=4.6m deep	m2	512.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	615.716	30	18471.48
Total			414171	

Section Cut and Cover  
Length of section: 78.47264 m

Section 9

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	1185.2	m3	
concrete=	523.203	m3	
rebar=	62.8	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	181.6642	m2	
SP&L<=4.6m deep	307.2	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	605.4753	m2	

**Calculated costs**

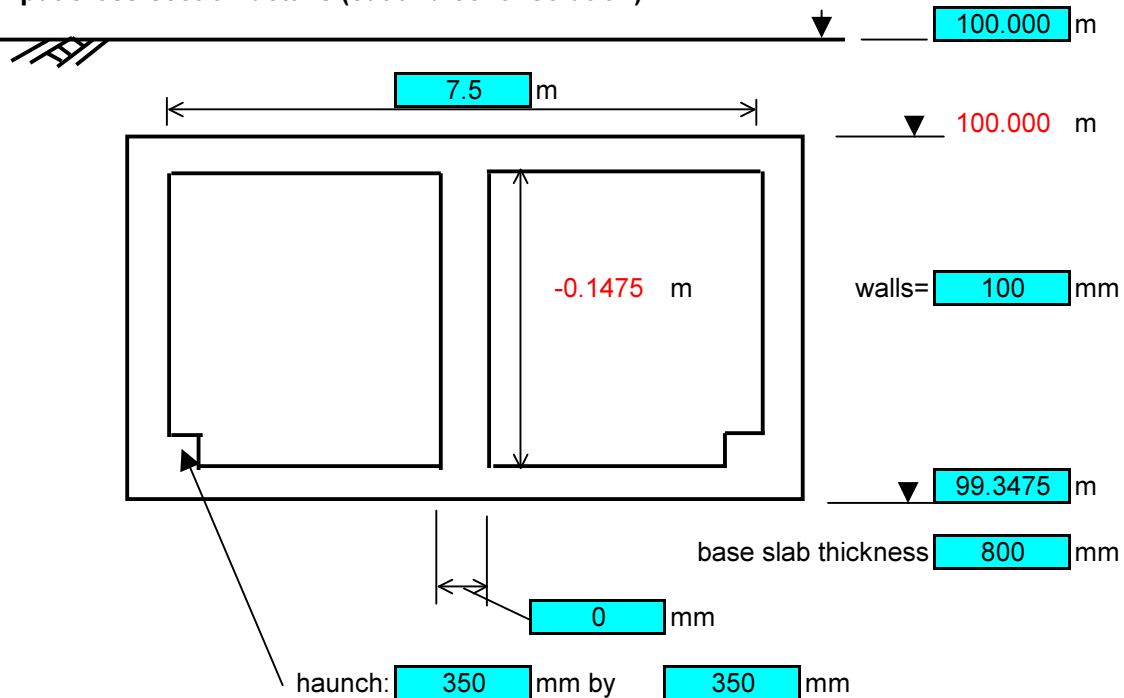
Item	Unit	Quantity	Rate	Cost
excavation	m3	1185.2	60	71113.07
concrete	m3	523.203	190.0	99408.58
rebar	tonnes	62.8	1600	100455
formwork/falsework	m2	181.6642	140	25432.98
SP&L<=4.6m deep	m2	307.2	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	605.4753	30	18164.26

Total 314573.9

Section Cut and Cover  
Length of section: 78.47264 m

Section 10

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	394.3	m3	
concrete=	500.3023	m3	
rebar=	60.0	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	-23.14943	m2	
SP&L<=4.6m deep	102.4	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	604.2393	m2	



**Calculated costs**

Item	Unit	Quantity	Rate	Cost
excavation	m3	394.3	60	23655.97
concrete	m3	500.3023	190.0	95057.44
rebar	tonnes	60.0	1600	96058.04
formwork/falsework	m2	-23.14943	140	-3240.92
SP&L<=4.6m deep	m2	102.4	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	604.2393	30	18127.18

Total 229657.7

**Newfoundland Fixed Link Pre-feasibility Study**  
**South Approach**  
**Bored Rail Tunnel**

**Date:** 8-Jun-04  
**Calculations by:** ANW

**Summary of Costs**

Markup for adjacent 0 %

<b>Section</b>	<b>Cost</b>
1	1589250
2	1442071
3	1225243
4	975887.9
5	788589
6	648806.9
7	525582
8	414171
9	314573.9
10	<u>229657.7</u>
Sub-total	<u>8153832</u>



**Newfoundland Fixed Link  
Pre-feasibility Study  
Preferred Fixed Link Option - TBM Bored Railway Tunnel  
Basis of Estimate**

**Scope**

Estimate includes:

- mobilisation of equipment and materials
- TBM bored tunnel excavation and lining
- TBM bored tunnel finishes
- north and south approaches to TBM bored rail tunnel
- north and south rail terminals including passenger facilities, maintenance facilities, tolling areas
- tunnel trackwork, drainage, ventilation, mechanical & electrical items
- shuttle trains, signalling, and OCS system
- allowances for indirect costs, contractor profit, and risk allowances

Estimate does not include:

- land purchase costs
- approach roads to the terminal areas (addressed separately)
- provision for bringing electrical power to the facility

**Assumptions**

Principal Assumptions:

- labour wages in accordance with Local 2003 Collective Agreement for Newfoundland & Labrador
- 7.5 metre internal diameter tunnel driven from Newfoundland side using an EPB type tunnel boring machine configured for rock
- tunnel approximately 26.3 kilometres in length
- 3 eight hour shifts 5 days per week for tunnelling operations
- tunnel lined with bolted precast concrete segmental tunnel liner
- average tunnelling advance rate of 81 metres per week
- tunnel drive encounters 14 faults each 100 metres wide where advance rate decreases by approximately 60%
- rail mounted loco and muck car system used for removal of tunnel spoil
- longitudinal system used for ventilation of the tunnel (permanent facility)

**Costs**

Cost assumptions

- All costs in 2004 Canadian dollars
- HST not included


**Newfoundland Fixed Link Pre-feasibility Study**  
**Road Connections**  
**Cost Estimate Summary**

The following is a summary of the costs of road works associated with the project.

<b>1</b>	<b>Road Tunnel Concept</b>	<b>Unit</b>	<b>Quantity</b>	<b>Unit Cost</b>	<b>Total Cost</b>
<b>1A</b>	<b>Newfoundland Side</b>				
0.1	New Road Construction	km	1.4	\$550,000	\$770,000
0.2	Intersection Construction	allowance	1	\$50,000	\$50,000
0.3	Marshalling Area	sq meter	36,000	\$45	\$1,620,000
	Sub Total Nfld Side				\$2,440,000
<b>1B</b>	<b>Labrador Side</b>				
0.1	New Road Construction	km	1	\$600,000	\$600,000
0.2	Intersection Construction	allowance	1	\$50,000	\$50,000
0.3	Marshalling Area	sq meter	36,000	\$57	\$2,052,000
	Sub Total Labrador Side				\$2,702,000
<b>2</b>	<b>Rail Tunnel Concept</b>	<b>Unit</b>	<b>Quantity</b>	<b>Unit Cost</b>	<b>Total Cost</b>
<b>2A</b>	<b>Newfoundland Side</b>				
0.1	New Road Construction	km	1.5	\$550,000	\$825,000
0.2	Intersection Construction	allowance	1	\$50,000	\$50,000
0.3	Marshalling Area	sq meter	36,000	\$45	\$1,620,000
	Sub Total Nfld Side				\$2,495,000
<b>2B</b>	<b>Labrador Side</b>				
0.1	New Road Construction	km	1	\$600,000	\$600,000

0.2	Intersection Construction	allowance	1	\$50,000	\$50,000
0.3	Marshalling Area	sq meter	36,000	\$57	\$2,052,000
	Sub Total Labrador Side				\$2,702,000

3	Quebec North Shore					
0.1	New Road Construction	km	350	\$720,000	\$252,000,000	
0.2	Road Upgrading	km	40	\$360,000	\$14,400,000	
0.3	Branch Roads	km	20	\$312,000	\$6,240,000	
0.4	Bridges	ea	9	\$1,200,000	\$10,800,000	
Sub Total Quebec North Shore Roads					\$283,440,000	
Total Road Costs						
Road Tunnel					\$288,582,000	
Rail Tunnel					\$288,637,000	

 Hatch Mott MacDonald		Newfoundland Fixed Link Pre-feasibility - TBM Bored Railway Tunnel - Cost Summary	
BORED TUNNEL CONSTRUCTION COSTS			
ITEM	UNIT	MAIN TUNNEL	
MOBILIZATION & DEMOBILIZATION	LS	8,000,000	
TUNNELLING	LS	375,031,000	
TUNNEL FINISHES	LS	75,539,979	
NORTH APPROACH STRUCTURES	LS	7,770,000	
SOUTH APPROACH STRUCTURES	LS	8,150,000	
RAIL TRACK	LS	13,923,100	
TUNNEL DRAINAGE	LS	7,820,000	
UTILITY DIVERSIONS	LS	1,000,000	
MONITORING	LS	1,000,000	
SUBTOTAL CIVIL		\$498,234,079	
CIVIL CONTINGENCIES			
CONTINGENCY	40%	\$199,293,632	
TOTAL CIVIL		\$697,527,711	
M&E, ROLLING STOCK, RAIL HARDWARE AND FINISHING WORK			
ROLLING STOCK, TERMINALS, OCS, ETC	LS	\$48,000,000	
VENTILATION EQUIPMENT	LS	\$3,000,000	
VENTILATION SHAFTS AND BUILDINGS x 2	LS	\$0	
FIRE SUPPRESSION SYSTEM	LS	\$2,000,000	
CONTROL CENTRE	LS	\$1,000,000	
SIGNALLING	LS	\$1,000,000	
LIGHTING	LS	\$1,000,000	
CCTV SYSTEM	LS	\$0	
GAS DETECTION	LS	\$900,000	
SUBSTATION, GENERATORS, UPS	LS	\$2,000,000	
SUBTOTAL M&E AND FINISHING		\$58,900,000	
CONTINGENCIES	20%	\$11,780,000	
TOTAL M&E AND FINISHING		\$70,680,000	
TOTAL CIVIL, M&E AND FINISHING		\$768,207,711	
ALLOWANCES			
CONTRACTOR OH	15%	\$115,231,157	
CONTRACTOR PROFIT	15%	\$115,231,157	
CONSTRUCTION TOTAL		\$999,000,000	
PRE-CONSTRUCTION AND SUPERVISION			
FEASIBILITY STUDY	LS	\$11,000,000	
ENVIRONMENTAL ASSESSMENT	LS	\$4,000,000	
DESIGN	5%	\$49,950,000	
CONSTRUCTION MANAGEMENT	10%	\$99,900,000	
OWNERS COSTS	2%	\$19,980,000	
PRE-CONSTRUCTION TOTAL		\$184,830,000	
GRAND TOTAL		\$1,183,830,000	





## Newfoundland Fixed Link Pre-feasibility - TBM Bored Railway Tunnel - Civil Costs

ITEM	UNIT	QTY	RATE	TOTAL
MOBILIZATION	LS	1.00	\$8,000,000	\$8,000,000
TUNNELLING				
- TBM launch shaft	LS	1.00	\$0	\$0
- Set-up TBM	LS	1.00	\$1,474,000	\$1,474,000
- Tunnel drive	LS	1.00	\$368,001,000	\$368,001,000
- TBM maintenance	LS	1.00	\$960,000	\$960,000
- Remove TBM	LS	1.00	\$812,000	\$812,000
- Clean tunnel	LS	1.00	\$3,784,000	\$3,784,000
- Structural finishes	LS	1.00	\$75,539,979	\$75,539,979
- TBM reception shaft	LS	1.00	\$0	\$0
NORTH APPROACH STRUCTURES				
- Cut and cover approach	LS	1.00	\$7,770,000	\$7,770,000
SOUTH APPROACH STRUCTURES				
- cut and cover approach	LS	1.00	\$8,150,000	\$8,150,000
DRAINAGE				
Drainage sumps and piping	LS	1.00	\$7,820,000	\$7,820,000
RAIL TRACK				
- bored tunnel	m2	40,050.00	\$20	\$801,000
- north approach	m2	31,150.00	\$20	\$623,000
- south approach	m2	1,602.00	\$30	\$48,060
SUB-TOTAL				\$483,783,039



## Detailed Cost Estimate Report

<b>Project:</b>	Newfoundland Fixed Link Pre-feasibility Study	<b>Project Number:</b>	213789
<b>Estimate Description:</b>	Set-up TBM	<b>Parent Estimate ID:</b>	1563
<b>Tunnel Name:</b>	Single Rail Bored	<b>Project Phase:</b>	Conceptual
<b>Construction Activity:</b>	Erect TBM Only	<b>Geology Type:</b>	Not Applicable
<b>Tunnel Technique:</b>	EPB TBM - Precast segmental	<b>Estimate Date:</b>	May 31, 2004
<b>Estimate Definition ID:</b>	2636	<b>Tunnel Characteristics ID:</b>	843

### Tunnel Characteristics

**Finished Diameter:** 7.5 m

### Activity Details

**Shift Arrangement** 3 - 8 hour shifts x 7 days per week

**Duration of Activity** 4.5 Weeks

**Total Number of Shifts** 94.5

Resource Name	Unit Rate	UOM	Unit Quantity	Resource Quantity	Total
<b>Labor</b>					
Pit boss	52.29	\$/hr	756.00	1.00	39,531
Tunnel miner	48.89	\$/hr	756.00	2.00	73,922
Shaft bottom	48.44	\$/hr	756.00	3.00	109,862
Tunnel fitter	49.34	\$/hr	756.00	1.00	37,301
Tunnel electrician	49.34	\$/hr	756.00	1.00	37,301
Shaft top	47.99	\$/hr	756.00	1.00	36,280
Crane operator	49.34	\$/hr	756.00	2.00	74,602
Surface laborer	47.99	\$/hr	756.00	1.00	36,280
Equipment laborer	48.44	\$/hr	756.00	1.00	36,621
				<b>13.00</b>	<b>\$481,701</b>
<b>Plant</b>					
Loco	5,000.00	\$/wk	4.50	1.00	22,500
Muck cars & grout cars	1,900.00	\$/wk	4.50	6.00	51,300
Flat cars	310.00	\$/wk	4.50	2.00	2,790
Transformers & switchgear - LV	750.00	\$/wk	4.50	1.00	3,375
Small tools	2,600.00	\$/wk	4.50	1.00	11,700
Shaft crane	9,000.00	\$/wk	4.50	1.00	40,500
Erection crane	10,000.00	\$/wk	4.50	1.00	45,000
Compressors	950.00	\$/wk	4.50	1.00	4,275
Generators	2,000.00	\$/wk	4.50	1.00	9,000
Transformers & switchgear - HV	5,200.00	\$/wk	4.50	1.00	23,400
Loaders	2,300.00	\$/wk	4.50	1.00	10,350
					<b>\$224,190</b>
<b>Consumables</b>					
Electrical power	0.00	\$/kwh	756.00	300.00	0
Gas oil	0.00	\$/L	0.00	1.00	0

**Estimate Definition ID:** 2636

**Estimated by:**

**Printed by:** whit2782, 8/16/04 11:42:50 AM

**Page 1 of 2**

**Checked by:**

Resource Name	Unit Rate	UOM	Unit Quantity	Resource Quantity	Total
Lubrication materials	0.00	\$/wk	4.50	1.00	0
Filters etc.	0.00	\$/wk	4.50	1.00	0
Hydraulic oil	0.00	\$/L	0.00	1.00	0
Other consumables	0.00	\$/wk	4.50	1.00	0
					\$0
<b>Materials</b>					
Temporary materials	2,000.00	\$/wk	4.50	1.00	9,000
Thrust frame	5,000.00	\$/wk	4.50	1.00	22,500
					\$31,500
<b>Total Estimated Cost:</b>					\$737,391



## Detailed Cost Estimate Report

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**Project:** Newfoundland Fixed Link Pre-feasibility Study  
**Estimate Description:** Drive from Newland  
**Tunnel Name:** Rail Bored 2 TBM NF  
**Construction Activity:** TBM Tunneling  
**Tunnel Technique:** EPB TBM - Precast segmental  
**Estimate Definition ID:** 2736

**Project Number:** 213789  
**Parent Estimate ID:** 2728  
**Project Phase:** Conceptual  
**Geology Type:** Not Applicable  
**Estimate Date:** September 13, 2004  
**Tunnel Characteristics ID:** 885

### Tunnel Characteristics

**Tunnel Length:** 13,161 m  
**Finished Diameter:** 7.5 m  
**Initial Support Type:** Not Applicable  
**Initial Support Thickness:** 0 m  
**Final Lining Thickness:** 0.35 m  
**Grout Thickness:** 0.1 m

### Theoretical Excavation Volumes

**Total Neat Excavation:** 729,352 Cubic Metres  
**Initial Lining Volume:** 0 Cubic Metres  
**Final Lining Volume:** 113,599 Cubic Metres  
**Theoretical Grout Volume:** 34,318 Cubic Metres

### Normal Excavation/Support Cycle

**Excavation Cycle Length:** 1.5 Metres  
**Excavate:** 24 Minutes  
**Erect Support:** 27 Minutes  
**Extend Services:** 0 Minutes  
**Total Cycle Time:** 51 Minutes

### Difficult Excavation/Support Cycle

**Length of Difficult Excavation:** 1400 Metres  
**Excavate:** 73 Minutes  
**Erect Support:** 54 Minutes  
**Extend Services:** 0 Minutes  
**Total Cycle Time:** 127 Minutes

### Reduction Factors

**Machine availability:** 80 %  
**Back up efficiency:** 55 %  
**Planned maintenance:** 5 %  
**Learning curve efficiency:** 40 %  
**Learning curve duration time:** 8 Weeks

**Learning Curve Rate:** 7.1 m/day  
**Experienced Advance Rate:** 17.7 m/day  
**Difficult Advance Rate:** 7.1 m/day

### TBM Skidding Through Excavation

**Duration of skidding:** 0 Weeks  
**Length of skidding:** 0 Metres

### Advance Rate and Shift Details

**Shift Arrangement:** 3 - 8 hour shifts x 7 days per week  
**Avg. Drive Advance per Shift:** 4.90 Metres  
**Avg. Drive Advance per Day:** 15 Metres  
**Avg. Drive Advance per Week:** 103 Metres  
**Duration of Tunneling (Incl. Skid):** 127.84 Weeks  
**Total number of shifts (Incl. Skid):** 2,685

	Metres	Days
<b>Learning Curve Drive:</b>	397	56
<b>Experienced Drive:</b>	11,364	642
<b>Difficult Drive:</b>	1,400	197
<b>Skidding Portion:</b>	0	0

Resource Name	Unit Rate	UOM	Unit Quantity	Resource Quantity	Total
<b>Labor</b>					
Pit boss	52.29	\$/hr	21,481.00	1.00	1,123,241
Working foreman	52.29	\$/hr	21,481.00	2.00	2,246,483
Tunnel miner	48.89	\$/hr	21,481.00	3.00	3,150,618
Tunnel laborer	48.44	\$/hr	21,481.00	4.00	4,162,159
Loco driver	49.34	\$/hr	21,481.00	3.00	3,179,618
Shaft bottom	48.44	\$/hr	21,481.00	1.00	1,040,540
TBM operator	49.34	\$/hr	21,481.00	1.00	1,059,873
Tunnel fitter	49.34	\$/hr	21,481.00	1.00	1,059,873
Tunnel electrician	49.34	\$/hr	21,481.00	1.00	1,059,873
Shaft top	47.99	\$/hr	21,481.00	2.00	2,061,746
Crane operator	49.34	\$/hr	21,481.00	1.00	1,059,873
Surface laborer	47.99	\$/hr	21,481.00	4.00	4,123,493
Equipment laborer	48.44	\$/hr	21,481.00	4.00	4,162,159
				<b>28.00</b>	<b>\$29,489,546</b>
<b>Plant</b>					
TBM	300,000.00	\$/m2	55.42	0.80	13,300,800
TBM backup	1,430,000.00	\$/Nr	1.00	1.00	1,430,000
Loco	5,000.00	\$/wk	127.84	3.00	1,917,600
Muck cars & grout cars	1,900.00	\$/wk	127.84	21.00	5,100,816
Flat cars	310.00	\$/wk	127.84	6.00	237,782
Manriders	310.00	\$/wk	127.84	2.00	79,261
Track	130.00	\$/m	13,161.00	1.00	1,710,930
Air pipe	30.00	\$/m	13,161.00	1.00	394,830
Water pipe	25.00	\$/m	13,161.00	1.00	329,025
Pump main	50.00	\$/m	13,161.00	1.00	658,050
Cabling	80.00	\$/m	13,161.00	1.00	1,052,880
Lighting	30.00	\$/m	13,161.00	1.00	394,830
Vent ducting	30.00	\$/m	13,161.00	1.00	394,830
Grout mixers	7,100.00	\$/wk	127.84	1.00	907,664
Grout pumps	3,400.00	\$/wk	127.84	1.00	434,656
Grout hoses & pipes	196.00	\$/wk	127.84	2.00	50,113
Transformers & switchgear - LV	750.00	\$/wk	127.84	2.00	191,760
Small tools	2,600.00	\$/wk	127.84	1.00	332,384
Shaft crane	9,000.00	\$/wk	127.84	1.00	1,150,560
Compressors	950.00	\$/wk	127.84	1.00	121,448
Low pressure C/A system	3,800.00	\$/wk	127.84	1.00	485,792
Pipework and controls	655.00	\$/wk	127.84	2.00	167,470
Generators	2,000.00	\$/wk	127.84	1.00	255,680
Transformers & switchgear - HV	5,200.00	\$/wk	127.84	1.00	664,768
Surface fans	800.00	\$/wk	127.84	2.00	204,544
Loaders	2,300.00	\$/wk	127.84	2.00	588,064
Other surface plant	2,600.00	\$/wk	127.84	1.00	332,384

Resource Name	Unit Rate	UOM	Unit Quantity	Resource Quantity	Total
Tunnel C/A system	40,000.00	\$/wk	127.84	1.00	5,113,600
					\$38,002,522
<b>Consumables</b>					
Electrical power	0.10	\$/kwh	21,481.00	3,000.00	6,444,300
Gas oil	0.45	\$/L	48,000.00	1.00	21,600
Lubrication materials	90.00	\$/wk	127.84	1.00	11,506
TBM spares, cutters	250.00	\$/m	13,161.00	1.00	3,290,250
Filters etc.	300.00	\$/wk	127.84	1.00	38,352
Hydraulic oil	0.90	\$/L	32,000.00	1.00	28,800
Other consumables	160.00	\$/wk	127.84	1.00	20,454
Tail seal grease	100.00	\$/m	13,161.00	1.00	1,316,100
					\$11,171,362
<b>Materials</b>					
Concrete lining rings	8,300.31	\$/Nr	8,774.00	1.00	72,826,912
Gaskets	130.00	\$/m	13,161.00	1.00	1,710,930
Bolts	12.00	\$/Nr	1,765.00	30.00	635,400
Grout	145.00	\$/m3	34,318.00	1.00	4,976,110
Grout plugs	0.50	\$/Nr	1,765.00	7.00	6,178
Packers	10.00	\$/Nr	3,633.00	12.00	435,960
Temporary materials	2,250.00	\$/wk	127.84	1.00	287,640
Other materials	0.00	\$/t	0.00	1.00	0
					\$80,879,129
<b>Subcontracts</b>					
Soil disposal	20.00	\$/m3	729,352.00	1.50	21,880,560
					\$21,880,560
<b>Total Estimated Cost:</b>					\$181,423,120
<b>Total Estimated Cost per Metre:</b>					\$13,785
<b>Total Estimated Cost per Week:</b>					\$1,419,180
<b>Total Estimated Cost per Shift:</b>					\$67,567



## Detailed Cost Estimate Report

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**Project:** Newfoundland Fixed Link Pre-feasibility Study  
**Estimate Description:** Drive from Labrador  
**Tunnel Name:** Rail Bored 2 TBM LB  
**Construction Activity:** TBM Tunneling  
**Tunnel Technique:** EPB TBM - Precast segmental  
**Estimate Definition ID:** 2737

**Project Number:** 213789  
**Parent Estimate ID:** 2728  
**Project Phase:** Conceptual  
**Geology Type:** Not Applicable  
**Estimate Date:** September 13, 2004  
**Tunnel Characteristics ID:** 886

### Tunnel Characteristics

**Tunnel Length:** 13,161 m  
**Finished Diameter:** 7.5 m  
**Initial Support Type:** Not Applicable  
**Initial Support Thickness:** 0 m  
**Final Lining Thickness:** 0.35 m  
**Grout Thickness:** 0.1 m

### Theoretical Excavation Volumes

**Total Neat Excavation:** 729,352 Cubic Metres  
**Initial Lining Volume:** 0 Cubic Metres  
**Final Lining Volume:** 113,599 Cubic Metres  
**Theoretical Grout Volume:** 34,318 Cubic Metres

### Normal Excavation/Support Cycle

**Excavation Cycle Length:** 1.5 Metres  
**Excavate:** 24 Minutes  
**Erect Support:** 27 Minutes  
**Extend Services:** 0 Minutes  
**Total Cycle Time:** 51 Minutes

### Difficult Excavation/Support Cycle

**Length of Difficult Excavation:** 1400 Metres  
**Excavate:** 73 Minutes  
**Erect Support:** 54 Minutes  
**Extend Services:** 0 Minutes  
**Total Cycle Time:** 127 Minutes

### Reduction Factors

**Machine availability:** 80 %  
**Back up efficiency:** 55 %  
**Planned maintenance:** 5 %  
**Learning curve efficiency:** 40 %  
**Learning curve duration time:** 8 Weeks

**Learning Curve Rate:** 7.1 m/day  
**Experienced Advance Rate:** 17.7 m/day  
**Difficult Advance Rate:** 7.1 m/day

### TBM Skidding Through Excavation

**Duration of skidding:** 0 Weeks  
**Length of skidding:** 0 Metres

### Advance Rate and Shift Details

**Shift Arrangement:** 3 - 8 hour shifts x 7 days per week  
**Avg. Drive Advance per Shift:** 4.90 Metres  
**Avg. Drive Advance per Day:** 15 Metres  
**Avg. Drive Advance per Week:** 103 Metres  
**Duration of Tunneling (Incl. Skid):** 127.84 Weeks  
**Total number of shifts (Incl. Skid):** 2,685

	Metres	Days
<b>Learning Curve Drive:</b>	397	56
<b>Experienced Drive:</b>	11,364	642
<b>Difficult Drive:</b>	1,400	197
<b>Skidding Portion:</b>	0	0

Resource Name	Unit Rate	UOM	Unit Quantity	Resource Quantity	Total
<b>Labor</b>					
Pit boss	52.29	\$/hr	21,481.00	1.00	1,123,241
Working foreman	52.29	\$/hr	21,481.00	2.00	2,246,483
Tunnel miner	48.89	\$/hr	21,481.00	3.00	3,150,618
Tunnel laborer	48.44	\$/hr	21,481.00	4.00	4,162,159
Loco driver	49.34	\$/hr	21,481.00	3.00	3,179,618
Shaft bottom	48.44	\$/hr	21,481.00	1.00	1,040,540
TBM operator	49.34	\$/hr	21,481.00	1.00	1,059,873
Tunnel fitter	49.34	\$/hr	21,481.00	1.00	1,059,873
Tunnel electrician	49.34	\$/hr	21,481.00	1.00	1,059,873
Shaft top	47.99	\$/hr	21,481.00	2.00	2,061,746
Crane operator	49.34	\$/hr	21,481.00	1.00	1,059,873
Surface laborer	47.99	\$/hr	21,481.00	4.00	4,123,493
Equipment laborer	48.44	\$/hr	21,481.00	4.00	4,162,159
				<b>28.00</b>	<b>\$29,489,546</b>
<b>Plant</b>					
TBM	300,000.00	\$/m2	55.42	0.80	13,300,800
TBM backup	1,430,000.00	\$/Nr	1.00	1.00	1,430,000
Loco	5,000.00	\$/wk	127.84	3.00	1,917,600
Muck cars & grout cars	1,900.00	\$/wk	127.84	21.00	5,100,816
Flat cars	310.00	\$/wk	127.84	6.00	237,782
Manriders	310.00	\$/wk	127.84	2.00	79,261
Track	130.00	\$/m	13,161.00	1.00	1,710,930
Air pipe	30.00	\$/m	13,161.00	1.00	394,830
Water pipe	25.00	\$/m	13,161.00	1.00	329,025
Pump main	50.00	\$/m	13,161.00	1.00	658,050
Cabling	80.00	\$/m	13,161.00	1.00	1,052,880
Lighting	30.00	\$/m	13,161.00	1.00	394,830
Vent ducting	30.00	\$/m	13,161.00	1.00	394,830
Grout mixers	7,100.00	\$/wk	127.84	1.00	907,664
Grout pumps	3,400.00	\$/wk	127.84	1.00	434,656
Grout hoses & pipes	196.00	\$/wk	127.84	2.00	50,113
Transformers & switchgear - LV	750.00	\$/wk	127.84	2.00	191,760
Small tools	2,600.00	\$/wk	127.84	1.00	332,384
Shaft crane	9,000.00	\$/wk	127.84	1.00	1,150,560
Compressors	950.00	\$/wk	127.84	1.00	121,448
Low pressure C/A system	3,800.00	\$/wk	127.84	1.00	485,792
Pipework and controls	655.00	\$/wk	127.84	2.00	167,470
Generators	2,000.00	\$/wk	127.84	1.00	255,680
Transformers & switchgear - HV	5,200.00	\$/wk	127.84	1.00	664,768
Surface fans	800.00	\$/wk	127.84	2.00	204,544
Loaders	2,300.00	\$/wk	127.84	2.00	588,064
Other surface plant	2,600.00	\$/wk	127.84	1.00	332,384



Resource Name	Unit Rate	UOM	Unit Quantity	Resource Quantity	Total
Tunnel C/A system	40,000.00	\$/wk	127.84	1.00	5,113,600
					\$38,002,522
<b>Consumables</b>					
Electrical power	0.18	\$/kwh	21,481.00	3,000.00	11,599,740
Gas oil	0.45	\$/L	48,000.00	1.00	21,600
Lubrication materials	90.00	\$/wk	127.84	1.00	11,506
TBM spares, cutters	250.00	\$/m	13,161.00	1.00	3,290,250
Filters etc.	300.00	\$/wk	127.84	1.00	38,352
Hydraulic oil	0.90	\$/L	32,000.00	1.00	28,800
Other consumables	160.00	\$/wk	127.84	1.00	20,454
Tail seal grease	100.00	\$/m	13,161.00	1.00	1,316,100
					\$16,326,802
<b>Materials</b>					
Concrete lining rings	8,300.31	\$/Nr	8,774.00	1.00	72,826,912
Gaskets	130.00	\$/m	13,161.00	1.00	1,710,930
Bolts	12.00	\$/Nr	1,765.00	30.00	635,400
Grout	145.00	\$/m3	34,318.00	1.00	4,976,110
Grout plugs	0.50	\$/Nr	1,765.00	7.00	6,178
Packers	10.00	\$/Nr	3,633.00	12.00	435,960
Temporary materials	2,250.00	\$/wk	127.84	1.00	287,640
Other materials	0.00	\$/t	0.00	1.00	0
					\$80,879,129
<b>Subcontracts</b>					
Soil disposal	20.00	\$/m3	729,352.00	1.50	21,880,560
					\$21,880,560
<b>Total Estimated Cost:</b>					\$186,578,560
<b>Total Estimated Cost per Metre:</b>					\$14,177
<b>Total Estimated Cost per Week:</b>					\$1,459,508
<b>Total Estimated Cost per Shift:</b>					\$69,487



## Detailed Cost Estimate Report

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<b>Project:</b>	Newfoundland Fixed Link Pre-feasibility Study	<b>Project Number:</b>	213789
<b>Estimate Description:</b>	Maintain TBM	<b>Parent Estimate ID:</b>	2638
<b>Tunnel Name:</b>	Rail Bored 2 TBM	<b>Project Phase:</b>	Conceptual
<b>Construction Activity:</b>	TBM Maintenance	<b>Geology Type:</b>	Not Applicable
<b>Tunnel Technique:</b>	EPB TBM - Precast segmental	<b>Estimate Date:</b>	August 17, 2004
<b>Estimate Definition ID:</b>	2729	<b>Tunnel Characteristics ID:</b>	879

### Tunnel Characteristics

**Finished Diameter:** 7.5 m

### Activity Details

**Shift Arrangement** 1 - 6 hour shifts x 1 days per week

**Duration of Activity** 127 Weeks

**Total Number of Shifts** 127

Resource Name	Unit Rate	UOM	Unit Quantity	Resource Quantity	Total
<b>Labor</b>					
Working foreman	52.29	\$/hr	762.00	1.50	59,767
Loco driver	49.34	\$/hr	762.00	1.50	56,396
Shaft bottom	48.44	\$/hr	762.00	1.50	55,367
TBM operator	49.34	\$/hr	762.00	1.50	56,396
Tunnel fitter	49.34	\$/hr	762.00	1.50	56,396
Tunnel electrician	49.34	\$/hr	762.00	1.50	56,396
Shaft top	47.99	\$/hr	762.00	1.50	54,853
Surface laborer	47.99	\$/hr	762.00	1.50	54,853
				<b>12.00</b>	<b>\$450,422</b>
<b>Consumables</b>					
Electrical power	0.10	\$/kwh	762.00	600.00	45,720
Gas oil	0.45	\$/L	0.00	1.00	0
Other consumables	0.00	\$/wk	127.00	1.00	0
					<b>\$45,720</b>
<b>Materials</b>					
Temporary materials	200.00	\$/wk	127.00	1.00	25,400
Other materials	0.00	\$/t	0.00	1.00	0
					<b>\$25,400</b>

**Total Estimated Cost:** \$521,542



### Detailed Cost Estimate Report

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<b>Project:</b>	Newfoundland Fixed Link Pre-feasibility Study	<b>Project Number:</b>	213789
<b>Estimate Description:</b>	Clean tunnel	<b>Parent Estimate ID:</b>	1562
<b>Tunnel Name:</b>	Single Rail Bored	<b>Project Phase:</b>	Conceptual
<b>Construction Activity:</b>	Tunnel Clean Up	<b>Geology Type:</b>	Not Applicable
<b>Tunnel Technique:</b>	EPB TBM - Precast segmental	<b>Estimate Date:</b>	May 21, 2004
<b>Estimate Definition ID:</b>	2639	<b>Tunnel Characteristics ID:</b>	843

#### Tunnel Characteristics

<b>Tunnel Length:</b>	26,322 m
<b>Finished Diameter:</b>	7.5 m (Circular Tunnels)
<b>Excavated Cross Section:</b>	0 m2 (Non-circular Tunnels)
<b>Excavated Perimeter:</b>	0 m (Non-circular Tunnels)

#### Productivity Cycle

<b>Section Length</b>	30 Metres
<b>Vent Line Removal Time</b>	120 Minutes
<b>Track Removal Time</b>	60 Minutes
<b>Temp Lighting Removal Time</b>	60 Minutes
<b>Clean Up Time</b>	120 Minutes
<b>Total Cycle Time</b>	360 Minutes

#### Reduction Factors

<b>Learning Curve Efficiency:</b>	50 %
<b>Back Up Efficiency:</b>	80 %
<b>Learning Curve Duration:</b>	1 Weeks

#### Shift Details

<b>Shift Arrangement:</b>	3 - 8 hour shifts x 7 days per week
<b>Avg. Advance per Shift:</b>	31.58 Metres
<b>Avg. Advance per Week:</b>	664 Metres
<b>Total number of hours:</b>	6,669

#### Clean Up Productivity Data

	<u>Average Advance</u>	<u>Drive Length</u>	<u>Drive Duration</u>		
<b>Learning Curve Portion:</b>	48.0 m/day	336 Metres	21 Shifts	7 Days	1.00 Weeks
<b>Experienced Drive Portion:</b>	96.0 m/day	25,986 Metres	812 Shifts	271 Days	38.67 Weeks
<b>Total:</b>	94.8 m/day	26,322 Metres	834 Shifts	278 Days	39.67 Weeks

Resource Name	Unit Rate	UOM	Unit Quantity	Resource Quantity	Total
<b>Labor</b>					
Tunnel laborer	48.44	\$/hr	6,668.00	6.00	1,937,988
Shaft bottom	48.44	\$/hr	6,668.00	1.00	322,998
Shaft top	47.99	\$/hr	6,668.00	1.00	319,997
Crane operator	49.34	\$/hr	6,668.00	1.00	328,999
				<b>9.00</b>	<b>\$2,909,982</b>
<b>Plant</b>					
Transformers & switchgear - LV	750.00	\$/wk	39.67	1.00	29,753

Estimate Definition ID: 2639

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Checked by:

Resource Name	Unit Rate	UOM	Unit Quantity	Resource Quantity	Total
Man hoists	2,600.00	\$/wk	39.67	1.00	103,142
Shaft crane	9,000.00	\$/wk	39.67	1.00	357,030
Compressors	950.00	\$/wk	39.67	1.00	37,687
Loaders	2,260.00	\$/wk	39.67	1.00	89,654
Other surface plant	2,600.00	\$/wk	39.67	1.00	103,142
Bobcat	500.00	\$/wk	39.67	1.00	19,835
					\$740,242
<b>Consumables</b>					
Electrical power	0.10	\$/kwh	6,668.00	200.00	133,360
					\$133,360

**Total Estimated Cost:** \$3,783,584  
**Total Estimated Cost per Metre:** \$144  
**Total Estimated Cost per Week:** \$95,377  
**Total Estimated Cost per Shift:** \$4,539



### Detailed Cost Estimate Report

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<b>Project:</b>	Newfoundland Fixed Link Pre-feasibility Study	<b>Project Number:</b>	213789
<b>Estimate Description:</b>	Remove TBM	<b>Parent Estimate ID:</b>	1564
<b>Tunnel Name:</b>	Single Rail Bored	<b>Project Phase:</b>	Conceptual
<b>Construction Activity:</b>	TBM Removal	<b>Geology Type:</b>	Not Applicable
<b>Tunnel Technique:</b>	EPB TBM - Precast segmental	<b>Estimate Date:</b>	May 21, 2004
<b>Estimate Definition ID:</b>	2640	<b>Tunnel Characteristics ID:</b>	843

#### Tunnel Characteristics

**Finished Diameter:** 7.5 m

#### Activity Details

**Shift Arrangement** 3 - 8 hour shifts x 7 days per week

**Duration of Activity** 2.2 Weeks

**Total Number of Shifts** 46.2

Resource Name	Unit Rate	UOM	Unit Quantity	Resource Quantity	Total
<b>Labor</b>					
Pit boss	52.29	\$/hr	370.00	1.00	19,347
Tunnel miner	48.89	\$/hr	370.00	3.00	54,268
Shaft bottom	48.44	\$/hr	370.00	2.00	35,846
Tunnel fitter	49.34	\$/hr	370.00	1.00	18,256
Tunnel electrician	49.34	\$/hr	370.00	1.00	18,256
Shaft top	47.99	\$/hr	370.00	2.00	35,513
Crane operator	49.34	\$/hr	370.00	2.00	36,512
Surface laborer	47.99	\$/hr	370.00	2.00	35,513
Equipment laborer	48.44	\$/hr	370.00	1.00	17,923
				<b>15.00</b>	<b>\$271,432</b>
<b>Plant</b>					
Loco	5,000.00	\$/wk	2.20	1.00	11,000
Muck cars & grout cars	1,900.00	\$/wk	2.20	6.00	25,080
Flat cars	310.00	\$/wk	2.20	4.00	2,728
Manriders	310.00	\$/wk	2.20	1.00	682
Booster fans	800.00	\$/wk	2.20	1.00	1,760
Transformers & switchgear - LV	750.00	\$/wk	2.20	1.00	1,650
Other plant	1,400.00	\$/wk	2.20	1.00	3,080
Man hoists	2,000.00	\$/wk	2.20	1.00	4,400
Shaft crane	9,000.00	\$/wk	2.20	1.00	19,800
50T Crane	3,000.00	\$/wk	2.20	1.00	6,600
TBM Crane	15,000.00	\$/wk	2.20	1.00	33,000
Compressors	950.00	\$/wk	2.20	1.00	2,090
Transformers & switchgear - HV	5,200.00	\$/wk	2.20	1.00	11,440
Surface fans	800.00	\$/wk	2.20	1.00	1,760
					<b>\$125,070</b>

**Estimate Definition ID:** 2640

**Estimated by:**

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**Checked by:**

Resource Name	Unit Rate	UOM	Unit Quantity	Resource Quantity	Total
<b>Consumables</b>					
Electrical power	0.00	\$/kwh	370.00	600.00	0
Gas oil	0.40	\$/L	15.00	1,000.00	6,000
Lubrication materials	0.00	\$/wk	2.20	1.00	0
Filters etc.	0.00	\$/wk	2.20	1.00	0
Hydraulic oil	0.00	\$/L	0.00	1.00	0
Other consumables	500.00	\$/wk	2.20	1.00	1,100
					\$7,100
<b>Materials</b>					
Temporary materials	500.00	\$/wk	2.20	1.00	1,100
Thrust frame	0.00	\$/wk	2.20	1.00	0
					\$1,100
<b>General Supplies</b>					
Small tools	700.00	\$/wk	2.20	1.00	1,540
					\$1,540
<b>Total Estimated Cost:</b>					\$406,242



## Detailed Cost Estimate Report

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<b>Project:</b>	NFLink	<b>Project Number:</b>	213789
<b>Estimate Description:</b>	Liner production	<b>Parent Estimate ID:</b>	1596
<b>Tunnel Name:</b>	Single Rail Bored	<b>Project Phase:</b>	Conceptual
<b>Construction Activity:</b>	Precast Linings	<b>Geology Type:</b>	Not Applicable
<b>Tunnel Technique:</b>	EPB TBM - Precast segmental	<b>Estimate Date:</b>	June 01, 2004
<b>Estimate Definition ID:</b>	2642	<b>Tunnel Characteristics ID:</b>	843

### Tunnel Characteristics

<b>Tunnel Length:</b>	26,322 m
<b>Finished Diameter:</b>	7.5 m
<b>Final Lining Thickness:</b>	0.35 m

### Assumptions

#### A) Duration

	Maximum	Minimum	
<b>TBM Fabrication Time</b>	19	15	Months
<b>TBM Erection Time</b>	3	2	Months
<b>Tunneling Time</b>	86	81	Months
<b>Total</b>	<b>108</b>	<b>98</b>	Months
<b>Facility Setup Time</b>	6	5	Months
<b>Learning Curve/Shakedown Time</b>	1	1	Months
<b>Concrete Strength Gain Time</b>	1	1	Months
<b>Available Manufacturing Time</b>	<b>100</b>	<b>91</b>	Months

#### B) Production

<b>Allowance for Damage</b>	2 %
<b>Ring Length</b>	1.5 m
<b>Number of Rings Required</b>	17,899
<b>Production Rate Required</b>	49.2 Rings/Week
<b>Actual Production Rate Achieved</b>	50 Rings/Week

**Investment on plant, equipment and moulds**

\$5,000,000

<b>Initial Shakedown Time</b>	4 Weeks
<b>Production Time</b>	358.0 Weeks

	Shakedown Crew	Production / QC Crew
<b>Shifts per Day</b>	1	2
<b>Hours per Shift</b>	12	12
<b>Days per Week</b>	5	5

<b>Number of Rings per Truck</b>	1
<b>Concrete</b>	12.95 m3/ring
<b>Reinforcing Steel</b>	120 kg/m3
<b>Dunnage Assumption</b>	50 % of total required storage

<b>C) Overheads</b>	<b>\$/Month</b>	<b>Months</b>	<b>Cost</b>	
<b>Project Manager Rate</b>	7,000	97	679,000	
<b>Plant Manager Rate</b>	5,000	95	475,000	
<b>Quality Manager Rate</b>	5,000	93	465,000	
<b>Secretary Rate</b>	2,000	97	194,000	
<b>Office Building Cost</b>			150,000	
<b>Office Equipment and Supplies Cost</b>			0	
<b>Finance Assume \$</b>	1,000,000	97	485,000	
<b>Financing @</b>	6 %			
<b>Head Office Support @</b>	1 %		1,286,778	
<b>Total Overhead Cost</b>				\$3,734,778
<b>Profit Margin</b>			10 %	

<b>Resource Name</b>	<b>Unit Rate</b>	<b>UOM</b>	<b>Unit Quantity</b>	<b>Resource Quantity</b>	<b>Total</b>
<b>Labor</b>					
Shakedown crew	25.00	\$/hr	240.00	30.00	180,000
Production & QC crew	32.00	\$/hr	42,958.00	30.00	41,239,680
				<b>60.00</b>	<b>\$41,419,680</b>
<b>Consumables</b>					
Power	0.06	\$/kwh	43,198.00	1,020.00	2,643,718
Heating	0.11	\$/m2/wk	362.00	10,600.00	422,092
Steam curing	0.54	\$/m2/wk	362.00	2,000.00	390,960
Fuel	0.50	\$/L	362.00	3,000.00	543,000
Water	0.05	\$/L	231,743.00	100.00	1,158,715
					<b>\$5,158,485</b>
<b>Materials</b>					
Concrete	84.00	\$/m3	12.95	17,899.00	19,470,532
Rebar	1.00	\$/kg	1,554.00	17,899.00	27,815,046
Grout nozzles	3.00	\$/Nr	17,899.00	12.00	644,364
Lifting socket	10.00	\$/Nr	17,899.00	12.00	2,147,880
Bolt inserts	5.00	\$/Nr	17,899.00	12.00	1,073,940
Gaskets	100.00	\$/Nr	17,899.00	12.00	21,478,800
Dunnage	2.50	\$/m	18.00	8,949.00	402,705
Site preparation	10.00	\$/m2	12.32	8,949.00	1,102,517
					<b>\$74,135,784</b>

Estimate Definition ID: 2642

Estimated by: \_\_\_\_\_

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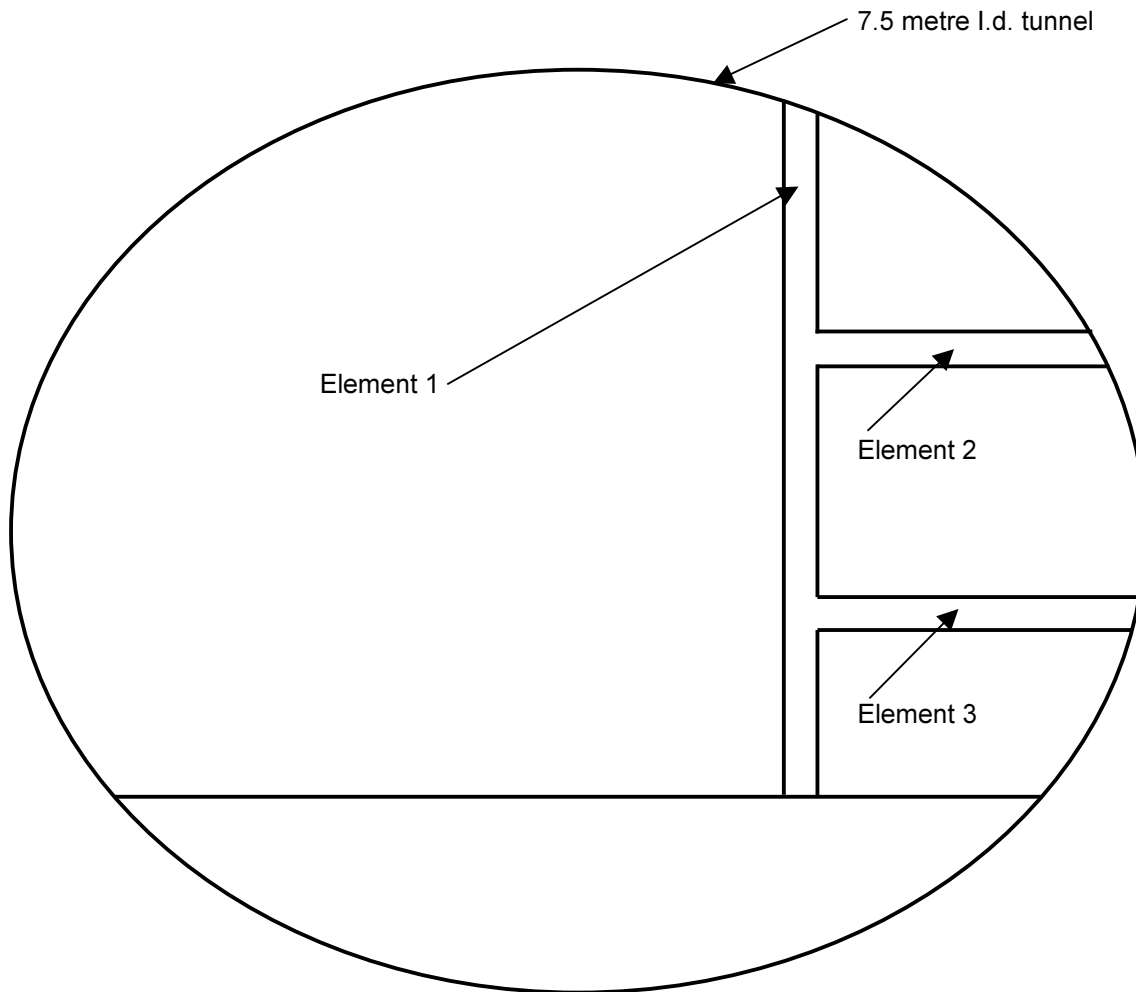
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Resource Name	Unit Rate	UOM	Unit Quantity	Resource Quantity	Total
<b>Subcontracts</b>					
Delivery	80.00	\$/hr	2.00	17,899.00	2,863,840
Testing	100,000.00	\$/Nr	1.00	1.00	100,000
					<hr/> \$2,963,840
<b>Subtotal:</b>					\$123,677,789
<b>Investment on Plant:</b>					\$5,000,000
<b>Total Overhead Cost:</b>					\$3,734,778
<b>Subtotal:</b>					\$132,412,566
<b>Profit:</b>					\$13,241,257
<b>Total Precast Lining Cost:</b>					<hr/> <b>\$145,653,823</b>
<b>Total Cost per Cubic Metre:</b>					<b>\$629</b>
<b>Total Cost per Ring:</b>					<b>\$8,138</b>

Tunnel length= 26320 m



Assumed tunnel cross section

Page 2 of 2  
Date: June 07, 2004  
Calculation by: A.White

Concrete	m3	65537	m3	at	190	=	12,451,992
Formwork	m2	373744	m2	at	140	=	52,324,160
Reinforcement	t	6727	t	at	1600	=	10,763,827
					\$		<u>75,539,979</u>

## Initialisation

**Project:** Newfoundland Fixed Link Pre-feasibility Study

**Section:** North Approach

**Option:** Bored Rail Tunnel

**Date:** 8-Jun-04

**Calculations by:** ANW

Surface gradient  %

+ sloping same way as track/road  
- sloping against track/road

Track/Road Gradient  %

Ground elevation  
at portal  m

Bottom of slab  
elevation at portal  m

Total length= 748.7091 m

Total Cost=\$ 7.8 M

**UNIT RATES**

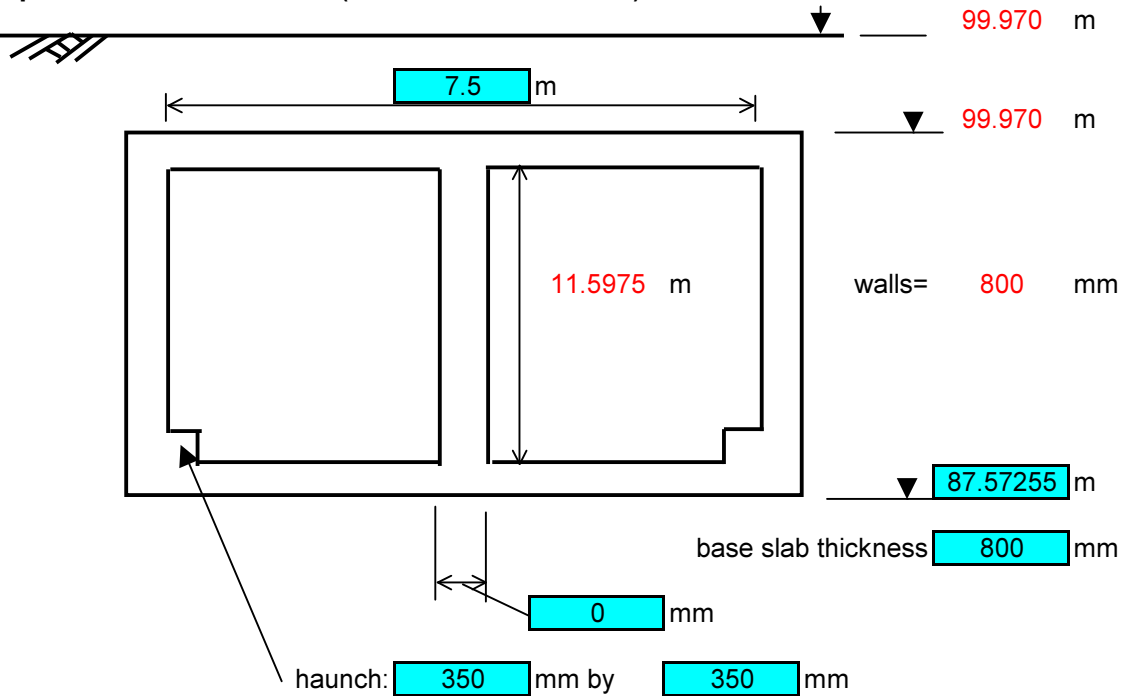
**Materials**

<b>Item</b>	<b>unit</b>	<b>Rate</b>
excavation	m3	60
concrete	m3	190
rebar	tonnes	1600
formwork/falsework	m2	140
SP&L<=4.6m deep	m2	0
4.6<SP&L<=6.7m deep	m2	0
6.7<SP&L<=10.6m deep	m2	0
10.6<SP&L<=13.7m deep	m2	0
13.7<SP&L<=16.8m deep	m2	0
16.8<SP&L<=20.0m deep	m2	0
20<SP&L<=25m deep	m2	0
backfill + compact	m3	40
surface reinstatement	m2	30

Section Cut and Cover  
Length of section: 74.87091 m

Section 1

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	8446.7	m3	
concrete=	1952.708	m3	
rebar=	234.3	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	1736.631	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	1856.4	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	681.3253	m2	

**Calculated costs**

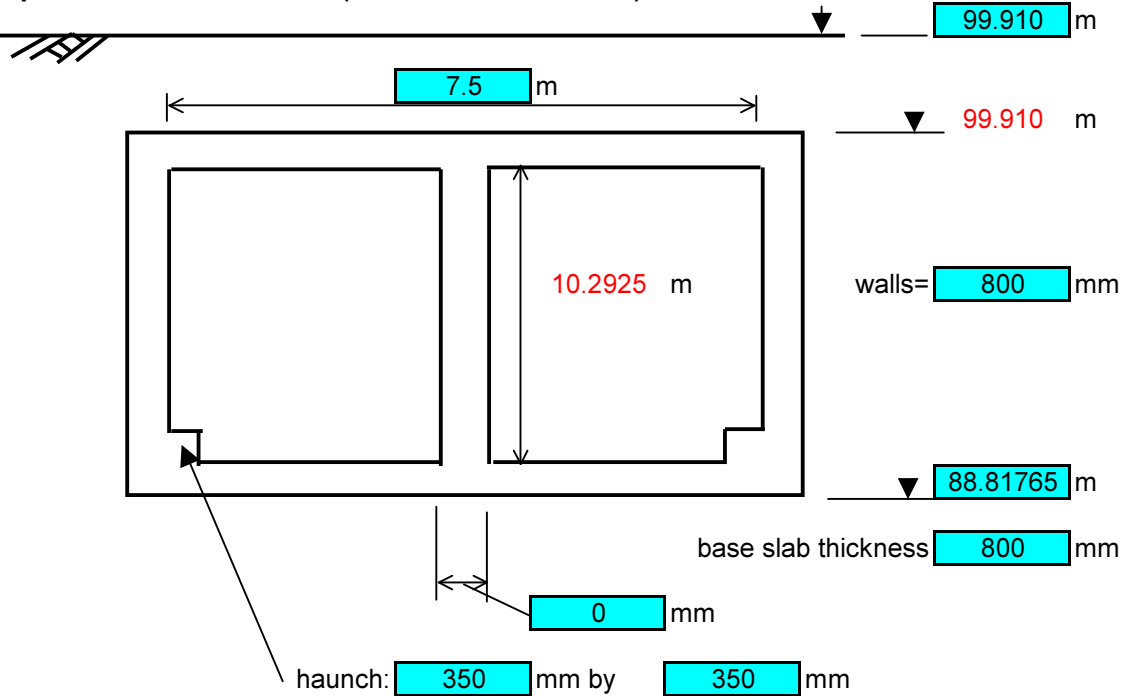
Item	Unit	Quantity	Rate	Cost
excavation	m3	8446.7	60	506803.8
concrete	m3	1952.708	190.0	371014.6
rebar	tonnes	234.3	1600	374920
formwork/falsework	m2	1736.631	140	243128.3
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	1856.4	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	681.3253	30	20439.76

Total 1516306

Section Cut and Cover  
Length of section: 74.87091 m

Section 2

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	7557.6	m3	
concrete=	1796.378	m3	
rebar=	215.6	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	1541.218	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	1661.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	681.3253	m2	



**Calculated costs**

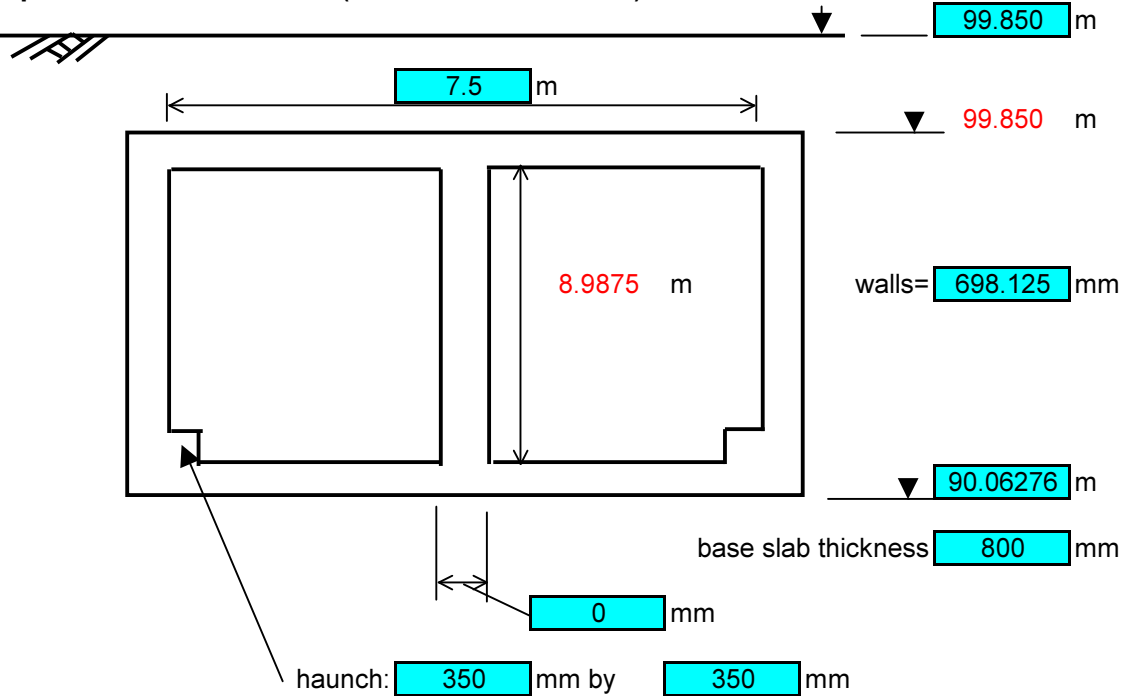
Item	Unit	Quantity	Rate	Cost
excavation	m3	7557.6	60	453456.1
concrete	m3	1796.378	190.0	341311.8
rebar	tonnes	215.6	1600	344904.5
formwork/falsework	m2	1541.218	140	215770.5
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	1661.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	681.3253	30	20439.76

Total 1375883

Section Cut and Cover  
Length of section: 74.87091 m

Section 3

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	6519.2	m3	
concrete=	1490.74	m3	
rebar=	178.9	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	1345.805	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	1465.6	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	666.0704	m2	

**Calculated costs**

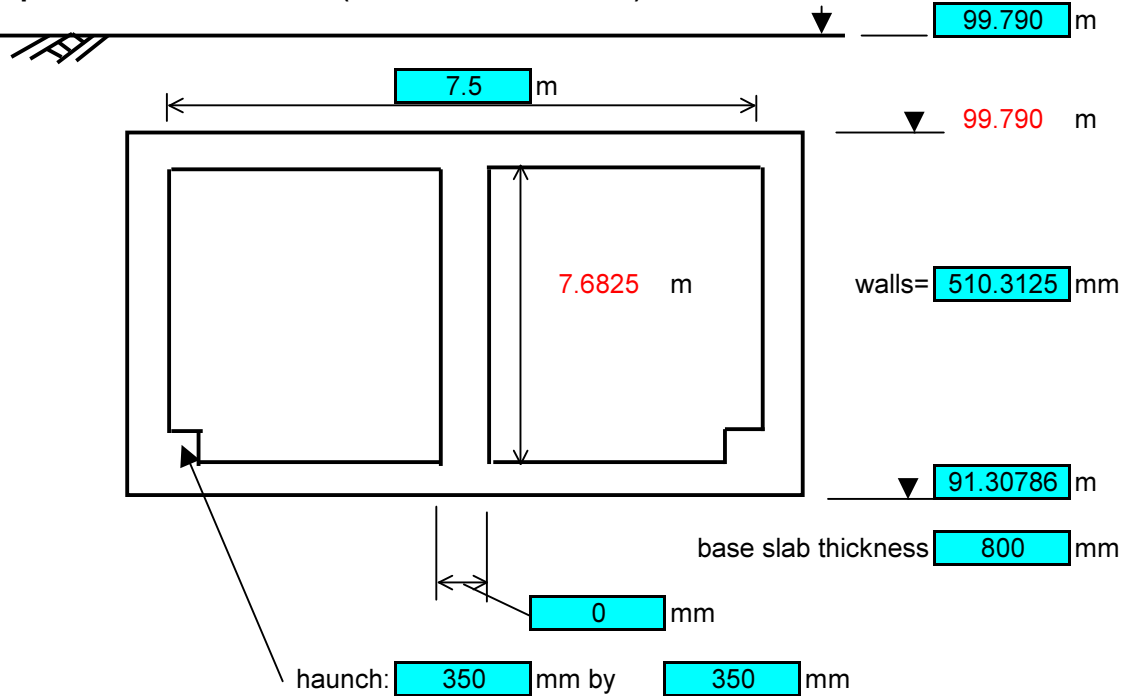
Item	Unit	Quantity	Rate	Cost
excavation	m3	6519.2	60	391149.8
concrete	m3	1490.74	190.0	283240.5
rebar	tonnes	178.9	1600	286222
formwork/falsework	m2	1345.805	140	188412.7
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	1465.6	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	666.0704	30	19982.11

Total 1169007

Section Cut and Cover  
Length of section: 74.87091 m

Section 4

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	5411.4	m3	
concrete=	1115.76	m3	
rebar=	133.9	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	1150.392	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	1270.2	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	637.947	m2	

**Calculated costs**

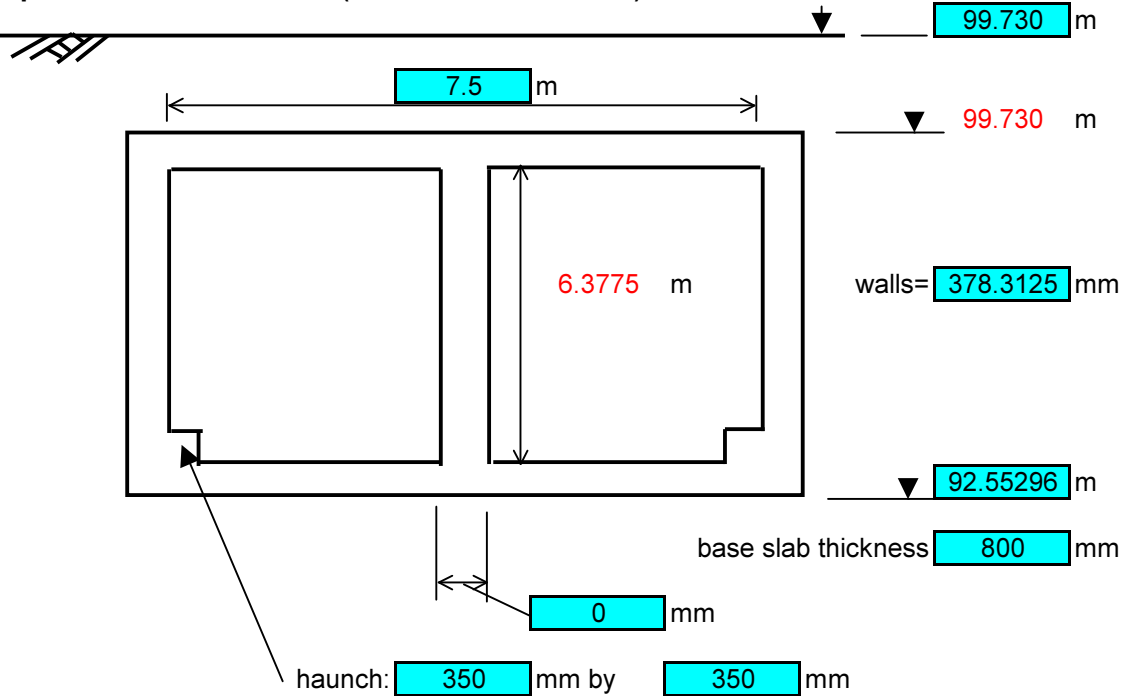
Item	Unit	Quantity	Rate	Cost
excavation	m3	5411.4	60	324683.1
concrete	m3	1115.76	190.0	211994.4
rebar	tonnes	133.9	1600	214225.9
formwork/falsework	m2	1150.392	140	161054.8
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	1270.2	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	637.947	30	19138.41

Total 931096.7

Section Cut and Cover  
Length of section: 74.87091 m

Section 5

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	4437.0	m3	
concrete=	874.1685	m3	
rebar=	104.9	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	954.9785	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	1074.8	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	618.181	m2	

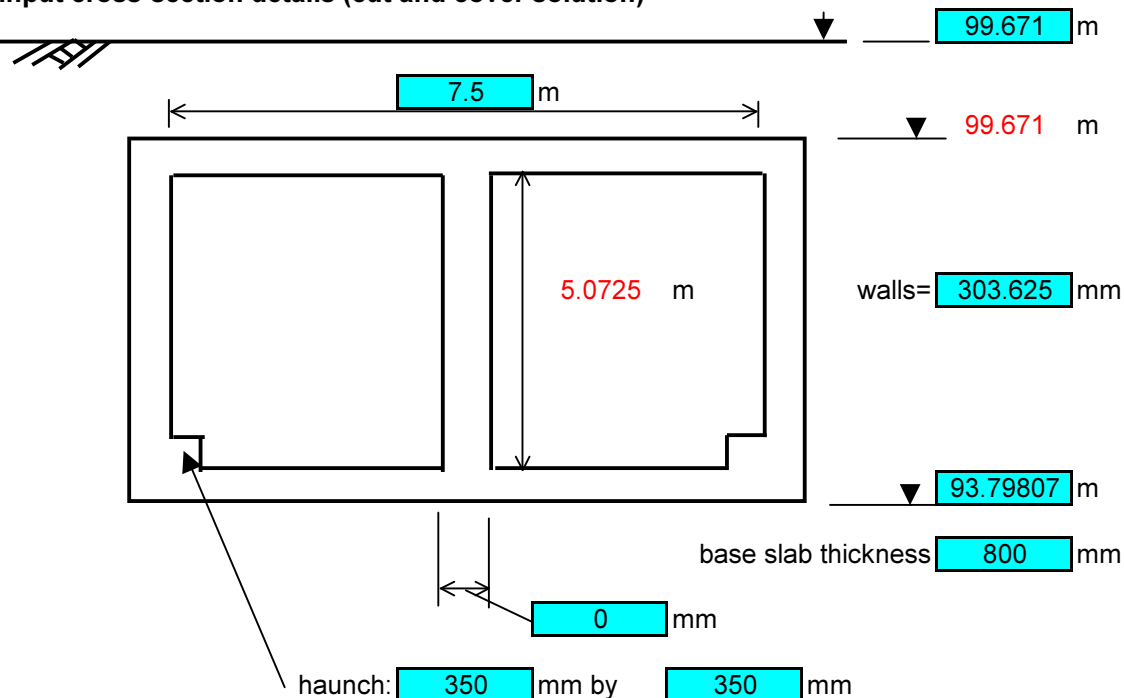
**Calculated costs**

Item	Unit	Quantity	Rate	Cost
excavation	m3	4437.0	60	266219.7
concrete	m3	874.1685	190.0	166092
rebar	tonnes	104.9	1600	167840.4
formwork/falsework	m2	954.9785	140	133697
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	1074.8	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	618.181	30	18545.43
Total				<u>752394.5</u>

Section Cut and Cover  
Length of section: 74.87091 m

Section 6

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	3564.6	m3	
concrete=	734.5642	m3	
rebar=	88.1	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	759.5654	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	879.4	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	606.9972	m2	



**Calculated costs**

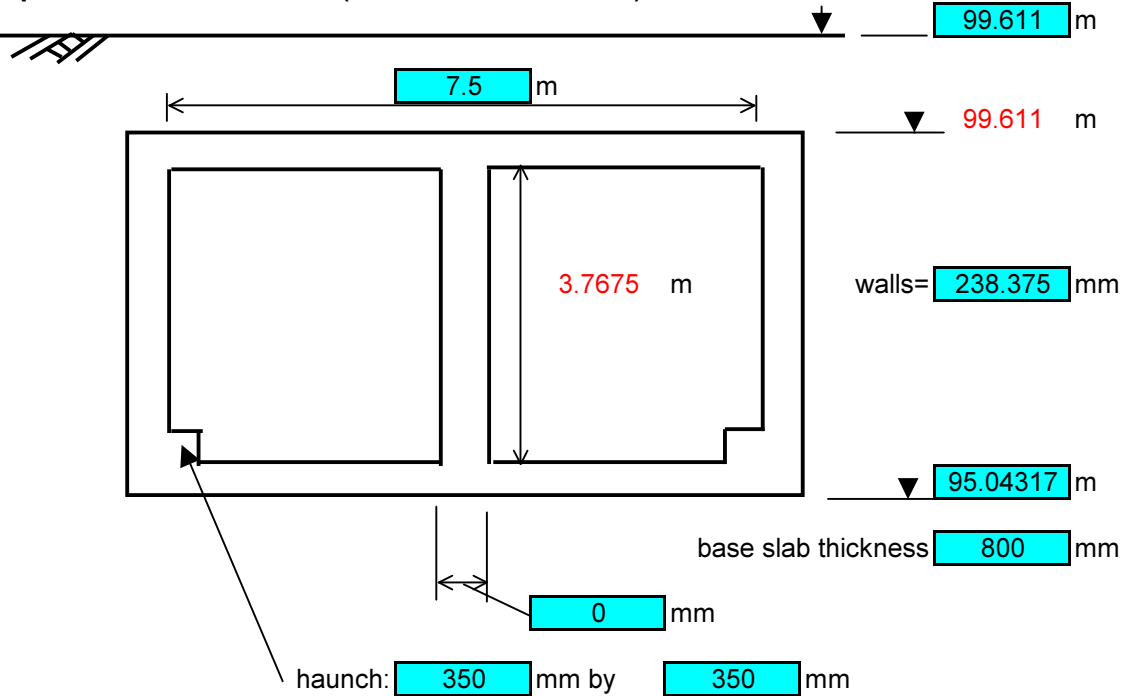
Item	Unit	Quantity	Rate	Cost
excavation	m3	3564.6	60	213875.5
concrete	m3	734.5642	190.0	139567.2
rebar	tonnes	88.1	1600	141036.3
formwork/falsework	m2	759.5654	140	106339.2
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	879.4	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	606.9972	30	18209.92

Total 619028.1

Section Cut and Cover  
Length of section: 74.87091 m

Section 7

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	2727.8	m3	
concrete=	630.6044	m3	
rebar=	75.7	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	564.1523	m2	
SP&L<=4.6m deep	683.9	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	597.2265	m2	

**Calculated costs**

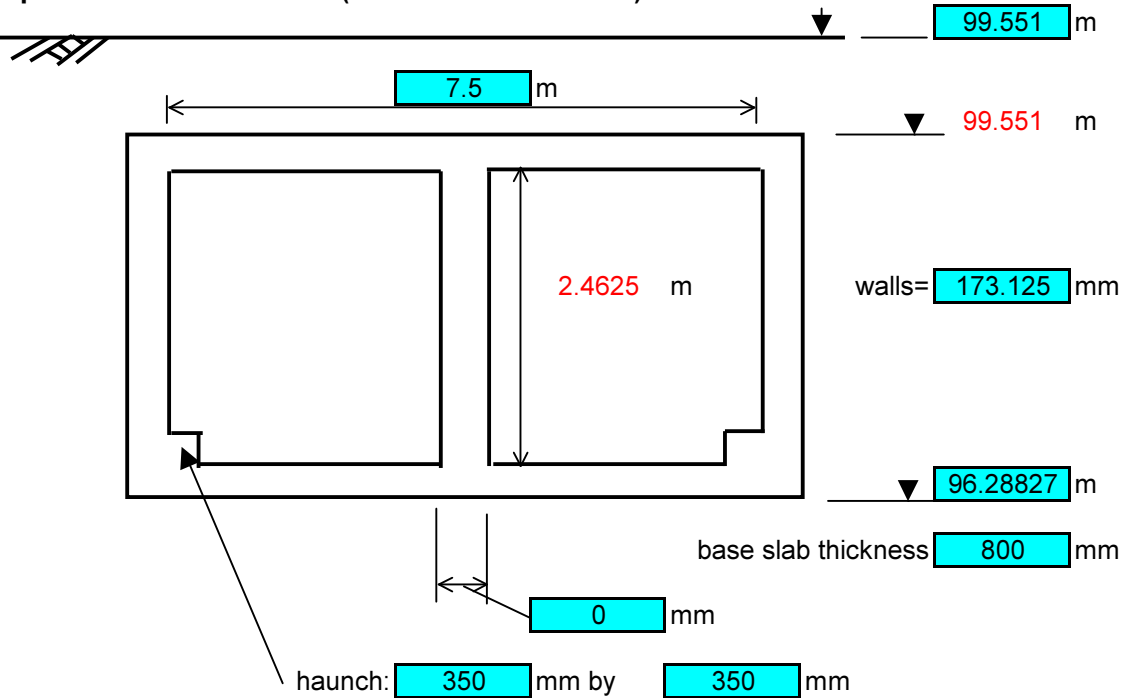
Item	Unit	Quantity	Rate	Cost
excavation	m3	2727.8	60	163669.9
concrete	m3	630.6044	190.0	119814.8
rebar	tonnes	75.7	1600	121076
formwork/falsework	m2	564.1523	140	78981.33
SP&L<=4.6m deep	m2	683.9	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	597.2265	30	17916.8

Total 501458.9

Section Cut and Cover  
Length of section: 74.87091 m

Section 8

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	1916.6	m3	
concrete=	552.1461	m3	
rebar=	66.3	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	368.7392	m2	
SP&L<=4.6m deep	488.5	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	587.4559	m2	

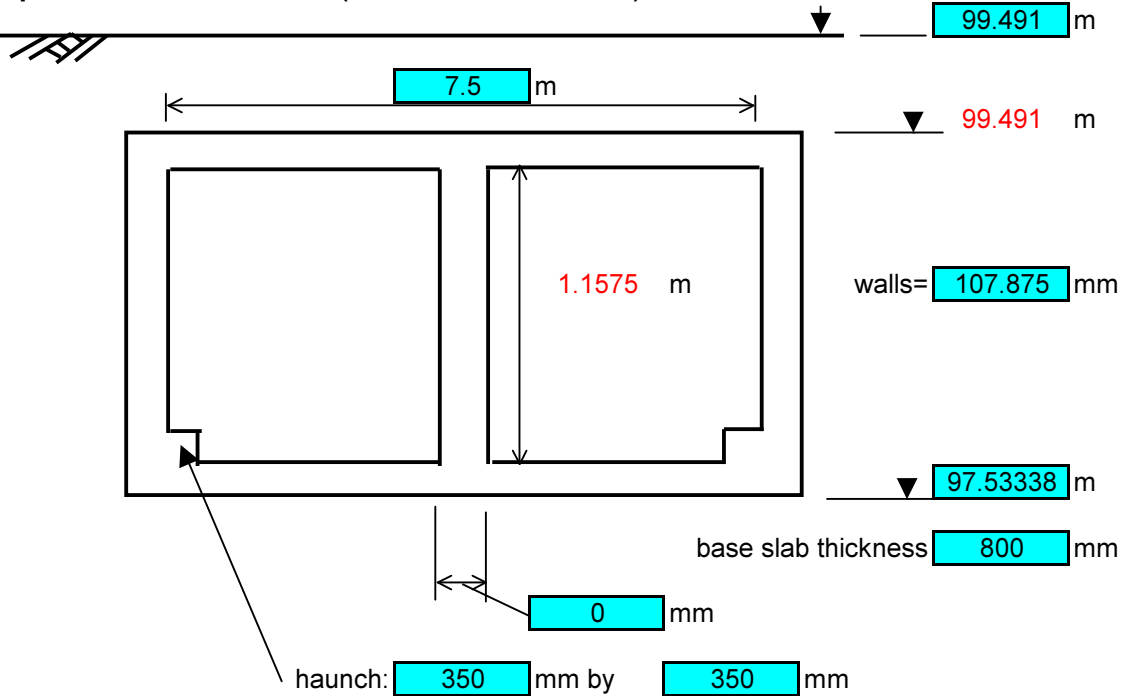
**Calculated costs**

Item	Unit	Quantity	Rate	Cost
excavation	m3	1916.6	60	114994.5
concrete	m3	552.1461	190.0	104907.8
rebar	tonnes	66.3	1600	106012
formwork/falsework	m2	368.7392	140	51623.49
SP&L<=4.6m deep	m2	488.5	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	587.4559	30	17623.68
Total				<u>395161.5</u>

Section Cut and Cover  
Length of section: 74.87091 m

Section 9

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	1130.8	m3	
concrete=	499.1891	m3	
rebar=	59.9	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	173.3262	m2	
SP&L<=4.6m deep	293.1	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	577.6852	m2	

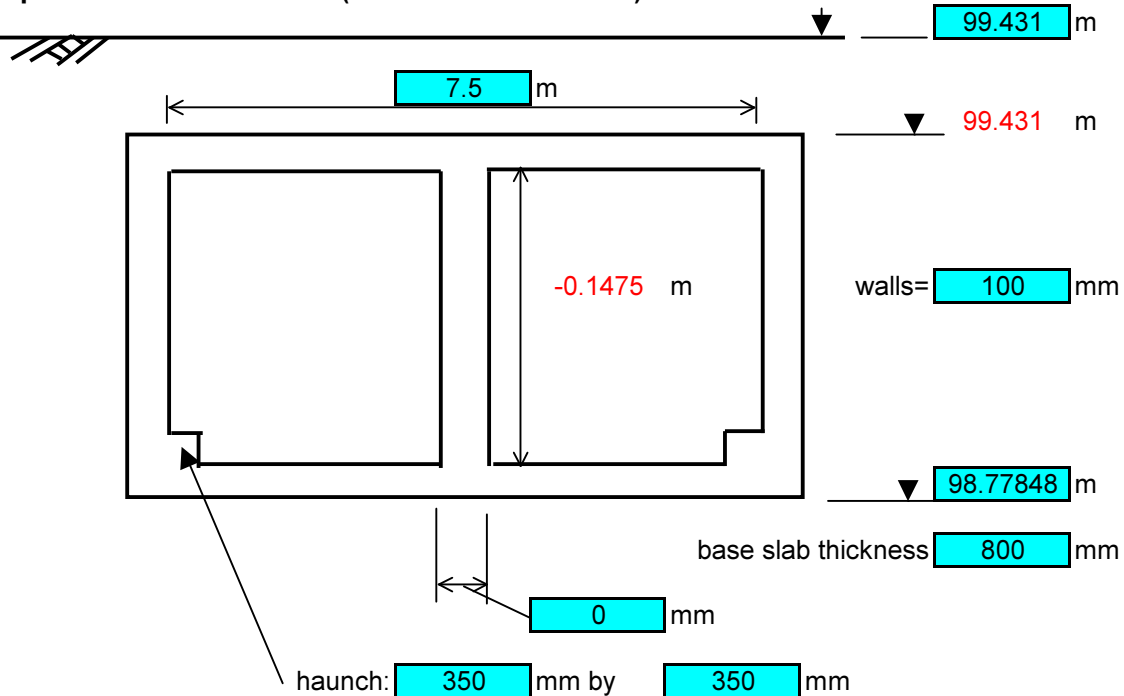
**Calculated costs**

Item	Unit	Quantity	Rate	Cost
excavation	m3	1130.8	60	67849.13
concrete	m3	499.1891	190.0	94845.93
rebar	tonnes	59.9	1600	95844.31
formwork/falsework	m2	173.3262	140	24265.66
SP&L<=4.6m deep	m2	293.1	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	577.6852	30	17330.56
Total				<u>300135.6</u>

Section Cut and Cover  
Length of section: 74.87091 m

Section 10

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	376.2	m3	
concrete=	477.3395	m3	
rebar=	57.3	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	-22.08692	m2	
SP&L<=4.6m deep	97.7	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	576.506	m2	



**Calculated costs**

Item	Unit	Quantity	Rate	Cost
excavation	m3	376.2	60	22570.21
concrete	m3	477.3395	190.0	90694.51
rebar	tonnes	57.3	1600	91649.18
formwork/falsework	m2	-22.08692	140	-3092.169
SP&L<=4.6m deep	m2	97.7	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	576.506	30	17295.18

Total 219116.9

**Newfoundland Fixed Link Pre-feasibility Study**  
**North Approach**  
**Bored Rail Tunnel**

**Date:** 8-Jun-04  
**Calculations by:** ANW

**Summary of Costs**

Markup for adjacent 0 %

<b>Section</b>	<b>Cost</b>
1	1516306
2	1375883
3	1169007
4	931096.7
5	752394.5
6	619028.1
7	501458.9
8	395161.5
9	300135.6
10	<u>219116.9</u>
Sub-total	<u>7779588</u>



## Initialisation

**Project:** Newfoundland Fixed Link Pre-feasibility Study

**Section:** South Approach

**Option:** Bored Rail Tunnel

**Date:** 8-Jun-04

**Calculations by:** ANW

Surface gradient  %

+ sloping same way as track/road  
- sloping against track/road

Track/Road Gradient  %

Ground elevation  
at portal  m

Bottom of slab  
elevation at portal  m

Total length= 784.7264 m

Total Cost=\$ 8.2 M

**UNIT RATES**

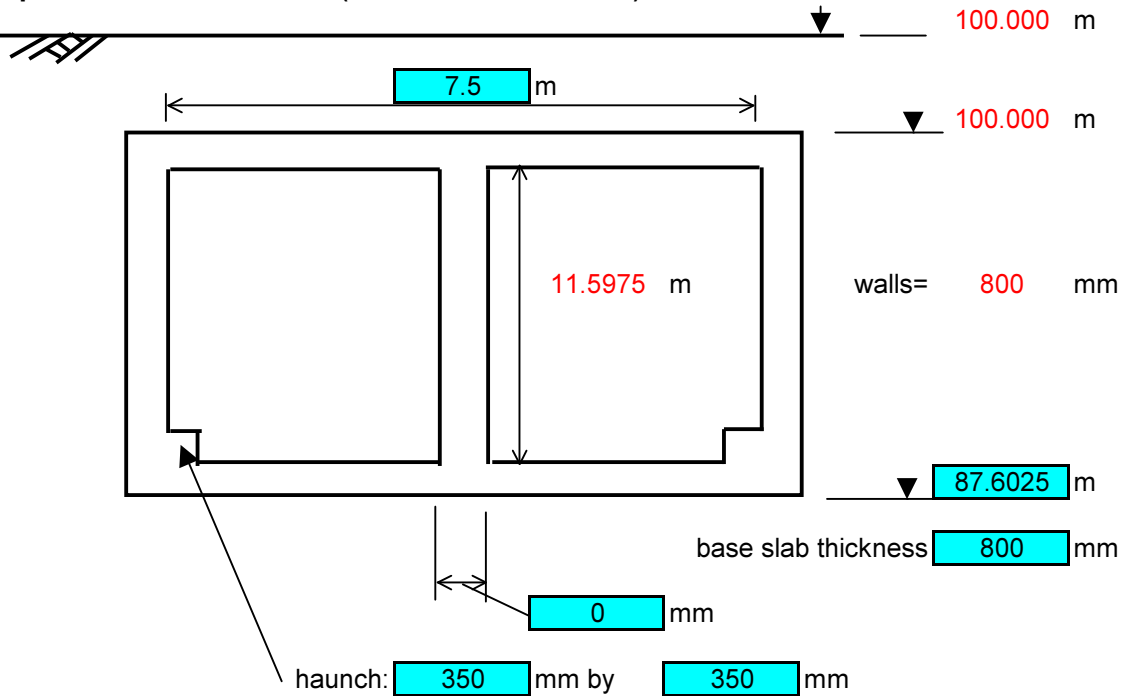
**Materials**

<b>Item</b>	<b>unit</b>	<b>Rate</b>
excavation	m3	60
concrete	m3	190
rebar	tonnes	1600
formwork/falsework	m2	140
SP&L<=4.6m deep	m2	0
4.6<SP&L<=6.7m deep	m2	0
6.7<SP&L<=10.6m deep	m2	0
10.6<SP&L<=13.7m deep	m2	0
13.7<SP&L<=16.8m deep	m2	0
16.8<SP&L<=20.0m deep	m2	0
20<SP&L<=25m deep	m2	0
backfill + compact	m3	40
surface reinstatement	m2	30

Section Cut and Cover  
Length of section: 78.47264 m

Section 1

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	8853.1	m3	
concrete=	2046.645	m3	
rebar=	245.6	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	1820.173	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	1945.7	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	714.101	m2	

**Calculated costs**

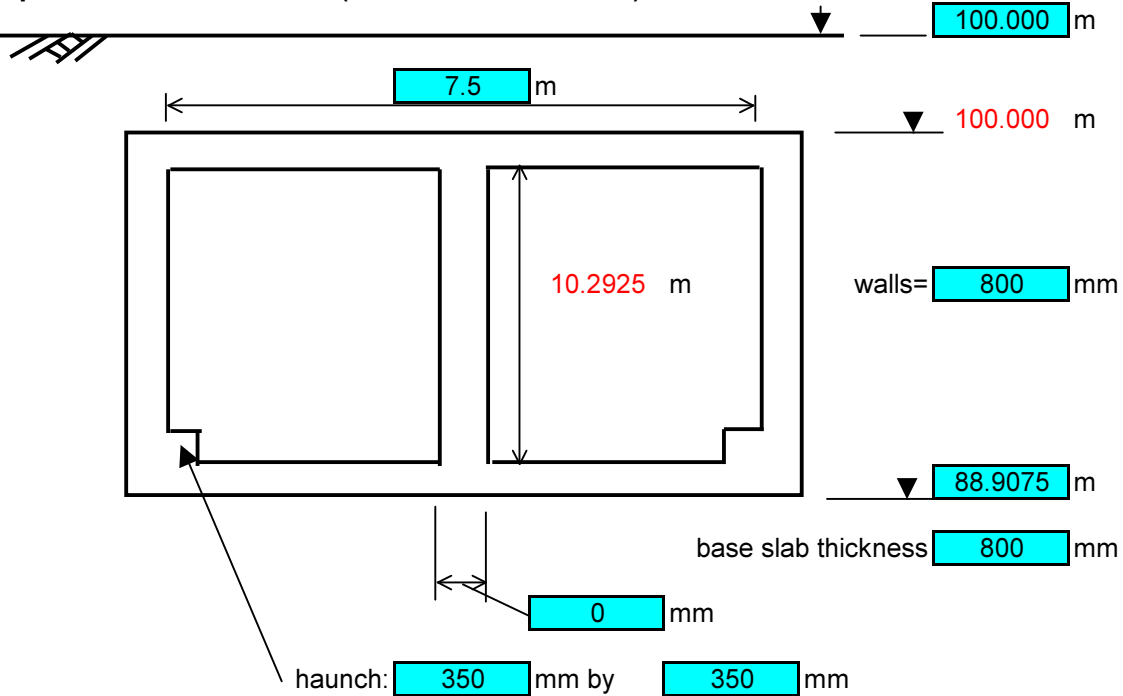
Item	Unit	Quantity	Rate	Cost
excavation	m3	8853.1	60	531184
concrete	m3	2046.645	190.0	388862.5
rebar	tonnes	245.6	1600	392955.8
formwork/falsework	m2	1820.173	140	254824.2
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	1945.7	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	714.101	30	21423.03

Total 1589250

Section Cut and Cover  
 Length of section: 78.47264 m

Section 2

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	7921.2	m3	
concrete=	1882.794	m3	
rebar=	225.9	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	1615.359	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	1740.9	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	714.101	m2	



**Calculated costs**

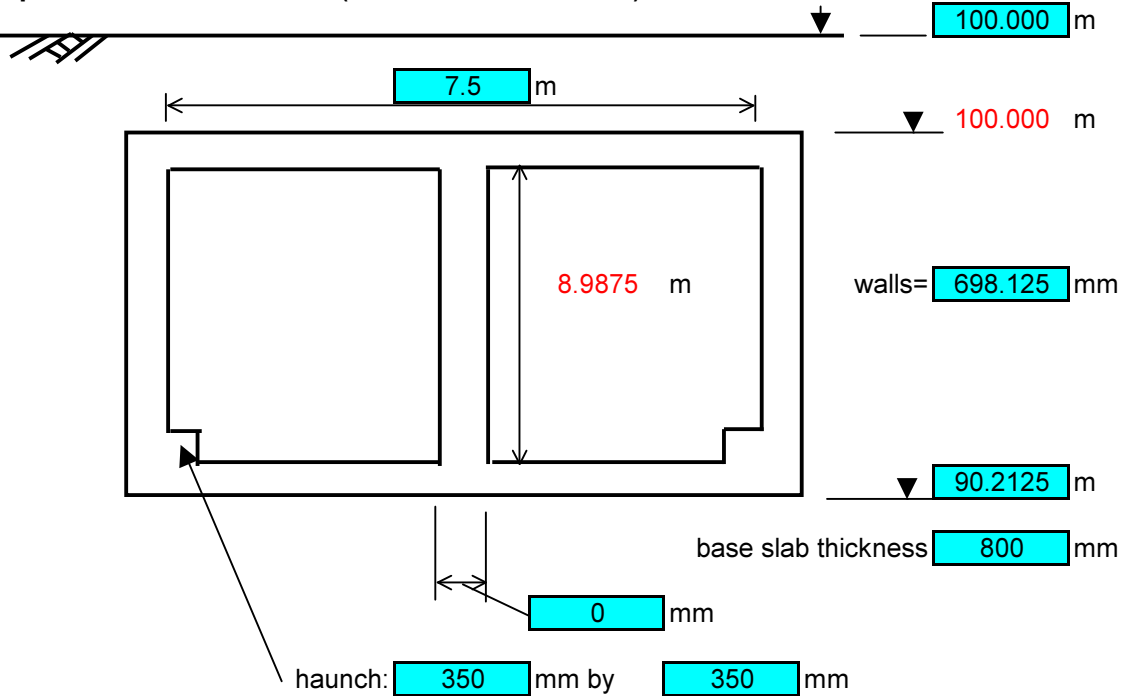
Item	Unit	Quantity	Rate	Cost
excavation	m3	7921.2	60	475269.9
concrete	m3	1882.794	190.0	357730.9
rebar	tonnes	225.9	1600	361496.5
formwork/falsework	m2	1615.359	140	226150.3
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	1740.9	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	714.101	30	21423.03

Total 1442071

Section Cut and Cover  
Length of section: 78.47264 m

Section 3

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	6832.8	m3	
concrete=	1562.453	m3	
rebar=	187.5	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	1410.546	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	1536.1	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	698.1122	m2	

**Calculated costs**

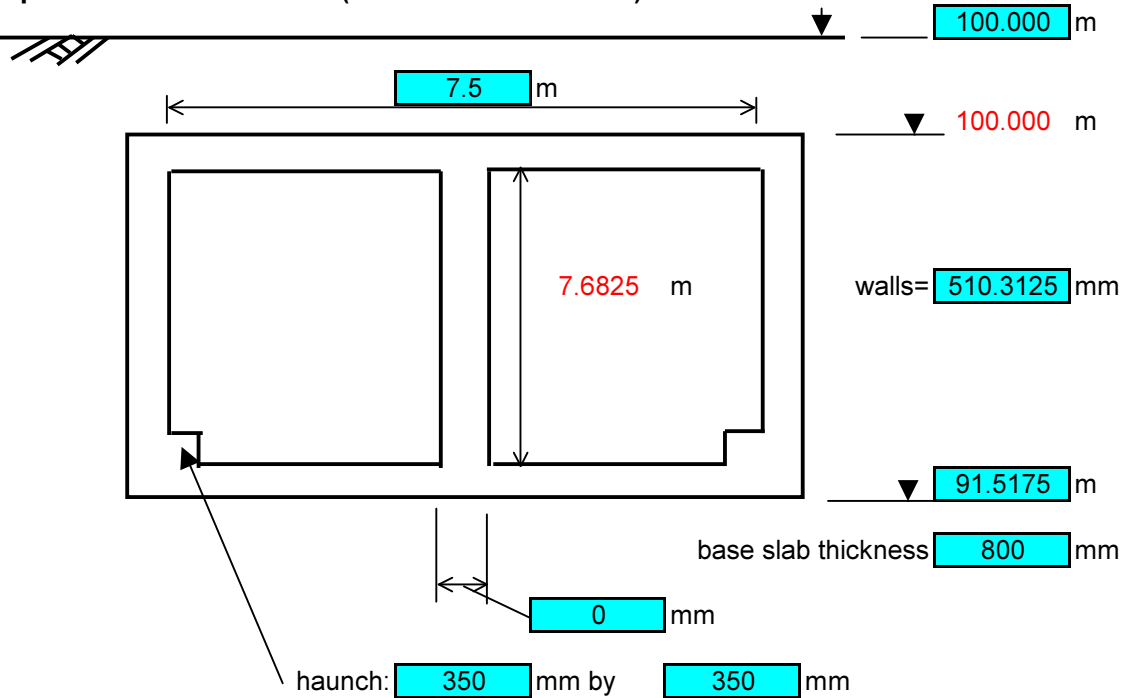
Item	Unit	Quantity	Rate	Cost
excavation	m3	6832.8	60	409966.4
concrete	m3	1562.453	190.0	296866
rebar	tonnes	187.5	1600	299990.9
formwork/falsework	m2	1410.546	140	197476.4
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	1536.1	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	698.1122	30	20943.37

Total 1225243

Section Cut and Cover  
Length of section: 78.47264 m

Section 4

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	5671.7	m3	
concrete=	1169.435	m3	
rebar=	140.3	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	1205.732	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	1331.3	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	668.6359	m2	

**Calculated costs**

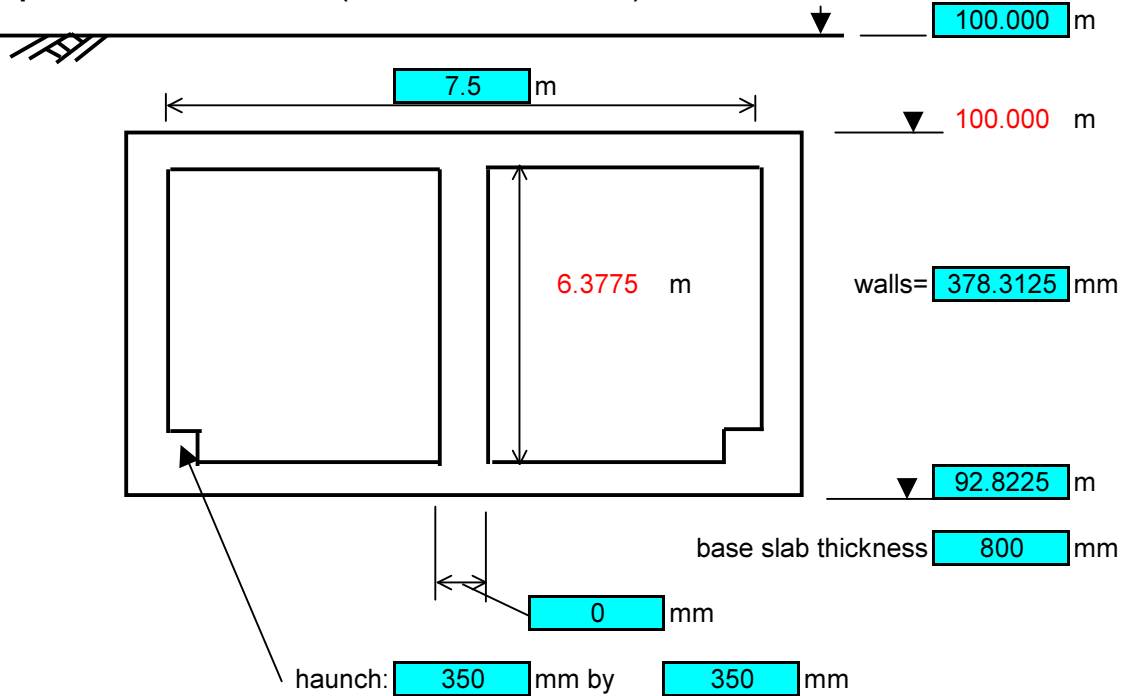
Item	Unit	Quantity	Rate	Cost
excavation	m3	5671.7	60	340302.3
concrete	m3	1169.435	190.0	222192.6
rebar	tonnes	140.3	1600	224531.5
formwork/falsework	m2	1205.732	140	168802.5
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	1331.3	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	668.6359	30	20059.08

Total 975887.9

Section Cut and Cover  
Length of section: 78.47264 m

Section 5

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	4650.4	m3	
concrete=	916.2211	m3	
rebar=	109.9	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	1000.919	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	1126.5	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	647.9192	m2	

**Calculated costs**

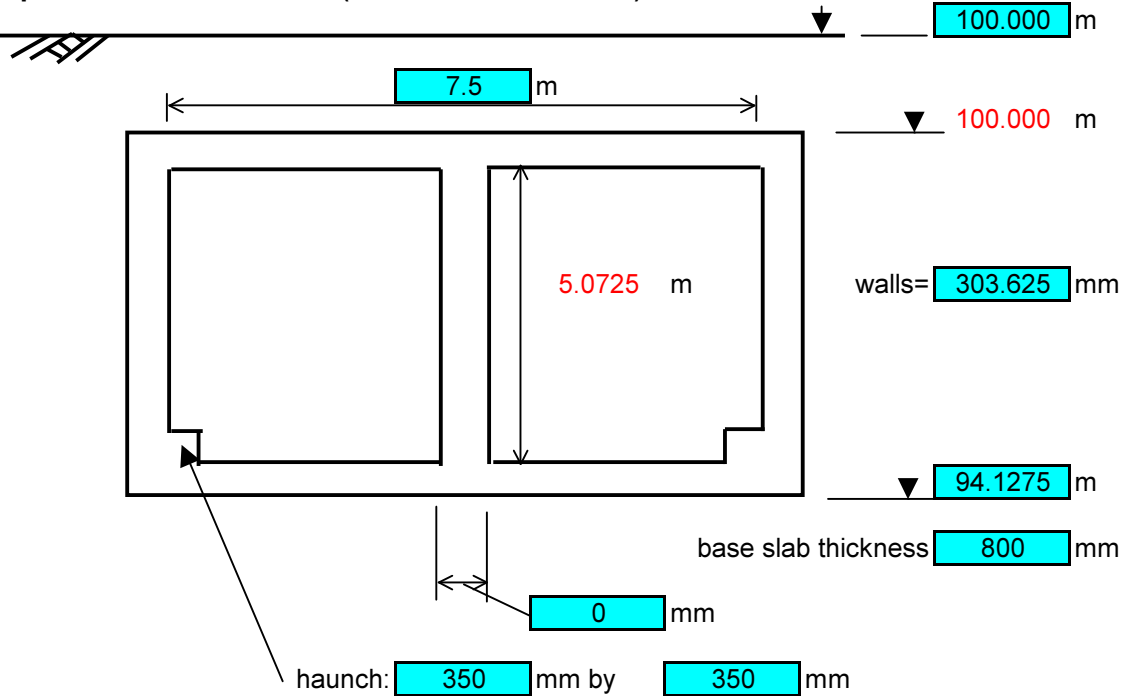
Item	Unit	Quantity	Rate	Cost
excavation	m3	4650.4	60	279026.4
concrete	m3	916.2211	190.0	174082
rebar	tonnes	109.9	1600	175914.5
formwork/falsework	m2	1000.919	140	140128.6
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	1126.5	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	647.9192	30	19437.57

Total 788589

Section Cut and Cover  
 Length of section: 78.47264 m

Section 6

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	3736.1	m3	
concrete=	769.901	m3	
rebar=	92.4	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	796.1049	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	921.7	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	636.1973	m2	



**Calculated costs**

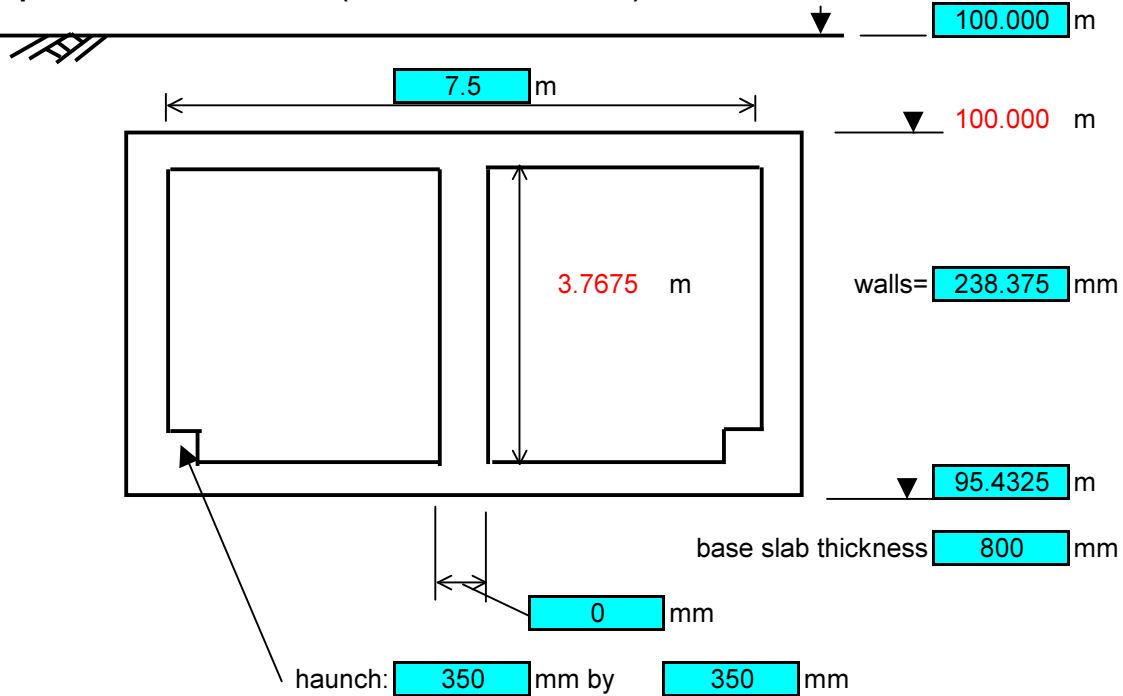
Item	Unit	Quantity	Rate	Cost
excavation	m3	3736.1	60	224164.1
concrete	m3	769.901	190.0	146281.2
rebar	tonnes	92.4	1600	147821
formwork/falsework	m2	796.1049	140	111454.7
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	921.7	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	636.1973	30	19085.92

Total 648806.9

Section Cut and Cover  
 Length of section: 78.47264 m

Section 7

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	2859.1	m3	
concrete=	660.9402	m3	
rebar=	79.3	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	591.2913	m2	
SP&L<=4.6m deep	716.8	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	625.9566	m2	

**Newfoundland Fixed Link Pre-feasibility Study**  
**South Approach**  
**Bored Rail Tunnel**

**Date:** 8-Jun-04  
**Calculations by:** ANW  
**Page 2 of 2**

**Calculated costs**

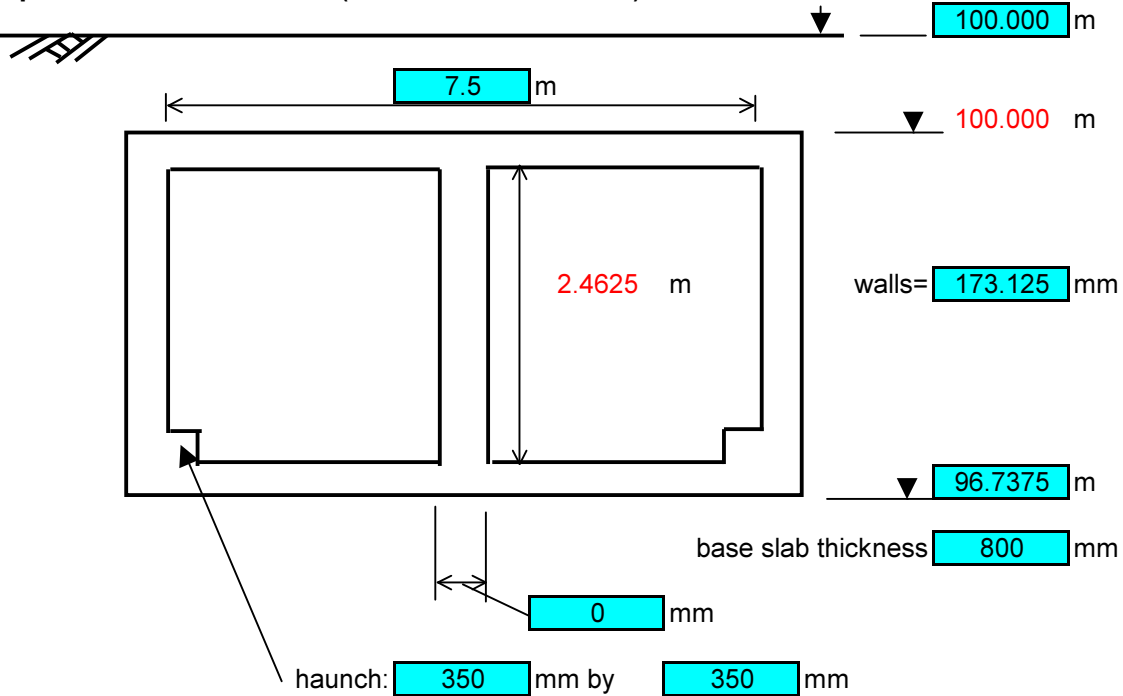
Item	Unit	Quantity	Rate	Cost
excavation	m3	2859.1	60	171543.4
concrete	m3	660.9402	190.0	125578.6
rebar	tonnes	79.3	1600	126900.5
formwork/falsework	m2	591.2913	140	82780.79
SP&L<=4.6m deep	m2	716.8	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	625.9566	30	18778.7

Total 525582

Section Cut and Cover  
 Length of section: 78.47264 m

Section 8

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	2008.8	m3	
concrete=	578.7075	m3	
rebar=	69.4	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	386.4778	m2	
SP&L<=4.6m deep	512.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	615.716	m2	

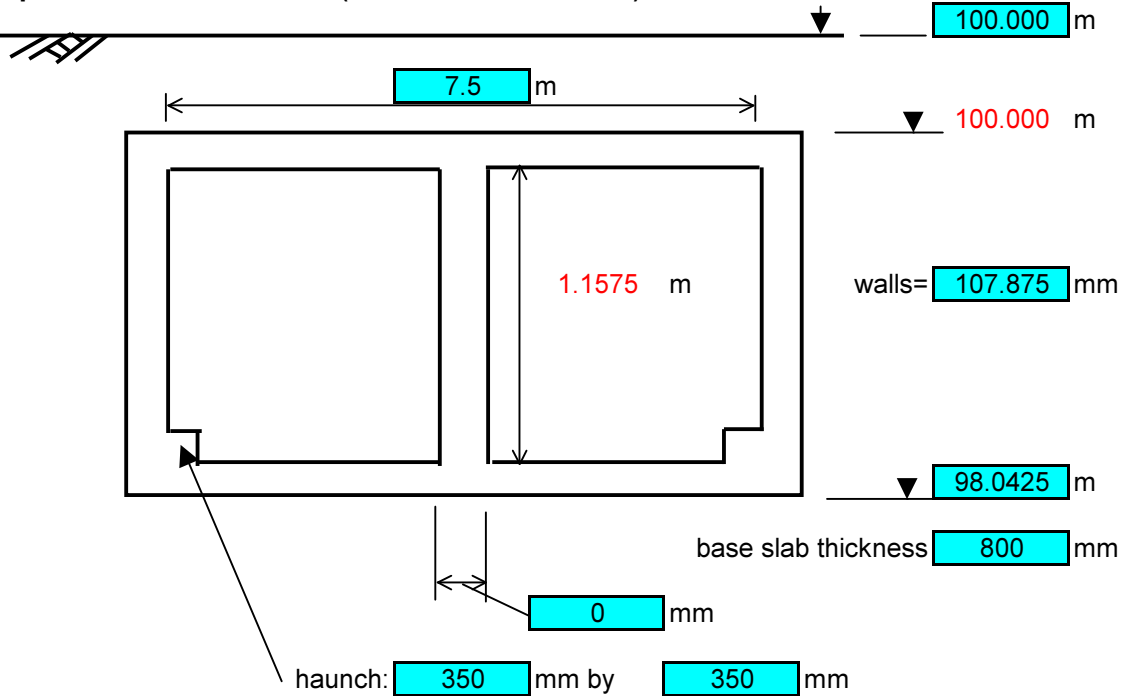
**Calculated costs**

Item	Unit	Quantity	Rate	Cost
excavation	m3	2008.8	60	120526.4
concrete	m3	578.7075	190.0	109954.4
rebar	tonnes	69.4	1600	111111.8
formwork/falsework	m2	386.4778	140	54106.89
SP&L<=4.6m deep	m2	512.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	615.716	30	18471.48
Total			414171	

Section Cut and Cover  
Length of section: 78.47264 m

Section 9

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	1185.2	m3	
concrete=	523.203	m3	
rebar=	62.8	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	181.6642	m2	
SP&L<=4.6m deep	307.2	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	605.4753	m2	

**Calculated costs**

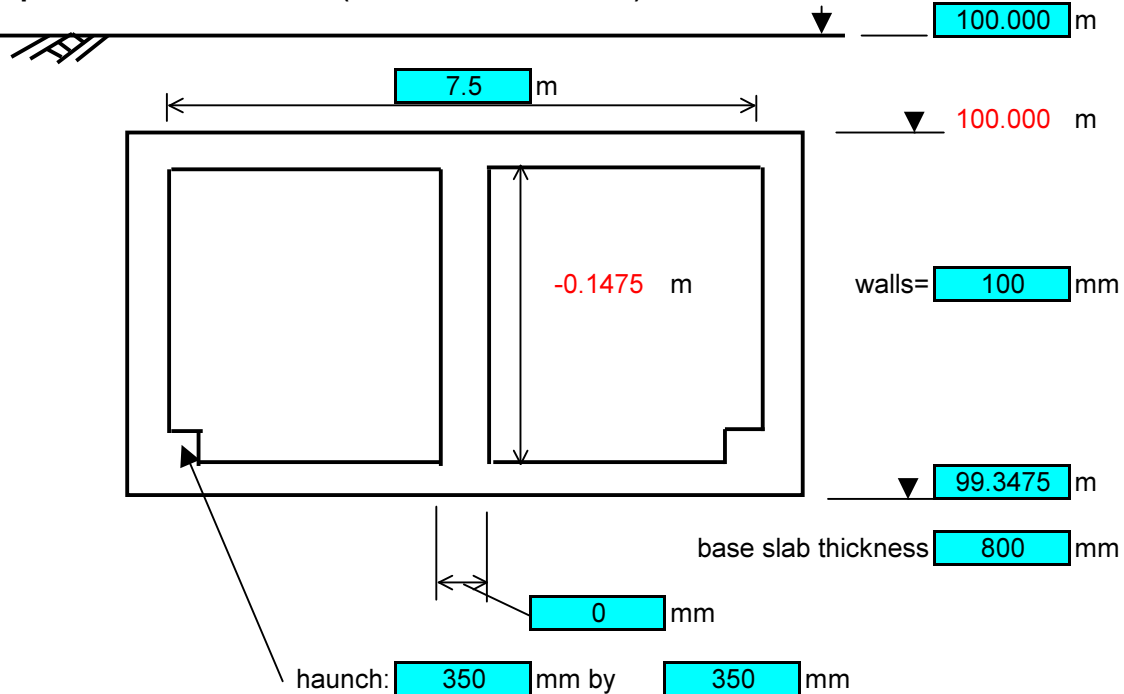
Item	Unit	Quantity	Rate	Cost
excavation	m3	1185.2	60	71113.07
concrete	m3	523.203	190.0	99408.58
rebar	tonnes	62.8	1600	100455
formwork/falsework	m2	181.6642	140	25432.98
SP&L<=4.6m deep	m2	307.2	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	605.4753	30	18164.26

Total 314573.9

Section Cut and Cover  
 Length of section: 78.47264 m

Section 10

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	394.3	m3	
concrete=	500.3023	m3	
rebar=	60.0	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	-23.14943	m2	
SP&L<=4.6m deep	102.4	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	604.2393	m2	



**Calculated costs**

Item	Unit	Quantity	Rate	Cost
excavation	m3	394.3	60	23655.97
concrete	m3	500.3023	190.0	95057.44
rebar	tonnes	60.0	1600	96058.04
formwork/falsework	m2	-23.14943	140	-3240.92
SP&L<=4.6m deep	m2	102.4	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	604.2393	30	18127.18

Total 229657.7

**Newfoundland Fixed Link Pre-feasibility Study**  
**South Approach**  
**Bored Rail Tunnel**

**Date:** 8-Jun-04  
**Calculations by:** ANW

**Summary of Costs**

Markup for adjacent 0 %

<b>Section</b>	<b>Cost</b>
1	1589250
2	1442071
3	1225243
4	975887.9
5	788589
6	648806.9
7	525582
8	414171
9	314573.9
10	<u>229657.7</u>
Sub-total	<u>8153832</u>



**Newfoundland Fixed Link Pre-feasibility Study**  
**Tunnel Drainage**  
**Bored Railway Tunnel**  
**Drainage Costs**

**Page 1 of 1**  
**Calculation by:** ANW  
**Date:** June 8, 2004

**Sump Sizing**

Assume inflow to tunnel of  litres/m<sup>2</sup>/24hours

Tunnel length=  m  
Tunnel diameter=  m

24 hour inflow= 1237002 litres = 1237 m<sup>3</sup>  
assume same again for firefighting= 1237 m<sup>3</sup>

Required sump capacity= 2474 m<sup>3</sup>

Assumed sump diameter=  m  
Assumed number of sump structures=  m

Required length of each sump= 44 m

**Piping**

Assume 300 mm diameter steel pipe connecting each sump to the portal areas  
Number of pipes=   
Assume sumps located at 1/3 and 2/3 of tunnel length

Total length of piping= 18967 m

**Rates**

Sump construction-\$ 17795 /m of sump  
Pipe-\$ 265 /m of pipe  
Pipe installation labour -\$ 29 /m of pipe (assume 6 man crew installing 100m/day)  
Pipe installation equipment-\$ 10 /m of pipe (assume \$1000/day for equipment)  
Pumps-\$ 125000 /pump

**Costs**

Item	Unit	Qty	Rate	\$-Cost
Sump construction	m	88	17795	1,565,960
Pipe	m	18967	265	5,026,167
Pipe installation	m	18967	29	546,240
Equipment	m	18967	10	189,667
Pumps	Nr	4	125000	500,000
<b>Total</b>				<u><b>7,828,033</b></u>

**Newfoundland Fixed Link  
Estimation of Capital Cost of Rail System**

**Table 2 - Estimated Capital Cost, not including Real Estate**

	Item	Qty	Unit	Unit Price	Cost
A	Rolling Stock				
	Locomotive -	5	Ea	2,750,000	13,750,000
	Transfer cars (std + 25% for mods)	7	Ea	162,671	1,138,699
	Auto/truck carriers (std + 25% for mods)	42	Ea	214,041	8,989,726
	Track Mobile	1	Ea	75,000	75,000
B	Trackwork				
	Track at terminals (incl. subgrade & ballast)	5,060	m	500	2,530,000
	#20 Turnouts	4	Ea	150,000	600,000
C	OCS System				
	OCS in tunnel	1	Ea	4,062,629	4,062,629
	OCS at terminals	2	Ea	1,068,271	2,136,543
	OCS at Maint. Facility	1	Ea	28,214	28,214
	Substations	2	Ea	1,535,714	3,071,429
D	Train Signal System				
	Microprocessor Based Signalling System	1	Ea	4,472,000	4,472,000
	Powered dials	2	Ea	60,000	120,000
	Power service to buildings and wayside cabinets	1	Ea	500,000	500,000
	Fibre optical cable and correspondence equipment	1	Ea	1,000,000	1,000,000
	Radio system	1	Ea	500,000	500,000
E	Loading/Unloading Facility				
	Staging area (incl. ramps, lighting)	50,000	m <sup>2</sup>	25	1,250,000
	Loading control system (incl. CCTV)	2	Ea	250,000	500,000
	Operations building (complete)	120	m <sup>2</sup>	1,800	216,000
	Public facilities building (complete)	50	m <sup>2</sup>	1,600	80,000
F	Maintenance & Emergency Response				
	Train maintenance bldg	1,200	m <sup>2</sup>	2,000	2,400,000
	Site maintenance bldg	144	m <sup>2</sup>	1,500	216,000
	Emergency evacuation bus w/ high rail gear	2	Ea	100,000	200,000
	Snow plow	2	Ea	100,000	200,000
	Pick-up truck with high rail gear	2	Ea	60,000	120,000
	SUV	2	Ea	50,000	100,000
	Tunnel fire engine (high rail mounted)	2	Ea	180,000	360,000
<b>TOTAL COST OF SHUTTLE TRAIN OPERATION EXCLUDING REAL ESTATE</b>					<b>\$ 48,616,239</b>

**Estimation of annual operating and maintenance costs**

**A. Energy Costs**

1. Tunnel lighting	3000000	kWh/yr @	0.1	\$/kWh= \$	300000	/yr
2. Ventilation fans	400000	kWh/yr @	0.1	\$/kWh= \$	40000	/yr
3. Sump pumps	20000	kWh/yr @	0.1	\$/kWh= \$	2000	/yr
Sub-total A - \$						342000 /yr

**B. Electrical Maintenance Costs**

1. Labour (Assume 1 electricians for 5 days per week throughout year)

Electrician 1      2080      hrs/yr @      65      \$/hr=      \$      135200      /yr

2. Materials/replacement of equipment (assume electrical equipment replaced once every 40 years)

Electrical equipment cost= \$      1000000  
written-off over      40      years = \$      25000      /yr

Sub-total B - \$      160200      /yr

**C. Mechanical Maintenance Costs**

1. Labour (Assume 1 mechanic/maintenance technician for 5 days per week throughout year)

Mechanic      2080      hrs/yr @      65      \$/hr=      \$      135200      /yr

2. Materials/replacement of equipment (assume mechanical equipment replaced every 40 years)

Ventilation system cost= \$      1000000  
written-off over      40      years = \$      25000      /yr

Emergency generators= \$      500000  
written-off over      40      years = \$      12500      /yr

Drainage pumps cost= \$      200000  
written-off over      40      years = \$      5000      /yr

Sub-total C - \$      177700      /yr

**contd.**

**Estimation of annual operating costs**

**D. Structure Maintenance Costs**

1. *Inspection (assume 3 man inspection crew for 10 weeks once every 4 years)*

Senior engineer	100	hrs/yr @	130	\$/hr=	\$	13000	/yr
Engineer 1	100	hrs/yr @	100	\$/hr=	\$	10000	/yr
Engineer 2	100	hrs/yr @	100	\$/hr=	\$	10000	/yr

2. *Tunnel Cleaning (Assume 4 man crew for 13 weeks once a year)*

Labourers	2080	hrs/yr @	60	\$/hr=	\$	124800	/yr
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3. *Sump clean-up (Assume 2 man crew for 2 days twice a year)*

Labourers	64	hrs/yr @	50	\$/hr=	\$	3200	/yr
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4. *Structure maintenance (Assume 4 man crew for 13 weeks once a year)*

Labourers	2080	hrs/yr @	50	\$/hr=	\$	104000	/yr
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5. *Permanent Way Inspection (Assume 2 men inspect track 3 times per week)*

Labourers	312	hrs/yr @	50	\$/hr=	\$	15600	/yr
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6. *Permanent way maintenance (Assume 4 man crew for 12 weeks once a year)*

Labourers	1920	hrs/yr @	50	\$/hr=	\$	96000	/yr
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Sub-total D - \$ 215600 /yr

**Total estimated maintenance cost=\$ 895,500 /yr**

**Newfoundland Fixed Link  
Rail System – Estimation of Annual Operating Cost**

**Table 3 - Estimated Shuttle Service Annual Operating Cost**

Item					Annual Cost
<i>Assumptions</i>					
Facility operates 12 hours/day, 7 days/week. 30 percent of this time the facility is fully staffed with toll collectors, the remainder of the time only 1 toll booth is operating on each side.					
<b>A</b>	<b>Salaried Staff</b>	<i>Unit</i>	<i>Unit</i>	<i>Rate</i>	
	Tunnel Manager	1.40	Year	100,000	140,000
	Tunnel Operator	1.40	Year	100,000	140,000
	Apprentice Operator	1.40	Year	60,000	84,000
	Site Maintenance Mgr	1.40	Year	50,000	70,000
<b>B</b>	<b>Hourly Staff</b>	<i>Quant</i>	<i>Unit</i>	<i>Rate</i>	
	Toll collectors - (2 FT, 4 PT, 1 PT Spare)	7,000	h	50	350,000
	Site Labor	4,000	h	35	140,000
	Electricians	6,000	h	65	390,000
	Mechanics	6,000	h	60	360,000
	Train drivers	8,000	h	85	680,000
	Loading foreman	4,000	h	55	220,000
	Laborers	20,000	h	40	800,000
<b>C</b>	<b>Subcontracted Work</b>				
	Locomotive maintenance	1	LS	120,000	120,000
	Rolling stock maintenance	1	LS	25,000	25,000
	Facility cleaning	52	w	250	13,000
	Landscaping	52	w	500	26,000
	Building maintenance	1	LS	10,000	10,000
<b>D</b>	<b>Power</b>	<i>Quant</i>	<i>Unit</i>	<i>Rate</i>	
		8,922	MWh	60	535,324
<b>E</b>	<b>Equipment Depreciation (straight-line)</b>	<i>Life</i>	<i>Unit</i>	<i>Cap. Cost</i>	
	Locomotives (20 years)	20	Year	13,750,000	687,500
	Rolling stock (20 years)	20	Year	10,128,425	506,421
	Buildings	30	Year	2,912,000	97,067
	Roads	30	Year	1,250,000	41,667
	Trackwork	25	Year	3,130,000	125,200
	OCS system	15	Year	9,298,814	619,921
	Signal system	15	Year	6,592,000	439,467
	Train loading system	12	Year	500,000	41,667
	Heavy vehicles	12	Year	560,000	46,667
	Light trucks	7	Year	220,000	31,429
<b>TOTAL ANNUAL OPERATING COST OF SHUTTLE TRAIN</b>					<b>\$ 6,740,328</b>



**Newfoundland Fixed Link  
Pre-feasibility Study  
Preferred Fixed Link Option - TBM Bored Railway Tunnel  
Basis of Estimate**

**Scope**

Estimate includes:

- mobilisation of equipment and materials
- TBM bored tunnel excavation and lining
- TBM bored tunnel finishes
- north and south approaches to TBM bored rail tunnel
- north and south rail terminals including passenger facilities, maintenance facilities, tolling areas
- tunnel trackwork, drainage, ventilation, mechanical & electrical items
- shuttle trains, signalling, and OCS system
- allowances for indirect costs, contractor profit, and risk allowances

Estimate does not include:

- land purchase costs
- approach roads to the terminal areas (addressed separately)
- provision for bringing electrical power to the facility

**Assumptions**

Principal Assumptions:

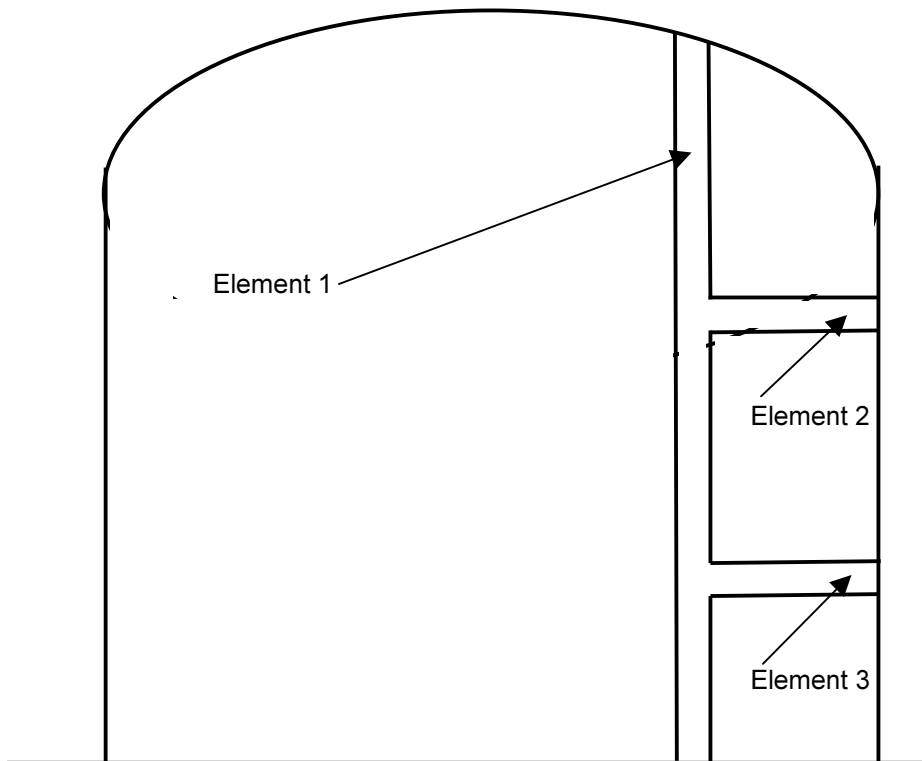
- labour wages in accordance with Local 2003 Collective Agreement for Newfoundland & Labrador
- 7.5 metre internal diameter tunnel driven from Newfoundland side using an EPB type tunnel boring machine configured for rock
- tunnel approximately 26.3 kilometres in length
- 3 eight hour shifts 5 days per week for tunnelling operations
- tunnel lined with bolted precast concrete segmental tunnel liner
- average tunnelling advance rate of 81 metres per week
- tunnel drive encounters 14 faults each 100 metres wide where advance rate decreases by approximately 60%
- rail mounted loco and muck car system used for removal of tunnel spoil
- longitudinal system used for ventilation of the tunnel (permanent facility)

**Costs**

Cost assumptions

- All costs in 2004 Canadian dollars
- HST not included

Tunnel length= 30667 m



Assumed tunnel cross section

**Newfoundland Fixed Link Pre-feasibility Study**  
**Cost Estimating**  
**Drill & Blast Railway Tunnel**  
**Tunnel Structural Finishes**

**Page 2 of 2**  
**Date:** June 07, 2004  
**Calculation by:** A.White

**Quantity Take-off**

<b>Concrete</b>					<b>Concrete</b>	<b>Rebar</b>
<b>Element</b>	<b>Nr.</b>	<b>L(m)</b>	<b>b(m)</b>	<b>d(m)</b>	<b>Qty(m3)</b>	<b>Qty(m3)</b>
1	1	30667	0.3	6.9	63481	7617.7
2	1	30667	1.5	0.3	13800	1656.0
3	1	30667	1.5	0.3	13800	1656.0
4	1	30667	5.5	1.0	168669	20240.2
					<u>259749</u> m3	<u>31170</u> t

**Formwork/falsework**

<b>Element</b>	<b>Nr.</b>	<b>L(m)</b>	<b>d(m)</b>	<b>Faces</b>	<b>Area(m2)</b>
1	1	30667	6.9	2	423204.6
2	1	30667	1.5	1	46000.5
3	1	30667	1.5	1	46000.5
4	1	30667	0	0	0
					<u>515205.6</u> m2

**Rates**

Concrete	m3	190
Formwork	m2	140
Reinforcement	t	1600

**Costs**

Concrete	m3	259749 m3	at	190	=	49,352,403
Formwork	m2	515206 m2	at	140	=	72,128,784
Reinforcement	t	31170 t	at	1600	=	49,871,902
				\$	<u>171,353,089</u>	

**Newfoundland Fixed Link Pre-feasibility Study**  
**Drill and Blast Rail Tunnel**  
**Tunnel Final Liner Cost Estimate**

Tunnel length= 30667 m  
 Liner cross section area= 13.5 m<sup>2</sup>

**Shift pattern**

Shifts	Hours	Days
3	8	5

Advance rate= 10 m/day

Rebar ratio= 0.12 t/m<sup>3</sup> of concrete

Concrete supply=\$ 135 /m<sup>3</sup>

Rebar supply=\$ 900 /t

Initial form set-up time= 4 weeks

**Durations**

Number of days= 3087 days  
 Number of hours= 74081 hours  
 Number of weeks= 617 weeks

**Labour**

Crew size 20  
 Average labour rate \$ 47 /hour

Total labour cost=\$ 69,635,952

**Equipment**

Form \$ 1000000  
 Weekly cost of other equipment \$ 15000 (see TED 2370)

Total equipment cost=\$ 10,260,100

**Materials**

Concrete= 414004.5 m<sup>3</sup>  
 Rebar= 49680.54  
 Concrete cost=\$ 55,890,608  
 Rebar cost=\$ 44,712,486

Total material cost=\$ 100,603,094

**Cost Summary**

Labour	69,635,952
Equipment	10,260,100
Materials	100,603,094
<b>Total</b>	<b>180,499,146</b>

## Initialisation

**Project:** Newfoundland Fixed Link Pre-feasibility Study

**Section:** North Approach

**Option:** D&B Rail Tunnel

**Date:** 8-Jun-04

**Calculations by:** ANW

Surface gradient  %

+ sloping same way as track/road  
- sloping against track/road

Track/Road Gradient  %

Ground elevation  
at portal  m

Bottom of slab  
elevation at portal  m

Total length= 784.7264 m

Total Cost=\$ 8.2 M

UNIT RATES

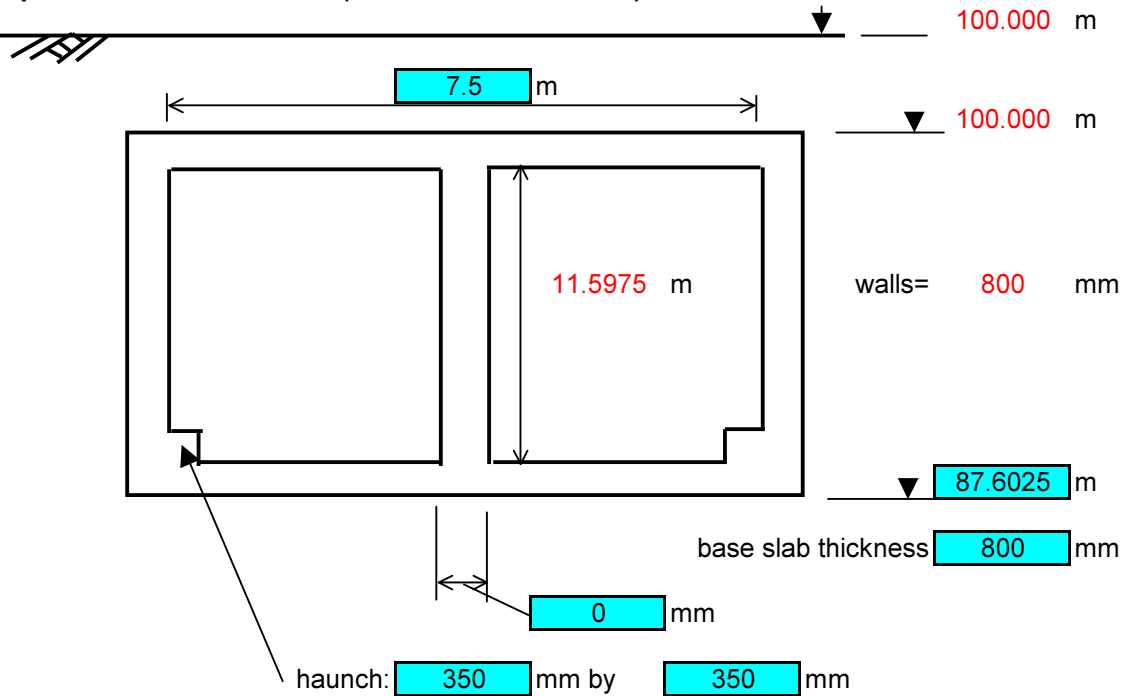
Materials

Item	unit	Rate
excavation	m3	60
concrete	m3	190
rebar	tonnes	1600
formwork/falsework	m2	140
SP&L<=4.6m deep	m2	0
4.6<SP&L<=6.7m deep	m2	0
6.7<SP&L<=10.6m deep	m2	0
10.6<SP&L<=13.7m deep	m2	0
13.7<SP&L<=16.8m deep	m2	0
16.8<SP&L<=20.0m deep	m2	0
20<SP&L<=25m deep	m2	0
backfill + compact	m3	40
surface reinstatement	m2	30

Section Cut and Cover  
Length of section: 78.47264 m

Section 1

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	8853.1	m3	
concrete=	2046.645	m3	
rebar=	245.6	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	1820.173	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	1945.7	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	714.101	m2	

**Calculated costs**

Item	Unit	Quantity	Rate	Cost
excavation	m3	8853.1	60	531184
concrete	m3	2046.645	190.0	388862.5
rebar	tonnes	245.6	1600	392955.8
formwork/falsework	m2	1820.173	140	254824.2
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	1945.7	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	714.101	30	21423.03

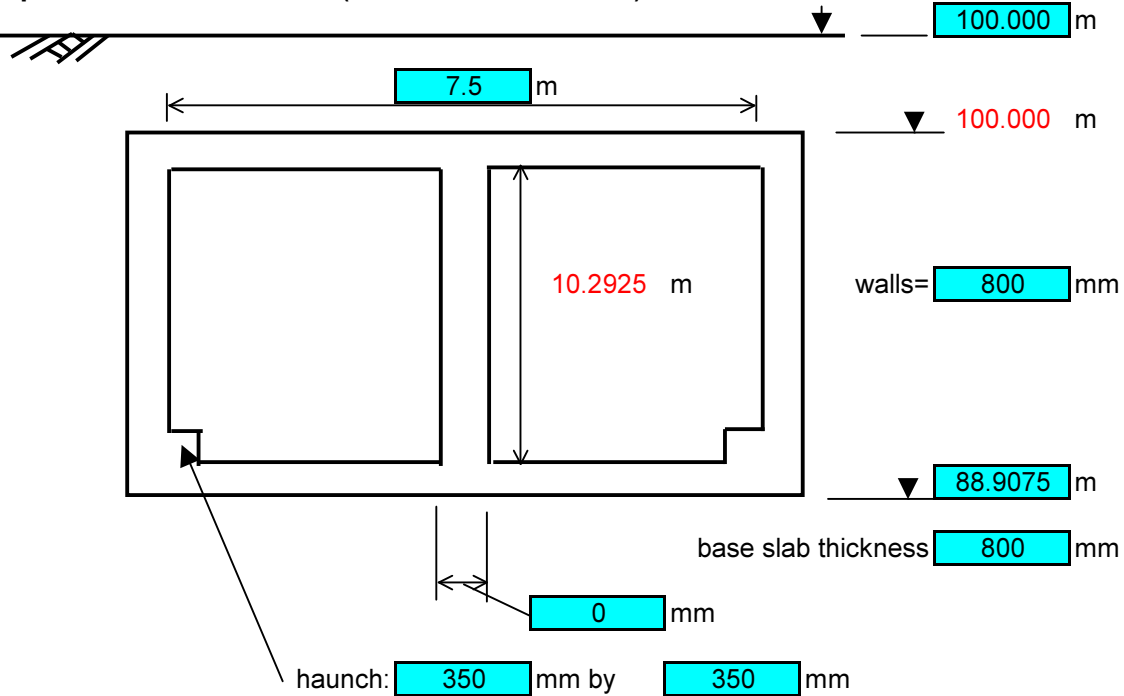
Total 1589250



Section Cut and Cover  
Length of section: 78.47264 m

Section 2

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	7921.2	m3	
concrete=	1882.794	m3	
rebar=	225.9	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	1615.359	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	1740.9	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	714.101	m2	

**Calculated costs**

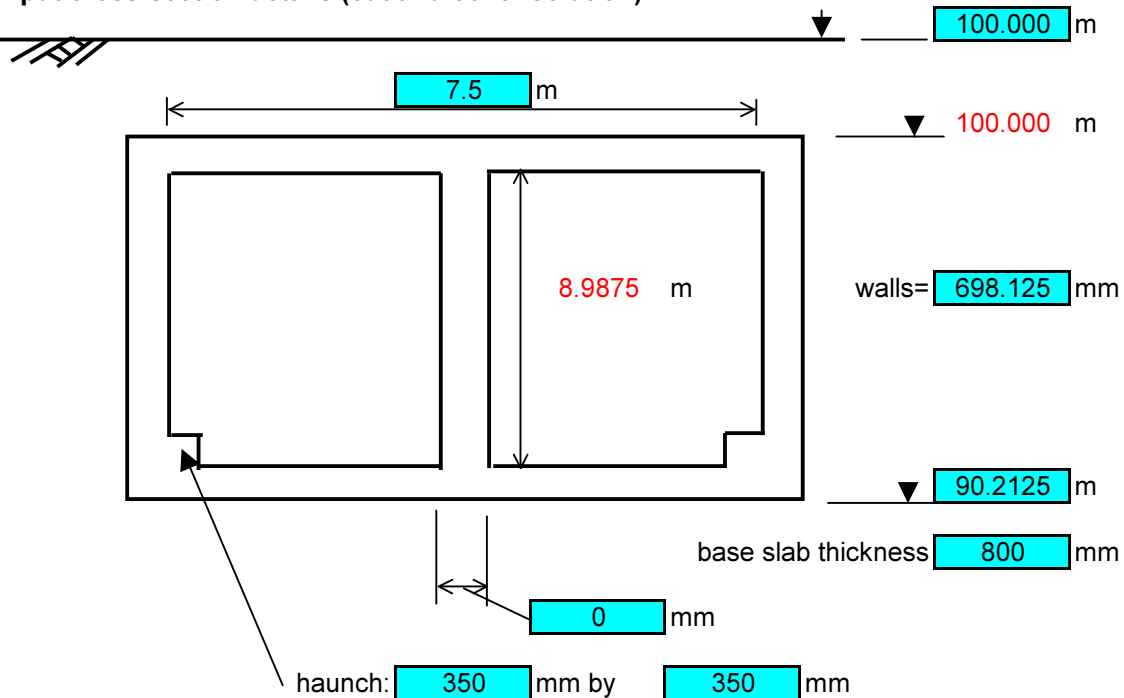
Item	Unit	Quantity	Rate	Cost
excavation	m3	7921.2	60	475269.9
concrete	m3	1882.794	190.0	357730.9
rebar	tonnes	225.9	1600	361496.5
formwork/falsework	m2	1615.359	140	226150.3
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	1740.9	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	714.101	30	21423.03

Total 1442071

Section Cut and Cover  
Length of section: 78.47264 m

Section 3

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	6832.8	m3	
concrete=	1562.453	m3	
rebar=	187.5	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	1410.546	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	1536.1	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	698.1122	m2	

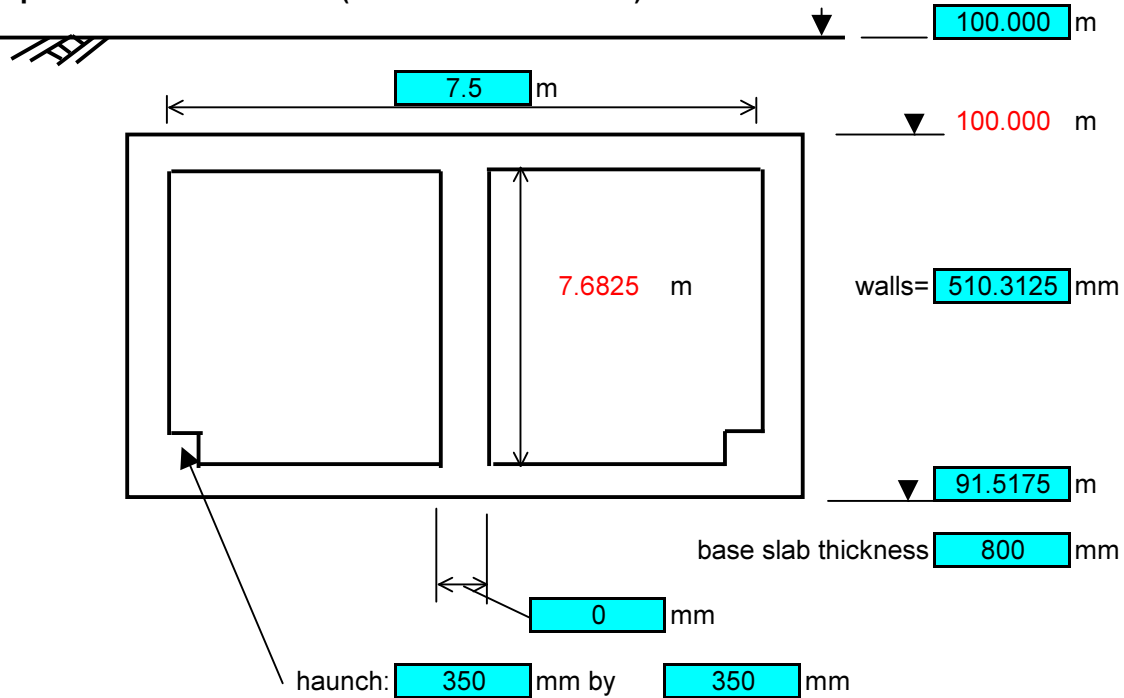
**Calculated costs**

Item	Unit	Quantity	Rate	Cost
excavation	m3	6832.8	60	409966.4
concrete	m3	1562.453	190.0	296866
rebar	tonnes	187.5	1600	299990.9
formwork/falsework	m2	1410.546	140	197476.4
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	1536.1	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	698.1122	30	20943.37
Total				<u>1225243</u>

Section Cut and Cover  
Length of section: 78.47264 m

Section 4

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	5671.7	m3	
concrete=	1169.435	m3	
rebar=	140.3	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	1205.732	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	1331.3	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	668.6359	m2	

**Calculated costs**

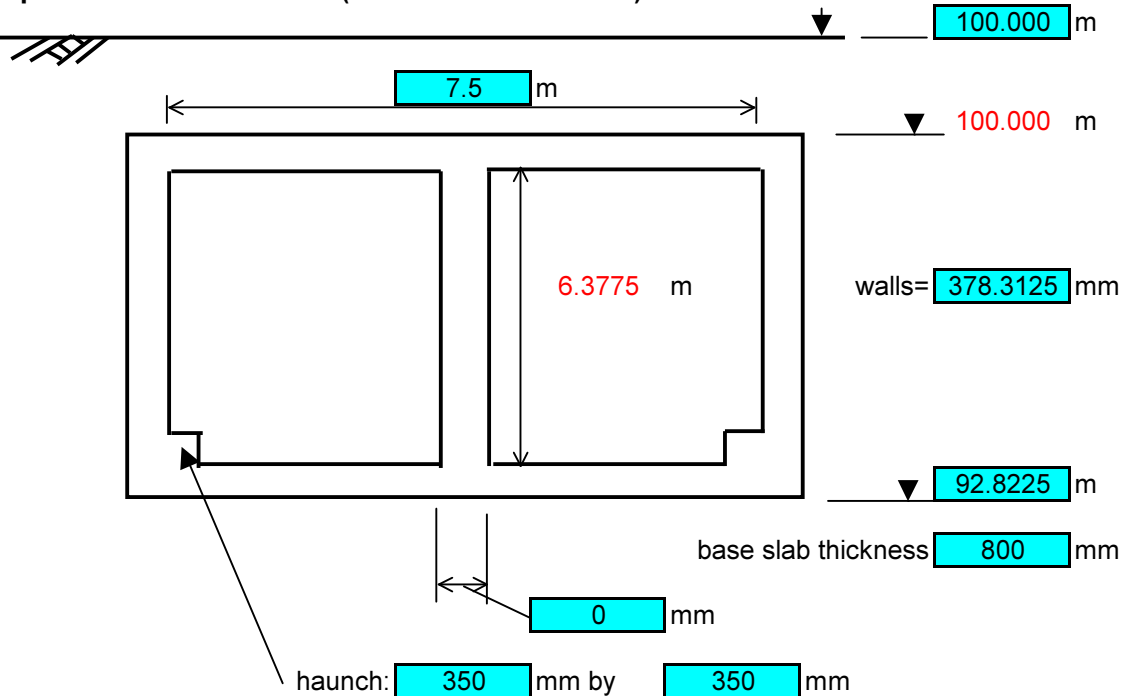
Item	Unit	Quantity	Rate	Cost
excavation	m3	5671.7	60	340302.3
concrete	m3	1169.435	190.0	222192.6
rebar	tonnes	140.3	1600	224531.5
formwork/falsework	m2	1205.732	140	168802.5
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	1331.3	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	668.6359	30	20059.08

Total 975887.9

Section Cut and Cover  
Length of section: 78.47264 m

Section 5

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	4650.4	m3	
concrete=	916.2211	m3	
rebar=	109.9	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	1000.919	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	1126.5	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	647.9192	m2	

**Calculated costs**

Item	Unit	Quantity	Rate	Cost
excavation	m3	4650.4	60	279026.4
concrete	m3	916.2211	190.0	174082
rebar	tonnes	109.9	1600	175914.5
formwork/falsework	m2	1000.919	140	140128.6
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	1126.5	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	647.9192	30	19437.57

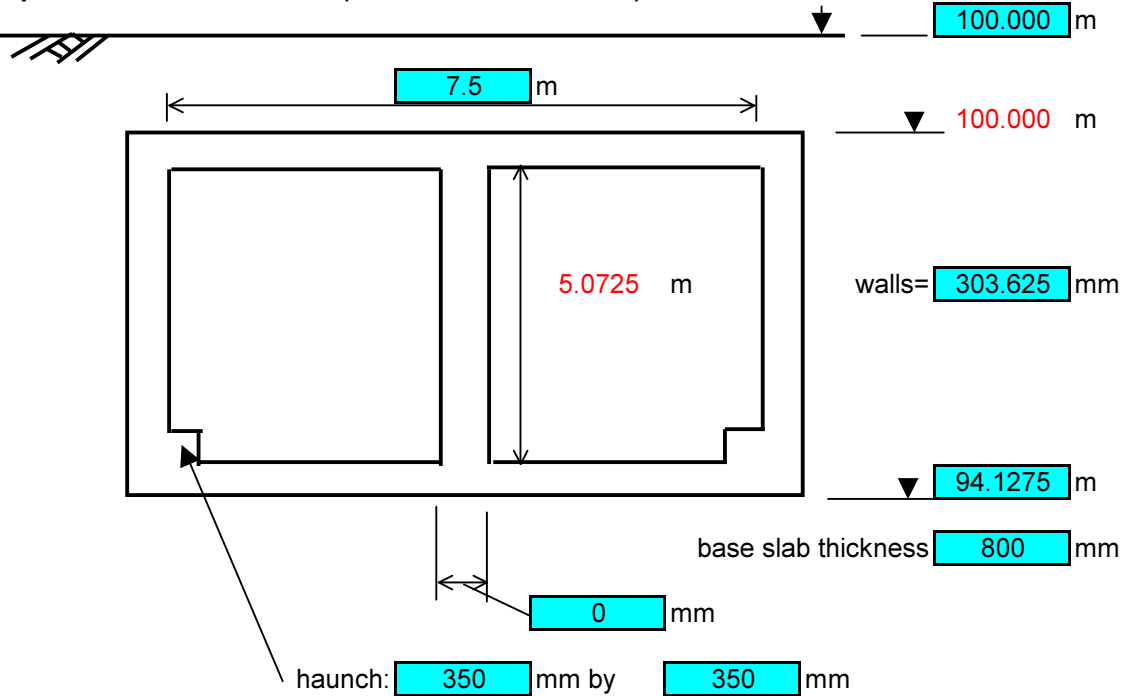
Total 788589



Section Cut and Cover  
Length of section: 78.47264 m

Section 6

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	3736.1	m3	
concrete=	769.901	m3	
rebar=	92.4	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	796.1049	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	921.7	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	636.1973	m2	

**Calculated costs**

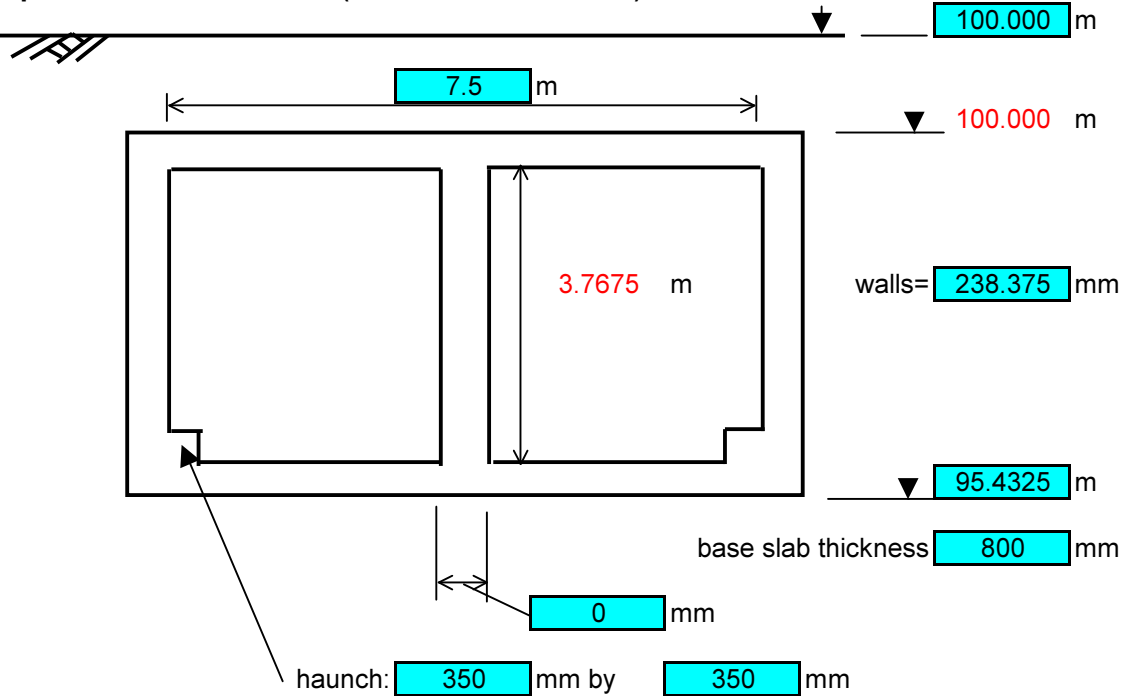
Item	Unit	Quantity	Rate	Cost
excavation	m3	3736.1	60	224164.1
concrete	m3	769.901	190.0	146281.2
rebar	tonnes	92.4	1600	147821
formwork/falsework	m2	796.1049	140	111454.7
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	921.7	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	636.1973	30	19085.92

Total 648806.9

Section Cut and Cover  
Length of section: 78.47264 m

Section 7

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	2859.1	m3	
concrete=	660.9402	m3	
rebar=	79.3	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	591.2913	m2	
SP&L<=4.6m deep	716.8	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	625.9566	m2	

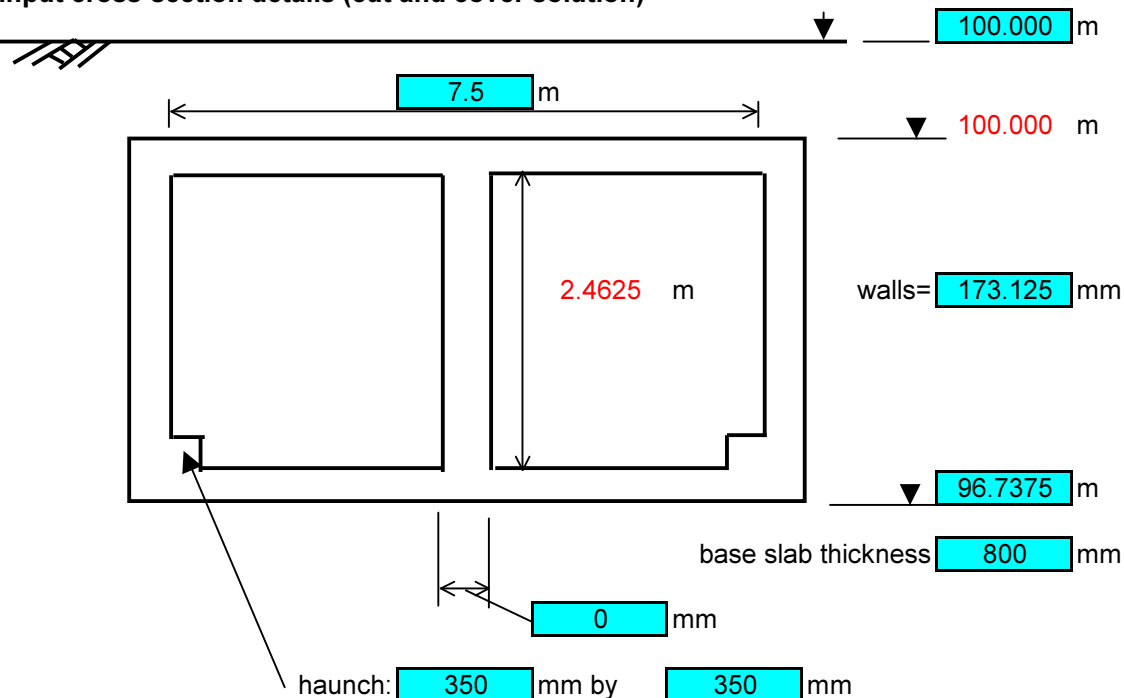
**Calculated costs**

Item	Unit	Quantity	Rate	Cost
excavation	m3	2859.1	60	171543.4
concrete	m3	660.9402	190.0	125578.6
rebar	tonnes	79.3	1600	126900.5
formwork/falsework	m2	591.2913	140	82780.79
SP&L<=4.6m deep	m2	716.8	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	625.9566	30	18778.7
Total				<u>525582</u>

Section Cut and Cover  
Length of section: 78.47264 m

Section 8

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	2008.8	m3	
concrete=	578.7075	m3	
rebar=	69.4	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	386.4778	m2	
SP&L<=4.6m deep	512.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	615.716	m2	

**Calculated costs**

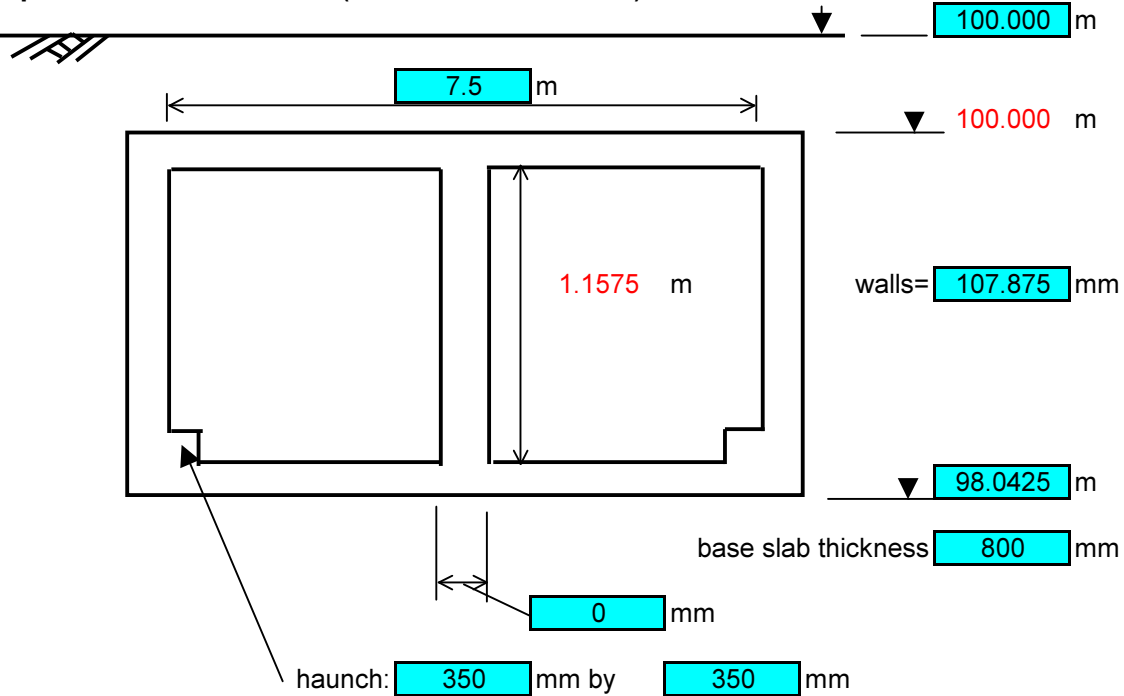
Item	Unit	Quantity	Rate	Cost
excavation	m3	2008.8	60	120526.4
concrete	m3	578.7075	190.0	109954.4
rebar	tonnes	69.4	1600	111111.8
formwork/falsework	m2	386.4778	140	54106.89
SP&L<=4.6m deep	m2	512.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	615.716	30	18471.48

Total 414171

Section Cut and Cover  
Length of section: 78.47264 m

Section 9

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	1185.2	m3	
concrete=	523.203	m3	
rebar=	62.8	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	181.6642	m2	
SP&L<=4.6m deep	307.2	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	605.4753	m2	

**Calculated costs**

Item	Unit	Quantity	Rate	Cost
excavation	m3	1185.2	60	71113.07
concrete	m3	523.203	190.0	99408.58
rebar	tonnes	62.8	1600	100455
formwork/falsework	m2	181.6642	140	25432.98
SP&L<=4.6m deep	m2	307.2	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	605.4753	30	18164.26

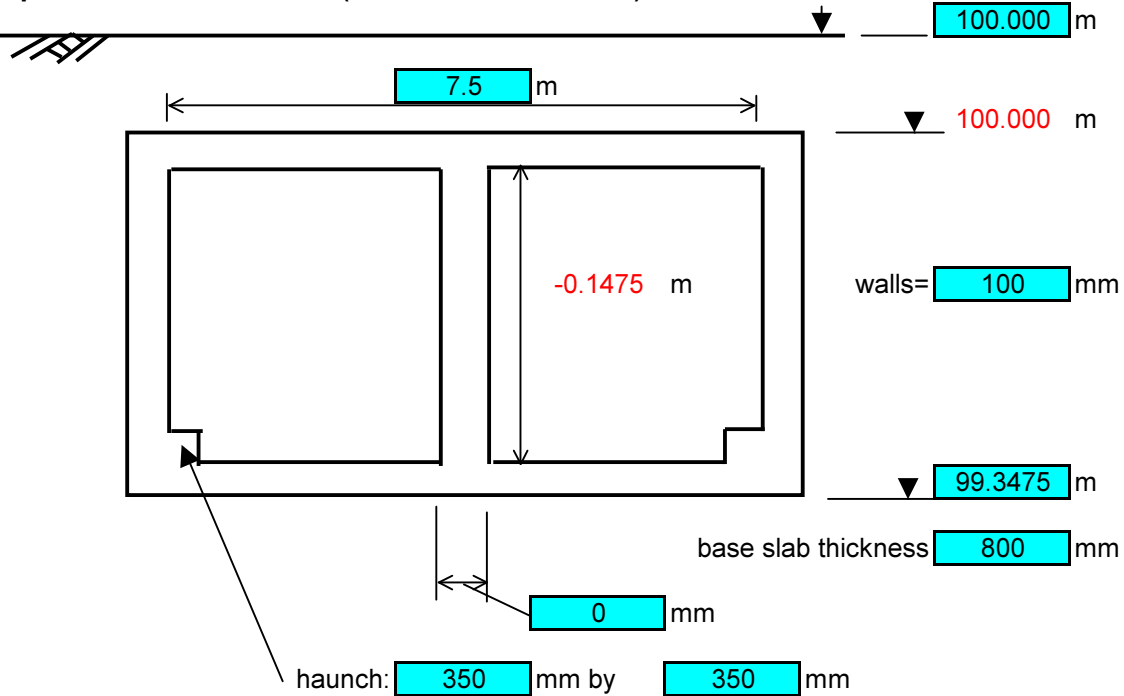
Total 314573.9



Section Cut and Cover  
Length of section: 78.47264 m

Section 10

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	394.3	m3	
concrete=	500.3023	m3	
rebar=	60.0	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	-23.14943	m2	
SP&L<=4.6m deep	102.4	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	604.2393	m2	

**Calculated costs**

Item	Unit	Quantity	Rate	Cost
excavation	m3	394.3	60	23655.97
concrete	m3	500.3023	190.0	95057.44
rebar	tonnes	60.0	1600	96058.04
formwork/falsework	m2	-23.14943	140	-3240.92
SP&L<=4.6m deep	m2	102.4	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	604.2393	30	18127.18

Total 229657.7

**Newfoundland Fixed Link Pre-feasibility Study**  
**North Approach**  
**D&B Rail Tunnel**

**Date:** 8-Jun-04  
**Calculations by:** ANW

**Summary of Costs**

Markup for adjacent 0 %

<b>Section</b>	<b>Cost</b>
1	1589250
2	1442071
3	1225243
4	975887.9
5	788589
6	648806.9
7	525582
8	414171
9	314573.9
10	<u>229657.7</u>
Sub-total	<u>8153832</u>

## Initialisation

**Project:** Newfoundland Fixed Link Pre-feasibility Study

**Section:** South Approach

**Option:** Bored Rail Tunnel

**Date:** 8-Jun-04

**Calculations by:** ANW

Surface gradient  %

+ sloping same way as track/road  
- sloping against track/road

Track/Road Gradient  %

Ground elevation  
at portal  m

Bottom of slab  
elevation at portal  m

Total length= 784.7264 m

Total Cost=\$ 8.2 M

UNIT RATES

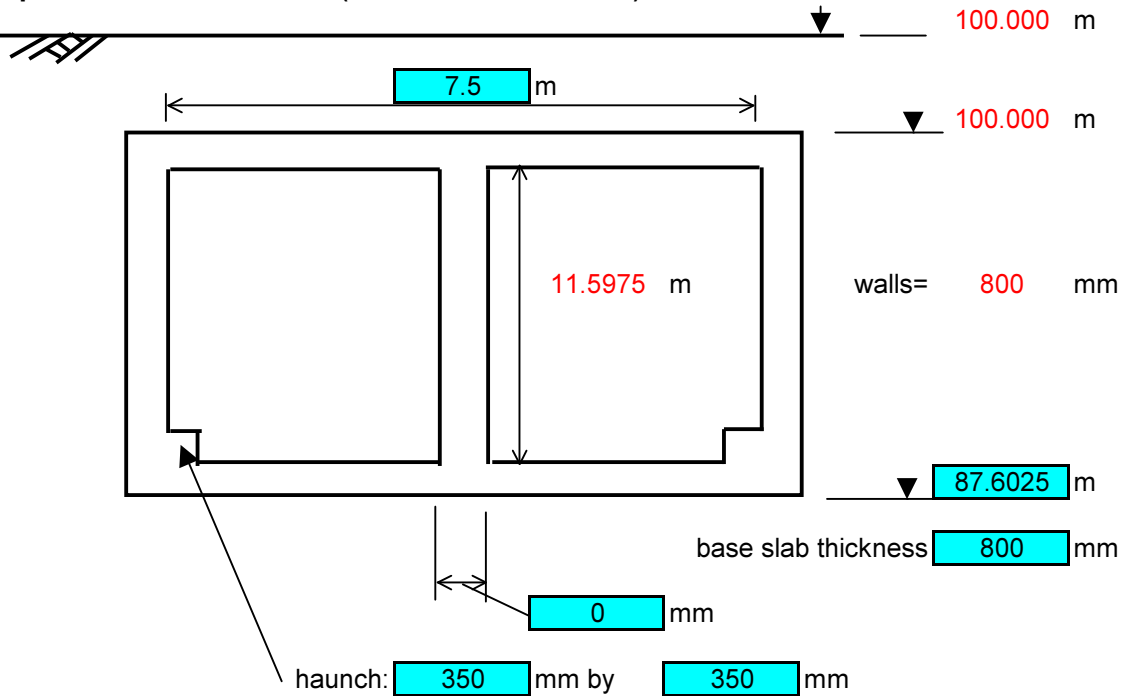
Materials

Item	unit	Rate
excavation	m3	60
concrete	m3	190
rebar	tonnes	1600
formwork/falsework	m2	140
SP&L<=4.6m deep	m2	0
4.6<SP&L<=6.7m deep	m2	0
6.7<SP&L<=10.6m deep	m2	0
10.6<SP&L<=13.7m deep	m2	0
13.7<SP&L<=16.8m deep	m2	0
16.8<SP&L<=20.0m deep	m2	0
20<SP&L<=25m deep	m2	0
backfill + compact	m3	40
surface reinstatement	m2	30

Section Cut and Cover  
Length of section: 78.47264 m

Section 1

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	8853.1	m3	
concrete=	2046.645	m3	
rebar=	245.6	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	1820.173	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	1945.7	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	714.101	m2	

**Calculated costs**

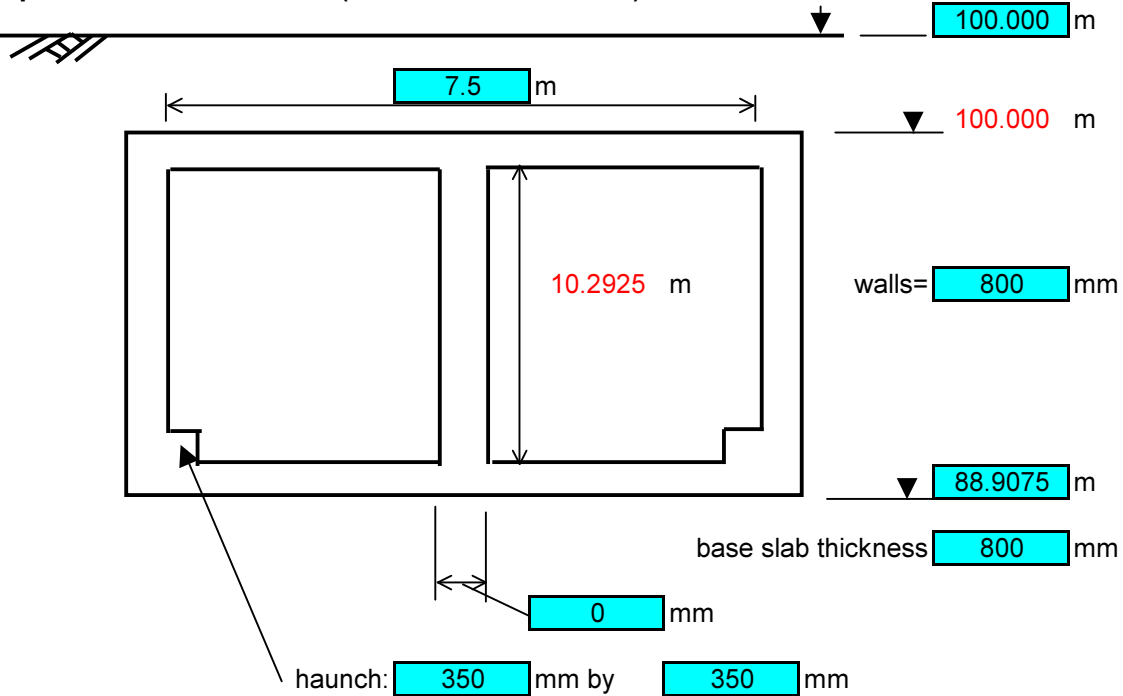
Item	Unit	Quantity	Rate	Cost
excavation	m3	8853.1	60	531184
concrete	m3	2046.645	190.0	388862.5
rebar	tonnes	245.6	1600	392955.8
formwork/falsework	m2	1820.173	140	254824.2
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	1945.7	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	714.101	30	21423.03

Total 1589250

Section Cut and Cover  
Length of section: 78.47264 m

Section 2

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	7921.2	m3	
concrete=	1882.794	m3	
rebar=	225.9	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	1615.359	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	1740.9	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	714.101	m2	



**Calculated costs**

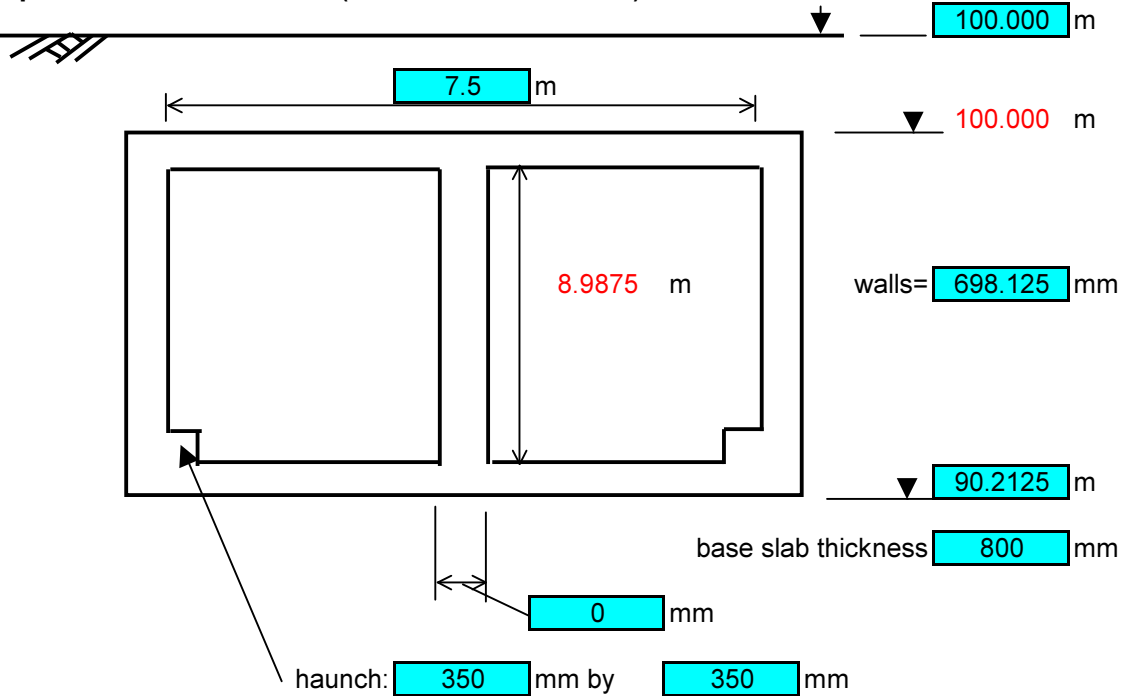
Item	Unit	Quantity	Rate	Cost
excavation	m3	7921.2	60	475269.9
concrete	m3	1882.794	190.0	357730.9
rebar	tonnes	225.9	1600	361496.5
formwork/falsework	m2	1615.359	140	226150.3
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	1740.9	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	714.101	30	21423.03

Total 1442071

Section Cut and Cover  
Length of section: 78.47264 m

Section 3

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	6832.8	m3	
concrete=	1562.453	m3	
rebar=	187.5	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	1410.546	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	1536.1	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	698.1122	m2	

**Calculated costs**

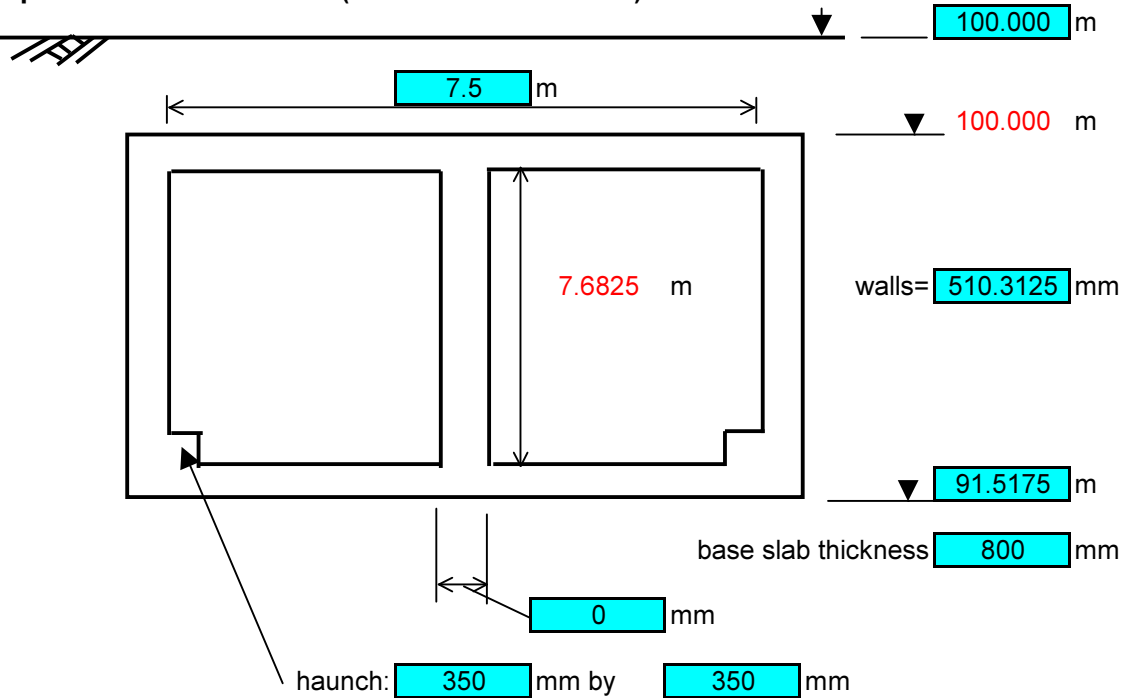
Item	Unit	Quantity	Rate	Cost
excavation	m3	6832.8	60	409966.4
concrete	m3	1562.453	190.0	296866
rebar	tonnes	187.5	1600	299990.9
formwork/falsework	m2	1410.546	140	197476.4
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	1536.1	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	698.1122	30	20943.37

Total 1225243

Section Cut and Cover  
Length of section: 78.47264 m

Section 4

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	5671.7	m3	
concrete=	1169.435	m3	
rebar=	140.3	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	1205.732	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	1331.3	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	668.6359	m2	

**Calculated costs**

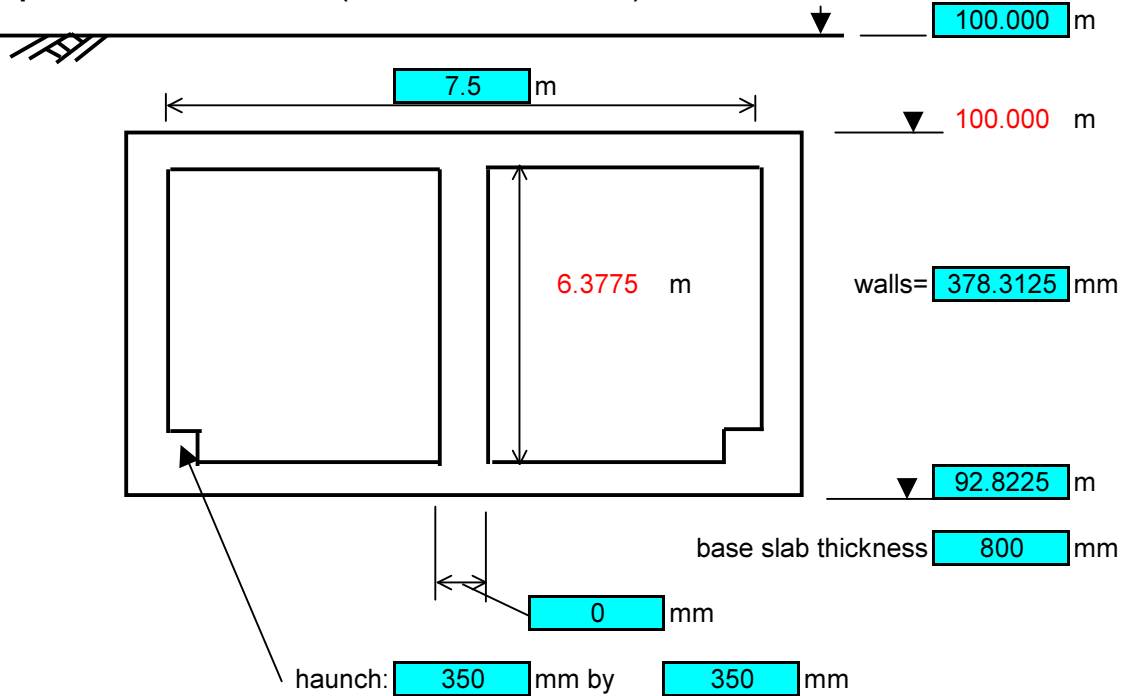
Item	Unit	Quantity	Rate	Cost
excavation	m3	5671.7	60	340302.3
concrete	m3	1169.435	190.0	222192.6
rebar	tonnes	140.3	1600	224531.5
formwork/falsework	m2	1205.732	140	168802.5
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	1331.3	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	668.6359	30	20059.08

Total 975887.9

Section Cut and Cover  
Length of section: 78.47264 m

Section 5

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	4650.4	m3	
concrete=	916.2211	m3	
rebar=	109.9	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	1000.919	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	1126.5	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	647.9192	m2	

**Calculated costs**

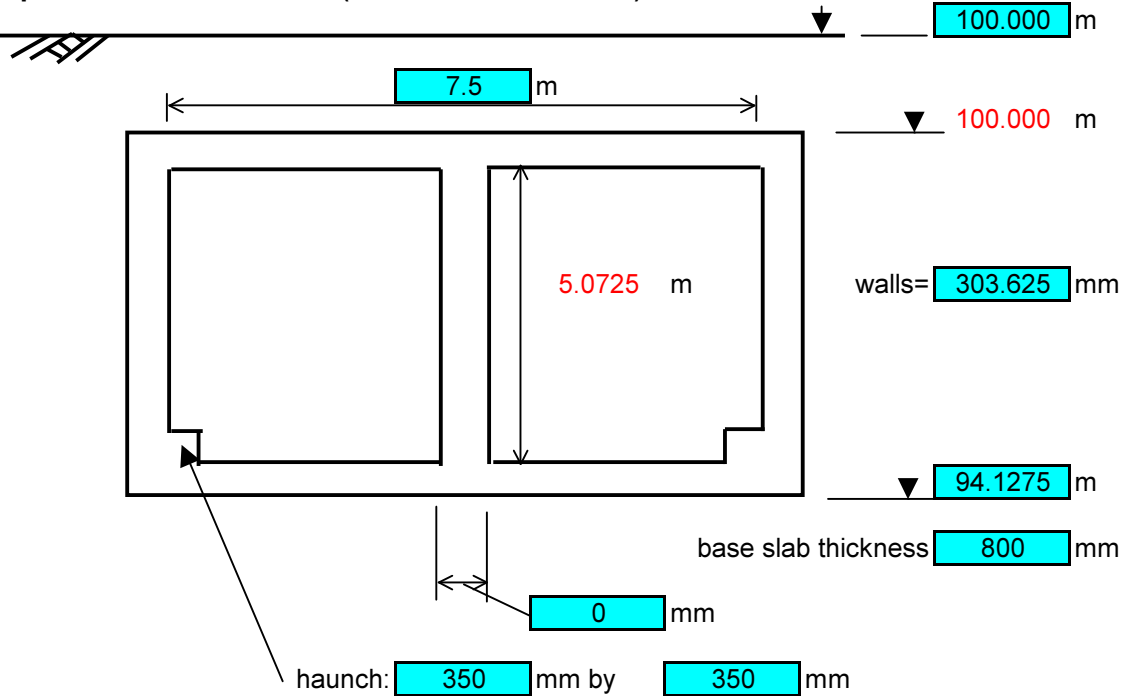
Item	Unit	Quantity	Rate	Cost
excavation	m3	4650.4	60	279026.4
concrete	m3	916.2211	190.0	174082
rebar	tonnes	109.9	1600	175914.5
formwork/falsework	m2	1000.919	140	140128.6
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	1126.5	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	647.9192	30	19437.57

Total 788589

Section Cut and Cover  
Length of section: 78.47264 m

Section 6

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	3736.1	m3	
concrete=	769.901	m3	
rebar=	92.4	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	796.1049	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	921.7	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	636.1973	m2	



**Calculated costs**

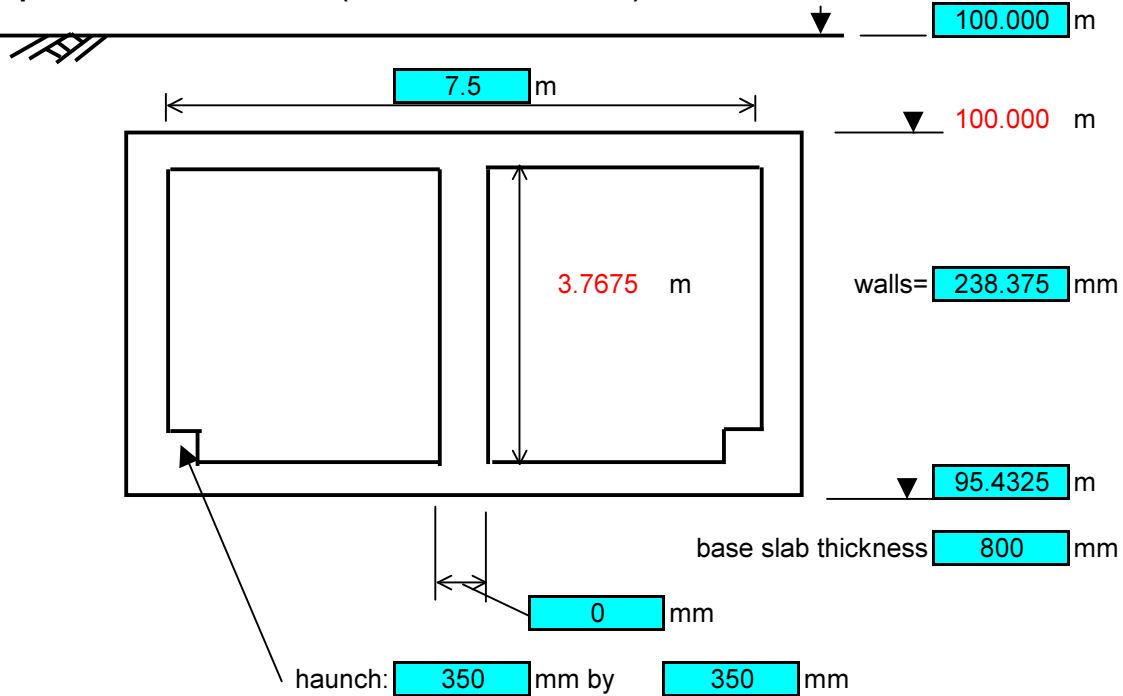
Item	Unit	Quantity	Rate	Cost
excavation	m3	3736.1	60	224164.1
concrete	m3	769.901	190.0	146281.2
rebar	tonnes	92.4	1600	147821
formwork/falsework	m2	796.1049	140	111454.7
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	921.7	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	636.1973	30	19085.92

Total 648806.9

Section Cut and Cover  
 Length of section: 78.47264 m

Section 7

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	2859.1	m3	
concrete=	660.9402	m3	
rebar=	79.3	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	591.2913	m2	
SP&L<=4.6m deep	716.8	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	625.9566	m2	

**Calculated costs**

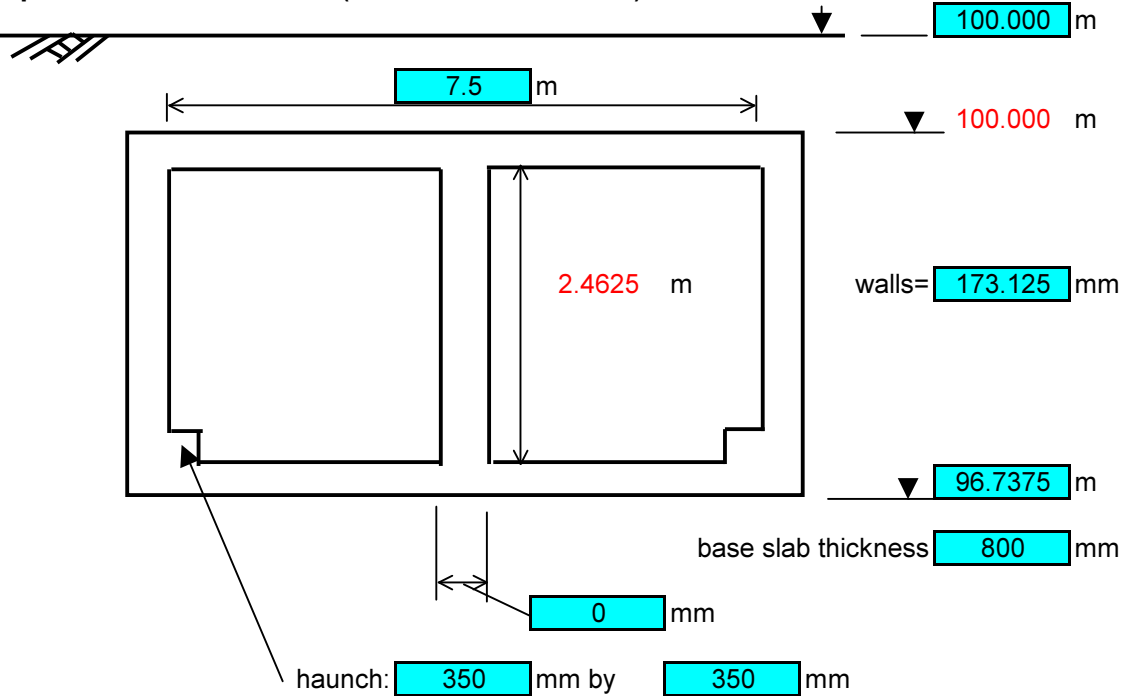
Item	Unit	Quantity	Rate	Cost
excavation	m3	2859.1	60	171543.4
concrete	m3	660.9402	190.0	125578.6
rebar	tonnes	79.3	1600	126900.5
formwork/falsework	m2	591.2913	140	82780.79
SP&L<=4.6m deep	m2	716.8	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	625.9566	30	18778.7

Total 525582

Section Cut and Cover  
Length of section: 78.47264 m

Section 8

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	2008.8	m3	
concrete=	578.7075	m3	
rebar=	69.4	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	386.4778	m2	
SP&L<=4.6m deep	512.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	615.716	m2	

**Calculated costs**

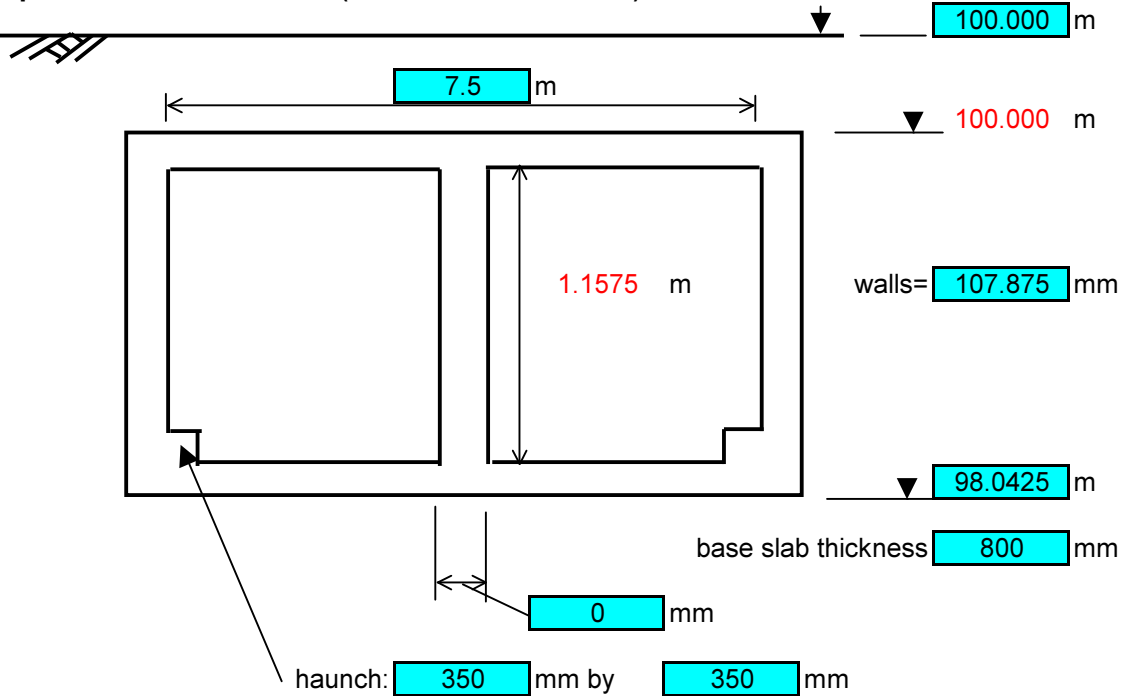
Item	Unit	Quantity	Rate	Cost
excavation	m3	2008.8	60	120526.4
concrete	m3	578.7075	190.0	109954.4
rebar	tonnes	69.4	1600	111111.8
formwork/falsework	m2	386.4778	140	54106.89
SP&L<=4.6m deep	m2	512.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	615.716	30	18471.48

Total 414171

Section Cut and Cover  
Length of section: 78.47264 m

Section 9

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	1185.2	m3	
concrete=	523.203	m3	
rebar=	62.8	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	181.6642	m2	
SP&L<=4.6m deep	307.2	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	605.4753	m2	

**Calculated costs**

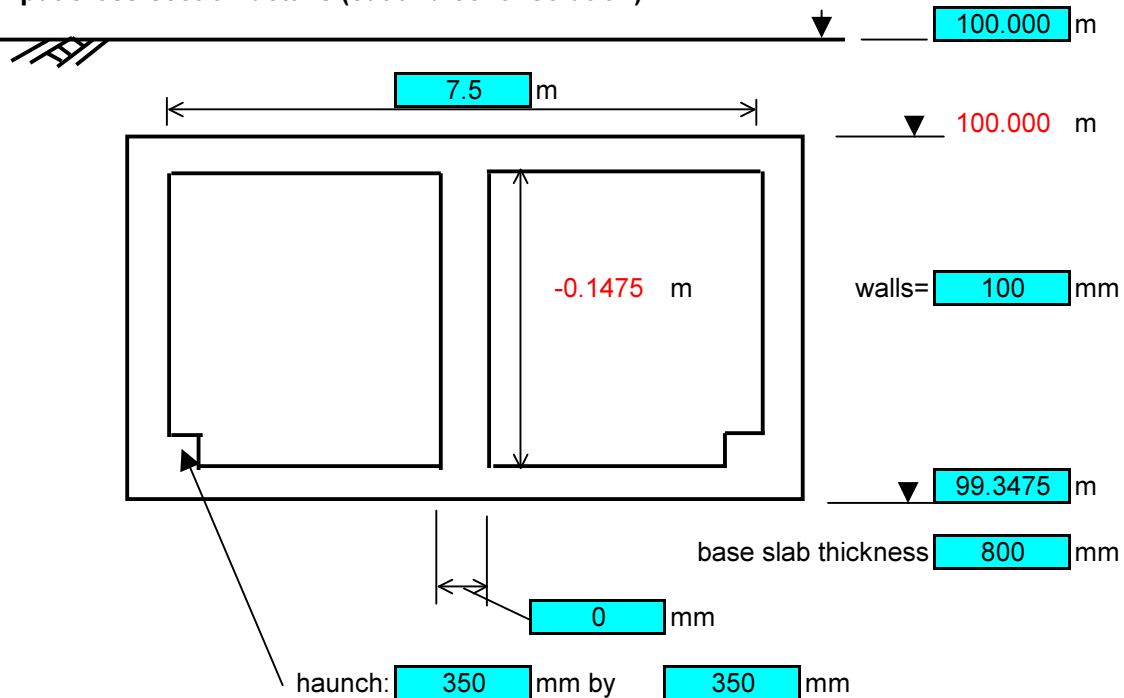
Item	Unit	Quantity	Rate	Cost
excavation	m3	1185.2	60	71113.07
concrete	m3	523.203	190.0	99408.58
rebar	tonnes	62.8	1600	100455
formwork/falsework	m2	181.6642	140	25432.98
SP&L<=4.6m deep	m2	307.2	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	605.4753	30	18164.26

Total 314573.9

Section Cut and Cover  
Length of section: 78.47264 m

Section 10

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	394.3	m3	
concrete=	500.3023	m3	
rebar=	60.0	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	-23.14943	m2	
SP&L<=4.6m deep	102.4	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	604.2393	m2	



**Calculated costs**

Item	Unit	Quantity	Rate	Cost
excavation	m3	394.3	60	23655.97
concrete	m3	500.3023	190.0	95057.44
rebar	tonnes	60.0	1600	96058.04
formwork/falsework	m2	-23.14943	140	-3240.92
SP&L<=4.6m deep	m2	102.4	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	604.2393	30	18127.18

Total 229657.7

**Newfoundland Fixed Link Pre-feasibility Study**  
**South Approach**  
**Bored Rail Tunnel**

**Date:** 8-Jun-04  
**Calculations by:** ANW

**Summary of Costs**

Markup for adjacent 0 %

<b>Section</b>	<b>Cost</b>
1	1589250
2	1442071
3	1225243
4	975887.9
5	788589
6	648806.9
7	525582
8	414171
9	314573.9
10	<u>229657.7</u>
Sub-total	<u>8153832</u>



## Newfoundland Fixed Link Pre-feasibility - Drill & Blast Railway Tunnel - Cost Summary

<b>BORED TUNNEL CONSTRUCTION COSTS</b>		
ITEM	UNIT	MAIN TUNNEL
MOBILIZATION & DEMOBILIZATION	LS	8,000,000
DRILL & BLAST TUNNELLING	LS	606,989,049
TUNNEL FINAL LINER	LS	180,499,146
TUNNEL FINISHES	LS	171,353,089
NORTH APPROACH STRUCTURES	LS	8,153,832
SOUTH APPROACH STRUCTURES	LS	8,153,832
RAIL TRACK	LS	16,086,400
TUNNEL DRAINAGE	LS	7,820,000
UTILITY DIVERSIONS	LS	1,000,000
MONITORING	LS	1,000,000
<b>SUBTOTAL CIVIL</b>		<b>\$1,009,055,348</b>
<b>CIVIL CONTINGENCIES</b>		
CONTINGENCY	40%	\$403,622,139
<b>TOTAL CIVIL</b>		<b>\$1,412,677,487</b>
<b>M&amp;E, ROLLING STOCK, RAIL HARDWARE AND FINISHING WORK</b>		
ROLLING STOCK, TERMINALS, OCS, ETC	LS	\$48,000,000
VENTILATION EQUIPMENT	LS	\$3,000,000
VENTILATION SHAFTS AND BUILDINGS x 2	LS	\$0
FIRE SUPPRESSION SYSTEM	LS	\$2,000,000
CONTROL CENTRE	LS	\$1,000,000
SIGNALLING	LS	\$1,000,000
LIGHTING	LS	\$1,000,000
CCTV SYSTEM	LS	\$0
GAS DETECTION	LS	\$900,000
SUBSTATION, GENERATORS, UPS	LS	\$2,000,000
<b>SUBTOTAL M&amp;E AND FINISHING</b>		<b>\$58,900,000</b>
<b>CONTINGENCIES</b>	20%	\$11,780,000
<b>TOTAL M&amp;E AND FINISHING</b>		<b>\$70,680,000</b>
<b>TOTAL CIVIL, M&amp;E AND FINISHING</b>		<b>\$1,483,357,487</b>
<b>ALLOWANCES</b>		
CONTRACTOR OH	15%	\$222,503,623
CONTRACTOR PROFIT	15%	\$222,503,623
<b>CONSTRUCTION TOTAL</b>		<b>\$1,929,000,000</b>
<b>PRE-CONSTRUCTION AND SUPERVISION</b>		
FEASIBILITY STUDY	LS	\$11,000,000
ENVIRONMENTAL ASSESSMENT	LS	\$4,000,000
DESIGN	5%	\$96,450,000
CONSTRUCTION MANAGEMENT	10%	\$192,900,000
OWNERS COSTS	2%	\$38,580,000
<b>PRE-CONSTRUCTION TOTAL</b>		<b>\$342,930,000</b>
<b>GRAND TOTAL</b>		<b>\$2,271,930,000</b>



Detailed Cost Estimate Report

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Project: Newfoundland Fixed Link Study

Estimate Description: Prefeasibility Level

Project Number: 213789

Project Phase: Prefeasibility Design

Estimate Date: June 11 2004

# Newfoundland Fixed Link Study

## Prefeasibility Level

213789

Prefeasibility Design

June 11 2004

STRUCTION AND SUPERVISION



### Detailed Cost Estimate Report

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<b>Project:</b>	<b>Newfoundland Fixed Link Study</b>	<b>Project Number:</b>	<b>213789</b>
<b>Estimate Description:</b>	<b>Prefeasibility Level</b>	<b>Parent Estimate ID:</b>	<b>V-300</b>
<b>Tunnel Name:</b>	<b>Railway Tunnel - Down Drive</b>	<b>Project Phase:</b>	<b>Prefeasibility Design</b>
<b>Construction Activity:</b>	<b>Excavation (Drill &amp; Blast) &amp; Initial Support</b>	<b>Geology Type:</b>	<b>Poor to Fair Sediments &amp; Volcanics</b>
<b>Estimate Definition ID:</b>	<b>V-315</b>	<b>Estimate Date:</b>	<b>June 11 2004</b>

<u>Tunnel Characteristics</u>			<u>Shift Details</u>	
<b>Tunnel Length:</b>	<b>15,333.0</b>	m	<b>Shift Arrangement:</b>	<b>3.0</b> Shifts / Day
<b>Design Width:</b>	<b>6.4</b>	m		<b>8.0</b> Hours / Shift
<b>Design Wall Height (Ave.)</b>	<b>6.6</b>	m		<b>7.0</b> Days / Week
<b>Design Wall to Roof:</b>	<b>2.5</b>		<u>Drill, Charge, Blast, Vent &amp; Mucking Details</u>	
<b>Design Max Height :</b>	9.1	m	<b>Survey Tunnel / Holes / Map:</b>	<b>30.0</b> Min / Cycle
<b>Ave Tunnel Overbreak:</b>	<b>20.0</b>	cm	<b>Drilling Blast Holes:</b>	
<b>Tunnel Face Area:</b>	59.3 (Includes Overbreak)	m <sup>2</sup>	<b>Hole Length:</b>	<b>3.9</b> m / Hole
<b>Crown Perimeter:</b>	9.6 (Includes Overbreak)	m	<b>Perim. Blast Hole Spacing:</b>	<b>0.50</b> m
<b>Wall &amp; Crown Perimeter:</b>	23.2 (Includes Overbreak)	m	<b>Interior Blast Hole Spacing:</b>	<b>1.25</b> m
<b>Wall &amp; Crown Area:</b>	355,933 (Includes Overbreak)	m <sup>2</sup>	<b>No. Perimeter Holes:</b>	46 No.
<b>Neat Tunnel Excav. Vol.:</b>	909,246 (Includes Overbreak)	m <sup>3</sup>	<b>No. Interior Area Holes:</b>	38.0 No.
<b>Re-Muck / Pull-Out Bays:</b>			<b>No. Blast Initiation Holes:</b>	14 No.
<b>Bay Length:</b>	<b>10.0</b>	m	<b>Number of Drillholes / Blast:</b>	99 Blastholes / Blast
<b>Spacing Bttn Bays:</b>	<b>1000.0</b>	m	<b>Blast Hole / Face Area Ratio:</b>	1.67 Holes / m <sup>2</sup>
<b>Number of Bays:</b>	15	No.	<b>Typical / Check Ratio:</b>	<b>1.56</b> Holes / m <sup>2</sup>
<b>Total Length of Bays:</b>	150.0	m	<b>Drill Eqpt Set-Up Time:</b>	<b>40</b> min / Set-up
<b>Neat Excavation Vol.:</b>	8,895	m <sup>3</sup>	<b>Drill Penetration Rate:</b>	<b>0.30</b> m / Min
<b>Total Tunnel Volume:</b>	918,141	m <sup>3</sup>		18 m/hour
<b>Muck Bulking Factor:</b>	<b>1.6</b>	Ratio	<b># of Drills or Booms:</b>	<b>3.0</b> No.
<b>Bulked Tunnel Volume:</b>	1,469,025 (Loose Muck Volume)	m <sup>3</sup>	<b>Charging &amp; Blasting:</b>	
<u>Primary Mucking Production Details</u>			<b>Prime &amp; Load Rate / Hole:</b>	<b>2.50</b> min / Blasthole
(Activity to remove blast muck from face to conveyor & muck cars)			<b>Prep &amp; Hook-up Time:</b>	<b>40.0</b> min / Set-up
<b>Muck Volume / Blast:</b>	313.1	m <sup>3</sup>	<b>Total No. Blasts / Tunnel:</b>	4692 No.
<b>Mucking Volume / Trip:</b>	<b>5.00</b>	m <sup>3</sup>	<b>Net Blast Break Length:</b>	<b>3.3</b> m / Blast
<b>Bucket Fill Factor (%):</b>	<b>90.0</b>	%	<b>Blast &amp; Ventilation Time:</b>	<b>1.0</b> Hours
<b>Number of Trips:</b>	70	No.	<u>Pre-Excavation Grouting Details</u>	
<b>Ave. Dist. to Load:</b>	<b>35.0</b> (Ave Distance One Way)	m	<b>% Tunnel to be Grouted:</b>	<b>10.0</b> %
<b>Ave. Tramming Speed:</b>	<b>8.0</b>	km/hr	<b>Tunnel Length to Grout:</b>	1533 m
<b>Load, Dump, Manoever:</b>	<b>1.0</b> (Time per Trip)	Min	<b>Grout Hole Length:</b>	<b>7.0</b> m
<b>Face Cleanup / Blast:</b>	<b>15.0</b>	Min	<b>No. of Grouting Applications:</b>	219 No.
<b>Mucking Time:</b>	2.0	Hours	<b>Perim. Grout Holes Spacing:</b>	<b>1.50</b> m
<b>Mucking Rate:</b>	155.1	m <sup>3</sup> / Hour	<b># Perim. Grout Holes:</b>	15 Holes / Grout Cycle
<u>Tunnel Support Class Details</u>			<b>Drilling Penetration Rate:</b>	<b>50</b> m/hour
<b>Class I - No Support:</b>	<b>0.0</b> (%)	0 (m)	<b>No. of Drill Booms:</b>	<b>2</b> No.
<b>Class II - Spot Bolts:</b>	<b>0.0</b> (%)	0 (m)	<b>Drilling Time per Cycle:</b>	237 Min
<b>Class III - Crown Only:</b>	<b>40.0</b> (%)	6,133 (m)	<b>Grout Eqpt. Set-Up Time:</b>	<b>1.0</b> Hours / Grout Cycle
<b>Class IV - Full Pattern:</b>	<b>50.0</b> (%)	7,667 (m)	<b>No. of Holes Grouted at Once:</b>	<b>2</b> Hoses
<b>Class V - Steel Sets:</b>	<b>10.0</b> (%)	<b>1,533</b> (m)	<b>Grouting Injection Rate:</b>	<b>10</b> min / Drillhole
<b>Total</b>	100.0	15,333 (m)	<b>Full Grout Cycle Time:</b>	122.7 Hours
<u>Initial Shotcrete Support Details</u>			<u>Steel Set Installation Details</u>	
<b>Support Arc Length:</b>	<b>23.2</b>	m	<b>Steel Set Spacing:</b>	<b>1.0</b> m
<b>Thickness:</b>	<b>25.0</b>	mm	<b>Total No. Sets / Tunnel:</b>	1,533 No.
<b>Volume / Round:</b>	2.2	m <sup>3</sup>	<b>Ave. Installation Time / Set:</b>	<b>3.0</b> Hours

<b>Time:</b>	0.8	(Includes Scaling & Equip Set-up)	Hours	<b>Total Installation Time:</b>	4,600	Hours
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<u>Wiremesh Installation Details</u>			<u>Rockbolt Support Class Details</u>		
Install Rate:	100	m <sup>2</sup> / Hour	(Bolts Per Row)	(Bolts Per m)	(Bolts Per Support Class)
Total Install Time:	3,924.2	Hours	Class I:	0.0	0
Ave. Install Time:	50.2	Min	Class II:	0.0	0
Overlap:	5	%	Class III:	4.0	24,533
Net Applied Area:	355,933 (Assume Class V only)	m <sup>2</sup>	Class IV:	10.0	76,665
Area with Overlap:	392,416	m <sup>2</sup>	Class V:	0.0	0
<u>Final Shotcrete Support Class Details</u>			Total:		101,198
Shotcrete Thickness:			<u>Face Scaling</u>		
Classes I and II:	0	mm	Scaling Time:	20.0	min / Blast
Class III:	0	mm	<u>Rockbolt Installation Details</u>		
Classes IV:	50	mm	Rockbolt Length:	3.0	m
Class V:	100	mm	Row Spacing:	1.5	m
Support Arc Length:			No. Rockbolts Required:	101,198	No.
Class I:	0.0	m	Ave. Bolts / Round:	21.8	Bolts / Blast
Class II:	0.0	m	Drilled Length / Round:	65	m
Class III:	0.0	m	Total Drilling Length:	303,593	m
Class IV:	23.2	m	Drill Penetration Rate:	1.5	m / Min
Class V:	23.2	m	# of Drills / Booms Used:	3	No.
<u>Initial and Final Shotcrete Application Details</u>			Ave. Drilling Time / Round:	14.5	Min
Net Volume:	12,458	m <sup>3</sup>	Bolt Install Rate:	2.0	Min / Bolt
Rebound / Waste:	15	%	Ave. Bolt Install Time:	43.6	Min
Final Layer Volume:	14,326	m <sup>3</sup>	Drill Set-Up Time:	10.0	Min
No. of Applications:	2695 (Required Per Bench)	No.	Total Bolt Drill/Install Time:	68.1	Min
Ave. Vol. / Application:	5.3	m <sup>3</sup>	<u>Drainhole Details</u>		
Surface Prep Time:	10.0	Min	Drainhole Spacing:	3.0	m
Total Surface Prep Time:	26,949	Min	Drainhole Length:	1.1	m
Application Rate:	24.0	m <sup>3</sup> / Hour	Total Area:	177,966.3	m <sup>2</sup>
Total Application Time:	35,816	Min	Total Drainholes:	19,774.0	# / Per Tunnel
Eqpt. Setup Time:	20.0	Min	Total Length:	21,751.4	m
Total Setup Time:	53,898	Min	Note: Activity carried out concurrent with other activities.		
Eqpt. Remove Time:	10.0 (Required Per Application)	Min	<u>Duration of Tunneling:</u>		
Total Remove Time:	26,949	Min	Pre-Exc. Grouting Time =	26,866.9	Hours
Total Shotcreting Time:	143,611 (For Final Shotcrete Layer)	Min	Drilling Time =	36,596.4	Hours
Equivalent Time / Blast:	30.6	Min / Cycle	Charge, Blast, Vent Time =	27,128.5	Hours
<u>Secondary Mucking Details</u>			Primary Mucking Time =	9,470.2	Hours
Req'd during Tunneling:	No (No if loaded directly into trucks in tunnel)		Scaling Time =	4,692.2	Hours
Ave. LHD Tram Speed:	0.0	km / hour	Survey / Map Time =	2,345.9	Hours
<u>Wick Drain Installation Details</u>			Install Steel Sets Time =	4,599.9	Hours
Drain Spacing:	0.0	m	Initial Shotcreting Time =	3,558.4	Hours
Installation Time / Row:	0.0	Hours / Drain	Install Services Time =	2,345.9	Hours
<u>Average Tunneling Productivity Cycle Details</u>			Rockbolting (of % Critical) =	1,597.1	Hours
Equiv. Pre-Exc. Grouting:	5.7	Hours	Non-Productive Time =	2,345.9	Hours
Drilling:	7.8	Hours	Total Time =	121,547.3	Hours
Charging:	4.8	Hours		167.0	Months
Blast & Venting:	1.0	Hours	(Critical Path Tunneling Activities Only)	723.5	Weeks
Mucking:	2.0	Hours		5,064.5	Days
Scaling:	0.3	Hours	<u>Other Concurrent Tunneling Activities</u>		
Surveying / Mapping:	0.5	Hours	Rockbolting (of % Not Critical) =	3,726.6	Hours
Initial Shotcreting:	0.8	Hours	Wiremesh Installation =	3,924.2	Hours
Install Services:	0.5 (Equiv. Time Per Cycle)	Hours	Final Shotcreting Time =	0.5	Hours
Non-Productive Time:	0.5 (Travel in/out, Break)	Hours	Drilling Drainholes =	29,001.9	Hours
Include Rockbolting:	Yes (Yes / No, as part of Cycle Time)		Secondary Mucking =	0.0	Hours
If yes, % of Support Req'd:	30 (% Req'd During Cycle for Poorer Ground)		Wick Drain Installation =	0.0	Hours
Rockbolting:	0.3	Hours	<u>Overall Advance Rate:</u>		
Total Cycle Time:	24.3	Hours		3.0	m / Day
				179.5	m <sup>3</sup> / Day

Resource Type	Resource Name	Unit Rate	Unit	Quantity	Resource Quantity	Total
<b>Labor</b>						
	Miner - Shift Boss	50.68	\$/hr	121,547.3	2.00	12,320,036.24
	Miner - Operator - Journeyman	47.84	\$/hr	121,547.3	11.00	63,963,061.06
	Miner - Foreman	50.68	\$/hr	121,547.3	3.00	18,480,054.35
	Miner - Laborer - Journeyman	47.40	\$/hr	121,547.3	5.00	28,806,714.56
	Miner - Laborer - Apprentice	45.00	\$/hr	121,547.3	5.00	27,348,146.73
	Tunnel Electrician - Journeyman	47.84	\$/hr	121,547.3	4.00	23,259,294.93
					30.00	174,177,307.87
<b>Plant</b>						
	Cable - Fans & Pumps - High Voltage	120.00	\$/m	15,333.0	0.20	367,992.00
	Cable - Lights / Controls - Low Voltage	10.00	\$/m	15,333.0	0.80	122,664.00
	Compressor	45.61	\$/wk	723.5	1.00	33,000.00
	Conveyor - Heading Muck Loading	1,788.19	\$/wk	723.5	1.00	1,293,750.00
	Drill - Jack-Leg	29.03	\$/wk	723.5	4.00	84,000.00
	Drill Jumbo - Rail Mounted - 2 Boom	362.82	\$/wk	723.5	1.00	262,500.00
	Drill Jumbo - Rail Mounted - 3 Boom	518.32	\$/wk	723.5	1.00	375,000.00
	Excavator - Rail Mounted	114.03	\$/wk	723.5	1.00	82,500.00
	Generator - Back-Up - 500KW	108.85	\$/wk	723.5	1.00	78,750.00
	Generator - Working - 1000KW	812.72	\$/wk	723.5	1.00	588,000.00
	Grout Plant-Consol-D&B-Pump, Hoses	68.42	\$/wk	723.5	1.00	49,500.00
	Lighting (Including Consumables)	7.50	\$/m	15,333.0	1.00	114,997.50
	Locomotive - Diesel - 16T	5,000.00	\$/wk	723.5	4.00	14,469,918.91
	LHD Loader - D&B Tunnel	347.79	\$/wk	723.5	1.00	251,625.00
	Manlift / Platform - Rail Mounted	152.04	\$/wk	723.5	1.00	110,000.00
	Pipe - 50mm (Water Supply)	7.50	\$/m	15,333.0	1.00	114,997.50
	Pipe - 100mm (Air Supply)	15.00	\$/m	15,333.0	1.00	229,995.00
	Pipe - 150mm (DeWatering)	25.00	\$/m	7,666.5	1.00	191,662.50
	Pipe - 250mm (Dewater)	70.00	\$/m	7,666.5	1.00	536,655.00
	Pipe - Dewatering Clamps (<=200mm)	7.00	\$/m	15,333.0	1.00	107,331.00
	Pumps - Dewatering - Tunnel - 50HP	34.89	\$/wk	361.7	15.00	189,337.50
	Rail - 80 lb/yd - Used	101.54	\$/m	31,066.0	0.60	1,892,636.31
	Rail - California Switch Gear	75,000.00	\$/Nr	1.0	3.00	225,000.00
	Rail Car - Flat	50,000.00	\$/Nr	1.0	3.00	150,000.00
	Rail Car - Man Rider	50,000.00	\$/Nr	1.0	1.00	50,000.00
	Rail Car - Muck Cars	1,900.00	\$/wk	723.5	18.00	24,743,561.33
	Rail Car - Muck Car Tipping System	75,000.00	\$/Nr	1.0	1.00	75,000.00
	Shotcrete Machine - Rail Mounted	166.90	\$/wk	723.5	1.00	120,750.00
	Shotcrete Machine - Tire Mounted	270.22	\$/wk	723.5	2.00	391,000.00
	Small Tools	200.00	\$/wk	723.5	1.00	144,699.19
	Tie Plates, Splice Bars, Bolts	150,000.00	LS	1.0	1.00	150,000.00
	Ties - Wooden - Untreated - 7" x 9" x 40"	23.00	\$/m	15,333.0	1.00	352,659.00
	Transformers & Switchgear - High Voltage	76.02	\$/wk	723.5	1.00	55,000.00
	Transformers-Switchgear-Low Voltage	38.01	\$/wk	723.5	1.00	27,500.00
	Ventilation Duct - Rigid	110.00	\$/m	15,333.0	1.00	1,686,630.00
	Ventilation Fans - 75HP	21.46	\$/wk	723.5	7.00	108,675.00
	Welder (Plant)	2.38	\$/wk	723.5	1.00	1,725.00
						49,829,011.74



Resource Type	Resource Name	Unit Rate	Unit	Quantity	Resource Quantity	Total
<b>Consumables</b>						
	Bits, Powder and Caps - Blasting	15.00	\$/m3	918,140.5	1.00	13,772,107.66
	Bits - (Drainholes & Rockbolts)	5.00	\$/m	325,344.8	1.00	1,626,724.21
	Drill Jumbo Maintenance	100.00	\$/hr	34,995.8	1.00	3,499,575.81
	Electricity - Tunnel Heading Conveyor	0.22	\$/kwh	150	1,172.95	38,707.50
	Electricity - Fans & Lighting	0.22	\$/kwh	437	60,773.66	5,849,350.37
	Electricity - Jumbo	0.22	\$/kwh	75	34,995.76	577,430.01
	Electricity - Pumps Dewatering	0.22	\$/kwh	559	85,083.12	10,468,668.61
	Lubricants	2,500.00	\$/wk	723.5	1.00	1,808,739.86
	Fuels & Lubricants	5,000.00	\$/wk	723.5	1.00	3,617,479.73
	Other Consumables	1,500.00	\$/wk	723.5	1.00	1,085,243.92
						\$ 42,344,027.69
<b>Materials</b>						
	Grout - Consolidation	50.00	\$/m3	2,000.0	1.00	100,000.00
	Other Materials	2,000.00	\$/wk	723.5	1.00	1,446,991.89
	Rock Bolts - No. 10 - 3.0m - (Non-Galv)	40.00	\$/Nr	101,198	1.00	4,047,912.00
	Shotcrete	180.00	\$/m3	14,326.3	1.00	2,578,732.41
	Steel Sets - W10 x 65	152.75	\$/m	1,533	23.21	5,436,871.99
	Synthetic Wick Drains	5.00	\$/m	0	1.00	-
	WWF mesh	5.50	\$/m2	392,416	1.00	2,158,286.91
						\$ 13,510,508.29
<b>Subcontracts</b>						
	Tunnel Muck - Miscel Surface Handling	20.00	\$/m3	1,469,024.82	1.00	29,380,496.35
						\$ 29,380,496.35
<div> <div>Total Estimated Cost: \$ 309,241,351.93</div> <div> <div>Per Meter: \$ 20,168.35</div> <div>Per m<sup>3</sup>: \$ 336.81</div> </div> </div>						



### Detailed Cost Estimate Report

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<b>Project:</b>	<b>Newfoundland Fixed Link Study</b>	<b>Project Number:</b>	<b>213789</b>
<b>Estimate Description:</b>	<b>Prefeasibility Level</b>	<b>Parent Estimate ID:</b>	<b>V-300</b>
<b>Tunnel Name:</b>	<b>Railway Tunnel - Up Drive</b>	<b>Project Phase:</b>	<b>Prefeasibility Design</b>
<b>Construction Activity:</b>	<b>Excavation (Drill &amp; Blast) &amp; Initial Support</b>	<b>Geology Type:</b>	<b>Poor to Fair Sediments &amp; Volcanics</b>
<b>Estimate Definition ID:</b>	<b>V-316</b>	<b>Estimate Date:</b>	<b>June 11 2004</b>

<u>Tunnel Characteristics</u>			<u>Shift Details</u>	
<b>Tunnel Length:</b>	<b>15,333.0</b>	m	<b>Shift Arrangement:</b>	<b>3.0</b> Shifts / Day
<b>Design Width:</b>	<b>6.4</b>	m		<b>8.0</b> Hours / Shift
<b>Design Wall Height (Ave.)</b>	<b>6.6</b>	m		<b>7.0</b> Days / Week
<b>Design Wall to Roof:</b>	<b>2.5</b>		<u>Drill, Charge, Blast, Vent &amp; Mucking Details</u>	
<b>Design Max Height :</b>	9.1	m	<b>Survey Tunnel / Holes / Map:</b>	<b>30.0</b> Min / Cycle
<b>Ave Tunnel Overbreak:</b>	<b>20.0</b>	cm	<b>Drilling Blast Holes:</b>	
<b>Tunnel Face Area:</b>	59.3 (Includes Overbreak)	m <sup>2</sup>	<b>Hole Length:</b>	<b>3.9</b> m / Hole
<b>Crown Perimeter:</b>	9.6 (Includes Overbreak)	m	<b>Perim. Blast Hole Spacing:</b>	<b>0.50</b> m
<b>Wall &amp; Crown Perimeter:</b>	23.2 (Includes Overbreak)	m	<b>Interior Blast Hole Spacing:</b>	<b>1.25</b> m
<b>Wall &amp; Crown Area:</b>	355,933 (Includes Overbreak)	m <sup>2</sup>	<b>No. Perimeter Holes:</b>	46 No.
<b>Neat Tunnel Excav. Vol.:</b>	909,246 (Includes Overbreak)	m <sup>3</sup>	<b>No. Interior Area Holes:</b>	38.0 No.
<b>Re-Muck / Pull-Out Bays:</b>			<b>No. Blast Initiation Holes:</b>	14 No.
<b>Bay Length:</b>	<b>10.0</b>	m	<b>Number of Drillholes / Blast:</b>	99 Blastholes / Blast
<b>Spacing Bttn Bays:</b>	<b>1000.0</b>	m	<b>Blast Hole / Face Area Ratio:</b>	1.67 Holes / m <sup>2</sup>
<b>Number of Bays:</b>	15	No.	<b>Typical / Check Ratio:</b>	<b>1.56</b> Holes / m <sup>2</sup>
<b>Total Length of Bays:</b>	150.0	m	<b>Drill Eqpt Set-Up Time:</b>	<b>40</b> min / Set-up
<b>Neat Excavation Vol.:</b>	8,895	m <sup>3</sup>	<b>Drill Penetration Rate:</b>	<b>0.30</b> m / Min
<b>Total Tunnel Volume:</b>	918,141	m <sup>3</sup>		18 m/hour
<b>Muck Bulking Factor:</b>	<b>1.6</b>	Ratio	<b># of Drills or Booms:</b>	<b>3.0</b> No.
<b>Bulked Tunnel Volume:</b>	1,469,025 (Loose Muck Volume)	m <sup>3</sup>	<b>Charging &amp; Blasting:</b>	
<u>Primary Mucking Production Details</u>			<b>Prime &amp; Load Rate / Hole:</b>	<b>2.50</b> min / Blasthole
(Activity to remove blast muck from face to conveyor & muck cars)			<b>Prep &amp; Hook-up Time:</b>	<b>40.0</b> min / Set-up
<b>Muck Volume / Blast:</b>	313.1	m <sup>3</sup>	<b>Total No. Blasts / Tunnel:</b>	4692 No.
<b>Mucking Volume / Trip:</b>	<b>5.00</b>	m <sup>3</sup>	<b>Net Blast Break Length:</b>	<b>3.3</b> m / Blast
<b>Bucket Fill Factor (%):</b>	<b>90.0</b>	%	<b>Blast &amp; Ventilation Time:</b>	<b>1.0</b> Hours
<b>Number of Trips:</b>	70	No.	<u>Pre-Excavation Grouting Details</u>	
<b>Ave. Dist. to Load:</b>	<b>35.0</b> (Ave Distance One Way)	m	<b>% Tunnel to be Grouted:</b>	<b>10.0</b> %
<b>Ave. Tramming Speed:</b>	<b>8.0</b>	km/hr	<b>Tunnel Length to Grout:</b>	1533 m
<b>Load, Dump, Manoever:</b>	<b>1.0</b> (Time per Trip)	Min	<b>Grout Hole Length:</b>	<b>7.0</b> m
<b>Face Cleanup / Blast:</b>	<b>15.0</b>	Min	<b>No. of Grouting Applications:</b>	219 No.
<b>Mucking Time:</b>	2.0	Hours	<b>Perim. Grout Holes Spacing:</b>	<b>1.50</b> m
<b>Mucking Rate:</b>	155.1	m <sup>3</sup> / Hour	<b># Perim. Grout Holes:</b>	15 Holes / Grout Cycle
<u>Tunnel Support Class Details</u>			<b>Drilling Penetration Rate:</b>	<b>50</b> m/hour
<b>Class I - No Support:</b>	<b>0.0</b> (%)	0 (m)	<b>No. of Drill Booms:</b>	<b>2</b> No.
<b>Class II - Spot Bolts:</b>	<b>0.0</b> (%)	0 (m)	<b>Drilling Time per Cycle:</b>	237 Min
<b>Class III - Crown Only:</b>	<b>40.0</b> (%)	6,133 (m)	<b>Grout Eqpt. Set-Up Time:</b>	<b>1.0</b> Hours / Grout Cycle
<b>Class IV - Full Pattern:</b>	<b>50.0</b> (%)	7,667 (m)	<b>No. of Holes Grouted at Once:</b>	<b>2</b> Hoses
<b>Class V - Steel Sets:</b>	<b>10.0</b> (%)	1,533 (m)	<b>Grouting Injection Rate:</b>	<b>10</b> min / Drillhole
<b>Total</b>	100.0	15,333 (m)	<b>Full Grout Cycle Time:</b>	122.7 Hours
<u>Initial Shotcrete Support Details</u>			<u>Steel Set Installation Details</u>	
<b>Support Arc Length:</b>	<b>23.2</b>	m	<b>Steel Set Spacing:</b>	<b>1.0</b> m
<b>Thickness:</b>	<b>25.0</b>	mm	<b>Total No. Sets / Tunnel:</b>	1,533 No.
<b>Volume / Round:</b>	2.2	m <sup>3</sup>	<b>Ave. Installation Time / Set:</b>	<b>3.0</b> Hours
<b>Time:</b>	0.8 (Includes Scaling & Equip Set-up)	Hours	<b>Total Installation Time:</b>	4,600 Hours

<u>Wiremesh Installation Details</u>			<u>Rockbolt Support Class Details</u>		
Install Rate:	100	m <sup>2</sup> / Hour		(Bolts Per Row)	(Bolts Per Support Class)
Total Install Time:	3,924.2	Hours	Class I:	0	0
Ave. Install Time:	50.2	Min	Class II:	0.0	0
Overlap:	5	%	Class III:	6	24,533
Net Applied Area:	355,933 (Assume Class V only)	m <sup>2</sup>	Class IV:	15	76,665
Area with Overlap:	392,416	m <sup>2</sup>	Class V:	0	0
			Total:		101,198
<u>Final Shotcrete Support Class Details</u>			<u>Face Scaling</u>		
Shotcrete Thickness:			Scaling Time:	20.0	min / Blast
Classes I and II:	0	mm	<u>Rockbolt Installation Details</u>		
Class III:	0	mm	Rockbolt Length:	3.0	m
Classes IV:	50	mm	Row Spacing:	1.5	m
Class V:	100	mm	No. Rockbolts Required:	101,198	No.
Support Arc Length:			Ave. Bolts / Round:	21.8	Bolts / Blast
Class I:	0.0	m	Drilled Length / Round:	65	m
Class II:	0.0	m	Total Drilling Length:	303,593	m
Class III:	0.0	m	Drill Penetration Rate:	1.5	m / Min
Class IV:	23.2	m	# of Drills / Booms Used:	3	No.
Class V:	23.2	m	Ave. Drilling Time / Round:	14.5	Min
<u>Initial and Final Shotcrete Application Details</u>			Bolt Install Rate	2.0	Min / Bolt
Net Volume:	12,458	m <sup>3</sup>	Ave. Bolt Install Time:	43.6	Min
Rebound / Waste:	15	%	Drill Set-Up Time:	10.0	Min
Final Layer Volume:	14,326	m <sup>3</sup>	Total Bolt Drill/Install Time:	68.1	Min
No. of Applications:	2695 (Required Per Bench)	No.	<u>Drainhole Details</u>		
Ave. Vol. / Application:	5.3	m <sup>3</sup>	Drainhole Spacing:	3.0	m
Surface Prep Time:	10.0	Min	Drainhole Length:	1.1	m
Total Surface Prep Time:	26,949	Min	Total Area:	177,966.3	m <sup>2</sup>
Application Rate:	24.0	m <sup>3</sup> / Hour	Total Drainholes:	19,774.0	# / Per Tunnel
Total Application Time:	35,816	Min	Total Length:	21,751.4	m
Eqpt. Setup Time:	20.0	Min	Note: Activity carried out concurrent with other activities.		
Total Setup Time:	53,898	Min	<u>Duration of Tunneling:</u>		
Eqpt. Remove Time:	10.0 (Required Per Application)	Min	Pre-Exc. Grouting Time =	26,866.9	Hours
Total Remove Time:	26,949	Min	Drilling Time =	36,596.4	Hours
Total Shotcreting Time:	143,611 (For Final Shotcrete Layer)	Min	Charge, Blast, Vent Time =	27,128.5	Hours
Equivalent Time / Blast:	30.6	Min / Cycle	Primary Mucking Time =	9,470.2	Hours
<u>Secondary Mucking Details</u>			Scaling Time =	4,692.2	Hours
Req'd during Tunneling:	No (No if loaded directly into trucks in tunnel)		Survey / Map Time =	2,345.9	Hours
Ave. LHD Tram Speed:	0.0	km / hour	Install Steel Sets Time =	4,599.9	Hours
<u>Wick Drain Installation Details</u>			Initial Shotcreting Time =	3,558.4	Hours
Drain Spacing:	0.0	m	Install Services Time =	2,345.9	Hours
Installation Time / Row:	0.0	Hours / Drain	Rockbolting (of % Critical) =	1,597.1	Hours
<u>Average Tunneling Productivity Cycle Details</u>			Non-Productive Time =	2,345.9	Hours
Equiv. Pre-Exc. Grouting:	5.7	Hours	Total Time =	121,547.3	Hours
Drilling:	7.8	Hours		167.0	Months
Charging:	4.8	Hours	(Critical Path Tunneling Activities Only)	723.5	Weeks
Blast & Venting:	1.0	Hours		5,064.5	Days
Mucking:	2.0	Hours	<u>Other Concurrent Tunneling Activities</u>		
Scaling:	0.3	Hours	Rockbolting (of % Not Critical) =	3,726.6	Hours
Surveying / Mapping:	0.5	Hours	Wiremesh Installation =	3,924.2	Hours
Initial Shotcreting:	0.8	Hours	Final Shotcreting Time =	0.5	Hours
Install Services:	0.5 (Equiv. Time Per Cycle)	Hours	Drilling Drainholes =	29,001.9	Hours
Non-Productive Time:	0.5 (Travel in/out, Break)	Hours	Secondary Mucking =	0.0	Hours
			Wick Drain Installation =	0.0	Hours
Include Rockbolting:	Yes (Yes / No, as part of Cycle Time)		<u>Overall Advance Rate:</u>		
If yes, % of Support Req'd:	30 (% Req'd During Cycle for Poorer Ground)			3.0	m / Day
Rockbolting:	0.3	Hours		179.5	m <sup>3</sup> / Day
Total Cycle Time:	24.3	Hours			

Resource Type	Resource Name	Unit Rate	Unit	Quantity	Resource Quantity	Total
<b>Labor</b>						
	Miner - Shift Boss	50.68	\$/hr	121,547.3	2.00	12,320,036.24
	Miner - Operator - Journeyman	47.84	\$/hr	121,547.3	11.00	63,963,061.06
	Miner - Foreman	50.68	\$/hr	121,547.3	3.00	18,480,054.35
	Miner - Laborer - Journeyman	47.40	\$/hr	121,547.3	5.00	28,806,714.56
	Miner - Laborer - Apprentice	45.00	\$/hr	121,547.3	5.00	27,348,146.73
	Tunnel Electrician - Journeyman	47.84	\$/hr	121,547.3	4.00	23,259,294.93
					30.00	174,177,307.87
<b>Plant</b>						
	Cable - Fans & Pumps - High Voltage	120.00	\$/m	15,333.0	0.20	367,992.00
	Cable - Lights / Controls - Low Voltage	10.00	\$/m	15,333.0	0.80	122,664.00
	Compressor	45.61	\$/wk	723.5	1.00	33,000.00
	Conveyor - Heading Muck Loading	1,788.19	\$/wk	723.5	1.00	1,293,750.00
	Drill - Jack-Leg	29.03	\$/wk	723.5	4.00	84,000.00
	Drill Jumbo - Rail Mounted - 2 Boom	362.82	\$/wk	723.5	1.00	262,500.00
	Drill Jumbo - Rail Mounted - 3 Boom	518.32	\$/wk	723.5	1.00	375,000.00
	Excavator - Rail Mounted	114.03	\$/wk	723.5	1.00	82,500.00
	Generator - Back-Up - 500KW	108.85	\$/wk	723.5	1.00	78,750.00
	Generator - Working - 1000KW	812.72	\$/wk	723.5	1.00	588,000.00
	Grout Plant-Consol-D&B-Pump, Hoses	68.42	\$/wk	723.5	1.00	49,500.00
	Lighting (Including Consumables)	7.50	\$/m	15,333.0	1.00	114,997.50
	Locomotive - Diesel - 16T	5,000.00	\$/wk	723.5	4.00	14,469,918.91
	LHD Loader - D&B Tunnel	347.79	\$/wk	723.5	1.00	251,625.00
	Manlift / Platform - Rail Mounted	152.04	\$/wk	723.5	1.00	110,000.00
	Pipe - 50mm (Water Supply)	7.50	\$/m	15,333.0	1.00	114,997.50
	Pipe - 100mm (Air Supply)	15.00	\$/m	15,333.0	1.00	229,995.00
	Rail - 80 lb/yd - Used	101.54	\$/m	31,066.0	0.60	1,892,636.31
	Rail - California Switch Gear	75,000.00	\$/Nr	1.0	3.00	225,000.00
	Rail Car - Flat	50,000.00	\$/Nr	1.0	3.00	150,000.00
	Rail Car - Man Rider	50,000.00	\$/Nr	1.0	1.00	50,000.00
	Rail Car - Muck Cars	1,900.00	\$/Nr	723.5	18.00	24,743,561.33
	Rail Car - Muck Car Tipping System	75,000.00	\$/Nr	1.0	1.00	75,000.00
	Shotcrete Machine - Rail Mounted	166.90	\$/wk	723.5	1.00	120,750.00
	Shotcrete Machine - Tire Mounted	270.22	\$/wk	723.5	2.00	391,000.00
	Small Tools	200.00	\$/wk	723.5	1.00	144,699.19
	Tie Plates, Splice Bars, Bolts	150,000.00	LS	1.0	1.00	150,000.00
	Ties - Wooden - Untreated - 7" x 9" x 40"	23.00	\$/m	15,333.0	1.00	352,659.00
	Transformers & Switchgear - High Voltage	76.02	\$/wk	723.5	1.00	55,000.00
	Transformers-Switchgear-Low Voltage	38.01	\$/wk	723.5	1.00	27,500.00
	Ventilation Duct - Rigid	110.00	\$/m	15,333.0	1.00	1,686,630.00
	Ventilation Fans - 75HP	21.46	\$/wk	723.5	7.00	108,675.00
	Welder (Plant)	2.38	\$/wk	723.5	1.00	1,725.00
						48,804,025.74
<b>Consumables</b>						
	Bits, Powder and Caps - Blasting	15.00	\$/m3	918,140.5	1.00	13,772,107.66
	Bits - (Drainholes & Rockbolts)	5.00	\$/m	325,344.8	1.00	1,626,724.21
	Drill Jumbo Maintenance	100.00	\$/hr	34,995.8	1.00	3,499,575.81
	Electricity - Tunnel Heading Conveyor	0.22	\$/kwh	150	1,172.95	38,707.50
	Electricity - Fans & Lighting	0.22	\$/kwh	437	60,773.66	5,849,350.37
	Electricity - Jumbo	0.22	\$/kwh	75	34,995.76	577,430.01
	Lubricants	2,500.00	\$/wk	723.5	1.00	1,808,739.86
	Fuels & Lubricants	5,000.00	\$/wk	723.5	1.00	3,617,479.73
	Other Consumables	1,500.00	\$/wk	723.5	1.00	1,085,243.92
						\$ 31,875,359.08

Resource Type	Resource Name	Unit Rate	Unit	Quantity	Resource Quantity	Total
<b>Materials</b>						
	Grout - Consolidation	50.00	\$/m3	2,000.0	1.00	100,000.00
	Other Materials	2,000.00	\$/wk	723.5	1.00	1,446,991.89
	Rock Bolts - No.10 - 3.0m - (Non-Galv)	40.00	\$/Nr	101,198	1.00	4,047,912.00
	Shotcrete	180.00	\$/m3	14,326.3	1.00	2,578,732.41
	Steel Sets - W10 x 65	152.75	\$/m	1,533	23.21	5,436,871.99
	Synthetic Wick Drains	5.00	\$/m	0	1.00	-
	WWF mesh	5.50	\$/m2	392,416	1.00	2,158,286.91
						\$ 13,510,508.29
<b>Subcontracts</b>						
	Tunnel Muck - Misc Surface Handling	20.00	\$/m3	1,469,024.82	1.00	29,380,496.35
						\$ 29,380,496.35

**Total Estimated Cost: \$ 297,747,697.32**

**Per Meter: \$ 19,418.75**

**Per m<sup>3</sup>: \$ 324.29**

## Initialisation

**Project:** Newfoundland Fixed Link Pre-feasibility Study

**Section:** South Approach

**Option:** Immersed Tube Rail Tunnel

**Date:** 8-Jun-04

**Calculations by:** ANW

Surface gradient  %

+ sloping same way as track/road  
- sloping against track/road

Track/Road Gradient  %

Ground elevation  
at portal  m

Bottom of slab  
elevation at portal  m

Total length= 713.1148 m

Total Cost=\$ 6.1 M

**UNIT RATES**

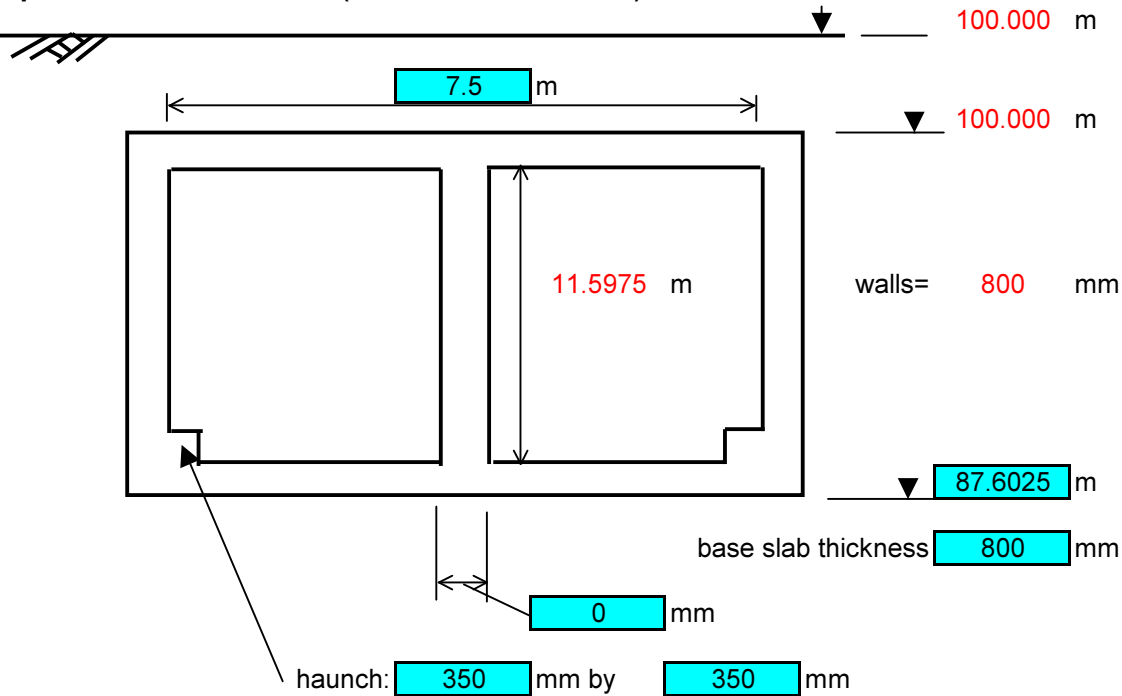
**Materials**

<b>Item</b>	<b>unit</b>	<b>Rate</b>
excavation	m3	60
concrete	m3	190
rebar	tonnes	1600
formwork/falsework	m2	140
SP&L<=4.6m deep	m2	0
4.6<SP&L<=6.7m deep	m2	0
6.7<SP&L<=10.6m deep	m2	0
10.6<SP&L<=13.7m deep	m2	0
13.7<SP&L<=16.8m deep	m2	0
16.8<SP&L<=20.0m deep	m2	0
20<SP&L<=25m deep	m2	0
backfill + compact	m3	40
surface reinstatement	m2	30

Section Cut and Cover  
 Length of section: 71.31148 m

Section 1

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	8045.2	m3	
concrete=	1859.875	m3	
rebar=	223.2	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	1654.07	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	1768.2	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	648.9344	m2	



**Newfoundland Fixed Link Pre-feasibility Study**  
**South Approach**  
**Immersed Tube Rail Tunnel**

**Date:** 8-Jun-04  
**Calculations by:** ANW  
**Page 2 of 2**

**Calculated costs**

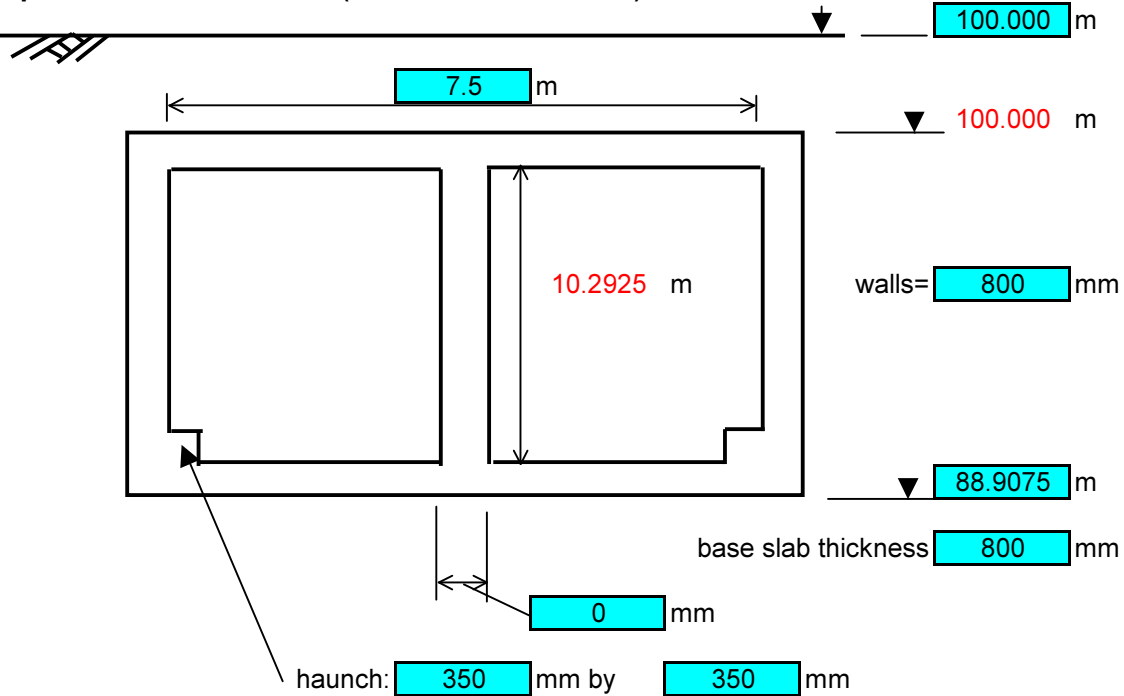
Item	Unit	Quantity	Rate	Cost
excavation	m3	8045.2	60	482709.9
concrete	m3	1859.875	190.0	353376.2
rebar	tonnes	223.2	1600	357095.9
formwork/falsework	m2	1654.07	140	231569.8
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	1768.2	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	648.9344	30	19468.03

Total 1444220

Section Cut and Cover  
 Length of section: 71.31148 m

Section 2

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	7198.3	m3	
concrete=	1710.976	m3	
rebar=	205.3	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	1467.947	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	1582.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	648.9344	m2	

**Calculated costs**

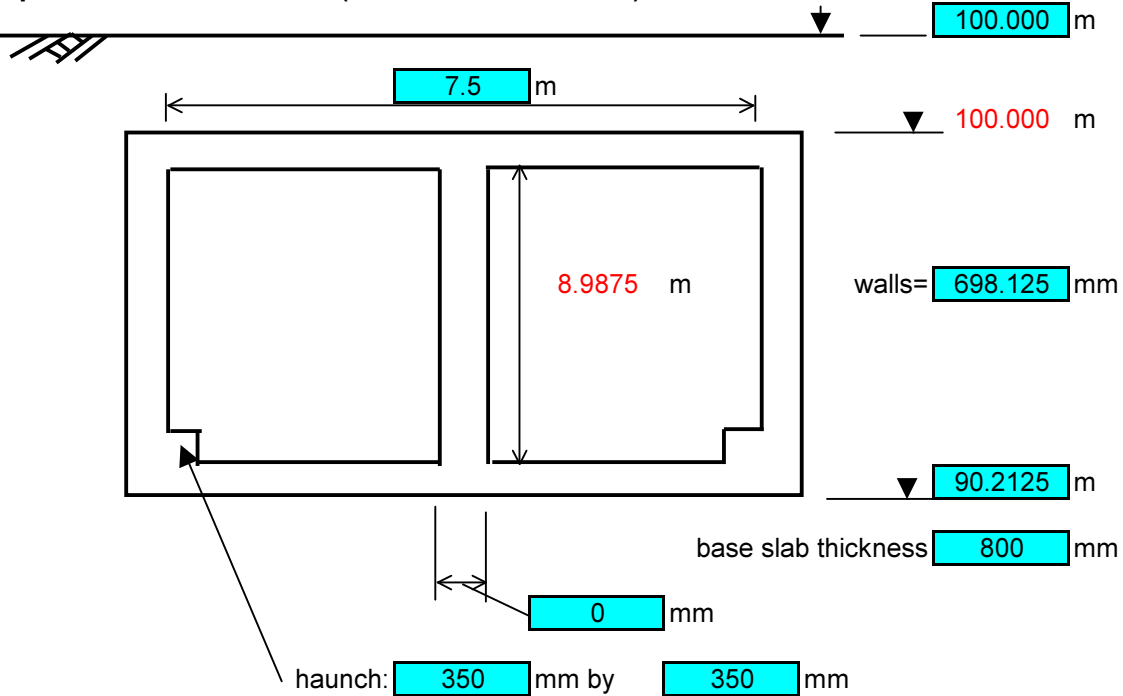
Item	Unit	Quantity	Rate	Cost
excavation	m3	7198.3	60	431898.3
concrete	m3	1710.976	190.0	325085.5
rebar	tonnes	205.3	1600	328507.4
formwork/falsework	m2	1467.947	140	205512.5
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	1582.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	648.9344	30	19468.03

Total 1310472

Section Cut and Cover  
 Length of section: 71.31148 m

Section 3

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	6209.2	m3	
concrete=	1419.868	m3	
rebar=	170.4	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	1281.824	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	1395.9	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	634.4047	m2	

**Calculated costs**

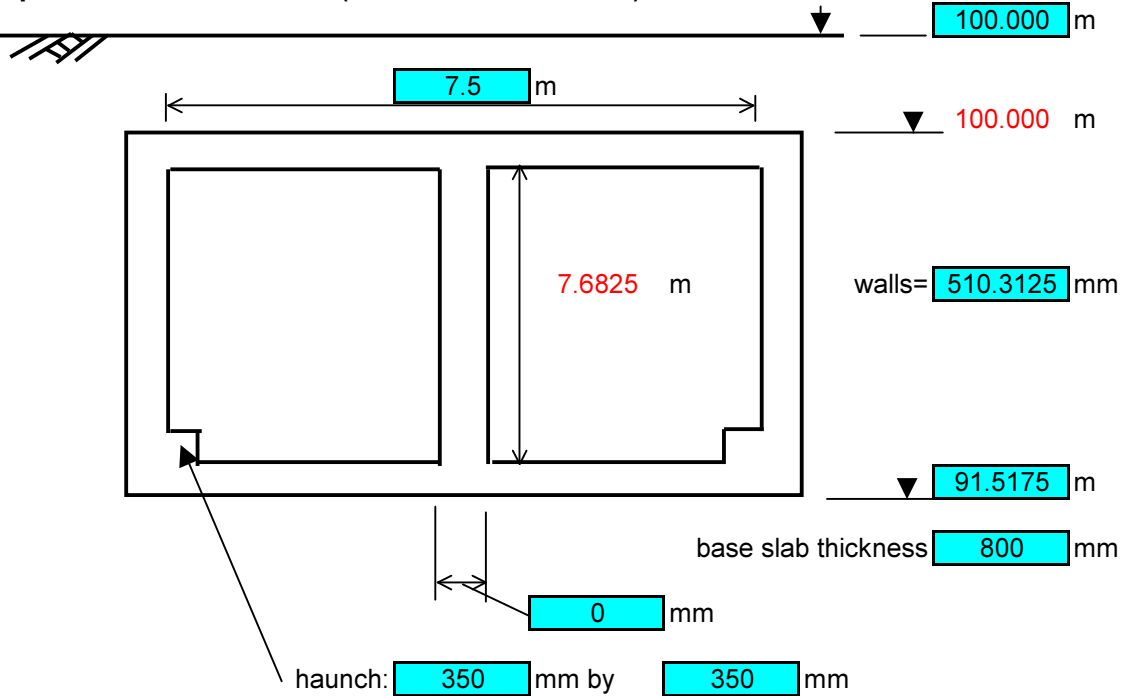
Item	Unit	Quantity	Rate	Cost
excavation	m3	6209.2	60	372554.2
concrete	m3	1419.868	190.0	269775
rebar	tonnes	170.4	1600	272614.7
formwork/falsework	m2	1281.824	140	179455.3
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	1395.9	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	634.4047	30	19032.14

Total 1113431

Section Cut and Cover  
 Length of section: 71.31148 m

Section 4

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	5154.1	m3	
concrete=	1062.716	m3	
rebar=	127.5	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	1095.701	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	1209.8	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	607.6183	m2	

**Calculated costs**

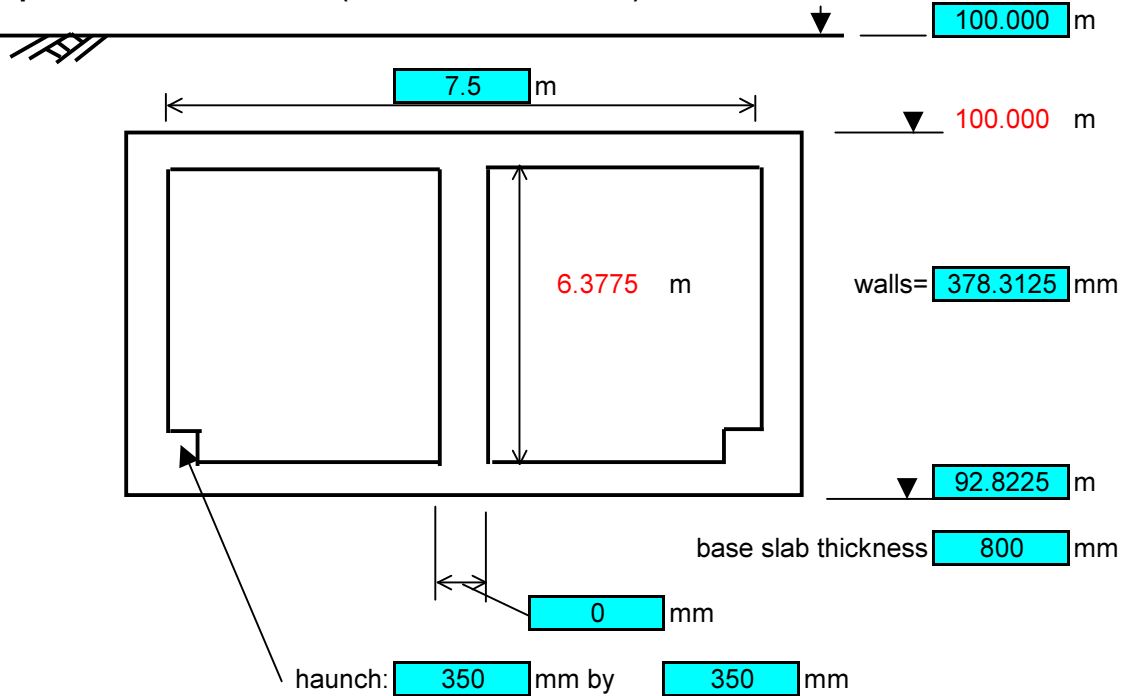
Item	Unit	Quantity	Rate	Cost
excavation	m3	5154.1	60	309247.4
concrete	m3	1062.716	190.0	201916
rebar	tonnes	127.5	1600	204041.4
formwork/falsework	m2	1095.701	140	153398.1
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	1209.8	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	607.6183	30	18228.55

Total 886831.5

Section Cut and Cover  
 Length of section: 71.31148 m

Section 5

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	4226.1	m3	
concrete=	832.6097	m3	
rebar=	99.9	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	909.5779	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	1023.7	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	588.7921	m2	



**Calculated costs**

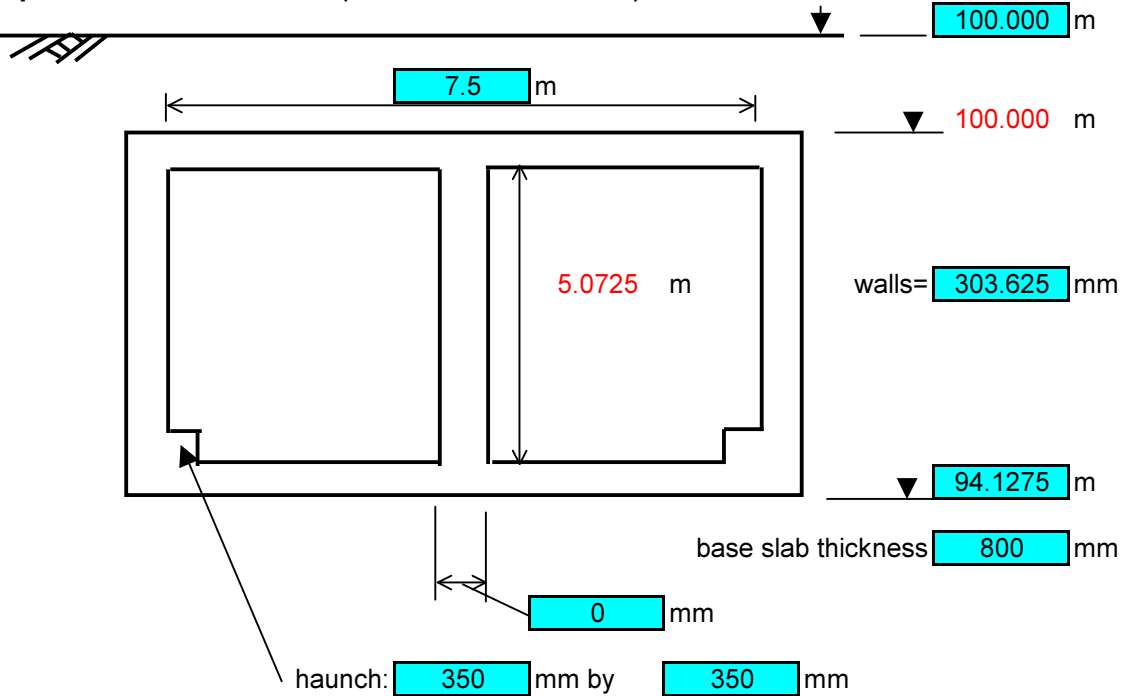
Item	Unit	Quantity	Rate	Cost
excavation	m3	4226.1	60	253563.3
concrete	m3	832.6097	190.0	158195.8
rebar	tonnes	99.9	1600	159861.1
formwork/falsework	m2	909.5779	140	127340.9
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	1023.7	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	588.7921	30	17663.76

Total 716624.9

Section Cut and Cover  
 Length of section: 71.31148 m

Section 6

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	3395.1	m3	
concrete=	699.6423	m3	
rebar=	84.0	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	723.4549	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	837.6	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	578.14	m2	

**Calculated costs**

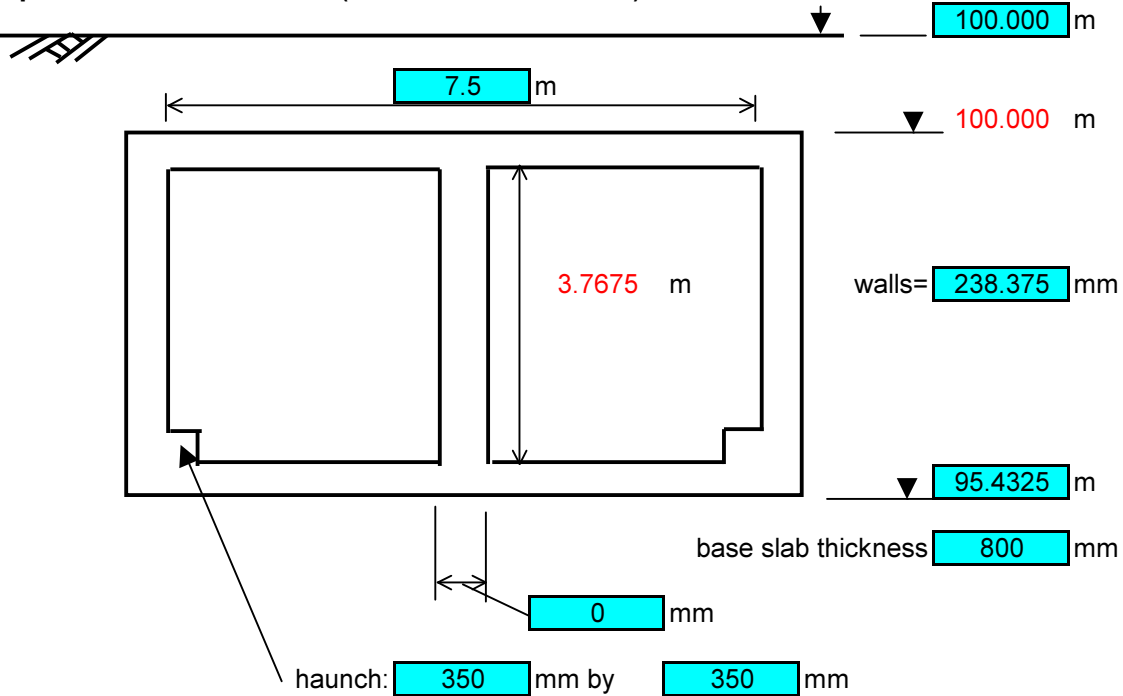
Item	Unit	Quantity	Rate	Cost
excavation	m3	3395.1	60	203707.6
concrete	m3	699.6423	190.0	132932
rebar	tonnes	84.0	1600	134331.3
formwork/falsework	m2	723.4549	140	101283.7
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	837.6	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	578.14	30	17344.2

Total 589598.9

Section Cut and Cover  
Length of section: 71.31148 m

Section 7

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	2598.1	m3	
concrete=	600.6249	m3	
rebar=	72.1	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	537.332	m2	
SP&L<=4.6m deep	651.4	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	568.8338	m2	

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**Calculated costs**

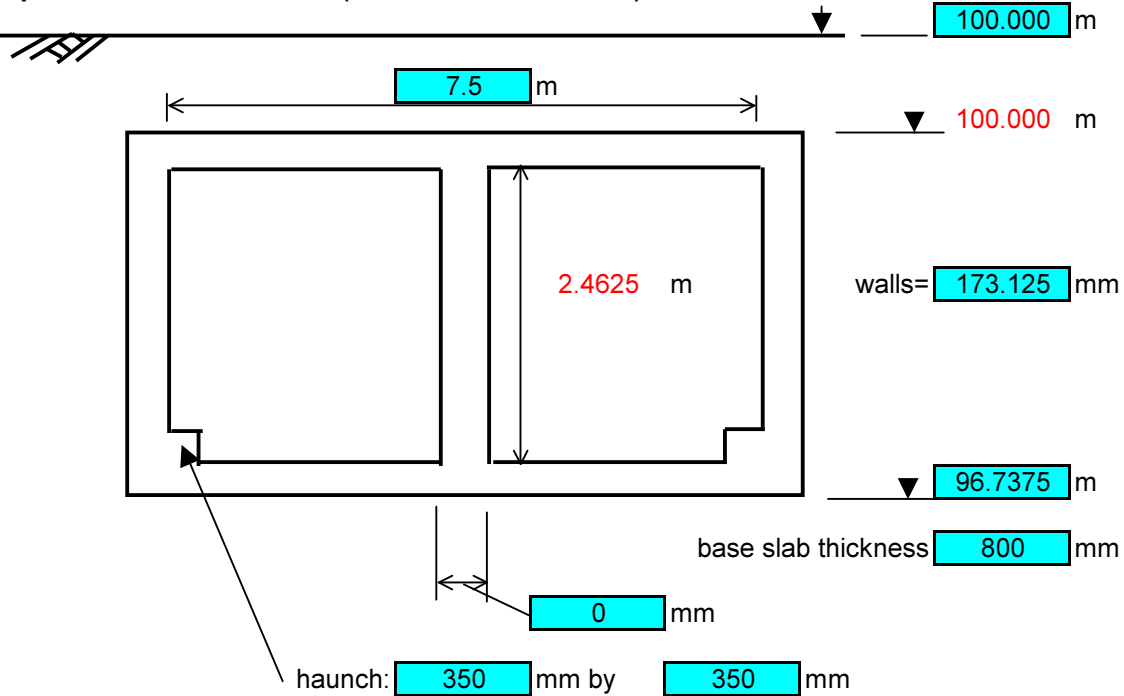
Item	Unit	Quantity	Rate	Cost
excavation	m3	2598.1	60	155888.9
concrete	m3	600.6249	190.0	114118.7
rebar	tonnes	72.1	1600	115320
formwork/falsework	m2	537.332	140	75226.48
SP&L<=4.6m deep	m2	651.4	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	568.8338	30	17065.01

Total 477619.1

Section Cut and Cover  
 Length of section: 71.31148 m

Section 8

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	1825.5	m3	
concrete=	525.8965	m3	
rebar=	63.1	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	351.209	m2	
SP&L<=4.6m deep	465.3	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	559.5277	m2	

**Calculated costs**

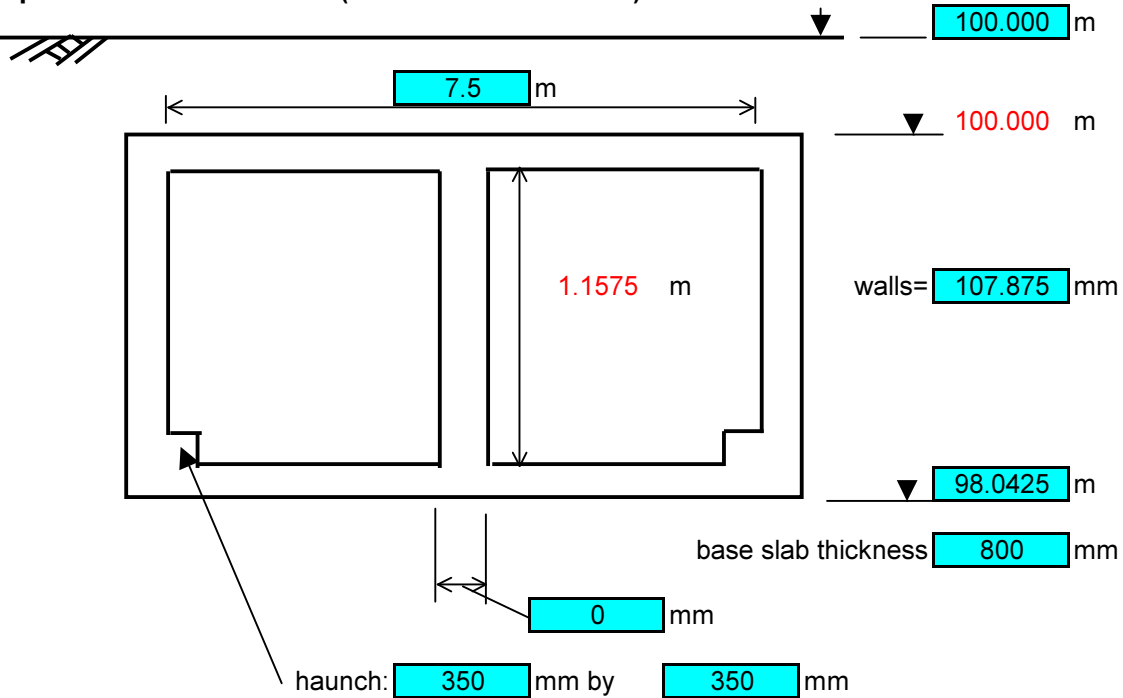
Item	Unit	Quantity	Rate	Cost
excavation	m3	1825.5	60	109527.5
concrete	m3	525.8965	190.0	99920.34
rebar	tonnes	63.1	1600	100972.1
formwork/falsework	m2	351.209	140	49169.26
SP&L<=4.6m deep	m2	465.3	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	559.5277	30	16785.83

Total 376375.1

Section Cut and Cover  
 Length of section: 71.31148 m

Section 9

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	1077.1	m3	
concrete=	475.4572	m3	
rebar=	57.1	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	165.0861	m2	
SP&L<=4.6m deep	279.2	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	550.2215	m2	



**Calculated costs**

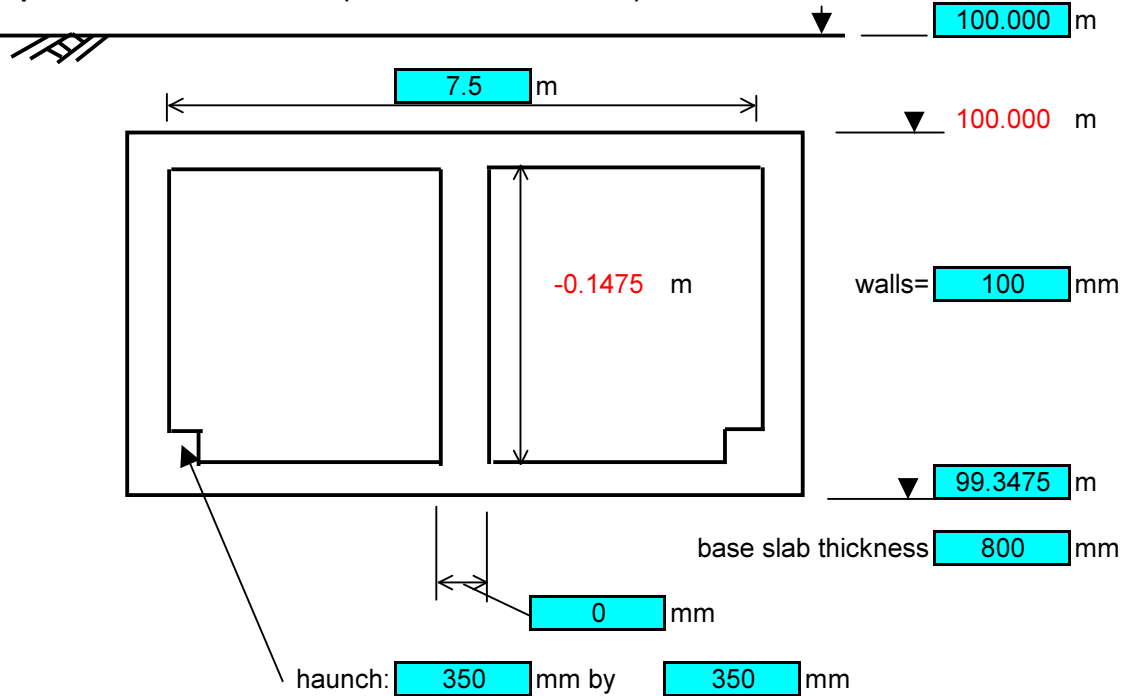
Item	Unit	Quantity	Rate	Cost
excavation	m3	1077.1	60	64623.52
concrete	m3	475.4572	190.0	90336.86
rebar	tonnes	57.1	1600	91287.78
formwork/falsework	m2	165.0861	140	23112.05
SP&L<=4.6m deep	m2	279.2	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	550.2215	30	16506.65

Total 285866.9

Section Cut and Cover  
 Length of section: 71.31148 m

Section 10

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	358.3	m3	
concrete=	454.6463	m3	
rebar=	54.6	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	-21.03689	m2	
SP&L<=4.6m deep	93.1	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	549.0984	m2	

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**Calculated costs**

Item	Unit	Quantity	Rate	Cost
excavation	m3	358.3	60	21497.2
concrete	m3	454.6463	190.0	86382.8
rebar	tonnes	54.6	1600	87292.09
formwork/falsework	m2	-21.03689	140	-2945.164
SP&L<=4.6m deep	m2	93.1	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	549.0984	30	16472.95

Total 208699.9

**Newfoundland Fixed Link Pre-feasibility Study**  
**South Approach**  
**Immersed Tube Rail Tunnel**

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**Calculations by:** ANW

**Summary of Costs**

Markup for adjacent 0 %

<b>Section</b>	<b>Cost</b>
1	1444220
2	1310472
3	1113431
4	886831.5
5	716624.9
6	589598.9
7	477619.1
8	376375.1
9	285866.9
10	<u>208699.9</u>
Sub-total	<u>6061178</u>



### Detailed Cost Estimate Report

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Version VANC-1.5

P:\MEMORIAL\213789\DESIGN\Cost Estimating & Scheduling\T - Rail [North D&B Approach June 11 2004.xls]\V-315

<b>Project:</b>	<b>Newfoundland Fixed Link Study</b>	<b>Project Number:</b>	<b>213789</b>
<b>Estimate Description:</b>	<b>Prefeasibility Level</b>	<b>Parent Estimate ID:</b>	<b>V-300</b>
<b>Tunnel Name:</b>	<b>North Drill &amp; Blast Approach</b>	<b>Project Phase:</b>	<b>Prefeasibility Design</b>
<b>Construction Activity:</b>	<b>Excavation (Drill &amp; Blast) &amp; Initial Support</b>	<b>Geology Type:</b>	<b>Poor to Fair Sediments &amp; Volcanics</b>
<b>Estimate Definition ID:</b>	<b>V-315</b>	<b>Estimate Date:</b>	<b>June 11 2004</b>

<u>Tunnel Characteristics</u>			<u>Shift Details</u>	
<b>Tunnel Length:</b>	<b>6,550.0</b>	m	<b>Shift Arrangement:</b>	<b>3.0</b> Shifts / Day
<b>Design Width:</b>	<b>6.4</b>	m		<b>8.0</b> Hours / Shift
<b>Design Wall Height (Ave.)</b>	<b>6.6</b>	m		<b>5.0</b> Days / Week
<b>Design Wall to Roof:</b>	<b>2.5</b>		<u>Drill, Charge, Blast, Vent &amp; Mucking Details</u>	
<b>Design Max Height :</b>	9.1	m	<b>Survey Tunnel / Holes / Map:</b>	<b>30.0</b> Min / Cycle
<b>Ave Tunnel Overbreak:</b>	<b>20.0</b>	cm	<b>Drilling Blast Holes:</b>	
<b>Tunnel Face Area:</b>	59.3 (Includes Overbreak)	m <sup>2</sup>	<b>Hole Length:</b>	<b>3.9</b> m / Hole
<b>Crown Perimeter:</b>	9.6 (Includes Overbreak)	m	<b>Perim. Blast Hole Spacing:</b>	<b>0.50</b> m
<b>Wall &amp; Crown Perimeter:</b>	23.2 (Includes Overbreak)	m	<b>Interior Blast Hole Spacing:</b>	<b>1.25</b> m
<b>Wall &amp; Crown Area:</b>	152,048 (Includes Overbreak)	m <sup>2</sup>	<b>No. Perimeter Holes:</b>	46 No.
<b>Neat Tunnel Excav. Vol.:</b>	388,414 (Includes Overbreak)	m <sup>3</sup>	<b>No. Interior Area Holes:</b>	38.0 No.
<b>Re-Muck / Pull-Out Bays:</b>			<b>No. Blast Initiation Holes:</b>	14 No.
<b>Bay Length:</b>	<b>10.0</b>	m	<b>Number of Drillholes / Blast:</b>	99 Blastholes / Blast
<b>Spacing Bttn Bays:</b>	<b>1000.0</b>	m	<b>Blast Hole / Face Area Ratio:</b>	1.67 Holes / m <sup>2</sup>
<b>Number of Bays:</b>	6	No.	<b>Typical / Check Ratio:</b>	<b>1.56</b> Holes / m <sup>2</sup>
<b>Total Length of Bays:</b>	60.0	m	<b>Drill Eqpt Set-Up Time:</b>	<b>20</b> min / Set-up
<b>Neat Excavation Vol.:</b>	3,558	m <sup>3</sup>	<b>Drill Penetration Rate:</b>	<b>1.50</b> m / Min
<b>Total Tunnel Volume:</b>	391,972	m <sup>3</sup>		90 m/hour
<b>Muck Bulking Factor:</b>	<b>1.6</b>	Ratio	<b># of Drills or Booms:</b>	<b>3.0</b> No.
<b>Bulked Tunnel Volume:</b>	627,156 (Loose Muck Volume)	m <sup>3</sup>	<b>Charging &amp; Blasting:</b>	
<u>Primary Mucking Production Details</u>			<b>Prime &amp; Load Rate / Hole:</b>	<b>1.25</b> min / Blasthole
(Activity to remove blast muck from face to conveyor & muck cars)			<b>Prep &amp; Hook-up Time:</b>	<b>20.0</b> min / Set-up
<b>Muck Volume / Blast:</b>	313.1	m <sup>3</sup>	<b>Total No. Blasts / Tunnel:</b>	2003 No.
<b>Mucking Volume / Trip:</b>	<b>5.00</b>	m <sup>3</sup>	<b>Net Blast Break Length:</b>	<b>3.3</b> m / Blast
<b>Bucket Fill Factor (%):</b>	<b>90.0</b>	%	<b>Blast &amp; Ventilation Time:</b>	<b>0.5</b> Hours
<b>Number of Trips:</b>	70	No.	<u>Pre-Excavation Grouting Details</u>	
<b>Ave. Dist. to Load:</b>	<b>35.0</b> (Ave Distance One Way)	m	<b>% Tunnel to be Grouted:</b>	<b>5.0</b> %
<b>Ave. Trammig Speed:</b>	<b>8.0</b>	km/hr	<b>Tunnel Length to Grout:</b>	328 m
<b>Load, Dump, Manoever:</b>	<b>1.0</b> (Time per Trip)	Min	<b>Grout Hole Length:</b>	<b>7.0</b> m
<b>Face Cleanup / Blast:</b>	<b>15.0</b>	Min	<b>No. of Grouting Applications:</b>	47 No.
<b>Mucking Time:</b>	2.0	Hours	<b>Perim. Grout Holes Spacing:</b>	<b>1.50</b> m
<b>Mucking Rate:</b>	155.1	m <sup>3</sup> / Hour	<b># Perim. Grout Holes:</b>	15 Holes / Grout Cycle
<u>Tunnel Support Class Details</u>			<b>Drilling Penetration Rate:</b>	<b>50</b> m/hour
<b>Class I - No Support:</b>	<b>0.0</b> (%)	0 (m)	<b>No. of Drill Booms:</b>	<b>2</b> No.
<b>Class II - Spot Bolts:</b>	<b>0.0</b> (%)	0 (m)	<b>Drilling Time per Cycle:</b>	51 Min
<b>Class III - Crown Only:</b>	<b>40.0</b> (%)	2,620 (m)	<b>Grout Eqpt. Set-Up Time:</b>	<b>1.0</b> Hours / Grout Cycle
<b>Class IV - Full Pattern:</b>	<b>50.0</b> (%)	3,275 (m)	<b>No. of Holes Grouted at Once:</b>	<b>2</b> Hoses
<b>Class V - Steel Sets:</b>	<b>10.0</b> (%)	655 (m)	<b>Grouting Injection Rate:</b>	<b>10</b> min / Drillhole
<b>Total</b>	100.0	6,550 (m)	<b>Full Grout Cycle Time:</b>	26.4 Hours
<u>Initial Shotcrete Support Details</u>			<u>Steel Set Installation Details</u>	
<b>Support Arc Length:</b>	<b>23.2</b>	m	<b>Steel Set Spacing:</b>	<b>1.0</b> m
<b>Thickness:</b>	<b>25.0</b>	mm	<b>Total No. Sets / Tunnel:</b>	655 No.
<b>Volume / Round:</b>	2.2	m <sup>3</sup>	<b>Ave. Installation Time / Set:</b>	<b>3.0</b> Hours

<b>Time:</b>	0.8	(Includes Scaling & Equip Set-up)	Hours	<b>Total Installation Time:</b>	1,965	Hours
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<u>Wiremesh Installation Details</u>			<u>Rockbolt Support Class Details</u>		
Install Rate:	100	m <sup>2</sup> / Hour	(Bolts Per Row)	(Bolts Per m)	(Bolts Per Support Class)
Total Install Time:	1,676.3	Hours	Class I:	0.0	0
Ave. Install Time:	50.2	Min	Class II:	0.0	0
Overlap:	5	%	Class III:	4.0	10,480
Net Applied Area:	152,048 (Assume Class V only)	m <sup>2</sup>	Class IV:	10.0	32,750
Area with Overlap:	167,633	m <sup>2</sup>	Class V:	0.0	0
<u>Final Shotcrete Support Class Details</u>			Total:		43,230
Shotcrete Thickness:			<u>Face Scaling</u>		
Classes I and II:	0	mm	Scaling Time:	20.0	min / Blast
Class III:	0	mm	<u>Rockbolt Installation Details</u>		
Classes IV:	50	mm	Rockbolt Length:	3.0	m
Class V:	100	mm	Row Spacing:	1.5	m
Support Arc Length:			No. Rockbolts Required:	43,230	No.
Class I:	0.0	m	Ave. Bolts / Round:	21.8	Bolts / Blast
Class II:	0.0	m	Drilled Length / Round:	65	m
Class III:	0.0	m	Total Drilling Length:	129,690	m
Class IV:	23.2	m	Drill Penetration Rate:	1.5	m / Min
Class V:	23.2	m	# of Drills / Booms Used:	3	No.
<u>Initial and Final Shotcrete Application Details</u>			Ave. Drilling Time / Round:	14.5	Min
Net Volume:	5,322	m <sup>3</sup>	Bolt Install Rate	2.0	Min / Bolt
Rebound / Waste:	15	%	Ave. Bolt Install Time:	43.6	Min
Final Layer Volume:	6,120	m <sup>3</sup>	Drill Set-Up Time:	10.0	Min
No. of Applications:	1151 (Required Per Bench)	No.	Total Bolt Drill/Install Time:	68.1	Min
Ave. Vol. / Application:	5.3	m <sup>3</sup>	<u>Drainhole Details</u>		
Surface Prep Time:	10.0	Min	Drainhole Spacing:	3.0	m
Total Surface Prep Time:	11,512	Min	Drainhole Length:	1.1	m
Application Rate:	24.0	m <sup>3</sup> / Hour	Total Area:	76,024.2	m <sup>2</sup>
Total Application Time:	15,300	Min	Total Drainholes:	8,447.1	# / Per Tunnel
Eqpt. Setup Time:	20.0	Min	Total Length:	9,291.9	m
Total Setup Time:	23,024	Min	Note: Activity carried out concurrent with other activities.		
Eqpt. Remove Time:	10.0 (Required Per Application)	Min	<u>Duration of Tunneling:</u>		
Total Remove Time:	11,512	Min	Pre-Exc. Grouting Time =	1,233.4	Hours
Total Shotcreting Time:	61,348 (For Final Shotcrete Layer)	Min	Drilling Time =	3,525.4	Hours
Equivalent Time / Blast:	30.6	Min / Cycle	Charge, Blast, Vent Time =	5,790.8	Hours
<u>Secondary Mucking Details</u>			Primary Mucking Time =	4,043.0	Hours
Req'd during Tunneling:	No (No if loaded directly into trucks in tunnel)		Scaling Time =	2,003.4	Hours
Ave. LHD Tram Speed:	0.0	km / hour	Survey / Map Time =	1,001.5	Hours
<u>Wick Drain Installation Details</u>			Install Steel Sets Time =	1,965.0	Hours
Drain Spacing:	0.0	m	Initial Shotcreting Time =	1,519.2	Hours
Installation Time / Row:	0.0	Hours / Drain	Install Services Time =	1,001.5	Hours
<u>Average Tunneling Productivity Cycle Details</u>			Rockbolting (of % Critical) =	681.8	Hours
Equiv. Pre-Exc. Grouting:	0.6	Hours	Non-Productive Time =	1,001.5	Hours
Drilling:	1.8	Hours	Total Time =	23,766.5	Hours
Charging:	2.4	Hours		45.7	Months
Blast & Venting:	0.5	Hours	(Critical Path Tunneling	198.1	Weeks
Mucking:	2.0	Hours	Activities Only)	990.3	Days
Scaling:	0.3	Hours	<u>Other Concurrent Tunneling Activities</u>		
Surveying / Mapping:	0.5	Hours	Rockbolting (of % Not Critical) =	1,590.9	Hours
Initial Shotcreting:	0.8	Hours	Wiremesh Installation =	1,676.3	Hours
Install Services:	0.5 (Equiv. Time Per Cycle)	Hours	Final Shotcreting Time =	0.5	Hours
Non-Productive Time:	0.5 (Travel in/out, Break)	Hours	Drilling Drainholes =	2,477.8	Hours
Include Rockbolting:	Yes (Yes / No, as part of Cycle Time)		Secondary Mucking =	0.0	Hours
If yes, % of Support Req'd:	30 (% Req'd During Cycle for Poorer Ground)		Wick Drain Installation =	0.0	Hours
Rockbolting:	0.3	Hours	<u>Overall Advance Rate:</u>		
Total Cycle Time:	10.2	Hours		6.6	m / Day
				392.2	m <sup>3</sup> / Day

Resource Type	Resource Name	Unit Rate	Unit	Quantity	Resource Quantity	Total
<b>Labor</b>						
	Miner - Shift Boss	50.68	\$/hr	23,766.5	2.00	2,408,975.63
	Miner - Operator - Journeyman	47.84	\$/hr	23,766.5	11.00	12,506,899.54
	Miner - Foreman	50.68	\$/hr	23,766.5	3.00	3,613,463.45
	Miner - Laborer - Journeyman	47.40	\$/hr	23,766.5	5.00	5,632,667.97
	Miner - Laborer - Apprentice	45.00	\$/hr	23,766.5	5.00	5,347,469.59
	Tunnel Electrician - Journeyman	47.84	\$/hr	23,766.5	4.00	4,547,963.47
					30.00	34,057,439.64
<b>Plant</b>						
	Cable - Fans & Pumps - High Voltage	120.00	\$/m	6,550.0	0.20	157,200.00
	Cable - Lights / Controls - Low Voltage	10.00	\$/m	6,550.0	0.80	52,400.00
	Compressor	166.62	\$/wk	198.1	1.00	33,000.00
	Conveyor - Heading Muck Loading	6,532.30	\$/wk	198.1	1.00	1,293,750.00
	Drill - Jack-Leg	106.03	\$/wk	198.1	4.00	84,000.00
	Drill Jumbo - Rail Mounted - 2 Boom	1,325.39	\$/wk	198.1	1.00	262,500.00
	Drill Jumbo - Rail Mounted - 3 Boom	1,893.42	\$/wk	198.1	1.00	375,000.00
	Excavator - Rail Mounted	416.55	\$/wk	198.1	1.00	82,500.00
	Generator - Back-Up - 500KW	397.62	\$/wk	198.1	1.00	78,750.00
	Generator - Working - 1000KW	2,968.88	\$/wk	198.1	1.00	588,000.00
	Grout Plant-Consol-D&B-Pump, Hoses	249.93	\$/wk	198.1	1.00	49,500.00
	Lighting (Including Consumables)	7.50	\$/m	6,550.0	1.00	49,125.00
	Locomotive - Diesel - 16T	591.50	\$/wk	198.1	4.00	468,600.00
	LHD Loader - D&B Tunnel	1,270.48	\$/wk	198.1	1.00	251,625.00
	Manlift / Platform - Rail Mounted	555.40	\$/wk	198.1	1.00	110,000.00
	Pipe - 50mm (Water Supply)	7.50	\$/m	6,550.0	1.00	49,125.00
	Pipe - 100mm (Air Supply)	15.00	\$/m	6,550.0	1.00	98,250.00
	Pipe - 150mm (DeWatering)	25.00	\$/m	3,275.0	1.00	81,875.00
	Pipe - 250mm (Dewater)	70.00	\$/m	3,275.0	1.00	229,250.00
	Pipe - Dewatering Clamps (<=200mm)	7.00	\$/m	6,550.0	1.00	45,850.00
	Pumps - Dewatering - Tunnel - 50HP	127.46	\$/wk	99.0	15.00	189,337.50
	Rail - 80 lb/yd - Used	101.54	\$/m	13,500.0	0.60	822,461.54
	Rail - California Switch Gear	75,000.00	\$/Nr	1.0	3.00	225,000.00
	Rail Car - Flat	50,000.00	\$/Nr	1.0	3.00	150,000.00
	Rail Car - Man Rider	50,000.00	\$/Nr	1.0	1.00	50,000.00
	Rail Car - Muck Cars	25,000.00	\$/Nr	1.0	18.00	450,000.00
	Rail Car - Muck Car Tipping System	75,000.00	\$/Nr	1.0	1.00	75,000.00
	Shotcrete Machine - Rail Mounted	609.68	\$/wk	198.1	1.00	120,750.00
	Shotcrete Machine - Tire Mounted	987.10	\$/wk	198.1	2.00	391,000.00
	Small Tools	200.00	\$/wk	198.1	1.00	39,610.89
	Tie Plates, Splice Bars, Bolts	150,000.00	LS	1.0	1.00	150,000.00
	Ties - Wooden - Untreated - 7" x 9" x 40"	23.00	\$/m	6,550.0	1.00	150,650.00
	Transformers & Switchgear - High Voltage	277.70	\$/wk	198.1	1.00	55,000.00
	Transformers-Switchgear-Low Voltage	138.85	\$/wk	198.1	1.00	27,500.00
	Ventilation Duct - Rigid	110.00	\$/m	6,550.0	1.00	720,500.00
	Ventilation Fans - 75HP	78.39	\$/wk	198.1	7.00	108,675.00
	Welder (Plant)	8.71	\$/wk	198.1	1.00	1,725.00
						8,167,509.92



Resource Type	Resource Name	Unit Rate	Unit	Quantity	Resource Quantity	Total
<b>Consumables</b>						
	Bits, Powder and Caps - Blasting	15.00	\$/m3	391,972.4	1.00	5,879,586.10
	Bits - (Drainholes & Rockbolts)	5.00	\$/m	138,981.9	1.00	694,909.25
	Drill Jumbo Maintenance	100.00	\$/hr	3,372.4	1.00	337,242.39
	Electricity - Tunnel Heading Conveyor	0.22	\$/kwh	150	500.76	16,525.00
	Electricity - Fans & Lighting	0.22	\$/kwh	411	11,883.27	1,074,857.29
	Electricity - Jumbo	0.22	\$/kwh	75	3,372.42	55,644.99
	Electricity - Pumps Dewatering	0.22	\$/kwh	559	16,636.57	2,046,971.87
	Lubricants	2,500.00	\$/wk	198.1	1.00	495,136.07
	Fuels & Lubricants	5,000.00	\$/wk	198.1	1.00	990,272.15
	Other Consumables	1,500.00	\$/wk	198.1	1.00	297,081.64
						<b>\$ 11,888,226.76</b>
<b>Materials</b>						
	Grout - Consolidation	50.00	\$/m3	2,000.0	1.00	100,000.00
	Other Materials	2,000.00	\$/wk	198.1	1.00	396,108.86
	Rock Bolts - No. 10 - 3.0m - (Non-Galv)	40.00	\$/Nr	43,230	1.00	1,729,200.00
	Shotcrete	180.00	\$/m3	6,120.0	1.00	1,101,591.16
	Steel Sets - W10 x 65	152.75	\$/m	655	23.21	2,322,540.37
	Synthetic Wick Drains	5.00	\$/m	0	1.00	-
	WWF mesh	5.50	\$/m2	167,633	1.00	921,983.91
						<b>\$ 5,549,440.39</b>
<b>Subcontracts</b>						
	Tunnel Muck - Misel Surface Handling	20.00	\$/m3	627,155.85	1.00	12,543,117.02
						<b>\$ 12,543,117.02</b>
					<b>Total Estimated Cost:</b>	<b>\$ 72,205,733.74</b>
					<b>Per Meter:</b>	<b>\$ 11,023.78</b>
					<b>Per m<sup>3</sup>:</b>	<b>\$ 184.21</b>

**Newfoundland Fixed Link Pre-feasibility Study**  
**Immersed Tube Rail Option      North D&B Approach Final Liner**  
**Tunnel Final Liner Cost Estimate**

Tunnel length= 6535 m  
 Liner cross section area= 13.5 m<sup>2</sup>

**Shift pattern**

Shifts	Hours	Days
3	8	5

Advance rate= 10 m/day

Rebar ratio= 0.12 t/m<sup>3</sup> of concrete

Concrete supply=\$ 135 /m<sup>3</sup>

Rebar supply=\$ 900 /t

Initial form set-up time= 4 weeks

**Durations**

Number of days= 674 days  
 Number of hours= 16164 hours  
 Number of weeks= 135 weeks

**Labour**

Crew size 20  
 Average labour rate \$ 47 /hour

Total labour cost=\$ 15,194,160

**Equipment**

Form \$ 1000000  
 Weekly cost of other equipment \$ 15000 (see TED 2370)

Total equipment cost=\$ 3,020,500

**Materials**

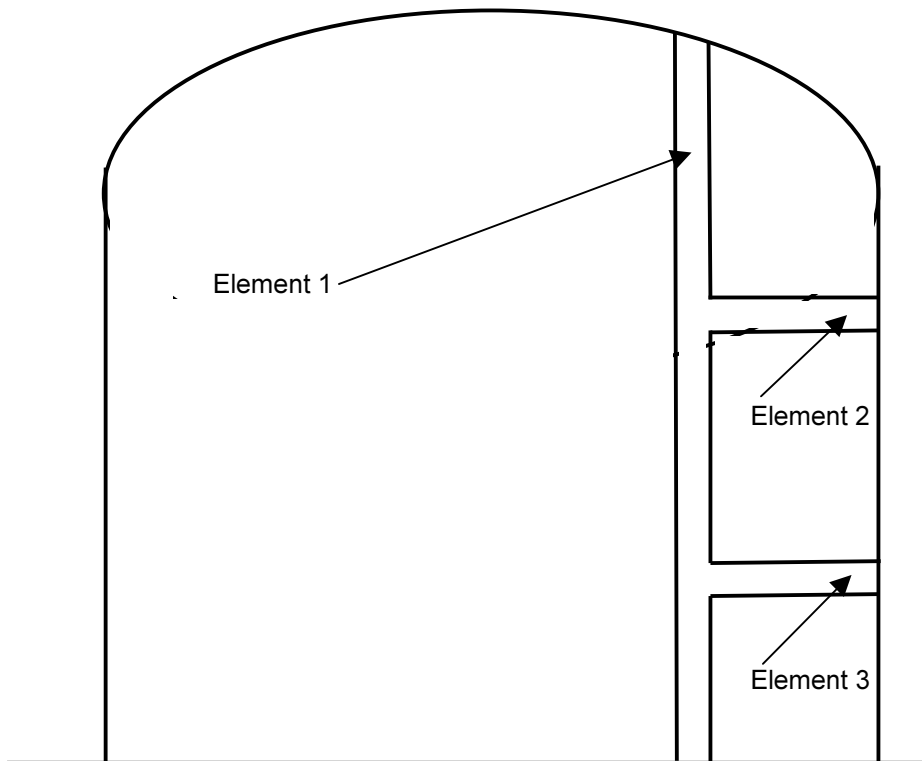
Concrete= 88222.5 m<sup>3</sup>  
 Rebar= 10586.7  
 Concrete cost=\$ 11,910,038  
 Rebar cost=\$ 9,528,030

Total material cost=\$ 21,438,068

**Cost Summary**

Labour 15,194,160  
 Equipment 3,020,500  
 Materials 21,438,068  
 Total 39,652,728

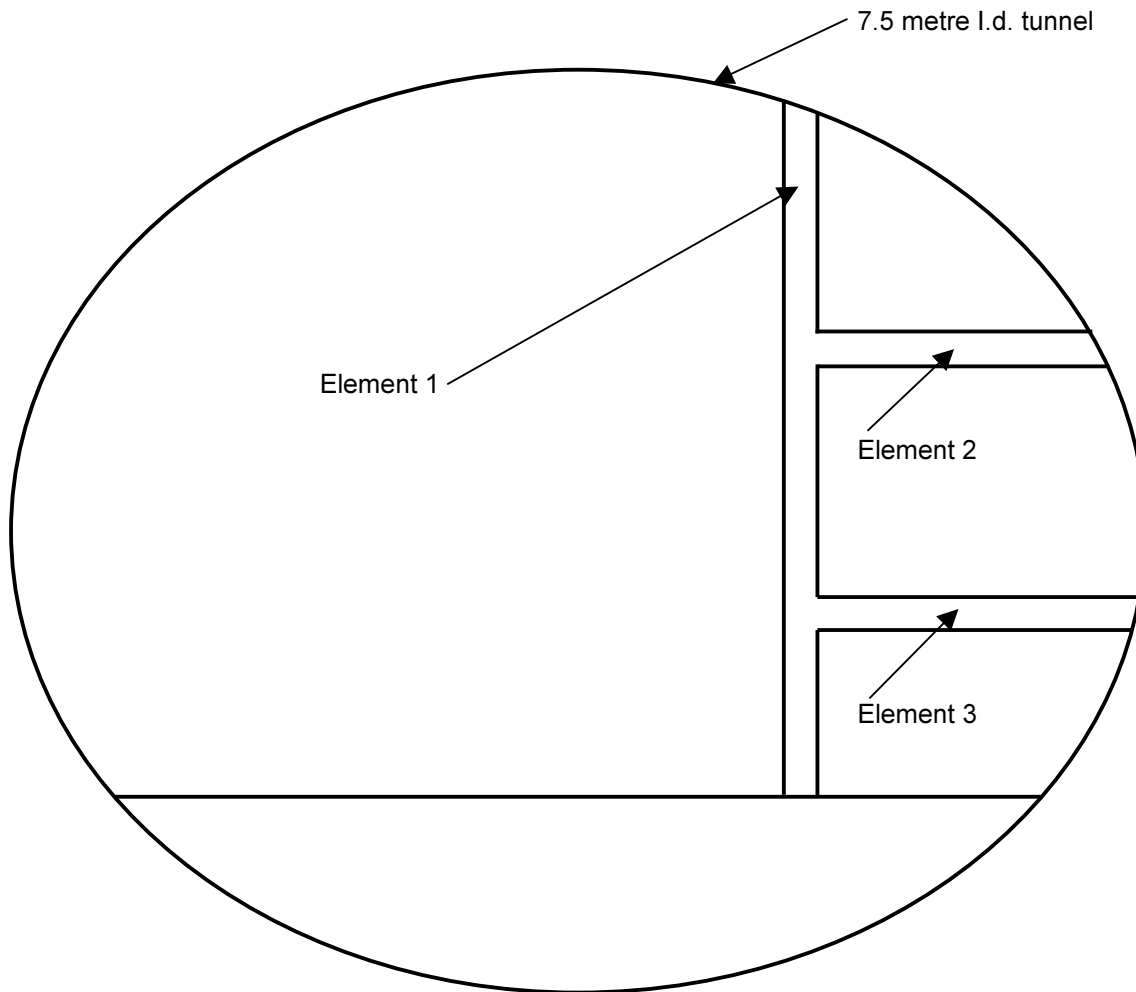
Tunnel length= 6550 m



Assumed tunnel cross section



Tunnel length= 6535 m



Assumed tunnel cross section

**Page 2 of 2**  
**Date:** June 07, 2004  
**Calculation by:** A.White

Concrete	m3	16272 m3	at	190	=	3,091,709
Formwork	m2	92797 m2	at	140	=	12,991,580
Reinforcement	t	1670 t	at	1600	=	2,672,554
				\$		<u>18,755,842</u>

## Initialisation

**Project:** Newfoundland Fixed Link Pre-feasibility Study

**Section:** North Approach

**Option:** Bored Rail Tunnel

**Date:** 8-Jun-04

**Calculations by:** ANW

Surface gradient  %

+ sloping same way as track/road  
- sloping against track/road

Track/Road Gradient  %

Ground elevation  
at portal  m

Bottom of slab  
elevation at portal  m

Total length= 339.8438 m

Total Cost=\$ 3.5 M

**UNIT RATES**

**Materials**

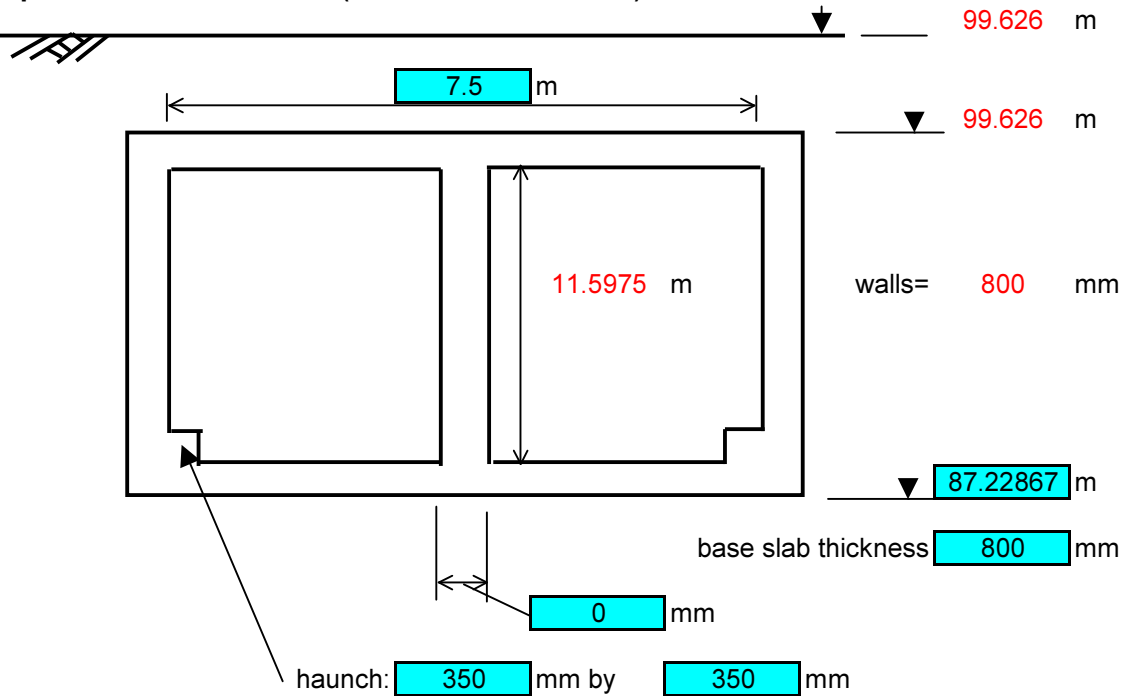
<b>Item</b>	<b>unit</b>	<b>Rate</b>
excavation	m3	60
concrete	m3	190
rebar	tonnes	1600
formwork/falsework	m2	140
SP&L<=4.6m deep	m2	0
4.6<SP&L<=6.7m deep	m2	0
6.7<SP&L<=10.6m deep	m2	0
10.6<SP&L<=13.7m deep	m2	0
13.7<SP&L<=16.8m deep	m2	0
16.8<SP&L<=20.0m deep	m2	0
20<SP&L<=25m deep	m2	0
backfill + compact	m3	40
surface reinstatement	m2	30



Section Cut and Cover  
Length of section: 33.98438 m

Section 1

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	3834.0	m3	
concrete=	886.3465	m3	
rebar=	106.4	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	788.2676	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	842.6	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	309.2578	m2	

**Calculated costs**

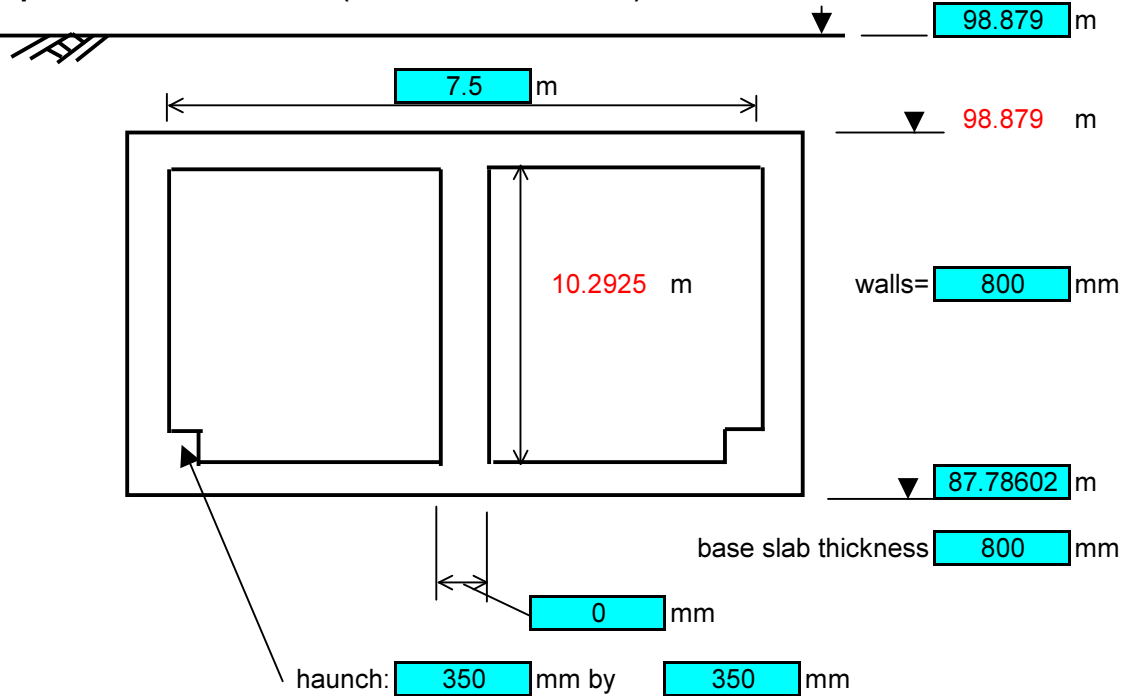
Item	Unit	Quantity	Rate	Cost
excavation	m3	3834.0	60	230041.4
concrete	m3	886.3465	190.0	168405.8
rebar	tonnes	106.4	1600	170178.5
formwork/falsework	m2	788.2676	140	110357.5
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	842.6	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	309.2578	30	9277.734

Total 688261

Section Cut and Cover  
 Length of section: 33.98438 m

Section 2

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	3430.4	m3	
concrete=	815.3871	m3	
rebar=	97.8	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	699.5684	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	753.9	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	309.2578	m2	

**Calculated costs**

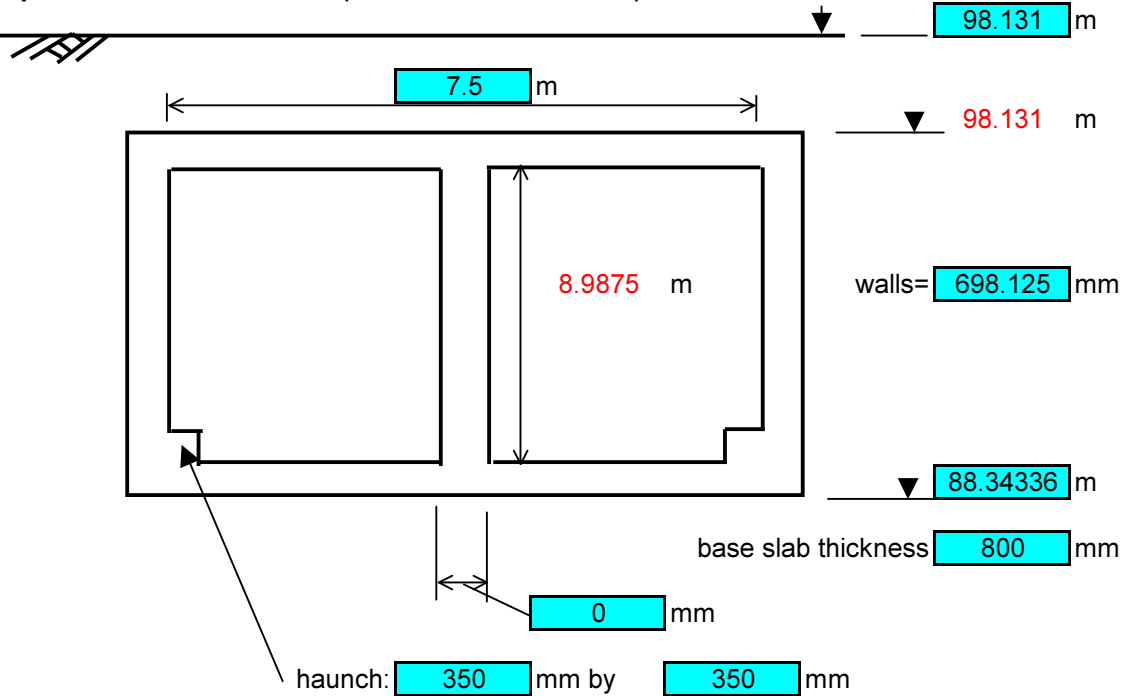
Item	Unit	Quantity	Rate	Cost
excavation	m3	3430.4	60	205826.5
concrete	m3	815.3871	190.0	154923.6
rebar	tonnes	97.8	1600	156554.3
formwork/falsework	m2	699.5684	140	97939.57
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	753.9	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	309.2578	30	9277.734

Total 624521.7

Section Cut and Cover  
Length of section: 33.98438 m

Section 3

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	2959.1	m3	
concrete=	676.656	m3	
rebar=	81.2	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	610.8691	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	665.2	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	302.3335	m2	

**Calculated costs**

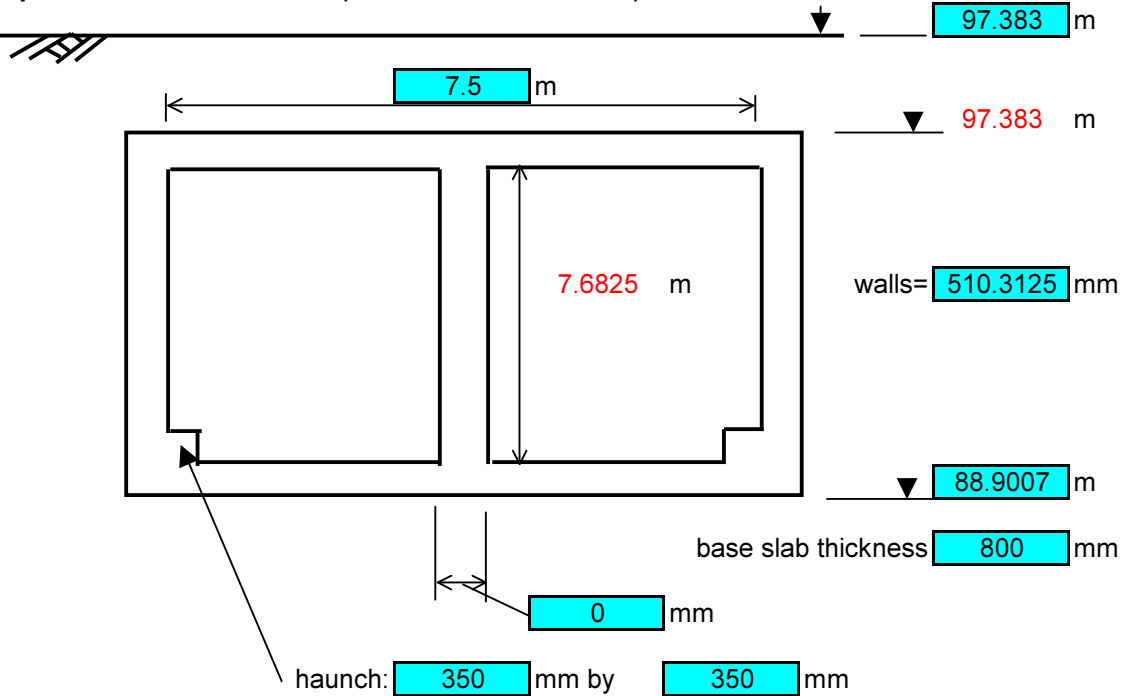
Item	Unit	Quantity	Rate	Cost
excavation	m3	2959.1	60	177545.3
concrete	m3	676.656	190.0	128564.6
rebar	tonnes	81.2	1600	129917.9
formwork/falsework	m2	610.8691	140	85521.68
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	665.2	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	302.3335	30	9070.005

Total 530619.6

Section Cut and Cover  
Length of section: 33.98438 m

Section 4

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	2456.3	m3	
concrete=	506.4505	m3	
rebar=	60.8	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	522.1699	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	576.5	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	289.5681	m2	

**Calculated costs**

Item	Unit	Quantity	Rate	Cost
excavation	m3	2456.3	60	147375.7
concrete	m3	506.4505	190.0	96225.6
rebar	tonnes	60.8	1600	97238.5
formwork/falsework	m2	522.1699	140	73103.79
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	576.5	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	289.5681	30	8687.043

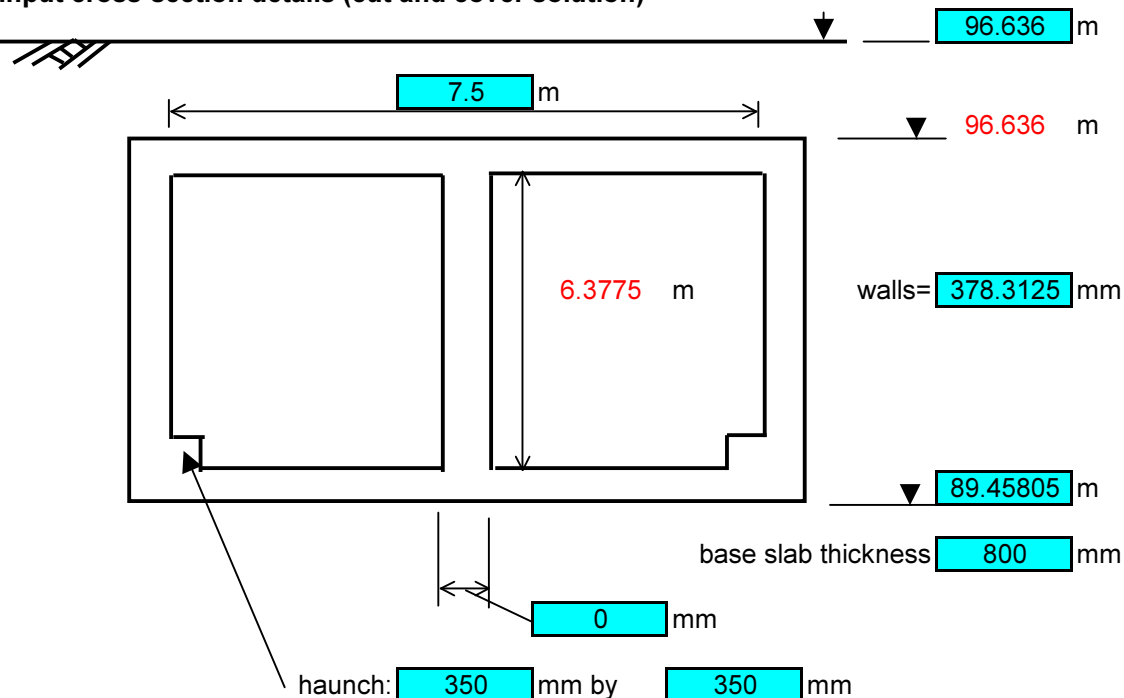
Total 422630.6



Section Cut and Cover  
Length of section: 33.98438 m

Section 5

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	2014.0	m3	
concrete=	396.7905	m3	
rebar=	47.6	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	433.4707	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	487.8	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	280.5962	m2	

**Calculated costs**

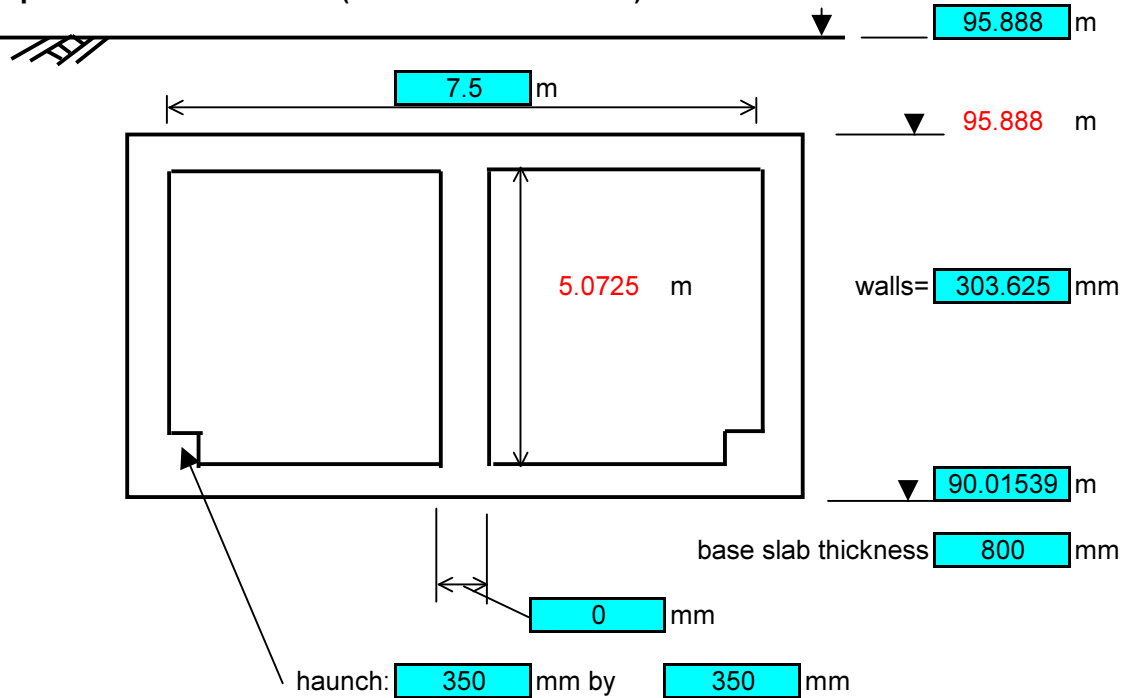
Item	Unit	Quantity	Rate	Cost
excavation	m3	2014.0	60	120838.8
concrete	m3	396.7905	190.0	75390.2
rebar	tonnes	47.6	1600	76183.79
formwork/falsework	m2	433.4707	140	60685.9
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	487.8	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	280.5962	30	8417.887

Total 341516.5

Section Cut and Cover  
 Length of section: 33.98438 m

Section 6

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	1618.0	m3	
concrete=	333.4233	m3	
rebar=	40.0	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	344.7715	m2	
SP&L<=4.6m deep	0.0	m2	
4.6<SP&L<=6.7m deep	399.1	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	275.5198	m2	

**Calculated costs**

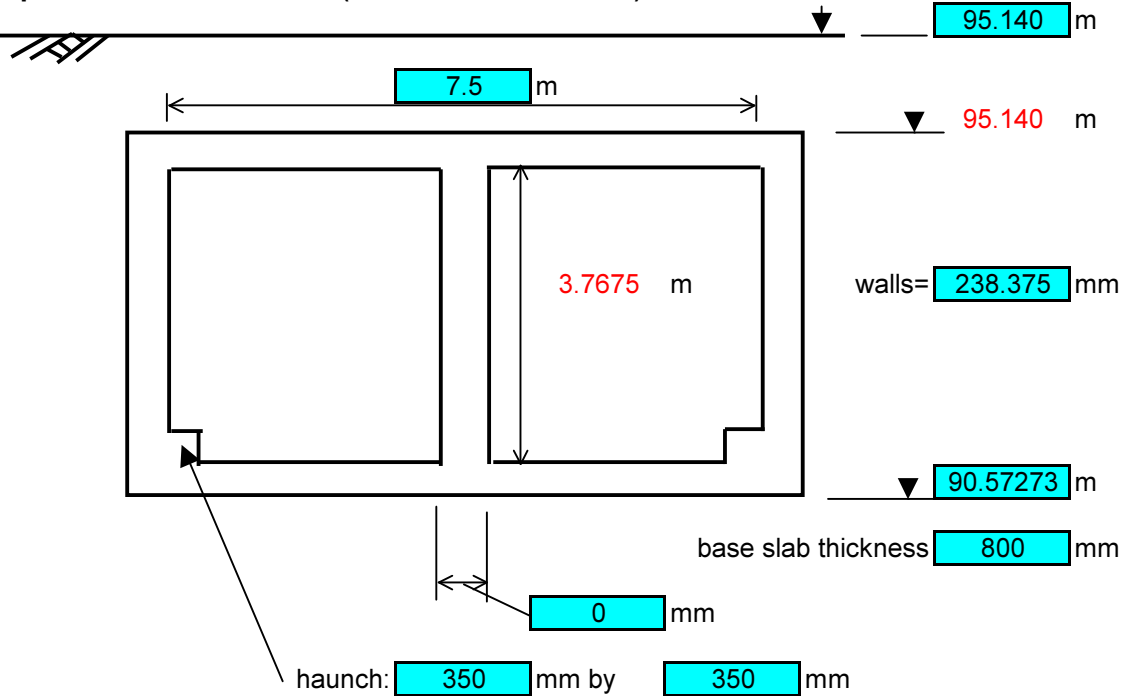
Item	Unit	Quantity	Rate	Cost
excavation	m3	1618.0	60	97079.41
concrete	m3	333.4233	190.0	63350.42
rebar	tonnes	40.0	1600	64017.27
formwork/falsework	m2	344.7715	140	48268.01
SP&L<=4.6m deep	m2	0.0	0	0
4.6<SP&L<=6.7m deep	m2	399.1	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	275.5198	30	8265.595

Total 280980.7

Section Cut and Cover  
Length of section: 33.98438 m

Section 7

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	1238.2	m3	
concrete=	286.2353	m3	
rebar=	34.3	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	256.0723	m2	
SP&L<=4.6m deep	310.4	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	271.0849	m2	

**Calculated costs**

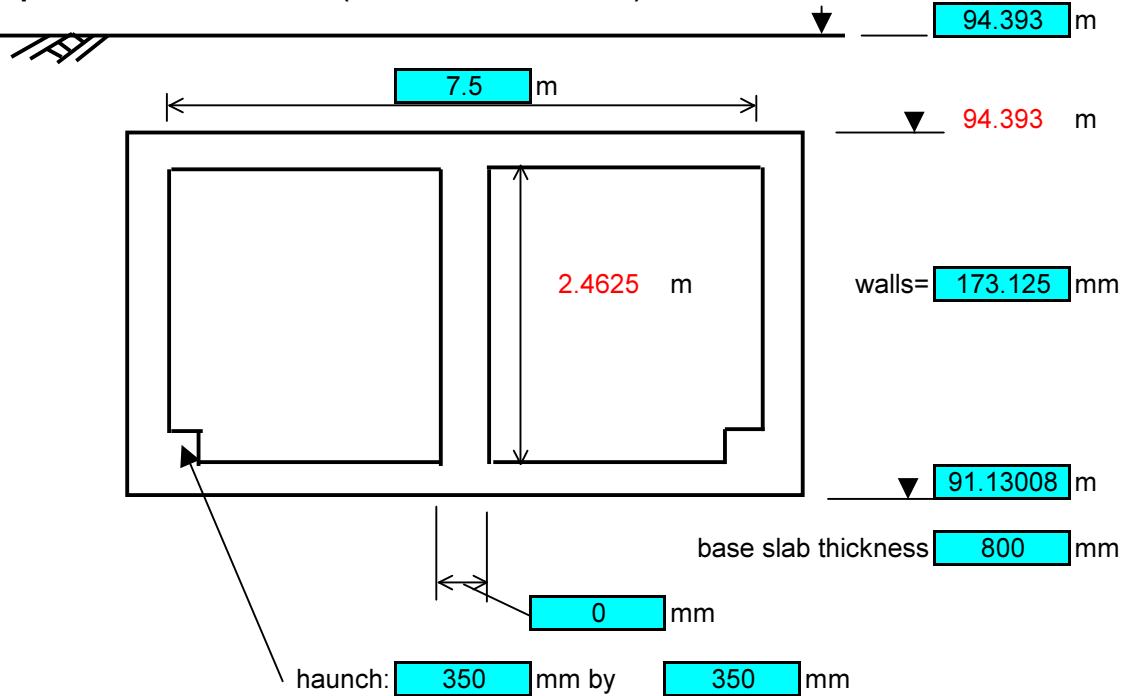
Item	Unit	Quantity	Rate	Cost
excavation	m3	1238.2	60	74290.81
concrete	m3	286.2353	190.0	54384.7
rebar	tonnes	34.3	1600	54957.18
formwork/falsework	m2	256.0723	140	35850.12
SP&L<=4.6m deep	m2	310.4	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	271.0849	30	8132.546

Total 227615.4

Section Cut and Cover  
Length of section: 33.98438 m

Section 8

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	869.9	m3	
concrete=	250.6226	m3	
rebar=	30.1	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	167.373	m2	
SP&L<=4.6m deep	221.7	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	266.6499	m2	

**Calculated costs**

Item	Unit	Quantity	Rate	Cost
excavation	m3	869.9	60	52196.72
concrete	m3	250.6226	190.0	47618.28
rebar	tonnes	30.1	1600	48119.53
formwork/falsework	m2	167.373	140	23432.23
SP&L<=4.6m deep	m2	221.7	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	266.6499	30	7999.497

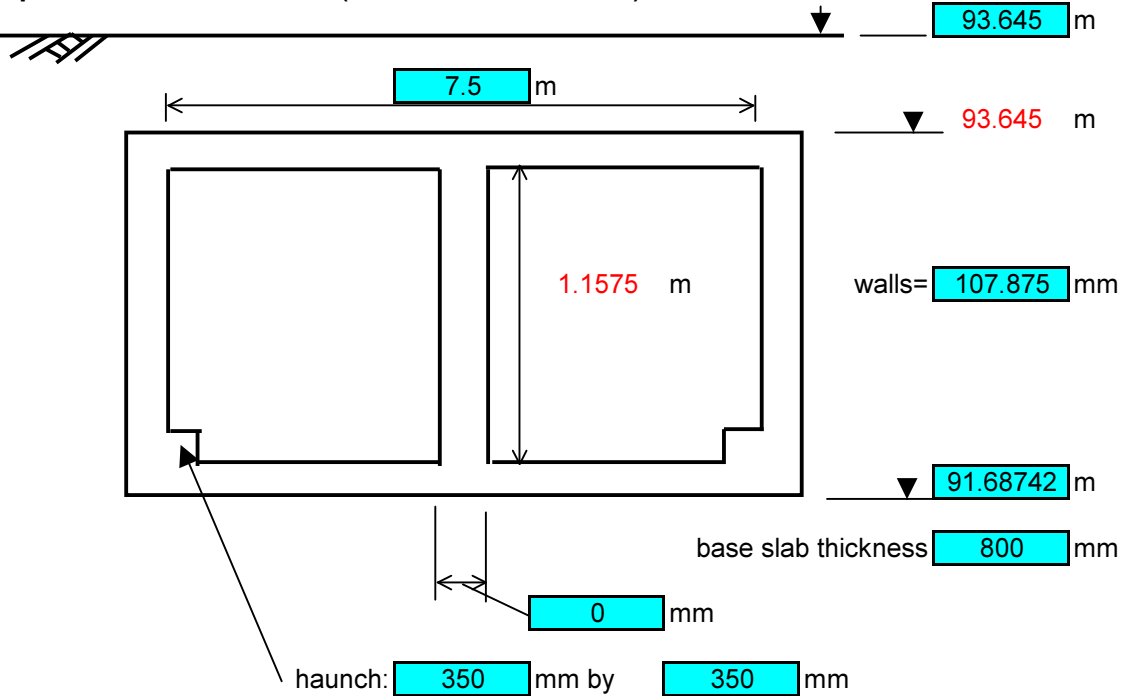
Total 179366.3



Section Cut and Cover  
Length of section: 33.98438 m

Section 9

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	513.3	m3	
concrete=	226.5851	m3	
rebar=	27.2	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	78.67383	m2	
SP&L<=4.6m deep	133.0	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	262.2149	m2	

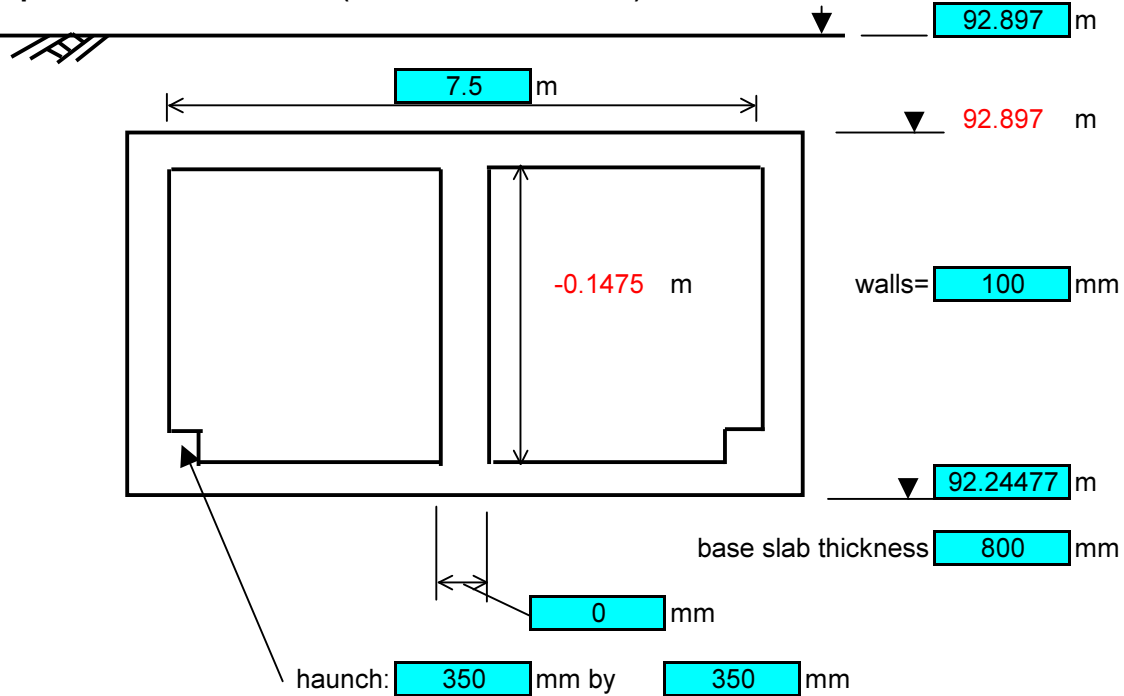
**Calculated costs**

Item	Unit	Quantity	Rate	Cost
excavation	m3	513.3	60	30797.14
concrete	m3	226.5851	190.0	43051.16
rebar	tonnes	27.2	1600	43504.33
formwork/falsework	m2	78.67383	140	11014.34
SP&L<=4.6m deep	m2	133.0	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	262.2149	30	7866.448
Total				<u>136233.4</u>

Section Cut and Cover  
 Length of section: 33.98438 m

Section 10

Input cross-section details (cut and cover solution)



### Calculated Quantities

excavation=	170.7	m3	
concrete=	216.6674	m3	
rebar=	26.0	tonnes	(assume 0.12t/m3 of concrete)
formwork/falsework=	-10.02539	m2	
SP&L<=4.6m deep	44.3	m2	
4.6<SP&L<=6.7m deep	0.0	m2	
6.7<SP&L<=10.6m deep	0.0	m2	
10.6<SP&L<=13.7m deep	0.0	m2	
13.7<SP&L<=16.8m deep	0.0	m2	
16.8<SP&L<=20.0m deep	0.0	m2	
20<SP&L<=25m deep	0.0	m2	
backfill=	0	m3	
surface reinstatement=	261.6797	m2	

**Calculated costs**

Item	Unit	Quantity	Rate	Cost
excavation	m3	170.7	60	10244.76
concrete	m3	216.6674	190.0	41166.8
rebar	tonnes	26.0	1600	41600.14
formwork/falsework	m2	-10.02539	140	-1403.555
SP&L<=4.6m deep	m2	44.3	0	0
4.6<SP&L<=6.7m deep	m2	0.0	0	0
6.7<SP&L<=10.6m deep	m2	0.0	0	0
10.6<SP&L<=13.7m deep	m2	0.0	0	0
13.7<SP&L<=16.8m deep	m2	0.0	0	0
16.8<SP&L<=20.0m deep	m2	0.0	0	0
20<SP&L<=25m deep	m2	0.0	0	0
backfill	m3	0	40	0
surface reinstatement	m2	261.6797	30	7850.391

Total 99458.54

**Newfoundland Fixed Link Pre-feasibility Study**  
**North Approach**  
**Bored Rail Tunnel**

**Date:** 8-Jun-04  
**Calculations by:** ANW

**Summary of Costs**

Markup for adjacent 0 %

<b>Section</b>	<b>Cost</b>
1	688261
2	624521.7
3	530619.6
4	422630.6
5	341516.5
6	280980.7
7	227615.4
8	179366.3
9	136233.4
10	99458.54
Sub-total	<u>3531204</u>



### Detailed Cost Estimate Report

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Version VANC-1.5

P:\MEMORIAL\213789\DESIGN\Cost Estimating & Scheduling\IT - Rail\South D&B Approach June 11 2004.xls\V-315

<b>Project:</b>	<b>Newfoundland Fixed Link Study</b>	<b>Project Number:</b>	<b>213789</b>
<b>Estimate Description:</b>	<b>Prefeasibility Level</b>	<b>Parent Estimate ID:</b>	<b>V-300</b>
<b>Tunnel Name:</b>	<b>IT Rail - South D&amp;B Approach</b>	<b>Project Phase:</b>	<b>Prefeasibility Design</b>
<b>Construction Activity:</b>	<b>Excavation (Drill &amp; Blast) &amp; Initial Support</b>	<b>Geology Type:</b>	<b>Poor to Fair Sediments &amp; Volcanics</b>
<b>Estimate Definition ID:</b>	<b>V-315</b>	<b>Estimate Date:</b>	<b>June 11 2004</b>

<u>Tunnel Characteristics</u>			<u>Shift Details</u>	
<b>Tunnel Length:</b>	<b>2,100.0</b>	m	<b>Shift Arrangement:</b>	<b>3.0</b> Shifts / Day
<b>Design Width:</b>	<b>6.4</b>	m		<b>8.0</b> Hours / Shift
<b>Design Wall Height (Ave.)</b>	<b>6.6</b>	m		<b>5.0</b> Days / Week
<b>Design Wall to Roof:</b>	<b>2.5</b>		<u>Drill, Charge, Blast, Vent &amp; Mucking Details</u>	
<b>Design Max Height :</b>	9.1	m	<b>Survey Tunnel / Holes / Map:</b>	<b>30.0</b> Min / Cycle
<b>Ave Tunnel Overbreak:</b>	<b>20.0</b>	cm	<b>Drilling Blast Holes:</b>	
<b>Tunnel Face Area:</b>	59.3 (Includes Overbreak)	m <sup>2</sup>	<b>Hole Length:</b>	<b>3.9</b> m / Hole
<b>Crown Perimeter:</b>	9.6 (Includes Overbreak)	m	<b>Perim. Blast Hole Spacing:</b>	<b>0.50</b> m
<b>Wall &amp; Crown Perimeter:</b>	23.2 (Includes Overbreak)	m	<b>Interior Blast Hole Spacing:</b>	<b>1.25</b> m
<b>Wall &amp; Crown Area:</b>	48,748 (Includes Overbreak)	m <sup>2</sup>	<b>No. Perimeter Holes:</b>	46 No.
<b>Neat Tunnel Excav. Vol.:</b>	124,530 (Includes Overbreak)	m <sup>3</sup>	<b>No. Interior Area Holes:</b>	38.0 No.
<b>Re-Muck / Pull-Out Bays:</b>			<b>No. Blast Initiation Holes:</b>	14 No.
<b>Bay Length:</b>	<b>10.0</b>	m	<b>Number of Drillholes / Blast:</b>	99 Blastholes / Blast
<b>Spacing Bttn Bays:</b>	<b>1000.0</b>	m	<b>Blast Hole / Face Area Ratio:</b>	1.67 Holes / m <sup>2</sup>
<b>Number of Bays:</b>	2	No.	<b>Typical / Check Ratio:</b>	<b>1.56</b> Holes / m <sup>2</sup>
<b>Total Length of Bays:</b>	20.0	m	<b>Drill Eqpt Set-Up Time:</b>	<b>20</b> min / Set-up
<b>Neat Excavation Vol.:</b>	1,186	m <sup>3</sup>	<b>Drill Penetration Rate:</b>	<b>1.50</b> m / Min
<b>Total Tunnel Volume:</b>	125,716	m <sup>3</sup>		90 m/hour
<b>Muck Bulking Factor:</b>	<b>1.6</b>	Ratio	<b># of Drills or Booms:</b>	<b>3.0</b> No.
<b>Bulked Tunnel Volume:</b>	201,145 (Loose Muck Volume)	m <sup>3</sup>	<b>Charging &amp; Blasting:</b>	
<u>Primary Mucking Production Details</u>			<b>Prime &amp; Load Rate / Hole:</b>	<b>1.25</b> min / Blasthole
(Activity to remove blast muck from face to conveyor & muck cars)			<b>Prep &amp; Hook-up Time:</b>	<b>20.0</b> min / Set-up
<b>Muck Volume / Blast:</b>	313.1	m <sup>3</sup>	<b>Total No. Blasts / Tunnel:</b>	642 No.
<b>Mucking Volume / Trip:</b>	<b>5.00</b>	m <sup>3</sup>	<b>Net Blast Break Length:</b>	<b>3.3</b> m / Blast
<b>Bucket Fill Factor (%):</b>	<b>90.0</b>	%	<b>Blast &amp; Ventilation Time:</b>	<b>0.5</b> Hours
<b>Number of Trips:</b>	70	No.	<u>Pre-Excavation Grouting Details</u>	
<b>Ave. Dist. to Load:</b>	<b>35.0</b> (Ave Distance One Way)	m	<b>% Tunnel to be Grouted:</b>	<b>5.0</b> %
<b>Ave. Tramming Speed:</b>	<b>8.0</b>	km/hr	<b>Tunnel Length to Grout:</b>	105 m
<b>Load, Dump, Manoever:</b>	<b>1.0</b> (Time per Trip)	Min	<b>Grout Hole Length:</b>	<b>7.0</b> m
<b>Face Cleanup / Blast:</b>	<b>15.0</b>	Min	<b>No. of Grouting Applications:</b>	15 No.
<b>Mucking Time:</b>	2.0	Hours	<b>Perim. Grout Holes Spacing:</b>	<b>1.50</b> m
<b>Mucking Rate:</b>	155.1	m <sup>3</sup> / Hour	<b># Perim. Grout Holes:</b>	15 Holes / Grout Cycle
<u>Tunnel Support Class Details</u>			<b>Drilling Penetration Rate:</b>	<b>50</b> m/hour
<b>Class I - No Support:</b>	<b>0.0</b> (%)	0 (m)	<b>No. of Drill Booms:</b>	<b>2</b> No.
<b>Class II - Spot Bolts:</b>	<b>0.0</b> (%)	0 (m)	<b>Drilling Time per Cycle:</b>	16 Min
<b>Class III - Crown Only:</b>	<b>40.0</b> (%)	840 (m)	<b>Grout Eqpt. Set-Up Time:</b>	<b>1.0</b> Hours / Grout Cycle
<b>Class IV - Full Pattern:</b>	<b>50.0</b> (%)	1,050 (m)	<b>No. of Holes Grouted at Once:</b>	<b>2</b> Hoses
<b>Class V - Steel Sets:</b>	<b>10.0</b> (%)	210 (m)	<b>Grouting Injection Rate:</b>	<b>10</b> min / Drillhole
<b>Total</b>	100.0	2,100 (m)	<b>Full Grout Cycle Time:</b>	26.4 Hours
<u>Initial Shotcrete Support Details</u>			<u>Steel Set Installation Details</u>	
<b>Support Arc Length:</b>	<b>23.2</b>	m	<b>Steel Set Spacing:</b>	<b>1.0</b> m
<b>Thickness:</b>	<b>25.0</b>	mm	<b>Total No. Sets / Tunnel:</b>	210 No.
<b>Volume / Round:</b>	2.2	m <sup>3</sup>	<b>Ave. Installation Time / Set:</b>	<b>3.0</b> Hours

<b>Time:</b>	0.8	(Includes Scaling & Equip Set-up)	Hours	<b>Total Installation Time:</b>	630	Hours
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<u>Wiremesh Installation Details</u>			<u>Rockbolt Support Class Details</u>		
Install Rate:	100	m <sup>2</sup> / Hour	(Bolts Per Row)	(Bolts Per m)	(Bolts Per Support Class)
Total Install Time:	537.5	Hours	Class I:	0.0	0
Ave. Install Time:	50.2	Min	Class II:	0.0	0
Overlap:	5	%	Class III:	4.0	3,360
Net Applied Area:	48,748	m <sup>2</sup> (Assume Class V only)	Class IV:	10.0	10,500
Area with Overlap:	53,745	m <sup>2</sup>	Class V:	0.0	0
<u>Final Shotcrete Support Class Details</u>			Total:		13,860
Shotcrete Thickness:			<u>Face Scaling</u>		
Classes I and II:	0	mm	Scaling Time:	20.0	min / Blast
Class III:	0	mm	<u>Rockbolt Installation Details</u>		
Classes IV:	50	mm	Rockbolt Length:	3.0	m
Class V:	100	mm	Row Spacing:	1.5	m
Support Arc Length:			No. Rockbolts Required:	13,860	No.
Class I:	0.0	m	Ave. Bolts / Round:	21.8	Bolts / Blast
Class II:	0.0	m	Drilled Length / Round:	65	m
Class III:	0.0	m	Total Drilling Length:	41,580	m
Class IV:	23.2	m	Drill Penetration Rate:	1.5	m / Min
Class V:	23.2	m	# of Drills / Booms Used:	3	No.
<u>Initial and Final Shotcrete Application Details</u>			Ave. Drilling Time / Round:	14.5	Min
Net Volume:	1,706	m <sup>3</sup>	Bolt Install Rate	2.0	Min / Bolt
Rebound / Waste:	15	%	Ave. Bolt Install Time:	43.6	Min
Final Layer Volume:	1,962	m <sup>3</sup>	Drill Set-Up Time:	10.0	Min
No. of Applications:	369	No. (Required Per Bench)	Total Bolt Drill/Install Time:	68.1	Min
Ave. Vol. / Application:	5.3	m <sup>3</sup>	<u>Drainhole Details</u>		
Surface Prep Time:	10.0	Min	Drainhole Spacing:	3.0	m
Total Surface Prep Time:	3,691	Min	Drainhole Length:	1.1	m
Application Rate:	24.0	m <sup>3</sup> / Hour	Total Area:	24,374.2	m <sup>2</sup>
Total Application Time:	4,905	Min	Total Drainholes:	2,708.2	# / Per Tunnel
Eqpt. Setup Time:	20.0	Min	Total Length:	2,979.1	m
Total Setup Time:	7,382	Min	Note: Activity carried out concurrent with other activities.		
Eqpt. Remove Time:	10.0	Min (Required Per Application)	<u>Duration of Tunneling:</u>		
Total Remove Time:	3,691	Min	Pre-Exc. Grouting Time =	395.4	Hours
Total Shotcreting Time:	19,669	Min (For Final Shotcrete Layer)	Drilling Time =	1,130.7	Hours
Equivalent Time / Blast:	30.6	Min / Cycle	Charge, Blast, Vent Time =	1,857.3	Hours
<u>Secondary Mucking Details</u>			Primary Mucking Time =	1,296.7	Hours
Req'd during Tunneling:	No	(No if loaded directly into trucks in tunnel)	Scaling Time =	642.8	Hours
Ave. LHD Tram Speed:	0.0	km / hour	Survey / Map Time =	321.2	Hours
<u>Wick Drain Installation Details</u>			Install Steel Sets Time =	630.0	Hours
Drain Spacing:	0.0	m	Initial Shotcreting Time =	487.2	Hours
Installation Time / Row:	0.0	Hours / Drain	Install Services Time =	321.2	Hours
<u>Average Tunneling Productivity Cycle Details</u>			Rockbolting (of % Critical) =	218.7	Hours
Equiv. Pre-Exc. Grouting:	0.6	Hours	Non-Productive Time =	321.2	Hours
Drilling:	1.8	Hours	Total Time =	7,622.4	Hours
Charging:	2.4	Hours		14.7	Months
Blast & Venting:	0.5	Hours	(Critical Path Tunneling Activities Only)	63.5	Weeks
Mucking:	2.0	Hours		317.6	Days
Scaling:	0.3	Hours	<u>Other Concurrent Tunneling Activities</u>		
Surveying / Mapping:	0.5	Hours	Rockbolting (of % Not Critical) =	510.3	Hours
Initial Shotcreting:	0.8	Hours	Wiremesh Installation =	537.5	Hours
Install Services:	0.5	Hours (Equiv. Time Per Cycle)	Final Shotcreting Time =	0.5	Hours
Non-Productive Time:	0.5	Hours (Travel in/out, Break)	Drilling Drainholes =	794.4	Hours
Include Rockbolting:	Yes	(Yes / No, as part of Cycle Time)	Secondary Mucking =	0.0	Hours
If yes, % of Support Req'd:	30	(% Req'd During Cycle for Poorer Ground)	Wick Drain Installation =	0.0	Hours
Rockbolting:	0.3	Hours	<u>Overall Advance Rate:</u>		
Total Cycle Time:	10.2	Hours		6.6	m / Day
				392.1	m <sup>3</sup> / Day



Resource Type	Resource Name	Unit Rate	Unit	Quantity	Resource Quantity	Total
<b>Labor</b>						
	Miner - Shift Boss	50.68	\$/hr	7,622.4	1.00	386,303.52
	Miner - Operator - Journeyman	47.84	\$/hr	7,622.4	7.00	2,552,591.23
	Miner - Foreman	50.68	\$/hr	7,622.4	3.00	1,158,910.57
	Miner - Laborer - Journeyman	47.40	\$/hr	7,622.4	3.00	1,083,906.10
	Miner - Laborer - Apprentice	45.00	\$/hr	7,622.4	3.00	1,029,024.77
	Tunnel Electrician - Journeyman	47.84	\$/hr	7,622.4	3.00	1,093,967.67
					20.00	7,304,703.86
<b>Plant</b>						
	Cable - Fans & Pumps - High Voltage	120.00	\$/m	2,100.0	0.20	50,400.00
	Cable - Lights / Controls - Low Voltage	10.00	\$/m	2,100.0	0.80	16,800.00
	Compressor	519.52	\$/wk	63.5	1.00	33,000.00
	Conveyor - Heading Muck Loading	20,367.59	\$/wk	63.5	1.00	1,293,750.00
	Drill - Jack-Leg	330.60	\$/wk	63.5	4.00	84,000.00
	Drill Jumbo - Rail Mounted - 2 Boom	4,132.55	\$/wk	63.5	1.00	262,500.00
	Drill Jumbo - Rail Mounted - 3 Boom	5,903.65	\$/wk	63.5	1.00	375,000.00
	Excavator - Rail Mounted	1,298.80	\$/wk	63.5	1.00	82,500.00
	Generator - Back-Up - 500KW	1,239.77	\$/wk	63.5	1.00	78,750.00
	Generator - Working - 1000KW	9,256.92	\$/wk	63.5	1.00	588,000.00
	Grout Plant-Consol-D&B-Pump, Hoses	779.28	\$/wk	63.5	1.00	49,500.00
	Lighting (Including Consumables)	7.50	\$/m	2,100.0	1.00	15,750.00
	Locomotive - Diesel - 16T	1,844.30	\$/wk	63.5	4.00	468,600.00
	LHD Loader - D&B Tunnel	3,961.35	\$/wk	63.5	1.00	251,625.00
	Manlift / Platform - Rail Mounted	1,731.74	\$/wk	63.5	1.00	110,000.00
	Pipe - 50mm (Water Supply)	7.50	\$/m	2,100.0	1.00	15,750.00
	Pipe - 100mm (Air Supply)	15.00	\$/m	2,100.0	1.00	31,500.00
	Pipe - 150mm (DeWatering)	25.00	\$/m	1,050.0	1.00	26,250.00
	Pipe - 250mm (Dewater)	70.00	\$/m	1,050.0	1.00	73,500.00
	Pipe - Dewatering Clamps (<=200mm)	7.00	\$/m	2,100.0	1.00	14,700.00
	Pumps - Dewatering - Tunnel - 50HP	397.43	\$/wk	31.8	15.00	189,337.50
	Rail - 80 lb/yd - Used	101.54	\$/m	4,600.0	0.60	280,246.15
	Rail - California Switch Gear	75,000.00	\$/Nr	1.0	3.00	225,000.00
	Rail Car - Flat	50,000.00	\$/Nr	1.0	3.00	150,000.00
	Rail Car - Man Rider	50,000.00	\$/Nr	1.0	1.00	50,000.00
	Rail Car - Muck Cars	25,000.00	\$/Nr	1.0	18.00	450,000.00
	Rail Car - Muck Car Tipping System	75,000.00	\$/Nr	1.0	1.00	75,000.00
	Shotcrete Machine - Rail Mounted	1,900.97	\$/wk	63.5	1.00	120,750.00
	Shotcrete Machine - Tire Mounted	3,077.77	\$/wk	63.5	2.00	391,000.00
	Small Tools	200.00	\$/wk	63.5	1.00	12,704.01
	Tie Plates, Splice Bars, Bolts	150,000.00	LS	1.0	1.00	150,000.00
	Ties - Wooden - Untreated - 7" x 9" x 40"	23.00	\$/m	2,100.0	1.00	48,300.00
	Transformers & Switchgear - High Voltage	865.87	\$/wk	63.5	1.00	55,000.00
	Transformers-Switchgear-Low Voltage	432.93	\$/wk	63.5	1.00	27,500.00
	Ventilation Duct - Rigid	110.00	\$/m	2,100.0	1.00	231,000.00
	Ventilation Fans - 75HP	244.41	\$/wk	63.5	7.00	108,675.00
	Welder (Plant)	27.16	\$/wk	63.5	1.00	1,725.00
						6,488,112.66

Resource Type	Resource Name	Unit Rate	Unit	Quantity	Resource Quantity	Total
<b>Consumables</b>						
	Bits, Powder and Caps - Blasting	15.00	\$/m3	125,715.8	1.00	1,885,737.15
	Bits - (Drainholes & Rockbolts)	5.00	\$/m	44,559.1	1.00	222,795.33
	Drill Jumbo Maintenance	100.00	\$/hr	1,081.6	1.00	108,156.51
	Electricity - Tunnel Heading Conveyor	0.22	\$/kwh	150	160.61	5,300.00
	Electricity - Fans & Lighting	0.22	\$/kwh	398	3,811.20	333,534.90
	Electricity - Jumbo	0.22	\$/kwh	75	1,081.57	17,845.82
	Electricity - Pumps Dewatering	0.22	\$/kwh	559	5,335.68	656,505.14
	Lubricants	2,500.00	\$/wk	63.5	1.00	158,800.12
	Fuels & Lubricants	5,000.00	\$/wk	63.5	1.00	317,600.24
	Other Consumables	1,500.00	\$/wk	63.5	1.00	95,280.07
						<b>\$ 3,801,555.29</b>
<b>Materials</b>						
	Grout - Consolidation	50.00	\$/m3	2,000.0	1.00	100,000.00
	Other Materials	2,000.00	\$/wk	63.5	1.00	127,040.10
	Rock Bolts - No. 10 - 3.0m - (Non-Galv)	40.00	\$/Nr	13,860	1.00	554,400.00
	Shotcrete	180.00	\$/m3	1,962.1	1.00	353,181.90
	Steel Sets - W10 x 65	152.75	\$/m	210	23.21	744,631.26
	Synthetic Wick Drains	5.00	\$/m	0	1.00	-
	WWF mesh	5.50	\$/m2	53,745	1.00	295,597.89
						<b>\$ 1,779,253.26</b>
<b>Subcontracts</b>						
	Tunnel Muck - Miscel Surface Handling	20.00	\$/m3	201,145.30	1.00	4,022,905.91
						<b>\$ 4,022,905.91</b>
					<b>Total Estimated Cost:</b>	<b>\$ 23,396,530.99</b>
					<b>Per Meter:</b>	<b>\$ 11,141.21</b>
					<b>Per m<sup>3</sup>:</b>	<b>\$ 186.11</b>

**Newfoundland Fixed Link Pre-feasibility Study**  
**IT Rail Tunnel - South D&B Approach Final Liner**  
**Tunnel Final Liner Cost Estimate**

Tunnel length= 2100 m  
 Liner cross section area= 13.5 m<sup>2</sup>

**Shift pattern**

Shifts	Hours	Days
3	8	5

Advance rate= 10 m/day

Rebar ratio= 0.12 t/m<sup>3</sup> of concrete

Concrete supply=\$ 135 /m<sup>3</sup>

Rebar supply=\$ 900 /t

Initial form set-up time= 4 weeks

**Durations**

Number of days= 230 days  
 Number of hours= 5520 hours  
 Number of weeks= 46 weeks

**Labour**

Crew size 20  
 Average labour rate \$ 47 /hour

Total labour cost=\$ 5,188,800

**Equipment**

Form \$ 1000000  
 Weekly cost of other equipment \$ 15000 (see TED 2370)

Total equipment cost=\$ 1,690,000

**Materials**

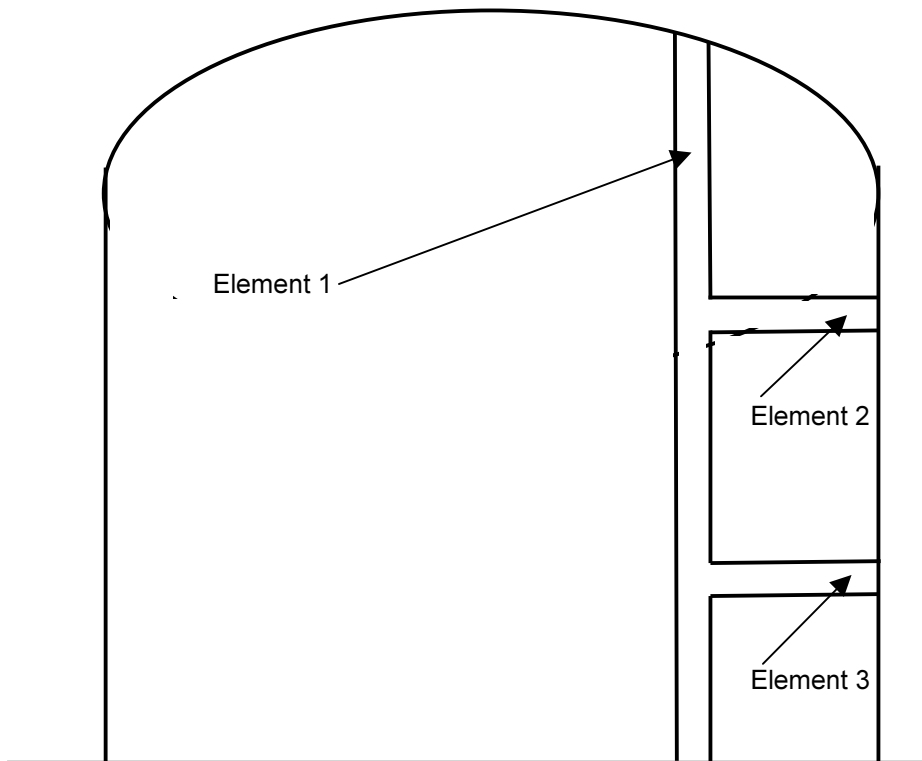
Concrete= 28350 m<sup>3</sup>  
 Rebar= 3402  
 Concrete cost=\$ 3,827,250  
 Rebar cost=\$ 3,061,800

Total material cost=\$ 6,889,050

**Cost Summary**


Labour 5,188,800  
 Equipment 1,690,000  
 Materials 6,889,050  
 Total 13,767,850

Tunnel length= 2100 m



Assumed tunnel cross section



 Hatch Mott MacDonald		Newfoundland Fixed Link Pre-feasibility - Immersed Tube Railway Tunnel - Cost Summary	
ITEM	UNIT	MAIN TUNNEL	
MOBILIZATION & DEMOBILIZATION	LS	43,756,161	
FABRICATION FACILITIES LEASE	LS	52,309,783	
TUNNEL ELEMENT FABRICATION	LS	576,906,382	
TUNNEL ELEMENT FINISHES	LS	49,530,184	
MARINE DREDGE & BACKFILL	LS	584,140,179	
UNIT TRANSPORT, PLACEMENT & CLOSURE	LS	247,961,957	
NORTH TBM TUNNEL	LS	110,073,842	
SOUTH D&B TUNNEL	LS	35,130,365	
SOUTH APPROACH STRUCTURE	LS	6,061,178	
NORTH APPROACH STRUCTURES	LS	3,531,204	
RAIL TRACK	LS	13,398,500	
TUNNEL DRAINAGE	LS	7,820,000	
UTILITY DIVERSIONS	LS	1,000,000	
MONITORING	LS	1,000,000	
SUBTOTAL CIVIL		\$1,732,619,735	
CIVIL CONTINGENCIES			
CONTINGENCY	40%	\$693,047,894	
TOTAL CIVIL		\$2,425,667,628	
M&E, ROLLING STOCK, RAIL HARDWARE AND FINISHING WORK			
ROLLING STOCK, TERMINALS, OCS, ETC	LS	\$48,000,000	
VENTILATION EQUIPMENT	LS	\$3,000,000	
VENTILATION SHAFTS AND BUILDINGS x 2	LS	\$0	
FIRE SUPPRESSION SYSTEM	LS	\$2,000,000	
CONTROL CENTRE	LS	\$1,000,000	
SIGNALLING	LS	\$1,000,000	
LIGHTING	LS	\$2,000,000	
CCTV SYSTEM	LS	\$0	
GAS DETECTION	LS	\$900,000	
SUBSTATION, GENERATORS, UPS	LS	\$2,000,000	
SUBTOTAL M&E AND FINISHING		\$59,900,000	
CONTINGENCIES	20%	\$11,980,000	
TOTAL M&E AND FINISHING		\$71,880,000	
TOTAL CIVIL, M&E AND FINISHING		\$2,497,547,628	
ALLOWANCES			
CONTRACTOR OH	15%	\$374,632,144	
CONTRACTOR PROFIT	15%	\$374,632,144	
CONSTRUCTION TOTAL		\$3,247,000,000	
PRE-CONSTRUCTION AND SUPERVISION			
FEASIBILITY STUDY	LS	\$11,000,000	
ENVIRONMENTAL ASSESSMENT	LS	\$4,000,000	
DESIGN	5%	\$162,350,000	
CONSTRUCTION MANAGEMENT	10%	\$324,700,000	
OWNERS COSTS	2%	\$64,940,000	
PRE-CONSTRUCTION TOTAL		\$566,990,000	
GRAND TOTAL		\$3,813,990,000	



Item	Unit	Quantity	Rate	Total
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**General Details**

Tunnel Length	18,000	metres		
Tunnel Element Length	150	metres	No. Elements =	120

**1 Tunnel Element Fabrication****Miscellaneous**

Mobilisation/demobilisation @ 3% of subtotal structure cost	ls	1	\$32,204,534.54	\$32,204,535
Fabrication facility lease (2 facilities assumed @ 5.5 yrs each)	year	11	\$3,500,000.00	\$38,500,000

**Concrete**

Structural grade 4,000 psi placed by pump - slab on grade	m <sup>3</sup>	165,150	\$157.32	\$25,981,398
Structural grade 4,000 psi placed by pump - elevated slab	m <sup>3</sup>	135,270	\$169.62	\$22,944,497
Structural grade 4,000 psi placed by pump - walls	m <sup>3</sup>	251,100	\$175.31	\$44,020,341
External Protection Layer, 2,500 psi, placed by pump	m <sup>3</sup>	22,410	\$153.34	\$3,436,349
Keyed control joints transverse (at 20m centres approx)	m <sup>2</sup>	32,310	\$13.25	\$428,108
Keyed control joints longitudinal (2 total at base/wall junction)	m	36,000	\$13.25	\$477,000
Curing, sprayed membrane, internal surfaces only	m	505,800	\$1.32	\$667,656

**Formwork**

Walls, multiple use forms	m <sup>2</sup>	626,400	\$78.92	\$49,435,488
Elevated Slab, multiple use forms	m <sup>2</sup>	113,400	\$81.48	\$9,239,832

**Reinforcement: grade 60 high yield**

Wall & Slab reinforcing, 130 kg/m <sup>3</sup>	tonnes	71,698	\$1,501.87	\$107,680,475
Bending, cutting & splicing	tonnes	71,698	\$270.44	\$19,389,899

**Waterproofing Membrane**

Steel skin plate, A36, 8 mm thick	tonnes	30,436	\$3,132.11	\$95,328,117
Shear connectors, 150 mm x 12 mm, including stud welding	each	2,592,000	\$0.10	\$259,200
Automated Welding	m	309,240	\$14.86	\$4,595,306

**Tunnel Joints**

Structural Steel End Frames (2/element)				
Embedded steel beams, 180 kg/m	tonnes	1,542	\$2,709.04	\$4,177,340
Front plates, 20 mm thick	tonnes	677	\$3,132.11	\$2,119,812
Gina fabrication, installation	each	120	\$18,524.00	\$2,222,880
Omega fabrication, installation & testing	each	120	\$23,335.00	\$2,800,200
Joint concrete, shear keys, cover plates etc.	each	120	\$20,000.00	\$2,400,000

Page Total **\$468,308,432**



Item	Unit	Quantity	Rate	Total
<b>Total Brought Forward</b>				<b>\$468,308,432</b>
<b>Temporary Works Items (Per Element)</b>				
Structural Steel Bulkheads (2/element)				
CO Support Columns, 250 kg/m	tonnes	1,920	\$2,709.04	\$5,201,357
ON Skin plate, 12 mm thick	tonnes	1,440	\$3,132.11	\$4,510,238
FE Shear connectors, 150 mm x 12 mm, including stud welding	1.1E+07	360	\$3,174.03	\$1,142,651
EN Automated Welding	4000000	120	\$3,174.03	\$380,884
DE	5% #####	53,880	\$14.86	\$800,657
CO	10% #####	53,880	\$40.06	\$2,158,433
OV	2% #####			
	tonnes	600	\$3,132.11	\$1,879,266
<b>PRE-CONSTRUCTION TOTAL</b>		#####		
	tonnes	2,640	\$2,709.04	\$7,151,866
<b>GRAND TOTAL</b>		#####		
	tonnes	42,768	\$60.40	\$2,583,187
Membrane liner	m <sup>2</sup>	42,768	\$27.84	\$1,190,661
<b>2 Tunnel Transport &amp; Placement</b>				
Element Transport: tug rental etc.	each	120	\$500,000.00	\$60,000,000
Element placement: barge/pontoons, divers, survey etc.	each	120	\$1,000,000.00	\$120,000,000
<b>Tunnel Closure</b>				
Underwater joint completion	each	1	\$2,500,000.00	\$2,500,000
<b>3 Internal Structural &amp; Civil Finish Works</b>				
<b>Ballast</b>				
Track ballast concrete, 2,500 psi, placed by chute	m3	54,000	\$140.06	\$7,563,240
Track ballast reinforcement: welded wire fabric 6 x 6 x #4, 2.8kg/m <sup>2</sup>	m <sup>2</sup>	81,000	\$9.36	\$758,160
Deduct in excess of 4.5 tonnes	tonne	222	-\$41.01	-\$9,104
Emergency corridor sand/cement mix for HVDC cables	m3	20,250	\$140.06	\$2,836,215
<b>Precast Divider for Emergency Egress Corridor</b>				
Panel fabrication, 8" thick, including reinforcement & lifting points	m <sup>2</sup>	103,500	\$196.98	\$20,387,430
Panel setting, based upon max panel weight of 6 tons.	each	9,000	\$285.70	\$2,571,300
Seal and caulk panels	m	36,000	\$5.48	\$197,280
Sprayed fireproofing for precast panels	m <sup>2</sup>	103,500	\$20.77	\$2,149,695
<b>Page Total</b>				<b>\$714,261,847</b>





<i>Item</i>	<i>Unit</i>	<i>Quantity</i>	<i>Rate</i>	<i>Total</i>
<i>Total Brought Forward</i>				<b>\$714,261,847</b>
<b>4 Marine Operation</b>				
<b>Dredging</b>				
Mobilization/Demobilization per season, 6 seasons, 2 vessels	each	24	\$150,000.00	\$3,600,000
Stage 1 bulk dredging of material	m3	4,028,049	\$84.00	\$338,356,116
Stage 2 fine tolerance dredging & additional trench cleaning	m3	604,207	\$43.00	\$25,980,901
<b>Foundation and Backfill</b>				
Screeded gravel foundation	m3	157,275	\$35.00	\$5,504,625
Selected locking fill	m3	377,496	\$35.00	\$13,212,360
Backfill	m3	550,368	\$35.00	\$19,262,880
Rock armor protection	m3	470,790	\$51.00	\$24,010,290
<b>Subtotal Structure Cost</b>				<b>\$1,144,189,019</b>
Tunnel MEP Systems	ls	10 % of structure cost		\$114,418,902
Rail Systems	ls	15 % of structure cost		\$171,628,353
Contingency on Tunnel Costs	ls	30% of subtotal structure cost		\$343,256,706
<b>"Soft" Costs</b>				
Engineers design & construction supervision fee	ls	10% of construction cost		\$177,349,298
<b>Estimated Construction Cost</b>				<b>\$1,950,842,278</b>
<b>Estimated Construction Cost per linear metre</b>				<b>\$108,380</b>

**Newfoundland Fixed Link Pre-feasibility Study**  
**Road Connections**  
**Cost Estimate Summary**

The following is a summary of the costs of road works associated with the project.

<b>1</b>	<b>Road Tunnel Concept</b>	<b>Unit</b>	<b>Quantity</b>	<b>Unit Cost</b>	<b>Total Cost</b>
<b>1A</b>	<b>Newfoundland Side</b>				
0.1	New Road Construction	km	1.4	\$550,000	\$770,000
0.2	Intersection Construction	allowance	1	\$50,000	\$50,000
0.3	Marshalling Area	sq meter	36,000	\$45	\$1,620,000
	Sub Total Nfld Side				\$2,440,000
<b>1B</b>	<b>Labrador Side</b>				
0.1	New Road Construction	km	1	\$600,000	\$600,000
0.2	Intersection Construction	allowance	1	\$50,000	\$50,000
0.3	Marshalling Area	sq meter	36,000	\$57	\$2,052,000
	Sub Total Labrador Side				\$2,702,000
<b>2</b>	<b>Rail Tunnel Concept</b>	<b>Unit</b>	<b>Quantity</b>	<b>Unit Cost</b>	<b>Total Cost</b>
<b>2A</b>	<b>Newfoundland Side</b>				
0.1	New Road Construction	km	1.5	\$550,000	\$825,000
0.2	Intersection Construction	allowance	1	\$50,000	\$50,000
0.3	Marshalling Area	sq meter	36,000	\$45	\$1,620,000
	Sub Total Nfld Side				\$2,495,000
<b>2B</b>	<b>Labrador Side</b>				
0.1	New Road Construction	km	1	\$600,000	\$600,000

0.2	Intersection Construction	allowance	1	\$50,000	\$50,000
0.3	Marshalling Area	sq meter	36,000	\$57	\$2,052,000
	Sub Total Labrador Side				\$2,702,000

<b>3</b>	<b>Quebec North Shore</b>					
0.1	New Road Construction	km	350	\$720,000	\$252,000,000	
0.2	Road Upgrading	km	40	\$360,000	\$14,400,000	
0.3	Branch Roads	km	20	\$312,000	\$6,240,000	
0.4	Bridges	ea	9	\$1,200,000	\$10,800,000	
	Sub Total Quebec North Shore Roads				\$283,440,000	
<b>Total Road Costs</b>						
	Road Tunnel				\$288,582,000	
	Rail Tunnel				\$288,637,000	