

Road improvements to the inland roads are recommended at Al Muladdah and Al Khaburah Roundabouts. Road widening on Route No.11 to Rustaq has already been committed by DGR. The section from Hanza to Rustaq on Route No.11 has already been completed.

## **(2) Geometric Improvements To Roundabouts**

The present roundabouts are elliptical in shape in order to give priority to through traffic weaving through the roundabouts. In future, when the flyovers are constructed, the roundabouts are recommended for improvement to a circular shape from the point view of traffic operation especially for ensuring smooth traffic flow for the left-turning traffic streams from Batinah Highway.

Exclusive right-turn lanes are presently provided only at A' Naseem Garden R/A towards the coast. Such exclusive lanes are necessary if right-turn traffic exceeds 50% of the total traffic. From the traffic turning movement survey results, right turn traffic volumes close to 50% are found at Sohar R/A (direction from Muscat) and at Al Muladdah (direction from inland towards Muscat). Exclusive right-turn lanes at these two locations are therefore recommended.

### **I. 4.7 Assumption of Future Traffic Composition**

For the purpose of design considerations on the proposed flyovers, rampways and other improvements to cross roads and roundabout, future traffic composition, in particular, the percentage share of heavy vehicles is important information.

The existing traffic composition has a small percentage of heavy vehicles amounting to an average of about 5% or less. Future industrial development along the Batinah region may induce changes to the traffic composition. However, urbanization of the region will also likely to increase the total number of passenger cars and pickups.

For these reasons, it is assumed in this study that the future traffic composition will not be significantly different from the present pattern. Heavy vehicles share in the total traffic volume will not likely to exceed 10%. For the purpose of design of highway and other roads, a percentage of maximum 10% of heavy vehicle in the future traffic composition is deemed appropriate.

Daily Traffic Volume, Turning Movement and Traffic Composition at 8 Roundabouts and Junctions, 1996

No.	R/A Name	Approach	Direction	24 Hours Traffic Volume	Traffic Composition				Turning Movement		Peak Hour			
					Car/Van	Pickup	M.Truck	H.Truck	Bus	Left Turn	Through	Right Turn	Turn Traffic %	Peak Traffic %
R-2	An-Naseem Garden	Miscut	Entry to R/A	11,350	78.8%	17.9%	1.3%	1.9%	0.2%	8.9%	89.8%	1.3%	12.6%	
			Exit from R/A	9,861	74.5%	21.6%	1.5%	2.2%	0.2%	-	-	-	8.8%	
			Total	21,211	76.7%	19.8%	1.4%	2.1%	0.2%	-	-	-	-	10.7%
	Agr	Coast	Entry to R/A	9,855	74.6%	21.6%	1.4%	2.2%	0.2%	3.5%	95.6%	0.9%	8.5%	
			Exit from R/A	10,872	80.5%	16.0%	1.3%	2.1%	0.2%	-	-	-	-	13.2%
			Total	20,727	77.6%	18.8%	1.4%	2.2%	0.2%	-	-	-	-	10.9%
	Inland	Coast	Entry to R/A	1,286	69.8%	27.8%	1.6%	0.9%	0.0%	20.9%	37.9%	41.2%	-	9.4%
			Exit from R/A	660	60.8%	35.8%	1.4%	2.1%	0.0%	-	-	-	-	13.2%
			Total	1,946	65.3%	31.8%	1.5%	1.5%	0.0%	-	-	-	-	11.3%
	Inland	Coast	Entry to R/A	493	52.5%	37.9%	4.3%	4.9%	0.4%	31.4%	34.1%	34.5%	-	8.7%
			Exit from R/A	1,591	60.0%	37.6%	1.6%	0.8%	0.0%	-	-	-	-	11.2%
			Total	2,084	56.3%	37.8%	3.0%	2.9%	0.2%	-	-	-	-	10.0%
R-3	Barka	Miscut	Entry to R/A	7,525	71.4%	24.9%	1.5%	2.1%	0.1%	32.8%	61.6%	5.6%	-	8.4%
			Exit from R/A	8,046	65.2%	31.6%	0.9%	2.0%	0.2%	-	-	-	-	9.8%
			Total	15,571	68.3%	28.3%	1.2%	2.1%	0.2%	-	-	-	-	9.1%
	Agr	Coast	Entry to R/A	7,953	68.4%	27.8%	1.6%	2.1%	0.2%	19.4%	76.0%	4.6%	-	9.7%
			Exit from R/A	6,369	56.7%	19.5%	0.9%	1.8%	0.2%	-	-	-	-	8.7%
			Total	14,322	62.6%	23.7%	1.3%	2.0%	0.2%	-	-	-	-	9.2%
	Coast	Inland	Entry to R/A	3,832	59.3%	39.0%	1.2%	0.3%	0.2%	35.2%	42.2%	22.5%	-	9.2%
			Exit from R/A	4,336	60.0%	38.2%	1.7%	0.1%	0.0%	-	-	-	-	8.5%
			Total	8,168	59.7%	38.6%	1.5%	0.2%	0.1%	-	-	-	-	8.9%
	Inland	Coast	Entry to R/A	3,897	52.4%	45.7%	1.3%	0.5%	0.1%	22.4%	60.8%	16.8%	-	7.3%
			Exit from R/A	4,456	60.9%	35.6%	2.6%	0.8%	0.1%	-	-	-	-	9.7%
			Total	8,353	56.7%	40.7%	2.0%	0.7%	0.1%	-	-	-	-	8.5%
R-5	Muladdah Junction	Miscut	Entry to R/A	8,291	71.6%	23.3%	1.5%	2.5%	1.2%	31.9%	68.1%	-	-	7.7%
			Exit from R/A	7,352	67.4%	28.1%	1.4%	2.4%	0.7%	-	-	-	-	7.5%
			Total	15,643	69.5%	25.7%	1.5%	2.5%	1.0%	-	-	-	-	7.6%
	Agr	Coast	Entry to R/A	6,645	61.0%	33.1%	1.9%	3.2%	0.8%	-	-	15.1%	-	7.4%
			Exit from R/A	7,305	67.5%	25.2%	2.4%	3.7%	1.2%	-	-	-	-	8.7%
			Total	13,950	64.3%	29.2%	2.2%	3.5%	1.0%	-	-	-	-	8.1%
	Inland	Coast	Entry to R/A	3,643	66.5%	29.1%	2.3%	2.1%	0.1%	51.8%	-	48.2%	-	7.5%
			Exit from R/A	3,639	69.5%	26.9%	2.2%	1.2%	0.2%	-	-	-	-	8.4%
			Total	7,282	68.0%	28.0%	2.3%	1.7%	0.2%	-	-	-	-	8.0%

Daily Traffic Volume, Turning Movement and Traffic Composition at 8 Roundabouts and Junction, 1996

No.	R/A Name	Approach	Direction	24 Hours		Traffic Composition					Turning Movement			Peak Hour	
				Traffic Volume	24 Hours	Car/Van	Pickup	M.Truck	H.Truck	Bus	Left Turn	Through	Right Turn	Traffic %	Traffic %
R-8	Al Khaburah	Muscat	Entry to R/A	5,724	63.2%	31.8%	1.2%	3.6%	0.2%	30.3%	55.8%	13.9%	6.6%		
			Exit from R/A	5,454	53.0%	41.3%	1.0%	4.5%	0.2%	-	-	-	6.3%		
			Total	11,178	58.1%	36.6%	1.1%	4.1%	0.2%	-	-	-	-	6.5%	
	Aqr	Coast	Entry to R/A	6,913	54.1%	41.5%	0.9%	3.3%	0.1%	33.9%	58.0%	8.2%	6.4%		
			Exit from R/A	5,658	59.9%	35.0%	0.9%	3.9%	0.2%	-	-	-	7.9%		
			Total	12,571	57.0%	38.3%	0.9%	3.6%	0.2%	-	-	-	-	7.2%	
	Coast	Inland	Entry to R/A	4,375	51.5%	42.4%	5.9%	0.2%	0.1%	19.8%	44.9%	35.3%	8.2%		
			Exit from R/A	4,409	57.3%	41.9%	0.6%	0.2%	0.0%	-	-	-	7.7%		
			Total	8,784	54.4%	42.2%	3.3%	0.2%	0.1%	-	-	-	-	8.0%	
	Inland	Muscat	Entry to R/A	2,670	57.2%	40.9%	0.7%	1.2%	0.1%	39.3%	47.8%	12.9%	7.3%		
			Exit from R/A	3,981	56.7%	35.2%	7.6%	0.4%	0.0%	-	-	-	11.2%		
			Total	6,651	57.0%	38.1%	4.2%	0.8%	0.1%	-	-	-	-	9.3%	
R-10	Sohar	Muscat	Entry to R/A	6,070	53.5%	35.6%	7.0%	4.0%	0.1%	21.1%	63.0%	15.9%	7.1%		
			Exit from R/A	6,312	52.0%	41.2%	3.6%	3.0%	0.1%	-	-	-	7.1%		
			Total	12,382	52.8%	38.4%	5.3%	3.5%	0.1%	-	-	-	-	7.1%	
	Aqr	Coast	Entry to R/A	5,201	52.0%	38.1%	4.9%	4.9%	0.2%	17.7%	64.9%	17.4%	7.4%		
			Exit from R/A	5,948	53.6%	38.0%	5.4%	2.7%	0.2%	-	-	-	8.1%		
			Total	11,149	52.8%	38.1%	5.2%	3.8%	0.2%	-	-	-	-	7.8%	
	Coast	Inland	Entry to R/A	5,126	49.5%	47.2%	2.3%	0.9%	0.0%	34.8%	50.4%	14.8%	8.7%		
			Exit from R/A	5,164	54.4%	39.2%	4.3%	1.8%	0.3%	-	-	-	7.9%		
			Total	10,290	52.0%	43.2%	3.3%	1.4%	0.2%	-	-	-	-	8.3%	
	Inland	Muscat	Entry to R/A	5,202	55.7%	40.3%	3.2%	0.4%	0.4%	28.8%	55.9%	15.2%	8.9%		
			Exit from R/A	4,508	50.6%	42.8%	4.2%	2.4%	0.1%	-	-	-	9.0%		
			Total	9,710	53.2%	41.6%	3.7%	1.4%	0.3%	-	-	-	-	9.0%	
R-12	Sohar	Muscat	Entry to R/A	4,415	55.4%	30.1%	6.8%	3.8%	3.9%	12.6%	43.5%	43.8%	7.5%		
			Exit from R/A	6,151	63.2%	33.7%	0.4%	2.5%	0.2%	-	-	-	7.6%		
			Total	10,566	59.3%	31.9%	3.6%	3.2%	2.1%	-	-	-	-	7.6%	
	Aqr	Coast	Entry to R/A	8,332	58.0%	39.0%	1.2%	1.8%	0.1%	68.0%	26.5%	5.5%	7.3%		
			Exit from R/A	5,970	55.6%	35.1%	3.9%	2.6%	2.7%	-	-	-	6.8%		
			Total	14,302	56.8%	37.1%	2.6%	2.2%	1.4%	-	-	-	-	7.1%	
	Coast	Inland	Entry to R/A	15,666	60.2%	38.8%	0.7%	0.2%	0.2%	27.5%	55.6%	16.9%	6.4%		
			Exit from R/A	10,279	61.8%	36.8%	1.2%	0.1%	0.1%	-	-	-	6.7%		
			Total	25,945	61.0%	37.8%	1.0%	0.2%	0.2%	-	-	-	-	6.6%	
	Inland	Muscat	Entry to R/A	3,699	54.8%	44.3%	0.6%	0.2%	0.1%	48.4%	47.4%	4.2%	7.2%		
			Exit from R/A	9,288	52.8%	45.0%	1.7%	0.3%	0.2%	-	-	-	6.8%		
			Total	12,987	53.8%	44.7%	1.2%	0.3%	0.2%	-	-	-	-	7.0%	

Daily Traffic Volume, Turning Movement and Traffic Composition at 8 Roundabouts and Junctions, 1996

No.	R/A Name	Approach	Direction	24 Hours Traffic Volume	Traffic Composition					Turning Movement			Peak Hour Traffic %
					Car/Van	Pickup	M.Truck	H.Truck	Bus	Left Turn	Through	Right Turn	
R-14	Falaj Al Qabail	Muscat	Entry to R/A	5,837	56.1%	33.9%	4.3%	4.7%	1.1%	30.4%	65.9%	3.7%	6.3%
			Exit from R/A	5,620	57.3%	32.7%	4.0%	5.6%	0.4%	-	-	-	7.4%
			Total	11,457	56.7%	33.3%	4.2%	5.2%	0.8%	-	-	-	-
	Aqr		Entry to R/A	4,578	54.4%	35.4%	3.8%	5.9%	0.5%	14.6%	74.1%	11.2%	6.5%
			Exit from R/A	5,355	57.5%	33.4%	5.6%	2.9%	0.5%	-	-	-	6.6%
			Total	9,933	56.0%	34.4%	4.7%	4.4%	0.5%	-	-	-	-
	Coast		Entry to R/A	2,127	57.5%	37.4%	3.2%	1.4%	0.6%	58.9%	29.8%	12.1%	10.7%
			Exit from R/A	1,540	60.5%	34.7%	2.8%	1.6%	0.4%	-	-	-	7.1%
			Total	3,667	59.0%	36.1%	3.0%	1.5%	0.5%	-	-	-	-
	Inland		Entry to R/A	3,281	61.0%	29.6%	6.5%	2.5%	0.3%	46.0%	17.3%	36.8%	6.2%
			Exit from R/A	3,169	52.9%	36.5%	5.2%	4.7%	0.6%	-	-	-	7.1%
			Total	6,450	57.0%	33.1%	5.9%	3.6%	0.5%	-	-	-	-
R-18	Aqr	Muscat	Entry to R/A	2,934	63.7%	29.0%	1.3%	4.0%	0.0%	62.9%	34.1%	3.0%	7.7%
			Exit from R/A	2,857	66.2%	29.9%	1.0%	2.8%	0.1%	-	-	-	8.7%
			Total	5,791	66.0%	29.5%	1.2%	3.4%	0.1%	-	-	-	-
	Malabab		Entry to R/A	1,739	72.0%	25.8%	0.5%	1.6%	0.1%	8.6%	72.0%	19.4%	8.7%
			Exit from R/A	1,464	67.0%	28.4%	1.5%	3.0%	0.0%	-	-	-	7.4%
			Total	3,203	69.5%	27.1%	1.0%	2.3%	0.1%	-	-	-	-
	Coast		Entry to R/A	237	63.7%	36.3%	0.0%	0.0%	0.0%	14.5%	23.9%	61.6%	11.8%
			Exit from R/A	376	68.0%	30.1%	0.5%	1.3%	0.0%	-	-	-	9.4%
			Total	613	65.9%	33.2%	0.3%	0.7%	0.0%	-	-	-	-
	Inland		Entry to R/A	2,179	61.5%	33.7%	1.4%	3.4%	0.0%	16.8%	3.7%	79.6%	8.6%
			Exit from R/A	2,463	65.9%	29.7%	1.0%	3.4%	0.0%	-	-	-	6.8%
			Total	4,642	63.7%	31.7%	1.2%	3.4%	0.0%	-	-	-	-

Note: Traffic at R-5 to R-18 are expanded from 12 hours counts to 24 hours

Traffic Turning Movement Counting Survey at Roundabout By Direction

No.2: A'Nascom Garden R/A

Date: 10/1/96 Wednesday

Time	From Muscat				From Inland				From Coast									
	Left Vehicles	Turns (%)	Through Vehicles	Traffic (%)	Right Vehicles	Turns (%)	Through Vehicles	Traffic (%)	Left Vehicles	Turns (%)	Through Vehicles	Traffic (%)	Right Vehicles	Turns (%)	Through Vehicles	Traffic (%)	Total Vehicles	Total (%)
06:00-07:00	66	25.0%	198	75.0%	0	0.0%	0	0.0%	41	54.7%	5	6.7%	29	38.7%	75	100.0%	364	100.0%
07:00-08:00	48	13.0%	303	81.9%	19	5.1%	19	5.1%	37	46.3%	11	13.8%	52	40.0%	80	100.0%	370	100.0%
08:00-09:00	50	12.2%	349	84.9%	12	2.9%	12	2.9%	2	2.6%	50	65.8%	24	31.6%	76	100.0%	411	100.0%
09:00-10:00	35	7.1%	451	91.3%	8	1.6%	8	1.6%	21	28.0%	26	34.7%	28	37.3%	75	100.0%	494	100.0%
10:00-11:00	74	12.1%	531	86.8%	7	1.1%	7	1.1%	64	61.0%	45	46.9%	51	53.1%	96	100.0%	612	100.0%
11:00-12:00	58	7.8%	678	91.0%	9	1.2%	9	1.2%	18	22.0%	20	24.4%	44	53.7%	82	100.0%	745	100.0%
12:00-13:00	33	3.9%	798	94.9%	10	1.2%	10	1.2%	0	0.0%	28	51.9%	26	48.1%	54	100.0%	880	100.0%
13:00-14:00	44	5.0%	830	94.3%	6	0.7%	6	0.7%	0	0.0%	43	42.6%	38	57.4%	101	100.0%	1076	100.0%
14:00-15:00	46	3.2%	1374	95.7%	15	1.0%	15	1.0%	4	3.8%	48	45.3%	54	50.9%	106	100.0%	1435	100.0%
15:00-16:00	62	5.8%	1066	91.5%	8	0.7%	8	0.7%	46	44.2%	29	27.9%	29	27.9%	104	100.0%	1076	100.0%
16:00-17:00	145	19.5%	591	79.3%	9	1.2%	9	1.2%	1	0.8%	80	66.1%	40	33.1%	121	100.0%	745	100.0%
17:00-18:00	70	10.8%	560	86.7%	16	2.5%	16	2.5%	11	14.9%	38	51.4%	25	33.8%	74	100.0%	646	100.0%
18:00-19:00	59	10.1%	523	89.4%	3	0.5%	3	0.5%	9	15.0%	29	48.3%	22	36.7%	60	100.0%	585	100.0%
19:00-20:00	54	10.1%	471	87.9%	11	2.1%	11	2.1%	5	16.1%	14	45.2%	12	38.7%	31	100.0%	536	100.0%
20:00-21:00	43	9.9%	345	88.7%	6	1.4%	6	1.4%	3	15.8%	9	47.4%	7	36.8%	19	100.0%	434	100.0%
21:00-22:00	31	9.2%	302	89.9%	3	0.9%	3	0.9%	1	11.1%	5	55.6%	3	33.3%	9	100.0%	336	100.0%
22:00-23:00	27	10.7%	222	88.1%	3	1.2%	3	1.2%	1	14.3%	3	42.9%	3	42.9%	7	100.0%	252	100.0%
23:00-24:00	18	9.8%	163	89.1%	2	1.1%	2	1.1%	1	16.7%	3	50.0%	2	33.3%	6	100.0%	183	100.0%
24:00-01:00	10	8.1%	112	91.1%	1	0.8%	1	0.8%	0	0.0%	1	100.0%	0	0.0%	1	100.0%	123	100.0%
01:00-02:00	9	10.7%	75	89.3%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	84	100.0%
02:00-03:00	4	8.5%	43	91.5%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	47	100.0%
03:00-04:00	5	12.2%	36	87.8%	0	0.0%	0	0.0%	1	0.0%	0	0.0%	0	0.0%	0	0.0%	41	100.0%
04:00-05:00	11	12.2%	79	89.2%	0	0.0%	0	0.0%	1	0.0%	0	0.0%	0	0.0%	0	0.0%	90	100.0%
05:00-06:00	12	10.0%	107	89.2%	1	0.8%	1	0.8%	3	0.0%	0	0.0%	0	0.0%	3	100.0%	120	100.0%
Total	1014	8.9%	10187	89.8%	149	1.3%	149	1.3%	269	20.9%	487	37.9%	530	41.2%	1246	100.0%	11350	100.0%

Time	From Agr				From Inland				From Coast									
	Left Vehicles	Turns (%)	Through Vehicles	Traffic (%)	Right Vehicles	Turns (%)	Through Vehicles	Traffic (%)	Left Vehicles	Turns (%)	Through Vehicles	Traffic (%)	Right Vehicles	Turns (%)	Through Vehicles	Traffic (%)	Total Vehicles	Total (%)
06:00-07:00	29	3.4%	808	96.1%	4	0.5%	4	0.5%	6	22.2%	0	0.0%	21	77.8%	27	100.0%	841	100.0%
07:00-08:00	1	0.1%	670	99.7%	1	0.1%	1	0.1%	7	23.3%	16	53.3%	7	23.3%	30	100.0%	672	100.0%
08:00-09:00	2	0.3%	603	99.3%	2	0.3%	2	0.3%	20	54.1%	10	27.0%	7	18.9%	37	100.0%	607	100.0%
09:00-10:00	0	0.0%	588	99.2%	5	0.8%	5	0.8%	4	14.3%	15	53.6%	9	32.1%	28	100.0%	593	100.0%
10:00-11:00	51	8.9%	519	90.3%	5	0.9%	5	0.9%	19	54.3%	7	20.0%	9	25.7%	35	100.0%	575	100.0%
11:00-12:00	21	4.9%	455	94.2%	6	1.3%	6	1.3%	22	56.4%	6	15.4%	11	28.2%	39	100.0%	462	100.0%
12:00-13:00	53	12.2%	373	86.1%	7	1.6%	7	1.6%	0	0.0%	16	57.1%	12	42.9%	28	100.0%	433	100.0%
13:00-14:00	10	2.3%	421	97.2%	2	0.5%	2	0.5%	27	69.2%	2	5.1%	10	25.6%	39	100.0%	433	100.0%
14:00-15:00	38	9.1%	573	90.1%	5	0.8%	5	0.8%	6	19.4%	14	45.2%	11	35.5%	31	100.0%	636	100.0%
15:00-16:00	13	2.0%	639	97.3%	5	0.8%	5	0.8%	8	44.4%	4	22.2%	6	33.3%	18	100.0%	657	100.0%
16:00-17:00	29	4.0%	687	95.4%	4	0.6%	4	0.6%	14	32.6%	13	30.2%	16	37.2%	43	100.0%	720	100.0%
17:00-18:00	18	2.3%	746	96.8%	7	0.9%	7	0.9%	2	6.5%	18	58.1%	11	35.5%	31	100.0%	771	100.0%
18:00-19:00	13	2.4%	516	96.8%	4	0.8%	4	0.8%	4	13.3%	15	50.0%	11	36.7%	30	100.0%	533	100.0%
19:00-20:00	13	2.5%	500	96.7%	4	0.8%	4	0.8%	7	23.3%	13	43.3%	10	33.3%	30	100.0%	517	100.0%
20:00-21:00	8	2.2%	348	97.2%	2	0.6%	2	0.6%	3	17.6%	8	47.1%	6	35.3%	17	100.0%	358	100.0%
21:00-22:00	6	2.3%	250	96.9%	2	0.8%	2	0.8%	3	21.4%	5	35.7%	6	42.9%	14	100.0%	258	100.0%
22:00-23:00	4	2.0%	181	96.8%	2	1.1%	2	1.1%	2	25.0%	3	37.5%	3	37.5%	8	100.0%	187	100.0%
23:00-24:00	3	2.3%	133	97.8%	0	0.0%	0	0.0%	1	20.0%	2	40.0%	2	40.0%	5	100.0%	136	100.0%
24:00-01:00	1	1.3%	71	92.2%	5	6.5%	5	6.5%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	77	100.0%
01:00-02:00	1	1.9%	49	92.5%	3	5.7%	3	5.7%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	53	100.0%
02:00-03:00	3	2.8%	101	93.5%	4	3.7%	4	3.7%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	108	100.0%
03:00-04:00	0	0.0%	21	95.5%	1	4.5%	1	4.5%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	22	100.0%
04:00-05:00	2	3.3%	56	91.8%	3	4.9%	3	4.9%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	61	100.0%
05:00-06:00	4	2.8%	134	92.4%	7	4.8%	7	4.8%	0	0.0%	1	33.3%	2	66.7%	3	100.0%	145	100.0%
Total	343	3.5%	9422	95.6%	90	0.9%	90	0.9%	155	31.4%	168	34.1%	170	34.9%	493	100.0%	9855	100.0%

Traffic Turning Movement Counting Survey at Roundabout By Direction  
 No.3: Barika R/A  
 Date: 9/1/96 Tuesday

Time	Miscut				Coast									
	Left Vehicles	Turns (%)	Through Vehicles	From Traffic (%)	Right Vehicles	Turns (%)	Through Vehicles	From Traffic (%)	Right Vehicles	Turns (%)	Total Vehicles	Total Vehicles (%)		
06:00-07:00	87	29.5%	190	67.5%	0	3.1%	295	100.0%	182	21.4%	477	100.0%		
07:00-08:00	102	30.2%	216	63.9%	20	5.9%	338	100.0%	44	17.2%	382	100.0%		
08:00-09:00	148	36.3%	326	57.8%	24	5.9%	408	100.0%	54	23.0%	452	100.0%		
09:00-10:00	78	18.2%	320	74.6%	31	7.2%	429	100.0%	76	24.5%	505	100.0%		
10:00-11:00	127	26.3%	313	64.8%	43	8.9%	483	100.0%	86	24.5%	569	100.0%		
11:00-12:00	142	31.2%	275	60.4%	38	8.4%	455	100.0%	84	27.4%	539	100.0%		
12:00-13:00	138	27.0%	347	67.8%	27	5.3%	512	100.0%	64	22.3%	576	100.0%		
13:00-14:00	175	32.3%	350	64.7%	16	3.0%	541	100.0%	47	24.0%	588	100.0%		
14:00-15:00	160	25.2%	460	72.6%	14	2.2%	634	100.0%	51	31.5%	685	100.0%		
15:00-16:00	173	28.2%	420	68.5%	20	3.3%	613	100.0%	45	22.3%	658	100.0%		
16:00-17:00	175	38.2%	242	52.8%	41	9.0%	458	100.0%	75	22.0%	533	100.0%		
17:00-18:00	140	42.6%	217	51.3%	26	6.1%	423	100.0%	51	18.5%	474	100.0%		
18:00-19:00	165	42.3%	198	51.0%	25	6.4%	388	100.0%	42	19.6%	430	100.0%		
19:00-20:00	155	42.1%	188	51.8%	20	5.5%	363	100.0%	38	20.3%	391	100.0%		
20:00-21:00	156	41.6%	196	52.3%	23	6.1%	375	100.0%	40	20.2%	415	100.0%		
21:00-22:00	84	38.9%	119	55.1%	13	6.0%	216	100.0%	35	20.7%	251	100.0%		
22:00-23:00	77	40.3%	102	53.0%	12	6.3%	191	100.0%	19	22.0%	210	100.0%		
23:00-24:00	49	40.2%	66	54.1%	7	5.7%	122	100.0%	7	23.3%	136	100.0%		
24:00-01:00	26	33.6%	43	58.9%	4	5.5%	73	100.0%	4	20.0%	77	100.0%		
01:00-02:00	16	33.3%	29	60.4%	3	6.3%	48	100.0%	2	0.0%	50	100.0%		
02:00-03:00	6	31.6%	12	63.2%	1	5.3%	19	100.0%	0	0.0%	20	100.0%		
03:00-04:00	6	33.3%	11	61.1%	1	5.6%	18	100.0%	1	33.3%	20	100.0%		
04:00-05:00	15	35.7%	25	59.5%	2	4.8%	42	100.0%	2	25.0%	44	100.0%		
05:00-06:00	29	35.3%	48	59.3%	4	4.9%	81	100.0%	5	19.2%	86	100.0%		
Total	2469	32.8%	4632	61.6%	424	5.6%	7525	100.0%	1349	35.2%	1619	42.2%	3832	100.0%

Time	Agr				Inland									
	Left Vehicles	Turns (%)	Through Vehicles	From Traffic (%)	Right Vehicles	Turns (%)	Through Vehicles	From Traffic (%)	Right Vehicles	Turns (%)	Total Vehicles	Total Vehicles (%)		
06:00-07:00	55	9.1%	519	86.2%	28	4.7%	602	100.0%	153	63.8%	240	100.0%		
07:00-08:00	98	16.3%	479	79.6%	25	4.2%	602	100.0%	50	19.4%	258	100.0%		
08:00-09:00	136	27.6%	334	67.7%	23	4.7%	493	100.0%	33	13.7%	241	100.0%		
09:00-10:00	111	23.6%	344	71.1%	25	5.3%	470	100.0%	27	10.2%	265	100.0%		
10:00-11:00	148	36.2%	236	57.7%	25	6.1%	409	100.0%	38	2.8%	258	100.0%		
11:00-12:00	123	34.8%	206	58.4%	24	6.8%	353	100.0%	50	18.4%	272	100.0%		
12:00-13:00	106	28.0%	267	65.3%	25	6.6%	378	100.0%	39	16.6%	255	100.0%		
13:00-14:00	72	19.5%	269	72.7%	29	7.8%	370	100.0%	32	5.4%	208	100.0%		
14:00-15:00	94	21.7%	316	73.0%	23	5.3%	433	100.0%	53	21.5%	266	100.0%		
15:00-16:00	45	9.2%	423	86.5%	21	4.3%	489	100.0%	18	9.4%	192	100.0%		
16:00-17:00	112	23.7%	336	71.2%	24	5.1%	472	100.0%	43	15.2%	283	100.0%		
17:00-18:00	114	14.8%	630	81.8%	26	3.4%	770	100.0%	26	9.7%	268	100.0%		
18:00-19:00	81	16.5%	391	79.8%	18	3.7%	490	100.0%	27	10.1%	268	100.0%		
19:00-20:00	65	17.7%	289	78.5%	14	3.8%	368	100.0%	25	10.6%	236	100.0%		
20:00-21:00	52	18.0%	227	78.5%	10	3.5%	289	100.0%	16	10.9%	147	100.0%		
21:00-22:00	41	17.6%	183	78.5%	9	3.9%	233	100.0%	14	11.7%	120	100.0%		
22:00-23:00	31	17.5%	140	79.1%	6	3.4%	177	100.0%	7	11.1%	63	100.0%		
23:00-24:00	19	17.3%	86	78.2%	5	4.5%	110	100.0%	5	11.0%	43	100.0%		
01:00-02:00	7	9.3%	66	88.0%	2	2.7%	75	100.0%	1	0.0%	11	100.0%		
02:00-03:00	4	7.8%	46	90.2%	1	2.0%	51	100.0%	0	0.0%	4	100.0%		
03:00-04:00	2	6.7%	27	90.0%	1	3.3%	30	100.0%	0	0.0%	1	100.0%		
04:00-05:00	6	9.2%	58	89.2%	0	0.0%	20	100.0%	0	0.0%	2	100.0%		
05:00-06:00	19	9.3%	182	89.2%	3	1.5%	204	100.0%	3	10.3%	29	100.0%		
Total	1543	19.4%	6042	76.0%	368	4.6%	7953	100.0%	873	22.4%	2369	60.8%	3897	100.0%

**Traffic Turning Movement Counting Survey at Roundabout By Direction**  
**No.5: Al Mulladah Junction**  
**Date: 8/1/96 (Monday)**

Time	From Muscat			Total Vehicles	Total (%)
	Left Vehicles	Through Vehicles	Right Traffic (%)		
06:00-07:00	61	159	72.3%	220	100.0%
07:00-08:00	111	217	66.2%	328	100.0%
08:00-09:00	160	224	58.3%	384	100.0%
09:00-10:00	195	263	57.7%	456	100.0%
10:00-11:00	245	393	61.6%	638	100.0%
11:00-12:00	170	326	65.7%	496	100.0%
12:00-13:00	134	383	74.1%	517	100.0%
13:00-14:00	147	320	68.5%	467	100.0%
14:00-15:00	114	445	79.6%	559	100.0%
15:00-16:00	169	456	73.0%	625	100.0%
16:00-17:00	126	319	71.7%	445	100.0%
17:00-18:00	158	315	66.6%	473	100.0%
Total	1788	3820	68.1%	5608	100.0%
24 Hrs	2,644	5,648		8,291	

Time	From Agr			From Inland			
	Through Traffic (%)	Right Vehicles	Turns (%)	Left Vehicles	Right Turns (%)	Total Vehicles	Total (%)
06:00-07:00	223	35	12.9%	59	44.3%	106	100.0%
07:00-08:00	274	97	26.1%	96	59.1%	235	100.0%
08:00-09:00	355	48	11.9%	88	58.1%	210	100.0%
09:00-10:00	295	54	15.5%	86	59.2%	211	100.0%
10:00-11:00	432	61	12.4%	124	49.2%	244	100.0%
11:00-12:00	324	49	13.1%	111	50.4%	224	100.0%
12:00-13:00	211	62	22.7%	163	40.5%	274	100.0%
13:00-14:00	289	57	16.5%	128	43.9%	228	100.0%
14:00-15:00	311	39	11.1%	85	52.5%	179	100.0%
15:00-16:00	333	40	10.7%	180	34.5%	275	100.0%
16:00-17:00	285	74	20.6%	134	45.3%	245	100.0%
17:00-18:00	305	34	10.0%	123	46.1%	228	100.0%
Total	3637	648	15.1%	1377	48.2%	2659	100.0%
24 Hrs	5,640	1,005		1,887		3,643	

**Traffic Turning Movement Counting Survey at Roundabout By Direction**  
**No.8: Al Khaburah R/A**  
**Date: 8/1/96 Sunday**

Time	From Muscat				From Traffic				From Inland				
	Left Vehicles	Turns (%)	Through Vehicles	Right Vehicles	Turns (%)	Through Vehicles	Right Vehicles	Left Vehicles	Turns (%)	Through Vehicles	Right Vehicles	Left Vehicles	Turns (%)
06:00-07:00	24	19.4%	92	74.2%	8	6.5%	124	29	38.2%	25	32.9%	22	28.9%
07:00-08:00	63	23.6%	175	65.5%	29	10.9%	267	22	11.9%	111	60.0%	52	28.1%
08:00-09:00	51	15.2%	244	72.6%	41	12.2%	336	57	24.2%	112	47.5%	67	28.4%
09:00-10:00	75	21.2%	219	61.9%	60	16.9%	354	50	14.0%	205	57.4%	102	28.6%
10:00-11:00	48	13.3%	265	73.2%	49	13.5%	362	143	40.1%	115	32.2%	99	27.7%
11:00-12:00	168	44.6%	137	36.3%	72	19.1%	377	32	9.6%	156	46.6%	147	43.9%
12:00-13:00	121	39.4%	130	42.3%	56	18.2%	307	40	12.7%	142	45.1%	133	42.2%
13:00-14:00	103	33.6%	163	53.1%	41	13.4%	307	42	26.3%	45	28.1%	73	45.6%
14:00-15:00	103	32.0%	191	59.3%	28	8.7%	322	1	0.6%	84	52.8%	74	46.5%
15:00-16:00	145	41.9%	176	50.9%	25	7.2%	346	17	11.4%	67	45.0%	65	43.6%
16:00-17:00	131	35.6%	183	49.7%	54	14.7%	368	48	13.8%	186	53.3%	115	33.0%
17:00-18:00	126	35.9%	156	44.4%	69	19.7%	351	113	35.0%	99	30.7%	111	34.4%
Total	1158	30.3%	2131	55.8%	532	13.9%	3821	594	19.8%	1347	44.9%	1060	35.3%
24 Hrs	1735		3192		797		5724	866		1964		1545	

Time	From Muscat				From Traffic				From Inland				
	Left Vehicles	Turns (%)	Through Vehicles	Right Vehicles	Turns (%)	Through Vehicles	Right Vehicles	Left Vehicles	Turns (%)	Through Vehicles	Right Vehicles	Left Vehicles	Turns (%)
06:00-07:00	28	17.7%	116	73.4%	14	8.9%	158	17	33.3%	26	51.0%	8	15.7%
07:00-08:00	50	17.2%	196	67.6%	44	15.2%	290	43	28.9%	81	54.4%	25	16.8%
08:00-09:00	136	36.6%	197	53.0%	39	10.5%	372	55	32.5%	99	58.6%	15	8.9%
09:00-10:00	177	48.1%	156	42.4%	35	9.5%	368	68	35.2%	104	53.9%	21	10.9%
10:00-11:00	186	47.3%	168	42.7%	39	9.9%	393	81	41.3%	84	42.9%	31	15.8%
11:00-12:00	168	38.0%	244	55.2%	30	6.8%	442	84	44.0%	85	44.5%	22	11.5%
12:00-13:00	145	37.5%	202	52.2%	40	10.3%	387	78	53.8%	51	35.2%	16	11.0%
13:00-14:00	104	32.6%	178	55.8%	37	11.6%	319	12	9.7%	97	78.2%	15	12.1%
14:00-15:00	94	24.6%	258	67.5%	30	7.9%	382	107	64.8%	29	17.6%	29	17.6%
15:00-16:00	94	24.1%	281	72.1%	15	3.9%	390	35	24.8%	91	64.5%	15	10.6%
16:00-17:00	167	38.4%	252	57.9%	16	3.7%	435	98	48.3%	74	36.5%	31	15.3%
17:00-18:00	139	30.4%	298	65.2%	20	4.4%	457	75	39.7%	94	49.7%	20	10.6%
Total	1488	33.9%	2546	58.0%	359	8.2%	4393	753	39.3%	915	47.8%	248	12.9%
24 Hrs	2342		4007		565		6913	1050		1275		346	



Traffic Turning Movement Counting Survey at Roundabout By Direction  
 No.10: Saham R/A  
 Date: 7/1/96 Sunday

Time	Muscatt			From Traffic			Coast						
	Left Vehicles	Turns (%)	Through Vehicles	Right Vehicles	Turns (%)	Total Vehicles	Left Vehicles	Turns (%)	Through Vehicles	Right Vehicles	Turns (%)	Total Vehicles	
06:00-07:00	19	12.3%	112	23	15.1%	154	34	35.8%	45	47.7%	15	16.5%	94
07:00-08:00	113	30.6%	159	98	26.4%	369	133	38.7%	142	41.4%	68	19.9%	343
08:00-09:00	103	29.9%	231	96	22.3%	429	113	38.0%	128	43.1%	56	19.0%	297
09:00-10:00	53	13.0%	307	48	11.8%	409	151	39.9%	183	48.2%	45	11.9%	380
10:00-11:00	77	19.1%	278	49	12.1%	405	133	32.9%	222	54.9%	50	12.2%	405
11:00-12:00	81	22.8%	209	67	18.8%	357	121	27.1%	247	55.2%	79	17.7%	447
12:00-13:00	93	26.7%	192	63	18.1%	348	115	28.2%	220	54.1%	72	17.7%	406
13:00-14:00	60	20.3%	183	51	17.9%	297	125	39.2%	141	44.2%	53	15.5%	319
14:00-15:00	69	23.6%	172	59	17.4%	292	58	35.7%	79	48.3%	26	15.9%	163
15:00-16:00	45	13.4%	257	32	9.6%	334	62	44.0%	68	48.6%	10	7.3%	140
16:00-17:00	92	23.0%	269	40	9.8%	401	71	31.4%	132	58.6%	23	10.0%	226
17:00-18:00	47	18.7%	180	25	9.8%	252	131	35.7%	202	55.2%	33	9.1%	366
Total	852	21.1%	2550	644	15.9%	4046	1246	34.8%	1808	50.4%	531	14.8%	3585
24 HRS	1278		3825	967		6070	1782		2585		759		5126

Time	Muscatt			From Traffic			Coast						
	Left Vehicles	Turns (%)	Through Vehicles	Right Vehicles	Turns (%)	Total Vehicles	Left Vehicles	Turns (%)	Through Vehicles	Right Vehicles	Turns (%)	Total Vehicles	
06:00-07:00	9	7.4%	94	23	18.5%	126	39	40.5%	42	44.0%	15	15.5%	96
07:00-08:00	39	27.1%	100	49	27.1%	219	110	35.8%	162	52.7%	35	11.3%	307
08:00-09:00	38	18.5%	118	47	23.4%	203	94	37.2%	127	50.1%	32	12.7%	253
09:00-10:00	28	12.9%	150	39	18.2%	217	89	21.6%	246	59.7%	77	18.7%	412
10:00-11:00	41	14.6%	212	30	10.7%	283	156	38.1%	208	50.8%	47	11.4%	409
11:00-12:00	67	17.5%	239	77	20.1%	383	98	21.1%	276	59.7%	89	19.2%	462
12:00-13:00	70	18.5%	233	76	20.1%	380	129	27.6%	251	54.3%	82	17.8%	462
13:00-14:00	64	18.0%	216	76	21.4%	356	100	28.4%	198	56.3%	54	15.2%	352
14:00-15:00	57	18.8%	197	49	16.3%	302	89	37.1%	123	51.3%	27	11.4%	240
15:00-16:00	51	17.0%	196	54	17.9%	301	25	10.1%	172	69.3%	51	20.6%	248
16:00-17:00	54	19.1%	211	16	5.8%	281	83	36.9%	121	53.9%	21	9.2%	224
17:00-18:00	55	18.1%	214	34	11.4%	303	67	24.4%	169	61.1%	40	14.5%	276
Total	593	17.7%	2179	583	17.4%	3355	1079	28.8%	2094	55.9%	570	15.2%	3743
24 HRS	920		3377	904		5201	1500		2910		792		5201

**Traffic Turning Movement Counting Survey at Roundabout By Direction**  
**No.12: Sohar R/A**  
**Date: 7/1/96 Sunday**

Time	Muscat				Coast				
	Left Vehicles	Turns (%)	Through Vehicles	From Traffic (%)	Right Vehicles	Turns (%)	Through Vehicles	From Traffic (%)	Total Vehicles
06:00-07:00	5	2.9%	99	56.9%	70	40.2%	174	69.1%	349
07:00-08:00	81	24.5%	96	29.0%	154	46.5%	331	59.1%	695
08:00-09:00	2	0.7%	122	44.9%	148	54.4%	272	79.2%	1102
09:00-10:00	54	21.2%	77	30.2%	124	48.6%	255	64.3%	903
10:00-11:00	32	12.6%	98	38.7%	123	48.0%	253	55.7%	1000
11:00-12:00	18	7.3%	111	44.8%	119	48.0%	248	47.9%	941
12:00-13:00	8	5.0%	72	44.7%	81	50.3%	161	47.6%	926
13:00-14:00	50	27.0%	63	34.1%	72	38.9%	185	26.9%	583
14:00-15:00	34	15.2%	128	57.1%	62	27.7%	224	34.4%	587
15:00-16:00	31	14.0%	117	52.7%	74	33.3%	224	54.6%	458
16:00-17:00	34	12.1%	125	44.6%	121	43.2%	280	60.2%	645
17:00-18:00	11	4.5%	133	54.3%	101	41.2%	245	55.7%	763
Total	360	12.6%	1241	43.5%	1249	43.8%	2850	55.6%	8952
24 HRS	558		1922		1935		4415		15666

Time	Agr				Inland				
	Left Vehicles	Turns (%)	Through Vehicles	From Traffic (%)	Right Vehicles	Turns (%)	Through Vehicles	From Traffic (%)	Total Vehicles
06:00-07:00	4	3.4%	94	80.3%	19	16.2%	117	72.2%	144
07:00-08:00	268	65.7%	112	27.5%	28	6.9%	408	63.2%	242
08:00-09:00	360	76.9%	87	18.6%	21	4.5%	468	34.0%	200
09:00-10:00	473	77.3%	110	18.0%	29	4.7%	612	32.8%	189
10:00-11:00	442	80.8%	60	11.0%	45	8.2%	547	34.7%	222
11:00-12:00	438	81.0%	78	14.4%	25	4.6%	541	52.6%	266
12:00-13:00	333	64.9%	167	32.6%	13	2.5%	513	46.2%	212
13:00-14:00	256	63.3%	97	25.9%	22	5.9%	375	49.4%	172
14:00-15:00	173	60.5%	107	37.4%	6	2.1%	286	58.4%	137
15:00-16:00	136	38.4%	191	54.0%	27	7.6%	354	44.2%	113
16:00-17:00	337	63.3%	172	32.3%	23	4.3%	532	41.8%	134
17:00-18:00	413	70.2%	141	24.0%	34	5.8%	588	41.3%	184
Total	3633	68.0%	1416	26.5%	292	5.5%	5341	47.4%	2215
24 HRS	5667		2209		456		8332		3699

Traffic Turning Movement Counting Survey at Roundabout By Direction  
 No.14: Falaj Al Qabail R/A  
 Date: 6/1/96 Saturday

Time	From Muscat				From Coast					
	Left Vehicles	Turns (%)	Through Vehicles	Traffic (%)	Right Vehicles	Turns (%)	Through Vehicles	Traffic (%)	Total Vehicles	Total (%)
06:00-07:00	126	48.3%	131	50.2%	4	1.5%	261	100.0%	261	100.0%
07:00-08:00	46	14.2%	257	79.6%	20	6.2%	323	100.0%	323	100.0%
08:00-09:00	84	28.3%	200	67.3%	13	4.4%	297	100.0%	297	100.0%
09:00-10:00	87	29.7%	196	66.9%	10	3.4%	293	100.0%	293	100.0%
10:00-11:00	118	32.7%	229	63.4%	14	3.9%	361	100.0%	361	100.0%
11:00-12:00	102	28.2%	244	67.4%	16	4.4%	362	100.0%	362	100.0%
12:00-13:00	101	27.3%	258	69.7%	11	3.0%	370	100.0%	370	100.0%
13:00-14:00	69	21.6%	245	76.6%	6	1.9%	320	100.0%	320	100.0%
14:00-15:00	122	36.9%	205	61.9%	4	1.2%	331	100.0%	331	100.0%
15:00-16:00	90	38.1%	126	53.4%	20	8.5%	236	100.0%	236	100.0%
16:00-17:00	89	32.2%	174	63.0%	13	4.7%	276	100.0%	276	100.0%
17:00-18:00	108	33.5%	206	64.0%	8	2.5%	322	100.0%	322	100.0%
Total	1142	30.4%	2471	65.9%	139	3.7%	3752	100.0%	3752	100.0%
24 HRS	1777		3844		216		5837		5837	

Time	From Agr				From Inland					
	Left Vehicles	Turns (%)	Through Vehicles	Traffic (%)	Right Vehicles	Turns (%)	Through Vehicles	Traffic (%)	Total Vehicles	Total (%)
06:00-07:00	14	9.2%	94	61.4%	45	29.4%	153	100.0%	153	100.0%
07:00-08:00	49	21.6%	156	68.7%	22	9.7%	227	100.0%	227	100.0%
08:00-09:00	21	7.7%	230	84.2%	22	8.1%	273	100.0%	273	100.0%
09:00-10:00	61	23.0%	184	69.4%	20	7.5%	265	100.0%	265	100.0%
10:00-11:00	22	8.5%	208	80.3%	29	11.2%	259	100.0%	259	100.0%
11:00-12:00	34	12.7%	210	78.7%	23	8.6%	267	100.0%	267	100.0%
12:00-13:00	44	18.8%	175	74.8%	15	6.4%	234	100.0%	234	100.0%
13:00-14:00	75	41.7%	56	31.1%	49	27.2%	180	100.0%	180	100.0%
14:00-15:00	3	1.6%	157	81.8%	32	16.7%	192	100.0%	192	100.0%
15:00-16:00	28	10.4%	222	82.5%	19	7.1%	269	100.0%	269	100.0%
16:00-17:00	27	9.1%	253	84.9%	18	6.0%	298	100.0%	298	100.0%
17:00-18:00	46	16.4%	203	72.2%	32	11.4%	281	100.0%	281	100.0%
Total	424	14.6%	2148	74.1%	326	11.2%	2898	100.0%	2898	100.0%
24 HRS	670		3393		515		4578		4578	

**Traffic Turning Movement Counting Survey at Roundabout By Direction**  
**No.18: Aqr R/A**  
**Date: 6/1/96 Saturday**

Time	Miscat				From				Coast				
	Left Vehicles	Turns (%)	Through Vehicles	Right Vehicles	From Traffic (%)	Through Vehicles	Turns (%)	Right Vehicles	From Traffic (%)	Through Vehicles	Turns (%)	Right Vehicles	Total Vehicles
06:00-07:00	137	61.0%	83	5	37.0%	5	2.0%	223	27.0%	4	54.0%	15	100.0%
07:00-08:00	100	60.0%	63	3	38.0%	3	2.0%	167	27.6%	2	52.4%	8	100.0%
08:00-09:00	89	65.3%	45	3	32.7%	3	2.0%	136	27.3%	2	53.2%	4	100.0%
09:00-10:00	71	65.7%	34	3	31.4%	3	2.9%	108	27.4%	5	54.7%	19	100.0%
10:00-11:00	97	66.7%	43	6	29.4%	6	3.9%	145	25.2%	2	56.3%	7	100.0%
11:00-12:00	83	62.0%	48	2	36.2%	2	1.7%	134	27.9%	4	53.2%	16	100.0%
12:00-13:00	86	61.1%	49	6	34.7%	6	4.2%	141	25.9%	3	55.2%	14	100.0%
13:00-14:00	80	64.3%	42	2	33.9%	2	1.7%	125	33.3%	1	55.2%	11	100.0%
14:00-15:00	95	63.3%	49	6	32.5%	6	4.2%	151	33.3%	2	66.7%	7	100.0%
15:00-16:00	98	63.6%	54	2	34.9%	2	1.6%	155	9.1%	1	81.8%	13	100.0%
16:00-17:00	107	61.9%	56	10	32.4%	10	5.8%	172	17.6%	21	76.5%	28	100.0%
17:00-18:00	117	62.7%	63	7	33.6%	7	3.7%	187	23.9%	35	61.6%	146	100.0%
Total	1161	62.9%	629	35	34.1%	35	3.0%	1846	37	57	146	237	
24 HRS	1846		1000	88				2934					

Time	Malahah				From				Inland				
	Left Vehicles	Turns (%)	Through Vehicles	Right Vehicles	From Traffic (%)	Through Vehicles	Turns (%)	Right Vehicles	From Traffic (%)	Through Vehicles	Turns (%)	Right Vehicles	Total Vehicles
06:00-07:00	7	7.0%	69	27	67.0%	27	26.0%	103	1.1%	0	36	41	100.0%
07:00-08:00	6	7.9%	50	21	65.3%	21	26.7%	77	3.2%	2	56	66	100.0%
08:00-09:00	6	7.5%	55	22	60.2%	22	26.4%	84	2.2%	1	57	66	100.0%
09:00-10:00	6	8.6%	50	15	70.6%	15	20.9%	70	2.0%	2	63	79	100.0%
10:00-11:00	6	8.1%	59	8	80.6%	8	11.3%	74	4.6%	6	99	123	100.0%
11:00-12:00	8	9.0%	74	10	79.8%	10	11.2%	93	2.2%	4	120	133	100.0%
12:00-13:00	7	8.6%	61	19	70.1%	19	21.4%	88	5.3%	7	101	106	100.0%
13:00-14:00	8	8.3%	66	22	68.8%	22	22.9%	96	2.3%	3	122	130	100.0%
14:00-15:00	7	8.0%	61	20	69.0%	20	23.0%	88	4.2%	5	90	121	100.0%
15:00-16:00	9	10.3%	62	12	74.7%	12	14.9%	82	2.4%	4	140	146	100.0%
16:00-17:00	14	9.3%	114	23	75.6%	23	15.1%	151	6.6%	11	132	171	100.0%
17:00-18:00	9	9.8%	67	13	75.1%	13	15.0%	89	4.4%	5	90	119	100.0%
Total	94	8.6%	789	212	72.0%	212	19.4%	1095	3.7%	51	1115	1402	100.0%
24 HRS	149		1253	337				1739		80	1734	2179	

**SUMMARY OF PEDESTRIAN COUNT AT BATINAH HIGHWAY**

Location	Direction	Adults - A	Children - C	Student - S	Total
P -1	1	1025	36	0	1061
	2	1274	38	230	1542
P -2	1	253	17	86	356
	2	283	14	119	416
P -3	1	1134	28	30	1192
	2	1061	34	58	1153
P -4	1	186	12	22	220
	2	203	30	6	239
P -5	1	501	25	27	553
	2	458	16	41	515
P -6	1	707	21	172	900
	2	749	25	400	1174
P -7	1	298	26	216	540
	2	321	30	219	570
P -8	1	204	7	64	275
	2	183	37	98	318
P -9	1	210	66	100	376
	2	191	52	145	388
P -10	1	105	0	142	247
	2	95	2	87	184
P -11	1	306	28	7	341
	2	165	8	17	190
P -12	1	231	5	25	261
	2	218	58	40	316
Total		10361	615	2351	13327

**SUMMARY OF TRAFFIC COUNT AT BATINAH HIGHWAY**

	Direction	Passenger Cars	Pick-ups & Light Trucks	Medium Trucks	Heavy Trucks	Buses	Total
P-1	To Aqr	3760	1421	78	86	7	5352
	To Muscat	3907	1860	58	99	13	5937
P-2	To Aqr	3370	689	348	199	44	4650
	To Muscat	2984	642	296	219	59	4200
P-3	To Aqr	3959	1368	96	121	64	5608
	To Muscat	3370	385	93	100	34	3982
P-4	To Aqr	3298	755	435	212	13	4713
	To Muscat	2955	758	456	203	39	4411
P-5	To Aqr	3528	1599	80	127	82	5416
	To Muscat	2762	1194	70	116	89	4231
P-6	To Aqr	3286	1035	120	102	9	4552
	To Muscat	2309	910	243	194	7	3663
P-7	To Aqr	2659	1105	116	113	9	4002
	To Muscat	1910	874	236	199	8	3227
P-8	To Aqr	2233	1030	217	142	73	3695
	To Muscat	1964	992	178	110	48	3292
P-9	To Aqr	2248	1147	194	127	33	3749
	To Muscat	2597	1294	207	130	21	4249
P-10	To Aqr	3057	1266	204	129	19	4675
	To Muscat	2606	1106	150	134	30	4026
P-11	To Aqr	1368	696	114	83	12	2273
	To Muscat	1609	515	69	108	7	2308
P-12	To Aqr	1243	746	116	81	5	2191
	To Muscat	1248	586	73	105	4	2016
Total		64230	23973	4247	3239	729	96418



**APPENDIX II**  
**TOPOGRAPHIC SURVEY**  
**AND DATA**





## **Appendices II TOPOGRAPHIC SURVEY**

### **II.1 Purpose of Topographic Survey**

#### **II.1.1 Purpose of Topographic Survey**

The most accurate information on present topography of the study area will be grasped in the stage of detailed design work.

The best way that the topographic survey should be carried out is by subcontracting to a local topographic survey company in order to obtain accurate and sufficient topographical information within the limited time schedule.

Therefore in this detailed design work, the topographic survey was executed with cooperation from Nortech surveys (Canada) Inc., which has done excellent work in Oman.

#### **II.1.2 Scope of Work**

The surveying works for this detailed design study of eight flyovers and twelve pedestrian underpasses is comprised of the following:

##### **(1) Topographic Survey for flyovers**

- (a) Setting control points
- (b) Traversing of control points
- (c) Topographic plane survey
- (d) Plotting and drawings

##### **(2) Topographic Survey for Pedestrian Underpasses**

- (a) Setting control points
- (b) Traversing of control points
- (c) Topographic plane survey
- (d) Plotting and drawings

### **II.2 Topographic Survey Method**

#### **II.2.1 Survey Method**

Topographic surveys are carried out at the study eight roundabout and twelve pedestrian underpass locations. The works implemented include plane surveying, setting and traversing of survey control points. The survey also performed the setting up of center points of pedestrian underpass locations in the highway median.

The method of the plane surveying and traversing was the Universal Transverse Method (UTM) using the total station equipment according to the Zone 40, CM 57, Spheroid, WGS84 Datum. The UTM WGS84 grid is adopted by the National Survey Authority.

The accuracy of topographic survey is as follows:

- Measurement distance    1/2,000
- Leveling                    2 cm  $\sqrt{S}$   
(S means survey single distance km)

## **II. 2.2 Survey Equipment**

Four Leica Dual Frequency GPS Receivers were used to collect Static and Rapid Static GPS Data. These are dual frequency receivers that track up to nine satellites simultaneously and receive the L1 (1,575.42 MHz) and L2 (1,227.6 MHz) signals emitted from the Global Positioning System (GPS) Navster satellites. The L1 band is tracked by reconstructing the carrier phase via the C/A code, while the L2 band is tracked by reconstructing the carrier phase via the P code. During encryption of the P code the L2 carrier automatically switches to a squaring technique.

Conventional traversing and detailing data was acquired using Geodimeter 400/500 series Total Stations. These are one second instruments with an internal memory. A Wild NAK2 Automatic Level was used to transfer the elevations. A Radiodetection RD 400 PXL locator was used to trace the underground services.

## **II. 2.3 Survey Works Log**

The field work was carried out between 5th January, 1996 and 17th March, 1996. The CAD works were carried out between 28th January, 1996 and 25 March, 1996.

## **II. 2.4 Survey Datum**

The surveys were carried out on the WGS84 Ellipsoid (Mapping Plane UTM Zone 40, CM 57) based on the National Survey Authority (NSA) primary network.

## **II.3 Results of Topographic Survey**

### **II.3.1 Survey Control Points**

#### **(1) Installation of Survey Control Points**

Four main control points were carried out at each roundabout (R/A) location with two main control points at each pedestrian underpass (P/U) location for a total of fifty-six new stations (968-01 to 968-56) which were allocated numbers but not established in the field.

The points were constructed of either pipe in concrete or a Hilti Nail into an existing concrete base. The station names are sequential from 968-01 to 968-56 (exempting 968-09 and 968-10). The station name is either inscribed in the concrete or stamped on an aluminum plate attached to the concrete base.

#### **(2) Coordinates of the Survey Control Points**

The survey control was established in a series of networks using both GPS and conventional techniques. There are three types of network, Primary, Secondary and Tertiary. Twelve Primary control were established by static GPS observations in closed traverses connecting NSA Primary Control. The secondary points were established using Rapid Static GPS techniques from the Primary stations. Both the Primary and Secondary networks were adjusted by the GEOLAB Least Squares Adjustment software package, holding fixed in three dimensions the NSA Primary control coordinates.

The Tertiary network was established using conventional methods and were adjusted using the Bowditch method. The Tertiary points were used for the topographic/detail surveys and were therefore of a temporary construction.

The survey control points of the eight study roundabout and of the twelve pedestrian underpass locations are given in Table III. 1 and Table III. 2 respectively.

Detail coordinates of these survey control points are given in Table III. 3.

**Table II.1 List of Topographic Survey Control Points at the 8 Study Roundabouts Locations**

Name of Roundabout	Survey Control Points			
R/A- 2 : A'Naseem Garden	968-01	968-02	968-03	968-04
R/A- 3 : Barka	968-05	968-06	968-07	968-08
Junc- 5 : Al Muladdah	968-15	968-16	968-17	968-18
R/A- 8 : Al Khaburah	968-29	968-30	968-31	968-32
R/A- 10 : Saham	968-33	968-34	968-35	968-36
R/A- 12 : Sohar	968-41	968-42	968-43	968-44
R/A- 14 : Falaj Al Qabail	968-45	968-46	968-47	968-48
R/A- 18 : Al Aqr	968-53	968-54	968-55	968-56
Total	32 numbers			

**Table II.2 List of Topographic Survey Control Points at the 12 Study Pedestrian Underpasses Locations**

Name of Pedestrian Underpass	Survey Control Points	
P/U- 1 : Barka	968-05	968-06
P/U- 2 : Al Billah	968-11	968-12
P/U- 3 : A' Tareef	968-13	968-14
P/U- 4 : Al Qarat	968-19	968-20
P/U- 5 : A' Thamad	968-21	968-22
P/U- 6 : A' Suweiq	968-25	968-26
P/U- 7 : Al Khadra	968-23	968-24
P/U- 8 : Qarih	968-27	968-28
P/U- 9 : Majaz A' Sughra	968-37	968-38
P/U- 10 : Khor A' Siyabi	968-39	968-40
P/U- 11 : Liwa	968-49	968-50
P/U- 12 : Asrar Bani Sa'd	968-51	968-52
Total	24 numbers	

Table II. 3 Detail Coordination of Survey Control Points at the 8 Study Roundabouts and 12 Pedestrian Underpass Locations

Control Point	Latitude			Longitude			Ellipsoidal Height	Northing	Easting	Orthometric Height (MSL)	OSU91A Geoid Height	Remarks		
	N	E	U	E	S	D								
968-01	N	23	41	28.30692	E	58	2	32.88246	-17.609	2,620,456.905	606,285.945	9.296	-26.905	R/A- 2 : A' Naseem Garden
968-02	N	23	41	24.40660	E	58	2	8.17405	-18.030	2,620,301.846	605,586.993	8.826	-26.856	R/A- 2 : A' Naseem Garden
968-03	N	23	41	16.01132	E	58	1	42.70336	-17.413	2,620,018.420	604,867.452	9.390	-26.803	R/A- 2 : A' Naseem Garden
968-04	N	23	41	7.43699	E	58	1	21.27685	-15.972	2,619,770.343	604,262.446	10.780	-26.752	R/A- 2 : A' Naseem Garden
968-05	N	23	39	55.53773	E	57	53	40.83586	-12.445	2,617,471.409	591,234.763	13.479	-25.924	R/A- 3 & P.U- 1 Barka
968-06	N	23	40	0.58649	E	57	53	14.76943	-12.519	2,617,622.074	590,495.388	13.375	-25.894	R/A- 3 & P.U- 1 Barka
968-07	N	23	40	4.11186	E	57	52	44.22971	-11.086	2,617,725.144	589,629.603	14.761	-25.853	R/A- 3 & P.U- 1 Barka
968-08	N	23	40	10.07305	E	57	52	26.12002	-11.355	2,617,905.330	589,115.480	14.480	-25.835	R/A- 3 & P.U- 1 Barka
968-11	N	23	42	45.01111	E	57	45	8.05206	-15.431	2,622,599.663	576,681.314	10.027	-25.458	P.U- 2 : Al Billah P.U-2
968-12	N	23	42	46.21448	E	57	45	2.43714	-14.732	2,622,635.833	576,522.120	10.721	-25.453	P.U- 2 : Al Billah P.U-2
968-13	N	23	44	41.11920	E	57	37	22.03475	-15.409	2,626,106.722	563,469.538	9.699	-25.108	P.U- 3 : A' Tarcef P.U-3
968-14	N	23	44	42.07995	E	57	37	18.37593	-14.762	2,626,135.866	563,365.829	10.343	-25.105	P.U- 3 : A' Tarcef P.U-3
968-15	N	23	45	21.91949	E	57	35	15.62284	-17.966	2,627,346.321	559,885.684	7.168	-25.134	Junc- 5 : Al Muladdah
968-16	N	23	45	21.90202	E	57	34	59.06812	-18.301	2,627,343.855	559,417.071	6.816	-25.117	Junc- 5 : Al Muladdah
968-17	N	23	45	14.13618	E	57	34	28.69193	-19.564	2,627,101.525	558,558.175	5.511	-25.075	Junc- 5 : Al Muladdah
968-18	N	23	45	11.79389	E	57	34	8.13177	-19.649	2,627,027.151	557,976.457	5.433	-25.051	Junc- 5 : Al Muladdah
968-19	N	23	46	41.75214	E	57	31	55.20571	-18.516	2,629,779.149	554,203.291	6.545	-25.061	P.U- 4 : Al Qarat
968-20	N	23	46	39.48414	E	57	31	51.71449	-17.613	2,629,709.030	554,104.742	7.439	-25.052	P.U- 4 : Al Qarat
968-21	N	23	47	9.36177	E	57	31	11.54370	-18.110	2,630,623.678	552,964.458	6.952	-25.062	P.U- 5 : A' Tharmad
968-22	N	23	47	16.85289	E	57	31	4.36816	-17.953	2,630,853.317	552,760.547	7.115	-25.068	P.U- 5 : A' Tharmad
968-23	N	23	51	38.84821	E	57	19	11.27841	-18.154	2,638,851.083	532,562.165	6.802	-24.956	P.U- 7 : Al Khadra
968-24	N	23	51	28.13883	E	57	19	12.28055	-16.478	2,638,521.795	532,591.253	8.457	-24.935	P.U- 7 : Al Khadra
968-25	N	23	49	28.06390	E	57	25	24.37499	-12.921	2,634,856.655	543,126.766	12.127	-25.048	P.U- 6 : A' Suweiq
968-26	N	23	49	34.07484	E	57	25	5.44223	-11.959	2,635,039.925	542,590.580	13.082	-25.041	P.U- 6 : A' Suweiq
968-27	N	23	53	52.87279	E	57	14	7.16767	-16.216	2,642,955.961	523,933.962	8.785	-25.001	P.U- 8 : Qarh
968-28	N	23	53	58.35600	E	57	13	47.07037	-17.130	2,643,123.655	523,385.428	7.867	-24.997	P.U- 8 : Qarh
968-29	N	23	57	47.83355	E	57	5	51.94340	-17.941	2,650,165.365	509,946.306	7.214	-25.155	R/A- 8 : Al Khaburah
968-30	N	23	58	9.80951	E	57	5	33.96763	-16.901	2,650,840.866	509,437.846	8.295	-25.196	R/A- 8 : Al Khaburah
968-31	N	23	58	23.03867	E	57	5	20.82846	-17.456	2,651,247.473	509,066.279	7.764	-25.220	R/A- 8 : Al Khaburah
968-32	N	23	58	35.38164	E	57	5	14.21590	-18.241	2,651,626.949	508,879.180	7.006	-25.247	R/A- 8 : Al Khaburah
968-33	N	24	8	5.69005	E	56	53	10.30826	-13.496	2,669,168.212	488,437.042	13.150	-26.646	R/A- 10 : Saham
968-34	N	24	8	16.60220	E	56	52	53.79391	-11.623	2,669,504.195	487,971.232	15.059	-26.673	R/A- 10 : Saham
968-35	N	24	8	37.57029	E	56	52	30.37232	-11.952	2,670,149.632	487,310.781	14.775	-26.727	R/A- 10 : Saham
968-36	N	24	8	46.07851	E	56	52	23.47291	-12.564	2,670,411.473	487,116.305	14.184	-26.748	R/A- 10 : Saham
968-37	N	24	13	30.55310	E	56	49	58.18329	-18.832	2,679,402.319	482,818.549	9.261	-27.523	P.U- 9 : Majaz A' Sughra
968-38	N	24	13	38.27097	E	56	49	50.79908	-18.262	2,679,402.319	482,818.549	9.261	-27.523	P.U- 9 : Majaz A' Sughra
968-39	N	24	17	39.89324	E	56	46	47.55209	-13.032	2,686,840.634	477,662.102	15.172	-28.704	P.U- 10 : Khor A' Siyabi
968-40	N	24	17	53.41069	E	56	46	38.12656	-15.395	2,687,256.789	477,397.075	12.839	-28.234	P.U- 10 : Khor A' Siyabi
968-041	N	24	20	7.57056	E	56	44	15.43227	-13.644	2,691,389.943	473,382.623	14.872	-28.516	R/A- 12 : Sohar
968-042	N	24	20	21.39312	E	56	44	6.29660	-14.595	2,691,815.538	473,125.993	13.949	-28.544	R/A- 12 : Sohar
968-043	N	24	20	38.01955	E	56	43	24.25030	-14.603	2,692,329.199	471,942.200	13.955	-28.588	R/A- 12 : Sohar
968-044	N	24	20	42.72275	E	56	43	10.28595	-14.618	2,692,474.631	471,549.068	13.983	-28.601	R/A- 12 : Sohar
968-045	N	24	25	12.51255	E	56	37	16.20134	-7.107	2,700,795.917	461,594.434	22.073	-29.180	R/A- 14 : Falaj Al Qabail
968-046	N	24	25	17.73832	E	56	36	58.44281	-6.737	2,700,958.017	461,094.781	22.458	-29.195	R/A- 14 : Falaj Al Qabail
968-047	N	24	25	39.54442	E	56	36	32.98713	-3.519	2,701,630.690	460,379.823	25.717	-29.236	R/A- 14 : Falaj Al Qabail
968-048	N	24	25	49.81055	E	56	36	27.76940	-1.504	2,701,946.851	460,233.789	27.747	-29.251	R/A- 14 : Falaj Al Qabail
968-049	N	24	31	29.79739	E	56	33	36.50609	-15.748	2,712,418.105	455,444.484	13.824	-29.572	P.U- 11 : Liwa
968-050	N	24	31	8.84458	E	56	33	39.26759	-13.316	2,711,773.421	455,520.137	16.241	-29.557	P.U- 11 : Liwa
968-051	N	24	34	30.43980	E	56	32	42.40449	-17.530	2,717,979.001	453,943.040	12.160	-29.690	P.U- 12 : Asrar Bani Sa'd
968-052	N	24	34	48.95406	E	56	32	17.79553	-17.791	2,718,550.752	453,250.249	11.918	-29.709	P.U- 12 : Asrar Bani Sa'd
968-053	N	24	48	12.67731	E	56	26	23.66721	-17.832	2,743,308.322	443,391.093	11.799	-29.631	R/A- 18 : Al Aqr
968-054	N	24	47	54.29040	E	56	26	33.62893	-17.917	2,742,741.632	443,668.473	11.716	-29.633	R/A- 18 : Al Aqr
968-055	N	24	48	37.40465	E	56	26	13.14476	-17.604	2,744,070.103	443,098.814	12.022	-29.626	R/A- 18 : Al Aqr
968-056	N	24	48	56.70746	E	56	26	7.31687	-18.394	2,744,664.497	442,937.650	11.225	-29.619	R/A- 18 : Al Aqr
NSA1001	N	24	17	40.23200	E	56	31	53.63000	252.370	2,686,913.350	452,463.563	280.789	-28.419	National Survey Authority
NSA1006	N	23	45	27.17900	E	57	34	31.31800	-20.290	2,627,502.943	558,630.890	4.806	-25.096	National Survey Authority
NSA1009	N	23	35	0.88800	E	58	17	42.32100	-11.730	2,608,721.920	632,153.001	16.218	-27.948	National Survey Authority

Note: Final control coordinates, WGS84 datum, Zone 40 UTM, CM 57 OSU91A geoid height obtained by using geolab's geoid manager

### **II.3.2 GPS and Conventional Observations**

Static and Rapid Static GPS observations were recorded at an epoch interval of fifteen seconds for a minimum of one hour and twenty minutes respectively. NAS stations 1001, 1006 and 1009 were used to control the GPS networks.

The area to be surveyed at each location was 2.1 km x 0.3 km (R/A) and 0.3 km x 0.1 km (P/U). The limits applied to the areas were either the specified distance or building frontage, which ever came first. Additional modifications were also carried out at the request of the study team. Topographic detail and underground services (where possible) were detailed with conventional observations. Plans obtained from the government of Oman, existing surface markers and the Radiodetection instrument were used to trace the underground services. Not all buried features could be traced, including some telephone cables and plastic pipes.

The Sohar and Muladdah R/As were under construction at the time of survey allowing only limited information to be collected. At Muladdah, the limited information was supplemented with the design data as supplied by the Directorate General of Roads and incorporated into the drawings.

### **II.3.3 Elevations**

Elevations were established by double run spirit leveling from one primary or secondary station selected as a starting benchmark. This provides a more accurate relative fit than is obtainable from the OSU91A geoid model.

### **II.3.4 Center Points Location of Pedestrian Underpasses**

Upon delivery of the draft plots, the survey control points were supplied with the center point coordinates of each pedestrian underpass. These were then set out by the survey's consultant to the supplied coordinates and approved for position by the Directorate General of Roads. The center point coordinates are annotated on the relevant P/U drawings.

Detail coordinates of these center points are given in Table III. 4.

**Table II.4 Detail Coordinates for Center points of the 12 Pedestrian Underpasses**

Center Point	Northing	Easting	Orthometric Height (MSL)	Remarks
CP-01	2,617,547.88	590,648.66	14.040	P/U- 1 : Barka
CP-02	2,622,581.69	576,591.44	10.629	P/U- 2 : Al Billah
CP-03	2,626,055.30	563,477.21	10.839	P/U- 3 : A'Tarcef
CP-04	2,629,758.40	554,141.36	8.855	P/U- 4 : Al Qarat
CP-05	2,630,737.88	552,898.88	6.550	P/U- 5 : A'Tharnad
CP-06	2,634,962.12	542,766.61	11.353	P/U- 6 : A' Suweiq
CP-07	2,638,907.89	532,613.52	7.078	P/U- 7 : Al Khadra
CP-08	2,643,043.51	523,511.49	9.020	P/U- 8 : Qarih
CP-09	2,679,075.30	483,137.68	8.503	P/U- 9 : Majaz A' Sughra
CP-10	2,686,836.02	477,709.27	14.376	P/U- 10 : Khor A' Siyabi
CP-11	2,712,031.66	455,442.03	15.105	P/U- 11 : Liwa
CP-12	2,718,344.15	453,449.83	12.995	P/U- 12 : Asrar Bani Sa'd

Note: Final control coordinates, WGS84 datum, Zone 40 UTM, CM 57  
OSU91A geoid height obtained by using goolab's geoid manager

### II.3.5 Performed Area of Topographic Plane Survey

Topographic plane survey was carried out at the eight roundabout and twelve pedestrian underpass locations.

The survey areas at eight roundabout locations and their respective chainage are given in Table III. 5, while those for 12 pedestrian underpass locations are given Table III. 6.



**Table II. 5 Quantities of Topographic Survey Area at the 8 Study Roundabouts Locations**

Name of roundabout	Survey area (sq. km)	Chainage (Approximately)
R/A- 2 : A' Naseem Garden	0.59950	5.+090
R/A- 3 : Barka	0.59540	20.+850
Junc- 5 : Al Muladdah	0.62425	54.+156
R/A- 8 : Al Khaburah	0.60125	110.+016
R/A- 10 : Saham	0.60675	139.+516
R/A- 12 : Sohar	0.59500	166.+968
R/A- 14 : Falaj Al Qabail	0.62400	183.+316
R/A- 18 : Al Aqr	0.87330	231.+316
<b>Total survey area (sq. km)</b>	<b>5.11945</b>	

**Table II. 6 Quantities of Topographic Survey Area at the 12 Study Pedestrian Underpasses Locations**

Name of pedestrian underpass	Survey area (sq. km)	Chainage (Approximately)
P/U- 1 : Barka	0.03000	20+317
P/U- 2 : Al Billah	0.03000	35+416
P/U- 3 : A' Tareef	0.03000	49+200
P/U- 4 : Al Qarat	0.03000	59+716
P/U- 5 : A' Tharnad	0.03000	61+216
P/U- 6 : A' Suweiq	0.03000	72+316
P/U- 7 : Al Khadra	0.03000	82+616
P/U- 8 : Qarih	0.03000	92+416
P/U- 9 : Majaz A' Sughra	0.03000	150+066
P/U- 10 : Khor A' Siyabi	0.03000	159+616
P/U- 11 : Liwa	0.03000	195+766
P/U- 12 : Asrar Bani Sa'd	0.03000	202+866
<b>Total survey area (sq. km)</b>	<b>0.36000</b>	

## **II. 4 Consideration of Detailed Design**

### **II. 4.1 GPS Baseline Processing**

The GPS data was processed using Leica's SKI software in conjunction with the broadcast ephemeris. The SKI software is a multi-baseline processing package which provides the best coronet solution by processing differential code and phase measurements simultaneously. SKI uses the Fast Ambiguity Resolution Approach (FARA), based on a sequential algorithm which utilizes carrier and code observation to determine the inter station vector for the baselines.

The baseline processing provided a fixed solution (ambiguities resolved) for all baseline below twenty kilometers in length. For baselines above twenty kilometers the software provides a float solution (ambiguities unresolved) as is normal for these distances.

### **II. 4.2 Network Adjustment**

All least squares adjustments were calculated on the WGS84 ellipsoid using the GEOLAB (version 2.4d) software package. The first stage was a minimally constrained adjustment to determine the internal strength of the network observations. The second stage was a fully constrained adjustment holding all given NSA control to their published values. Five baseline only achieved Canadian Forth Order Specification, this is due to the very short distance (less than five hundred meters) between them, the majority of the error is in the elevation which was remedied by spirit leveling all stations at any one location. All the remaining baselines meet Canadian Third Order Specifications.

### **II. 4.3 Conventional Processing**

The conventional data from the Geodimeter was processed using the Bowditch Adjustment for the Traversing and the survey consultant's in-house software for the topographic/detail survey. All conventional traverse accuracy's met 1:20,000.

#### **II. 4.4 Undulation and MSL Calculation**

The Geoid model OSU91A was used to calculate an undulation value for all the Primary and Secondary stations. This was applied to the WGS84 ellipsoid elevation to give an MSL value using the following formula:

$$H = h - N$$

where: **H** = derived orthometric height

**N** = Geoid undulation from OSU91A

**h** = ellipsoidal elevation

As noted in section 2.3.3 of main report, one station at each location was selected as a starting point for spirit leveling to the other stations. The starting elevation was taken from the above calculation and using the double run spirit leveling an elevations for the temporary stations.

#### **II. 4.5 CAD Processing**

The survey consultant's in house software 'DETAIL' was used to transfer the raw data into AutoCAD format. AutoCAD (Release 12) with the Third Party Application GWN - DTM for contouring was used to produce the drawings. Xerox A3 size plotting drafts were produced. HP750 Inkjet A1 final plots being A1 Mylar sheets at 1:500.

#### **II. 4.6 Plane Drawings**

Topographic plane drawings were submitted A1 and A3 sizes drawings by the survey consultant as the result of plane table topographic survey. Scale of the each drawing shows as follows:

- A1 size drawings

Roundabouts; scale = 1/500

Pedestrian underpass; scale = 1/500

- A3 size drawings

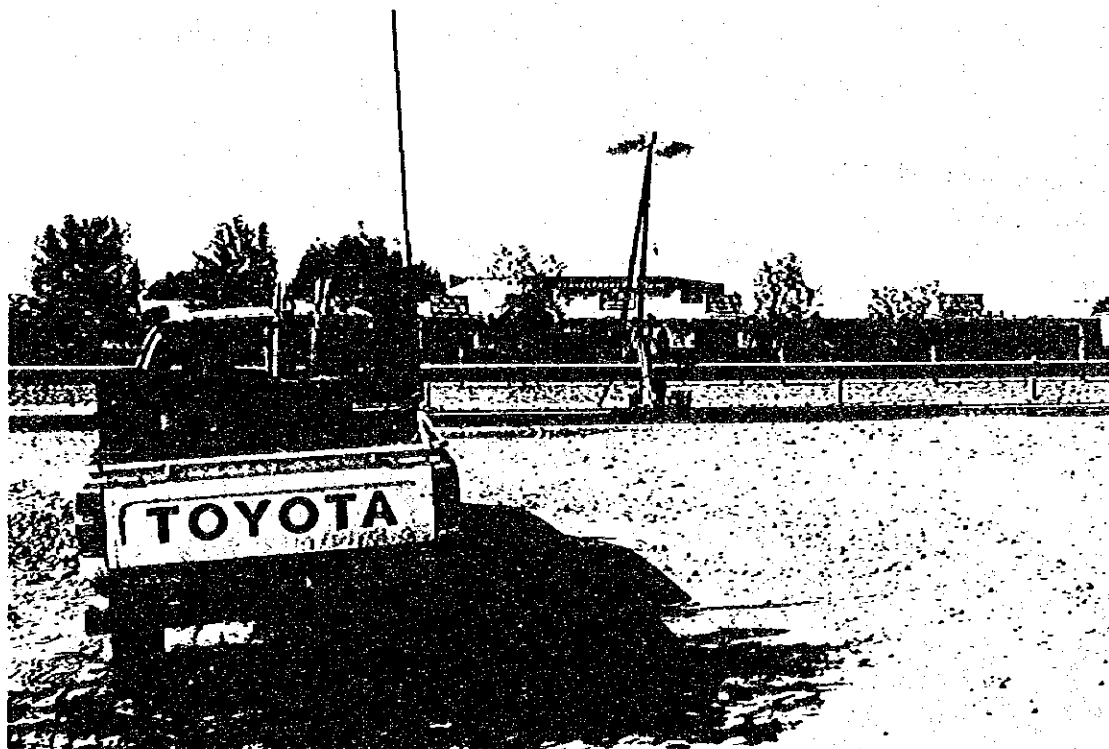
Roundabouts; scale = 1/1,000

Pedestrian underpass; scale = 1/1,000

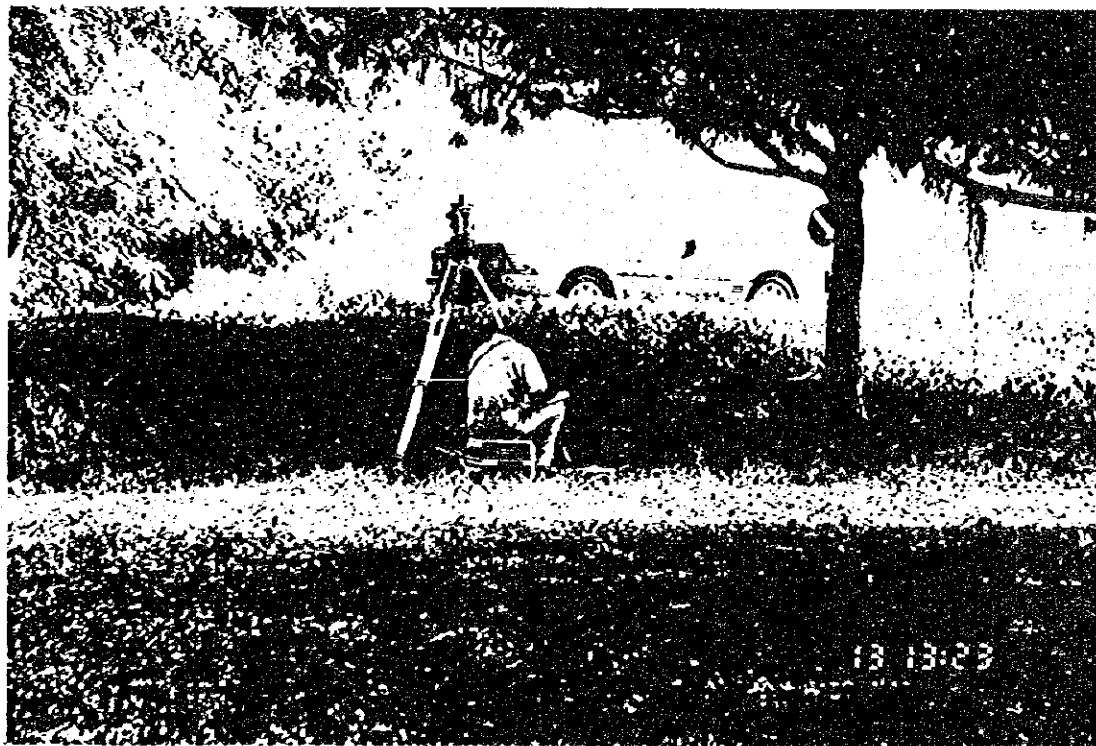
#### **II. 4.7 Digital Data of DXF File on the Plane Survey**

Digital data of DXF file on auto computer-aided design system were obtained from the survey consultant as being useful for geometric highway design.

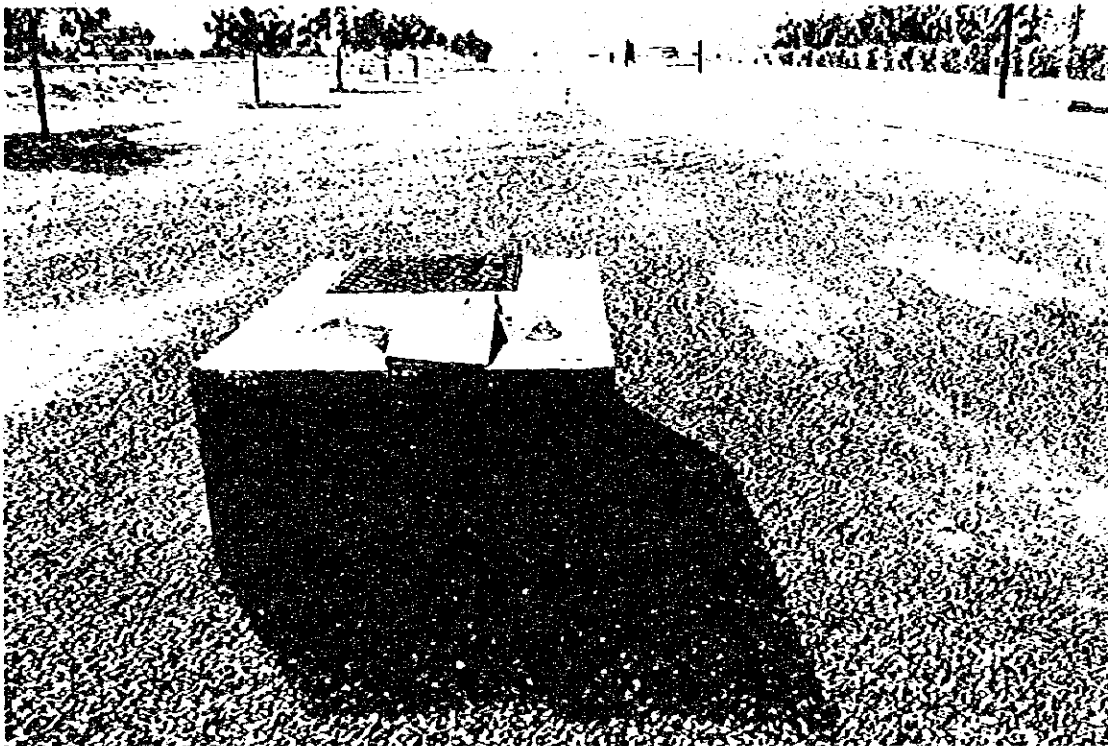
Appendix III.1 Photographs of Field Topographic Survey Works and  
Setting Condition of Survey Control Points



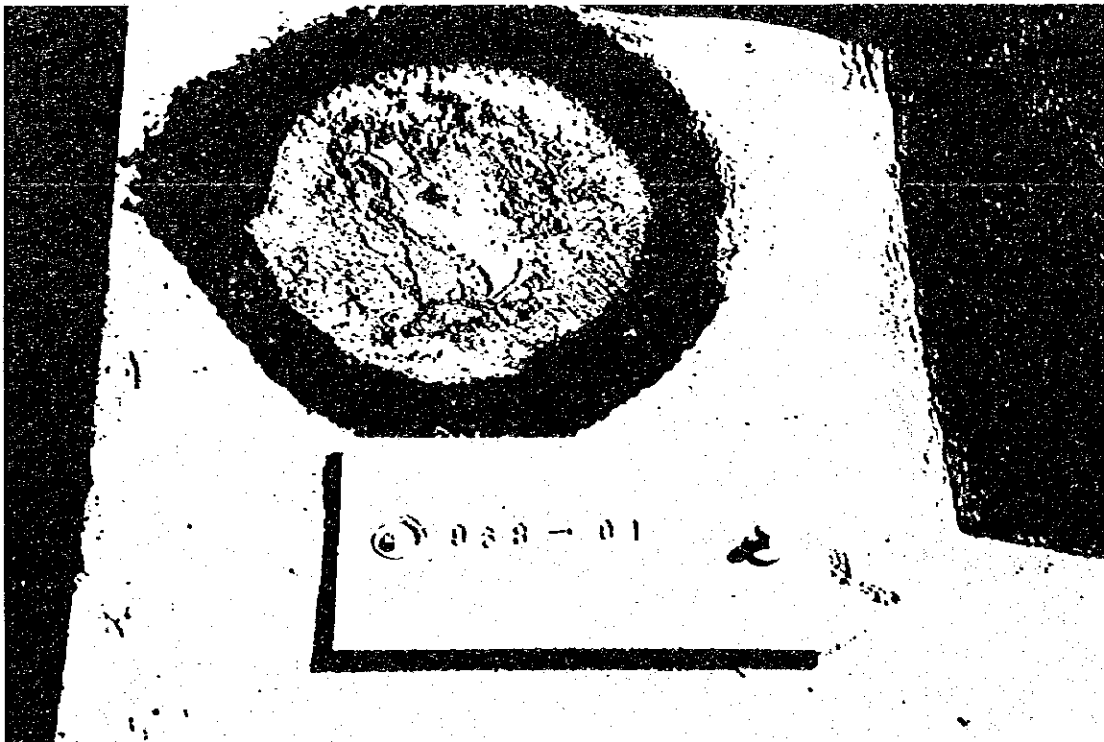
Field Topographic Survey Works at R/A-8, Al Kaburah



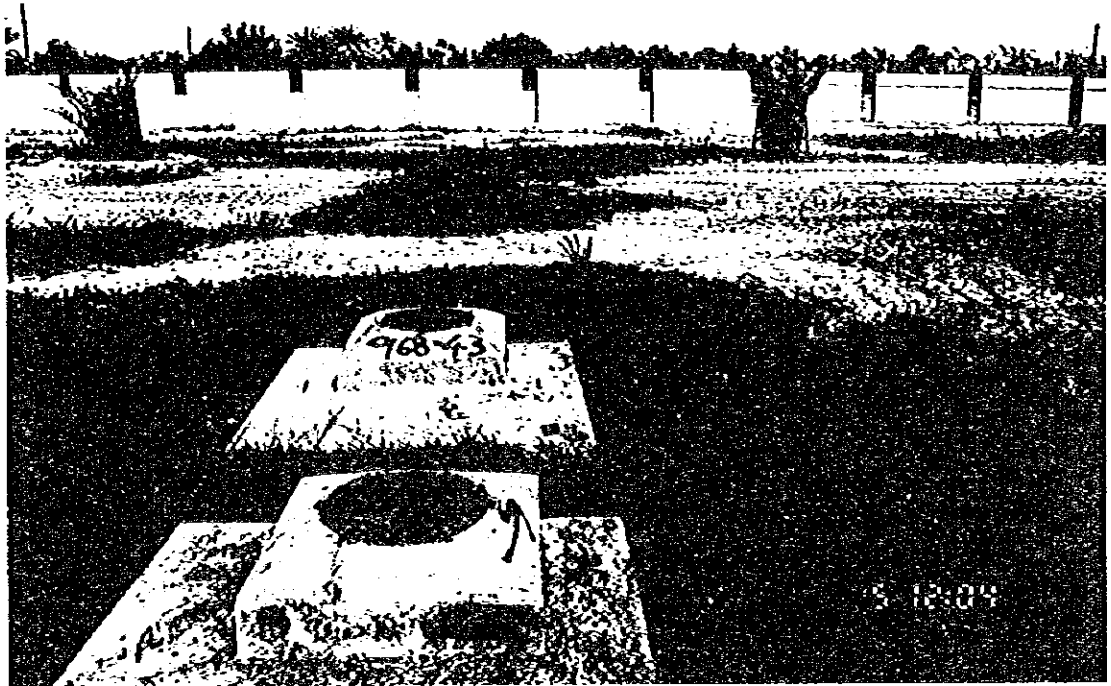
Field Topographic Survey Works at R/A-12, Sohar



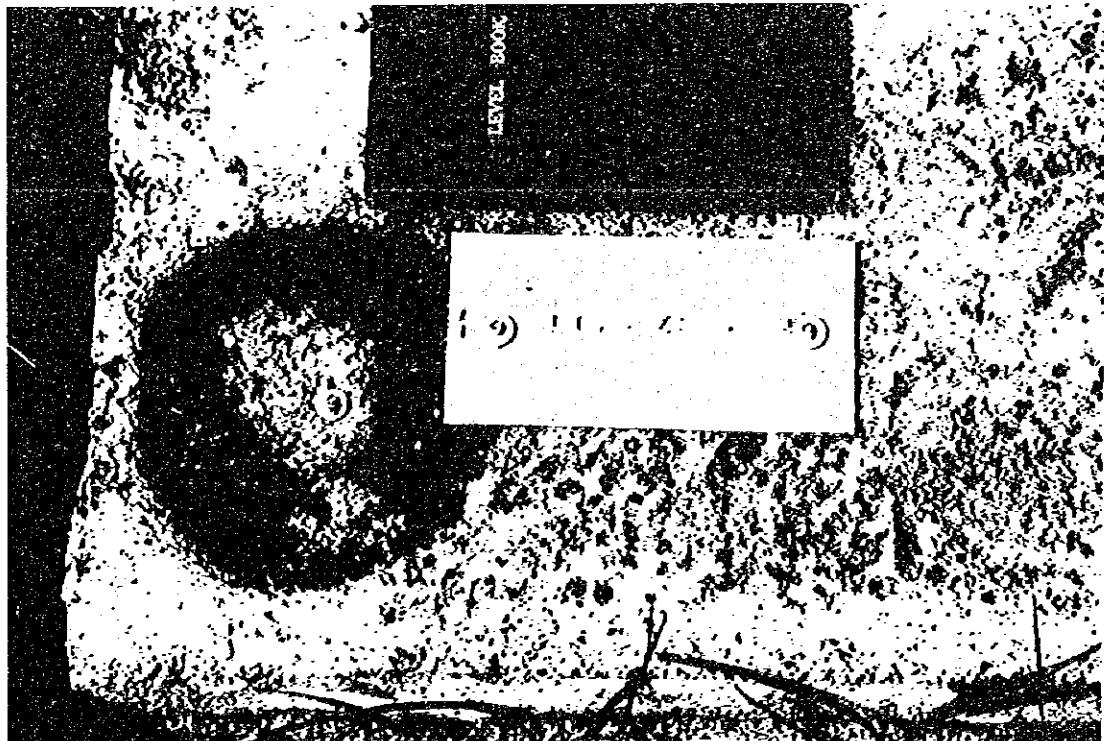
Setting Condition of Survey Control Points, No.968-01 at R/A-3, Barka  
(Landscape)



Setting Condition of Survey Control Points, No.968-01 at R/A-3, Barka  
(Close-up)



Setting Condition of Survey Control Points, No.968-43 at R/A-12, Sohar  
(Landscape)



Setting Condition of Survey Control Points, No.968-43 at R/A-12, Sohar  
(Close-up)

Appendix III.2 Details of Survey Control Points at the Proposed Study Areas of Roundabouts and Pedestrian Underpasses

(1/3)

Details of Survey Control Points at the Proposed Study areas of Roundabouts and Pedestrian Underpasses

Control Point	Latitude	Longitude	Ellipsoidal Height	Northing	Easting	Orthometric Height (MSL)	OSU91A Geoid Height	Remarks
968-01	N 23 41 28.30692	E 58 2 52.83246	-17.609	2,620,426.905	606,285.945	9.296	-26.905	R/A- 2 : A' Naseem Garden
968-02	N 23 41 24.40660	E 58 2 8.17405	-18.030	2,620,301.846	605,586.993	8.826	-26.856	R/A- 2 : A' Naseem Garden
968-03	N 23 41 16.01132	E 58 1 42.70386	-17.413	2,620,038.420	604,867.452	9.390	-26.803	R/A- 2 : A' Naseem Garden
968-04	N 23 41 7.43699	E 58 1 21.27685	-15.972	2,619,770.343	604,262.446	10.780	-26.752	R/A- 2 : A' Naseem Garden
968-05	N 23 39 55.53773	E 57 53 40.83586	-12.445	2,617,471.409	591,234.763	13.479	-25.924	R/A- 3 & P/U- 1 Barka
968-06	N 23 40 0.58649	E 57 53 14.76943	-12.519	2,617,622.074	590,495.388	13.375	-25.894	R/A- 3 & P/U- 1 Barka
968-07	N 23 40 4.11186	E 57 52 44.22971	-11.086	2,617,725.144	589,629.603	14.767	-25.853	R/A- 3 & P/U- 1 Barka
968-08	N 23 40 10.07305	E 57 52 26.12002	-11.355	2,617,905.330	589,115.480	14.480	-25.835	R/A- 3 & P/U- 1 Barka
968-11	N 23 42 45.01111	E 57 45 8.05206	-15.431	2,622,599.663	576,681.314	10.027	-25.458	P/U- 2 : Al Billah P/U-2
968-12	N 23 42 46.21448	E 57 45 2.43714	-14.732	2,622,635.833	576,522.120	10.721	-25.453	P/U- 2 : Al Billah P/U-2
968-13	N 23 44 41.11920	E 57 37 22.03475	-15.409	2,626,106.772	563,469.538	9.699	-25.108	P/U- 3 : A' Tareef P/U-3
968-14	N 23 44 42.07995	E 57 37 18.37593	-14.762	2,626,135.866	563,365.829	10.343	-25.105	P/U- 3 : A' Tareef P/U-3
968-15	N 23 45 21.91949	E 57 35 15.62284	-17.966	2,627,346.321	559,885.684	7.168	-25.134	Junc- 5 : Al Muladdah
968-16	N 23 45 21.90202	E 57 34 59.06812	-18.301	2,627,343.855	559,417.071	6.816	-25.117	Junc- 5 : Al Muladdah
968-17	N 23 45 14.13618	E 57 34 28.69193	-19.564	2,627,101.525	558,558.175	5.511	-25.075	Junc- 5 : Al Muladdah
968-18	N 23 45 11.79389	E 57 34 8.13177	-19.648	2,627,027.151	557,976.457	5.403	-25.051	Junc- 5 : Al Muladdah
968-19	N 23 46 41.75214	E 57 31 55.20571	-18.516	2,629,779.149	554,203.291	6.545	-25.061	P/U- 4 : Al Qarat
968-20	N 23 46 39.48414	E 57 31 51.71449	-17.613	2,629,709.030	554,104.742	7.439	-25.052	P/U- 4 : Al Qarat
968-21	N 23 47 9.36177	E 57 31 11.54370	-18.110	2,630,623.678	552,964.458	6.952	-25.062	P/U- 5 : A' Tharnad
968-22	N 23 47 16.85289	E 57 31 4.36816	-17.953	2,630,853.317	552,760.547	7.115	-25.068	P/U- 5 : A' Tharnad

Note: Final control coordinates, WGSS84 datum, Zone 40 UTM, CM 57  
OSU91A geoid height obtained by using geolab's geoid manager

## Details of Survey Control Points at the Proposed Study areas of Roundabouts and Pedestrian Underpasses

Control Point	Latitude	Longitude	Ellipsoidal Height	Northing	Easting	Orthometric Height (MSL)	OSU91A Geoid Height	Remarks
968-23	N 23 51 38.84821	E 57 19 11.27841	-18.154	2.638.851.083	532.562.165	6.802	-24.956	P/U- 7 : Al Khadra
968-24	N 23 51 28.13883	E 57 19 12.28055	-16.478	2.638.521.795	532.591.253	8.457	-24.935	P/U- 7 : Al Khadra
968-25	N 23 49 28.06390	E 57 25 24.37499	-12.921	2.634.856.655	543.126.766	12.127	-25.048	P/U- 6 : A' Suweiq
968-26	N 23 49 34.07484	E 57 25 5.44223	-11.959	2.635.039.925	542.590.580	13.082	-25.041	P/U- 6 : A' Suweiq
968-27	N 23 53 52.87279	E 57 14 7.16767	-16.216	2.642.955.961	523.933.962	8.785	-25.001	P/U- 8 : Qarh
968-28	N 23 53 58.35600	E 57 13 47.07037	-17.130	2.643.123.655	523.385.428	7.867	-24.997	P/U- 8 : Qarh
968-29	N 23 57 47.83355	E 57 5 51.94340	-17.941	2.650.165.365	509.946.306	7.214	-25.155	R/A- 8 : Al Khaburah
968-30	N 23 58 9.80951	E 57 5 33.96763	-16.901	2.650.840.866	509.437.846	8.295	-25.196	R/A- 8 : Al Khaburah
968-31	N 23 58 23.03867	E 57 5 20.82846	-17.456	2.651.247.473	509.066.279	7.764	-25.220	R/A- 8 : Al Khaburah
968-32	N 23 58 35.38164	E 57 5 14.21590	-18.241	2.651.626.949	508.879.180	7.006	-25.247	R/A- 8 : Al Khaburah
968-33	N 24 8 5.69005	E 56 53 10.30826	-13.496	2.669.168.212	488.437.042	13.150	-26.646	R/A- 10 : Saham
968-34	N 24 8 16.60220	E 56 52 53.79391	-11.623	2.669.504.195	487.971.232	15.050	-26.673	R/A- 10 : Saham
968-35	N 24 8 37.57029	E 56 52 30.37232	-11.952	2.670.149.632	487.310.781	14.775	-26.727	R/A- 10 : Saham
968-36	N 24 8 46.07851	E 56 52 23.47291	-12.564	2.670.411.473	487.116.305	14.184	-26.748	R/A- 10 : Saham
968-37	N 24 13 30.55310	E 56 49 58.18329	-18.832	2.679.164.706	483.026.524	8.673	-27.505	P/U- 9 : Majaz A' Sughra
968-38	N 24 13 38.27097	E 56 49 50.79908	-18.262	2.679.402.319	482.818.549	9.261	-27.523	P/U- 9 : Majaz A' Sughra
968-39	N 24 17 39.89324	E 56 46 47.55209	-13.032	2.686.840.634	477.662.102	15.172	-28.204	P/U- 10 : Khor A' Sivabi
968-40	N 24 17 53.41069	E 56 46 38.12656	-15.395	2.687.256.789	477.397.075	12.839	-28.234	P/U- 10 : Khor A' Sivabi
968-041	N 24 20 7.57096	E 56 44 15.43227	-13.644	2.691.389.943	473.382.623	14.872	-28.516	R/A- 12 : Sohar
968-042	N 24 20 21.39312	E 56 44 6.29660	-14.595	2.691.815.538	473.125.993	13.949	-28.544	R/A- 12 : Sohar

Note: Final control coordinates, WGS84 datum, Zone 40 UTM, CM 57  
OSU91A geoid height obtained by using geolab's geoid manager



Details of Survey Control Points at the Proposed Study areas of Roundabouts and Pedestrian Underpasses

(3/3)

Control Point	Latitude	Longitude	Ellipsoidal Height	Northing	Easting	Orthometric Height (MSL)	OSU91A Geoid Height	Remarks
968-043	N 24 20 38.01955	E 56 43 24.25030	-14.603	2.692.329.199	471.942.200	13.985	-28.588	R/A- 12 : Sohar
968-044	N 24 20 42.72275	E 56 43 10.28595	-14.618	2.692.474.637	471.549.008	13.983	-28.601	R/A- 12 : Sohar
968-045	N 24 25 12.51255	E 56 37 16.20134	-7.107	2.700.795.917	461.594.434	22.073	-29.180	R/A- 14 : Falaj Al Qabail
968-046	N 24 25 17.73832	E 56 36 58.44281	-6.737	2.700.958.017	461.094.781	22.458	-29.195	R/A- 14 : Falaj Al Qabail
968-047	N 24 25 39.54442	E 56 36 32.98713	-3.519	2.701.630.690	460.379.823	25.717	-29.236	R/A- 14 : Falaj Al Qabail
968-048	N 24 25 49.81055	E 56 36 27.76940	-1.504	2.701.946.851	460.233.789	27.747	-29.251	R/A- 14 : Falaj Al Qabail
968-049	N 24 31 29.79739	E 56 33 36.50609	-15.748	2.712.418.105	455.444.484	13.824	-29.572	P/U- 11 : Liwa
968-050	N 24 31 8.84458	E 56 33 39.26759	-13.316	2.711.773.421	455.520.137	16.241	-29.557	P/U- 11 : Liwa
968-051	N 24 34 30.43980	E 56 32 42.49449	-17.530	2.717.979.001	453.943.040	12.160	-29.690	P/U- 12 : Asrar Bani Sa'd
968-052	N 24 34 48.95406	E 56 32 17.79553	-17.791	2.718.550.752	453.250.249	11.918	-29.709	P/U- 12 : Asrar Bani Sa'd
968-053	N 24 48 12.67731	E 56 26 23.66721	-17.832	2.745.308.322	443.391.098	11.799	-29.631	R/A- 18 : Al Aqr
968-054	N 24 47 54.29040	E 56 26 33.62893	-17.917	2.742.741.632	443.668.473	11.716	-29.633	R/A- 18 : Al Aqr
968-055	N 24 48 37.40465	E 56 26 13.14496	-17.604	2.744.070.103	443.098.814	12.022	-29.626	R/A- 18 : Al Aqr
968-056	N 24 48 56.70746	E 56 26 7.31687	-18.394	2.744.664.497	442.937.650	11.225	-29.619	R/A- 18 : Al Aqr
NSA1001	N 24 17 40.23200	E 56 31 53.63000	252.370	2.686.913.350	452.463.563	280.789	-28.419	National Survey Authority
NSA1006	N 23 45 27.17900	E 57 34 31.31800	-20.290	2.627.502.943	558.630.890	4.806	-25.096	National Survey Authority
NSA1009	N 23 55 0.88800	E 58 17 42.32100	-11.730	2.608.721.920	632.153.001	16.218	-27.948	National Survey Authority

Note: Final control coordinates, WGS84 datum, Zone 40 UTM, CM 57

OSU91A geoid height obtained by using geolab's geoid manager

Appendix III.3 Details of Center Points for Pedestrian Underpass locations

Details of Center Points for the Proposed Study Pedestrian Underpasses

Center Point	Latitude	Longitude	Ellipsoidal Height	Northing	Easting	Orthometric Height (MSL)	OSU91A Geoid Height	Remarks
CP-01	N	N.A.	N.A.	2,617,547.800	590,648.700	N.A.	N.A.	P/U- 1 : Barka
CP-02	N	N.A.	N.A.	2,622,581.700	576,591.400	N.A.	N.A.	P/U- 2 : Al Billah
CP-03	N	N.A.	N.A.	2,626,055.300	563,477.200	N.A.	N.A.	P/U- 3 : A' Tareef
CP-04	N	N.A.	N.A.	2,629,758.300	554,141.300	N.A.	N.A.	P/U- 4 : Al Qarat
CP-05	N	N.A.	N.A.	2,630,757.900	552,898.900	N.A.	N.A.	P/U- 5 : A' Tharmad
CP-06	N	N.A.	N.A.	2,634,962.100	542,766.600	N.A.	N.A.	P/U- 6 : A' Suweig
CP-07	N	N.A.	N.A.	2,638,907.900	532,613.500	N.A.	N.A.	P/U- 7 : Al Khadra
CP-08	N	N.A.	N.A.	2,643,043.500	523,511.500	N.A.	N.A.	P/U- 8 : Qarih
CP-09	N	N.A.	N.A.	2,679,075.300	483,137.700	N.A.	N.A.	P/U- 9 : Majaz A' Sughra
CP-10	N	N.A.	N.A.	2,686,836.000	477,709.300	N.A.	N.A.	P/U- 10 : Khor A' Sivabi
CP-11	N	N.A.	N.A.	2,712,031.700	455,442.000	N.A.	N.A.	P/U- 11 : Liwa
CP-12	N	N.A.	N.A.	2,718,344.100	453,449.800	N.A.	N.A.	P/U- 12 : Asrar Bani Sa'd

Note: Final control coordinates, WGS84 datum, Zone 40 UTM, CM 57

OSU91A geoid height obtained by using geolab's geoid manager

N.A.: Not available at the time of this reporting

