## A4.6 INTERSECTION AND ROUNDABOUTS TRAFFIC VOLUME COUNT

## A4.6.1 Design of Survey

## a. Survey Stations

Intersection and roundabout traffic volume count was carried out to grasp necessary data and informations for the further improving planning of the bottleneck points of the entire traffic flow in the Study Area. Eight (8) stations in total were selected in consideration of similar kind of surveys conducted by the World Bank in 1995 to compare the data of traffic flow, but omitted some points from where already covered by the other intersection surveys conducted by the JICA Advisor to MPWT in 1999. The bcations of the survey stations for the intersection traffic volume count are shown in Figure A4.1.2 (b).

## b. Survey Item and Time Duration

Classified vehicle counting (six transport modes, plus walking) by each movement at each leg were conducted at three (3) intersections for fourteen (14) hours from 06:00 in the morning to 20:00 in the evening. In addition, same classified vehicle counting by direction at each leg were also conducted at five (5) roundabouts for same duration.

## A4.6.2 Survey Output

Table A4.6.1 and Figure A4.6.1 shows the brief summary of the intersection and roundabout traffic volume count carried out on May 16 (Tuesday) and May 19 (Friday) of 2000. Detailed calculation of saturation degree and other related values regarding present condition of the intersections and the roundabouts are stated in the Chapter 8.

Table A4.6.1 Summaries of Intersection and Roundabouts Traffic Counting Stations

| Stations | Daytime 12-hr Traffic | Morning Peak Hour |  |  | Evening Peak Hour |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | Ratio | Traffic | Time | Ratio | Traffic | Time |
| TM-01 | 65,362 | 0.111 | 7,279 | 07:00~08:00 | 0.114 | 7,479 | 17:00~18:00 |
| TM-02 | 58,366 | 0.105 | 6,122 | 07:00~08:00 | 0.118 | 6,899 | 18:00~19:00 |
| TM-03 | 70,327 | 0.101 | 7,120 | 07:00~08:00 | 0.106 | 7,448 | 17:00~18:00 |
| TM-04 | 106,565 | 0.117 | 12,459 | 07:00~08:00 | 0.100 | 10,682 | 17:00~18:00 |
| TM-05 | 49,274 | 0.094 | 4,638 | 07:00~08:00 | 0.111 | 5,469 | 17:00~18:00 |
| TM-06 | 73,705 | 0.095 | 6,975 | 07:00~08:00 | 0.108 | 7,992 | 17:00~18:00 |
| TM-07 | 75,522 | 0.100 | 7,558 | 08:00~09:00 | 0.098 | 7,376 | 17:00~18:00 |
| TM-08 | 62,585 | 0.116 | 7,289 | 07:00~08:00 | 0.104 | 6,527 | 16:00~17:00 |
| Average | 70,213 | 0.106 | 7,430 | --- | 0.107 | 7,484 | --- |
| Unit of Traffic Volume: Passenger Car Units (PCU's) |  |  |  |  |  |  |  |

The largest daytime 12 -hours (06:00~18:00) traffic volume was doserved at out-bound lane to the west of the Intersection of Norodom Blvd with Confederation de la Russie Blvd (TM-04), with a total count of 106,028 units, of which 84,612 units ( $79.8 \%$ ) were motorbikes. It was followed by a total count of 77,645 units at in-bound lane from the north of the same Intersection TM-04, of which 64,675 units $(83.3 \%)$ were also motorbikes. On this intersection, traffic flow from north to west was the largest and counted up to 49,826 units, of which 42,955 units $(86.2 \%)$ were motorbikes. Peak hour of this intersection was observed around 07:00~08:00 with a total count of 15,128 units per hour at out-bound lane to the west, and 11,028 units per hour at in-bound lane from the north, of which 8,103 units were north to west movement, and they were equivalent 6,278 pcu's, 4,328 pcu's, and 3,103 pcu's per hour respectively.

At the other intersections and roundabouts, peak hours were occurred in the morning (except TM-07;

07:00~08:00, TM-07; 08:00~09:00) and in the evening (except TM-02 \& TM-08; 17:00~18:00, TM-02; 18:00~19:00, TM-08; 16:00~17:00), although each leg has different peak hours. Furthermore, the traffic flow into or out from the intersections or roundabout had never exceeded 3,000 pcu's per hour at any legs nor any directions.

In the evening peak hours (16:00~19:00), the legs with traffic flow over 2,500 pcu's per hour were Leg-6 (west / in-bound) \& Leg-2 (east / out-bound) of the Roundabout of Monivong with Norodom Blvd (TM-01). In addition, Leg-6 (west / in-bound) \& Leg-4 (south / out-bound) of the Intersection of Monivong with Mao Tse Toung Blvd (TM-02), and Leg-8 (north / out-bound) of the Intersection of Monivong with Charles de Gaulle Blvd (TM-03). Moreover, Leg-5 (southwest / in-bound) of the Roundabout of Charles de Gaulle with Tcheco-Slovaquie Blvd (TM-06), and Leg-3 (southeast / in-bound) \& Leg-8 (north / out-bound) of the Roundabout of Charles de Gaulle with Sihanouk Blvd (TM-07).

In the morning peak hours (06:00~09:00), the traffic flow at Leg-8 (north / out-bound) of the Roundabout of Charles de Gaulle with Sihanouk Blvd (TM-07), and Leg-5 (southwest / out-bound) of the Roundabout of Monireth with Mao Tse Toung Blvd (TM-08) also showed more than 2,500 pcu's per hour.

| TM－01 |  | Out－bound |  |  |  | Total |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| （06：00－18：00） |  | E | 5 | W | N |  |
| $\begin{aligned} & \text { 믈 } \\ & \text { 镸 } \\ & \end{aligned}$ | E | ， | 2，703 | 7，872 | 7，771 | 18，346 |
|  | S | 2，745 | $\cdots$ | 6，244 | 6，164 | 15，152 |
|  | W | 9.157 | 7，151 | － | 2.562 | 18，870 |
|  | N | 6，047 | 4，722 | 1，714 | － | 12，483 |
| Total |  | 17，950 | 14，575 | 15，829 | 16，497 | 64，851 |

1C：Chba Ampou RA


Figure A4．6．1（a）Daytime Traffic Volume \＆Flow at Roundabout（TM－01）

| TM－03 |  | Out－bound |  |  |  | Total |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| （06：00－18：00） |  | NE | S | SW | N |  |
| $\begin{aligned} & \text { 品 } \\ & \text { 号 } \\ & \text { 品 } \end{aligned}$ | NE | C | 2，667 | 9，137 | 3，982 | 15，786 |
|  | S | 4，450 |  | 8 | 13，961 | 18，419 |
|  | SW | 13，607 | 1，283 | － | 4，615 | 19，505 |
|  | N | 4 | 11，635 | 4，978 | － | 16，617 |
| Total |  | 18，061 | 15，585 | 14，123 | 22，558 | 70，327 |

IC：Monivong／C．D．Gaull


Figure A4．6．1（c）Daytime Traffic Volume \＆Flow at Intersection（TM－03）

Intersection of Monivong Blvd with Mao Tse Toung Blvd

| TM－02 |  | Out－bound |  |  |  | Total |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| （06：00－18：00） |  | E | $S$ | W | N |  |
| $\begin{aligned} & \text { 岢 } \\ & \text { 号 } \end{aligned}$ | E | － | 1，576 | 7，424 | 1，288 | 10，288 |
|  | S | 2，083 | － | 5，955 | 6，526 | 14，564 |
|  | W | 9，400 | 8，009 | － | 2，797 | 20，206 |
|  | N | 1，372 | 8，118 | 3，818 | － | 13，308 |
| Total |  | 12，855 | 17，703 | 17，197 | 10，611 | 58，366 |

IC：Monivong／MaoTseToung


Figure A4．6．1（b）Daytime Traffic Volume \＆Flow at Intersection（TM－02）

| TM－04 |  | Out－bound |  |  |  |  | Total |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| （06：00－18：00） |  | E | SE | S | W | N |  |
|  | E |  | ＋ | － | 10，903 | 2，051 | 12，954 |
|  | SE | － |  | － | 6，642 | 697 | 7，339 |
|  | S | 2，552 | － | － | 10，461 | 17，183 | 30，196 |
|  | W | 13，684 | 5，196 | 2，935 | ］－ | － | 21，815 |
|  | N | 1，292 | 1，936 | 9.535 | 21，498 | － | 34，261 |
| Total |  | 17，528 | 7，132 | 12，470 | 49，504 | 19，931 | 106，565 |

IC：Monivong／Russlan


Figure A4．6．1（d）Daytime Traffic Volume \＆Flow at Intersection（TM－04）

| TM－05 |  | Out－bound |  |  |  |  |  | Total |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| （06：00－18：00） |  | NE | E | SE | S | W | N |  |
| $\begin{aligned} & \text { 号 } \\ & \stackrel{8}{8} \\ & \dot{d} \end{aligned}$ | NE |  | 1，715 | 402 | 5，164 | 618 | 785 | 8，684 |
|  | E | 1，323 | － | 1，448 | 4，647 | 556 | 706 | 8，681 |
|  | SE | 365 | 3，408 | $\cdots$ | 427 | 1，229 | 1，561 | 6，990 |
|  | S | 4，328 | 5，047 | 591 | － | 1，819 | 2，311 | 14，097 |
|  | W | 659 | 768 | 721 | 2，313 | － | 352 | 4，812 |
|  | N | 801 | 933 | 876 | 2.812 | 337 | － | 5，758 |
| Tota！ |  | 7，476 | 11，872 | 4，038 | 15，362 | 4.559 | 5，715 | 49，023 |

IC：Old Stadium RA


Figure A4．6．1（e）Daytime Traffic Volume \＆Flow at Roundabout（TM－05）

| $\frac{\text { TM-07 }}{(06: 00-18: 00)}$ |  | Out－bound |  |  |  | Total |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | NE | SE | SW | N |  |
| $\begin{aligned} & \vec{\square} \\ & \frac{\rightharpoonup}{\widehat{S}} \\ & \text { 品 } \end{aligned}$ | NE | $\bigcirc$ | 7.193 | 6，015 | 4，734 | 17，942 |
|  | SE | 6，493 | 2 | 4，142 | 13，051 | 23，686 |
|  | SW | 4，318 | 3，294 | － | 8，680 | 16，292 |
|  | N | 2，606 | 7.960 | 6，656 | － | 17，222 |
| Total |  | 13，418 | 18，446 | 16，813 | 26，466 | 75，143 |
|  |  |  |  |  | Unit： | CU／12－hr |



Figure A4．6．1（g）Daytime Traffic Volume \＆Flow at Roundabout（TM－07）

Roundabout of Charles de Gaulle Blvd with Tcheco－Slovaquie Blvd

| $\frac{\text { TM－06 }}{\text {（06：00－18：00）}}$ |  | Out－bound |  |  |  |  | Total |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | NE | E | SW | W | N |  |
| $\begin{aligned} & \text { 블 } \\ & \text { B } \\ & \text { 品 } \end{aligned}$ | NE | － | 613 | 9，367 | 5，035 | 767 | 15，781 |
|  | E | 496 |  | 3，769 | 2，026 | 4，633 | 10，924 |
|  | SW | 8，408 | 6，268 |  | 2，859 | 6，542 | 24，078 |
|  | W | 2，571 | 1，917 | 1，627 | $\cdots$ | 2，001 | 8，117 |
|  | N | 668 | 5，977 | 5.075 | 2.729 | － | 14，449 |
| Total |  | 12，143 | 14，776 | 19，838 | 12，649 | 13，943 | 73，348 |

## IC：Neang Kong Hing RA



Figure A4．6．1（f）Daytime Traffic Volume \＆Flow at Roundabout（TM－06）

| $\frac{\text { TM－08 }}{\text {（ } 06: 00 \sim 18: 00)}$ |  | Out－bound |  |  |  | Total |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | NE | SE | SW | N |  |
| $\begin{aligned} & \text { 嘏 } \\ & \text { 相 } \end{aligned}$ | NE |  | 5，109 | 9，444 | 4，829 | 19，382 |
|  | SE | 6，237 | － | 4，673 | 4，779 | 15，689 |
|  | SW | 6，566 | 2，661 | － | 5，031 | 14，258 |
|  | N | 3，906 | 3，167 | 5.854 | ， | 12.927 |
| Total |  | 16，709 | 10，937 | 19，971 | 14，639 | 62，256 |





Figure A4.6.1 (a) Hourly Fluctuatlots of Roundaboat Traffic Sorvey Station (TM-01)



Figure A4.6.1 (c) Iourly Fluctuations of Intersection Traffic Survey Siation (TM-03)



Figure A4.6.1 (b) Hourly Fioctuations of Iticersection Traflic Survey Staion (TM-02)



Figure A4.6.1 (d) Hourly Fluctuations of Intersection Traffic Survey Staloa (TM-04)



Figure A4.6.1 (c) Howuly Fivaualions of Roundabout Traffic Survey Statioe (TM-0))



Figure A4.6.1 (g) Howity Figctuations of Roundabout Trafic Survey Station (TM-07)



Figure As.6.1 (f) Hourly Flactuations of Roundabout Traflic Survey Station (TM-06)


Table A4.6.1 (a) Classified Daytime Traffic Volume at Intersections


Table A4.6.1 (b) Classified Daytime Traffic Volume at Roundabouts

Table A4.6.1 (b) Classified Daytime Traffic Volume at Roundabouts

Table A4.6.2 (a) Morning Peak Hour's Traffic Volume at Intersections



Appendix 4.6


Table A4.6.2 (b) Morning Peak Hour's Traffic Volume at Roundabouts

Table A4.6.3 (a) Evening Peak Hour's Traffic Volume at Intersections


Table A4.6.3 (b) Evening Peak Hour's Traffic Volume at Roundabouts


Table A4.6.3 (b) Evening Peak Hour's Traffic Volume at Roundabouts


## A4.7 TRAVEL SPEED SURVEY

## A4.7.1 Design of Survey

## a. Survey Routes

Travel speed survey was carried out to grasp necessary data and informations for the further analysis of the bottleneck points of the entire traffic flow in the Study Area. Seven (7) routes were selected along the arterial streets such as major radial roads and circular roads in the central districts of the Study Area. The routes of the travel speed survey are shown in Figure A4.1.2 (c).

## b. Survey Item and Time Duration

Floating car method was applied to carry out the travel speed survey. This survey was conducted for three (3) repetitions on average in the morning, evening, and lunchtime peak hours of weekdays. Before conducting the survey, several checkpoints were selected along the survey routes; mainly those checkpoints are major intersections with traffic signals and roundabouts crossing with the other arterial roads. During the surveys, time of passing the checkpoints and time of stop and re-start, in case of brief stopping, were recorded with cumulative distances.

## A4.7.2 Survey Output

Table A4.7.1 shows the brief summary of the travel speed survey carried out from mid May and mid August of 2000.

Table A4.7.1 Summary of the Travel Speed Survey \& Level of Service

| Route |  | Street Name | Direction | AM | Noon | PM | Average |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| TS-01 |  | France / Norodom | N -bound | $24.5 / \mathrm{C}$ | 28.2/C | $26.1 / \mathrm{C}$ | 26.3/C |
|  |  |  | S-bound | $24.4 / \mathrm{C}$ | 29.0/C | $22.7 / \mathrm{C}$ | 25.4/C |
| TS. 02 |  | Monivong | N -bound | 21.4/C | 26.2/C | 22.3 / C | 23.3/C |
|  |  |  | S-bound | $22.7 / \mathrm{C}$ | 26.3/C | $22.5 / \mathrm{C}$ | 23.8/C |
| TS-03 |  | Charles de Gaulle / Monireth | NE-bound | $15.6 / \mathrm{D}$ | 20.4/C | $17.0 / \mathrm{D}$ | 17.6/D |
|  |  |  | SW-bound | 18.1/D | 17.5/D | 17.3 / D | 17.6 / D |
| TS-04 |  | Confederation de la Russie | E-bound | 28.2/C | 39.1/B | $28.5 / \mathrm{C}$ | 31.9/B |
|  |  |  | W-bound | $31.5 / \mathrm{B}$ | 37.2/B | 27.3/C | 32.0/B |
| TS-05 |  | Inner Ring Road | S/E-bound | 19.0/D | 21.9/C | 20.5/C | 20.5/C |
|  |  |  | W/N-bound | 19.1/D | 21.1/C | 20.0/C | 20.1/C |
| TS-06 |  | Kim Il Sung / Mao Tse Toung / Sisowath | S/E/N-bound | 22.3/C | 29.8/C | 22.7/C | 24.9/C |
|  |  |  | S/W/N-bound | 23.9/C | 27.4/C | $21.7 / \mathrm{C}$ | 24.3/C |
| TS-07 |  | Jawaharlal Nerhu / Sihanouk | S/E-bound | 17.1/D | $24.2 / \mathrm{C}$ | 20.7/C | 21.0/C |
|  |  |  | W/N-bound | 19.4/D | 24.0/C | 18.1 / D | 20.6/C |

On radial roads, consisting four (4) routes, average travel speed were ranged from $17.6 \mathrm{~km} / \mathrm{h}$ on the routes along Charles de Gaulle and Monireth Blvd's (TS-03) to $32.0 \mathrm{~km} / \mathrm{h}$ on the route along Confederation de la Russie Blvd (TS-04). Average speeds on the route along France/Norodom Blvd's (TS-01) and Monivong Blvd (TS-02) were $25.8 \mathrm{~km} / \mathrm{h}$ and $23.6 \mathrm{~km} / \mathrm{h}$ respectively. Present levels of service of these roads are ranged from Level B (TS-04) to Level D (TS-03), and average is considered as Level C.

On circular roads, consisting three (3) routes, average travel speeds were $20.8 \mathrm{~km} / \mathrm{h}$ on the route along Sihanouk and Jawaharlal Nerhu Blvd's (TS-07), or $24.6 \mathrm{~km} / \mathrm{h}$ on the route along Sisowath, Sothearos, Mao Tse Toung, and Kim Il Sung Blvd's (TS-06). In addition, it was also observed that average travel speed was $20.3 \mathrm{~km} / \mathrm{h}$ on the route along the Inner Ring Road (TS-05). Present levels of service of these roads are considered as Level C.

## A4.8 COMMODITY MOVEMENT SURVEY

## A4.8.1 Design of the Survey

## a. Survey Stations

The commodity movement survey was carried out to collect necessary data and information for estimating the present freight demand linked road sector in the Study Area. Thirty (30) major transports related companies/organizations (i.e. cargo, petroleum, construction, industry companies/factories, and some public service) were selected for to be interviewed at random basis in advance. Moreover, inter-regional terminals (i.e. airport, railway station, river port, and land port [container yard]) were also appointed for additional interview to cover feeder movements of inter-regional transport. Besides that, some international organizations (i.e. the Cambodia Red Cross, the World Food Programme [WFP], and the Cambodian Mine Action Center [CMAC]), based in the Study Area and operating their own fleets for relief activities, were appointed as well to cover still relatively large part of the role regarding the commodity movement throughout the country.

## b. Survey Item and Method

Several teams of interviewers would be deployed throughout the Study Area to collect necessary data with a request letter provided by DPWT. At the selected companies/factories/warehouses or interregional terminals, if the records of freight operations were obtainable, they were collected by interviewer, and if they were not, the cargo trucks coming into or going out from those facilities were interviewed directly at random basis. Table A4.8.1 shows outline of the commodity movement survey.

Table A4.8.1 Outline of the Commodity Movement Survey

| $\#$ | Survey Item | Contents |
| :--- | :--- | :--- |
| (1) | Company Attributes | - Name \& Address of Company |
|  |  | - Category |
|  |  | - Number of Fleet |
| (2) | Trip Informations | - Number Plate (if possible) |
|  |  | - Number of Trip per Day |
|  |  | - Origin \& Destination |
|  |  | - Trip Time |
|  |  | - Loading Items |
|  |  | - Loading Volume |

## A4.8.2 Survey Output

## a. Effective Number of Sample

Total of one (1) supervisors and six (6) surveyors were mobilized from early June to mid June 2000 into the Study Area. After completion of the error check, the total number of effective interviewed samples became five hundred ninety-nine (599) with nine hundred eighteen (918) trips. Table A4.8.2 shows the major figures of the commodity movement survey.

Table A4.8.2 Summary of the Commodity Movement Survey

| Item | Figures |
| :--- | :---: |
| Estimated Number of Registered Freight Vehicles | 11,100 |
| Estimated Number of Registered Heavy Duty Equipment | 310 |
| Number of Sampled Vehicles \& Equipment | 599 |
| Number of Total Trips | 918 |
| Sampling Ratio of Vehicles (\%) | 5.25 |
| Trip Production Ratio (per vehicle, Gross) | 1.53 |

b. Summary of Commodity Movement
(1) Category

As shown in Figure A4.8.1, the major category of commodity except "Others" and "Empty/Return" was "Construction" with a share of $23.7 \%$, followed by "Light Industry/Electronics" with $13.7 \%$, "Chemical' with $10.1 \%$
(2) Trip Time

Average trip time for all cargo truck was estimated around 180 minutes (3 hours), while almost half of their movements were less than 120 minutes ( 2 hours) and remaining half were more than 120 minutes. The major in the short trip was "less than 30 minutes" with a share of $18.5 \%$, followed by " $30 \sim 60$ minutes" with $14.7 \%$, and the major in the long trip was " $4 \sim 6$ hours" with a share of $21.4 \%$, followed by " $3 \sim 4$ hours" with $15.3 \%$ as well. Distributions of trip time are shown in Figure A4.8.2


Figure A4.8.1 Category of Commodity Movement


Figure A4.8.2 Trip Time of Commodity Movement
(3) Origin and Destination (OD)

As shown in Figure A4.8.3 (a) and (b), almost $70 \%$ of commodity were originated from inner zone. Within the inner zone, the major crigin was "Mean Chey" (zone 0600) with a share of $25.6 \%$, followed by "Tuol Kouk" (zone 0400) with $11.8 \%$. About half of outer zone based movements were originated from the regions along National Route No. 4 (zone 4000).


Figure A4.8.3 (a) Origin of Commodity Movement

As shown in Figure A4.8.3 (b), the major destination within the inner zone was "Mean Chey" (zone 0600) with a share of $21.0 \%$, followed by "Tuol Kouk" (zone 0400) with $11.9 \%$, and "Dangkao" (zone 0500) with 9.7\%. Within the outer zone, the regions along National Route No. 4 (zone 4000) were the major destinations with a total share of $16.4 \%$.


Figure A4.8.3 (b) Destination of Commodity Movement

