CYCLING AS AN ATTRACTIVE MODE OF TRANSPORT IN UTP

By

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FINAL PROJECT REPORT

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CERTIFICATION OF APPROVAL

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Approved:

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TRONOH, PERAK

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CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

Aisyah Sakina Ahmad

ACKNOWLEDGEMENT

I would like to take this opportunity to express my appreciation to those who had assisted me in completing my final year project.

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ABSTRACT

The need for more transportation options in UTP is increasing. Thus UTP clearly need more transportation alternatives to meet the travel demand without increasing vehicle emission or congestion. Therefore, the author had proposed cycling as an alternative to travel within the UTP. The main objective is to propose and improves bicycle facilities in UTP. The project covers three steps, which are; 1) Questionnaire and Data Survey Analysis, 2) Traffic Modelling and 3) Design the facilities to be provided. The approach that is commonly used to forecast travel demand is the 'four-step process' of; 1) Trip Generation and Attraction, 2) Trip Distribution, 3) Modal Choice and 4) Traffic Assignment.

EMME2 software is used to forecast the travel demand in two times horizon, which are 2005 and 2010. The total population of UTP students in 2005 base year is 4400 and for 2010, total population for fully developed is 6600. From EMME2 analysis, UTP will experienced great traffic congestion in year 2010. The volume on link increased up to 2000 trips per day. Road provided in UTP is only two lanes for both ways. Reconnaissance survey was conducted to provide an assessment of the physical features in the study area. The best route location for cycle network was identified where the distance to travel was kept to minimum. Shared cycle and walkway and two-way segregated cycle path are to be proposed. The proposed cycle network will focus in the region of villages and academic buildings. Cycle racks are also to be proposed at the entrance of academic building in order to ease the bicyclers to park their bicycle.

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1.0 INTRODUCTION

1.1 Background of Project

Universiti Teknologi PETRONAS (UTP) was established on January 10, 1997 when PETRONAS was invited by the Government to set up a University. It is an institute of higher learning which provides opportunities for the pursuit for knowledge and expertise for the advancement of engineering, science and technology to enhance the nation's competitiveness. The objective is to produce well-rounded graduates who are creative and innovative with the potential to become leaders of industry and the nation and the aim is to nurture creativity and innovativeness and expand the frontiers of technology and education for the betterment of society. UTP vision is to become a leader in technology education and centre for creativity and innovation [12].

One of the ways to achieve the objective is to enhance the environment of study in UTP by providing good facilities to the students so that the students can adapt to the surrounding and improve their achievement in academic and non-academic. For example transport facilities. Providing such facilities are very important to the students as they need to travel within the campus area for almost everyday either to attend the classes and other academic or non-academic activities.

UTP is also aspired to produce healthy and physically strong students since UTP mission is to produce well-rounded graduates.

1.2 Problem Statement

Bicycle is not a popular mode to travel in UTP. Currently, car is the most popular mode to travel in UTP, either to attend classes, library or even to withdraw money at the ATM machine. This could cause traffic congestion during the peak hour as the road provided in UTP is only 2 lanes for both ways with unpaved shoulder and could become worst if there are cars parked at one lane of the road causing only one lane is available to be used. The risk of accident will increase. These problems do not happen only to students but also involve the UTP staff and sometimes the visitors.

For most people, the private car is regarded more as a necessity than luxury, and owning a personal car is everybody's dream, i.e. lifestyle to be emulated. The issue is to reverse this trend as private car usage is costly in terms of road space usage, operation and adverse impacts on the environment. Students bring their vehicle to UTP because they find it is hard to travel in UTP due to lack of facilities provided to travel from the hostel to the academic area. Weather is also one of the factors that increase the level of vehicle ownership in UTP. To overcome these problems, the author had proposed cycling as the main mode of travel within the UTP area instead of decreasing the level of vehicle ownership or introduces parking fees. If enough facilities are provided, cycling will be the most attractive mode of transportation in UTP like many other universities overseas

1.3 Objective

The need for more transportation options is greater than ever. UTP clearly need more transportation alternatives to meet the travel demand without increasing vehicle emission or congestion. The main objective is to propose and improves bicycle facilities in UTP. The goal is to ensure that cycling is convenient, safe and practical means of transportation throughout UTP. The concern is to entice student to leave their cars at hostel and instead use bicycle as this transport of travel requires less road space per user, cheaper and results in less damaging impacts on the environment. Well designed cycling facilities will encourage the student to use bicycle.

1.4 Scope of Study

The scope of study involves the following:

i. <u>Questionnaires and Data Survey Analysis</u>

- Questionnaire will be conducted in order to determine the trips origin and destination. UTP plan is needed to determine the trip zone. The form will be distribute to the students and staffs in UTP.
- The questions will also include their opinions in choosing mode of travel in UTP. It is also important to gather information on what new facilities or improvement to existing facilities can increase the level of cycling.

ii. Traffic Modelling

- The approach most commonly used to forecast travel demand is the 'four-step process' which is:

1. Trip generation
2. Trip distribution } Origin Destination Survey
3. Modal choice; Car and Bicycle
4. Traffic assignment; EMME/2 software

The trips generation and attraction are defined as the number of trips produced and attracted respectively by each traffic zones and are represented in a matrix format. The matrix provided a fundamental picture of travel demand in a study area and estimation of its cell values is a key component of many transport analyses. The trip matrix is simply a square table showing the land use zones as origins (rows) and destinations (columns) with each cell in the matrix representing the number of trips from one zone to another.

The software involve is EMME/2, which is the tool for traffic modelling. EMME/2 is a multimodal programme that can generate assigned traffic flows. Seven (7) scenarios will be analysed by the author involving two (2) modes of transport, car and bicycle for two time horizons (2005 and 2010).

iii. Design the facilities to be provided

- The cycle path must be designed effectively. The distance must be kept to minimum. Covered cycle path is recommended due to the weather condition in UTP. Cycle rack should be provided and must be user friendly and located near to the main entrance. Well designed cycle park will encourage the students to use bicycle.

2.0 LITERATURE REVIEW

2.1 Identify the needs for cyclist

Before deciding on the appropriate extent and standard of cyclist facilities, it is important to assess the potential demand. There are two steps in the process: 1): Obtaining reliable estimates of the existing demand and 2) projecting this demand to a future design year. Most techniques are concerned with the first step [1].

Manual Counts

Manual counts are concerned with counting the flow of pedestrian or cyclist through a junction, across a road or along the road section/footway. If manual counts are to be useful, they need to satisfy the following [1]:

1. The time period(s) in the day over which the counts are undertaken must coincide with the peak times.
2. The survey locations need to be carefully selected in order to ensure that the total existing demand is observed.

Video Survey

Cameras are set up at the selected sites and video recordings of pedestrian or cyclist movements, together with their interaction with vehicles where appropriate, during the selected observations period. Such survey produces a permanent record of pedestrian or cyclist movement and their interaction with vehicles [1].

Attitude Survey

This required detailed questionnaires based on the attitude surveys, often directed at particular target groups. Attitudes survey enables complete information to be obtained on why existing trips are made by the current mode of travel but not others. They can also gather information on what new facilities or improvement to existing facilities, need to be provided to divert trips to cycling and increase the amount of current cycling activities [1].

2.2 Needs of Cyclist

Cycling has played an important part in the transport system in the past and no doubt will continue to do so. Therefore, it is important that the future needs of cyclist are identified and appropriate resources allocated [1].

The main objectives relating to the provision of new or improved cycle facilities can be summarized as follow [1]:

- To encourage increased cycling activity by providing facilities which give increased convenience, comfort and safety to cyclist
- To minimize direct conflict between cyclist and vehicles, especially at busy roads and junctions
- To ensure that where there are significant numbers of cyclist, traffic speeds are kept low

There are a number of design principles influencing the location if a cycle route which to be taken into consideration. The most important of these are [1]:

- Routes should be located to maximize demand
- Routes should be as direct as possible to minimize travel distance
- Segregated cycle routes should have frequent access points onto the local road system
- Steep gradient should be avoided, where possible
- Routes on high and open ground in windy, wet or icy conditions are unpopular with cyclist and should be avoided
- Segregated routes are preferable, for safety reasons, because of the absence of motor vehicles.

Finally, cycle parking racks must be conveniently located to use, plentiful in supply and secure from theft if cycling is to be encouraged.

2.3 Forecasting Travel Demand

Travel demand is expressed as the number of persons or vehicles per unit time that can be expected to travel on a given segment of a transportation system under a set of given landuse, socio-economic and environmental conditions. The approach that is commonly used to forecast travel demand is the 'four-step process' of (Figure 1):

1. Trip Generation and Attraction
    - The number of trips by persons and vehicles
2. Trip Distribution
    - The distribution of the trips throughout the area
3. Modal Choice
    - The type of mode, usually private or public, used for the trip
4. Traffic Assignment
    - The highway or transit route that the trips takes

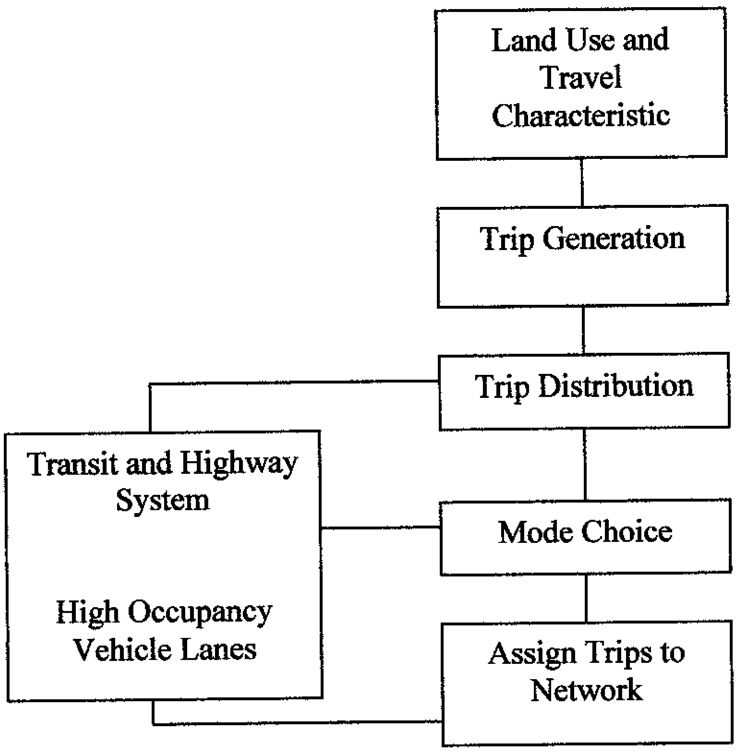

Figure 1: Travel Forecasting Process [7]

2.4 Cycle lane

Cycle lane is lane marked on existing carriageway and designated for cyclist use. The majority of cycle 'facilities' in the UK are painted cycle lanes, which may have a dotted white line defining the outside of the lane to signify that they are 'advisory', or a solid white line to indicate that they are 'mandatory'. The standard width for with-flow cycle lanes should be 1.5 meters, with an absolute minimum width of 1.2 meters. One clear advantage of cycle lanes is they encourage better lane discipline for motor vehicles, so that cyclists are more easily able to get to the front of a queue of stationary or slow moving vehicles. However the existence of a cycle lane may cause cyclists to be less aware of the dangers of car doors suddenly opening in their faces, or motorists moving into the cycle lane without warning [10].

Figure 2: Example of cycle lane [10]

2.5 Cycle track / Segregated Cycle path

Cycle Track is like a cycle path, but alongside (but not on) a carriageway. Segregated Cycle Path is a road dedicated to cyclists on separate right of way. A Cycle track (UK & Ireland) or Sidepath (U.S.) is used to denote a footway or sidewalk type structure that has been designated for use by cyclists and is attached to an existing roadway. These are dedicated lanes for cyclists, where there is a physical barrier to prevent use by motor vehicles [4].

The absolute minimum width for a one way track should be 1.5 meters. For two way tracks the absolute minimum width should be 2.5 meters, with a preferred standard 3 meter width [10].

Cycle tracks have a number of advantages [10]:

- They represent an unambiguous reallocation of road space from motor traffic to cycles.
- By physically narrowing the main carriageway width, motor traffic capacity is reduced & motor vehicle speeds are lowered.
- They encourage non-cyclists to take up cycling

Figure 3: Example of segregated cycle path [10]

2.6 Shared pedestrian/cycle Track

These are usually very popular facilities for cyclists as they are normally motor vehicle free; they are often used across parks, may provide a short in connection between streets, or may run alongside a road. They can either be shared, or segregated with a white line to delineate which half is to be used by pedestrians, and which by cyclists. Minimum width should be 3 meters, 1.5 meters for cycle lane and 1.5 meters for walkway [10].

Figures 4 to 7 show some example of bicycle facilities [2].

Figure 4: Steps with cycle ramp at Singapore

Figure 5: cycle track and pedestrian walkway at Japan

Figure 6: Cycle path at Manchester

Figure 7: Cycle racks provided at Bristol

3.0 METHODOLOGY

3.1 Procedure Identification

3.1.1 *Data and Literature Review*

The task started with acquiring UTP development plan and relevant documents. UTP plan is needed to determine the traffic zone for traffic modelling purpose while the relevant document is to review the existing data. Literature review is done to collect the relevant information.

3.1.2 *Questionnaires*

The questionnaire is divided into 2 sections and distributed to all blocks with 40 copies each, which catered for about 20% of total the population (total population for year 2005 is 4400). The first section asked about the trip origin and destination generated by the students per hour based on one of their typical day. The purpose of this survey is to know the number of trips produced and attracted respectively by each traffic zones. The trips were made from 6am until 7pm on weekdays based on the student's typical day. The study area was divided into 14 zones as illustrated in Figure 8, which are:

1. **Zone 1** : Village 1
2. **Zone 2** : Village 2
3. **Zone 3** : Village 3
4. **Zone 4** : Village 4
5. **Zone 5** : Village 5 (Base year and future)
6. **Zone 11** : Chancellor Complex
7. **Zone 13** : Pocket C
8. **Zone 12** : Pocket D
9. **Zone 14** : USM Building
10. **Zone 19** : Pocket A and B (Future)
11. **Zone 21** : Sport Complex
12. **Zone 22** : Mosque
13. **Zone 23** : V4 Field
14. **Zone 31** : Outside UTP

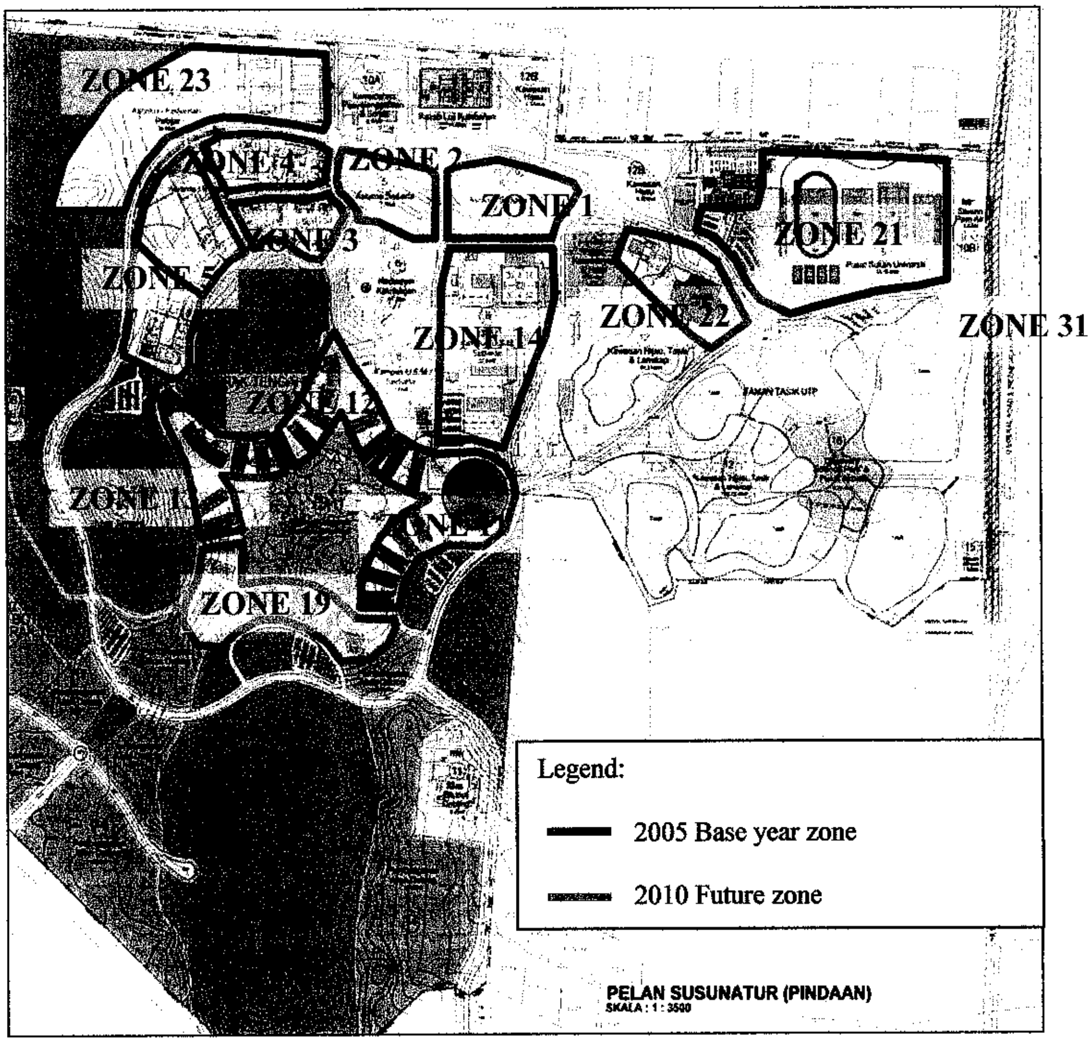

Figure 8: Zoning system

The questionnaires for second section are conducted to know many percent of students are willing to shift their mode of transport from car to bicycle if well designed bicycle facilities are provided. The percentage will be used as an input for matrix 2010 do something under traffic assignment. Apart from that, it is also conducted in order to know the student's opinions in choosing mode of travel in UTP and also to gather information on what new facilities or improvement to existing facilities can increase the level of cycling. 1000 questionnaires were distributed to all villages. For V5, only 6 out of 10 blocks are fully occupied by students for year 2005. Table 1 indicates the total numbers of block and population for each village for year 2005. Samples of questionnaires are shown in the appendix.

Table 1: the numbers of block and population for each village for year 2005

VILLAGE	NUMBER OF BLOCK	POPULATION
Village 1 (V1)	4	600
Village 2 (V2)	6	728
Village 3 (V3)	5	840
Village 4 (V4)	5	840
Village 5 (V6)	6 out of 10	1392 out of 2328

3.1.3 *Reconnaissance Survey*

Reconnaissance survey is conducted to provide an assessment of the physical features in the study area. It is conducted in order to identify the best route location to be proposed, where the distance to travel must be kept to minimum. The survey was conducted within the hostels area (V1, V2, V3, V4 and V5), new campus (POCKET C and D), USM building and sport complex. The proposed cycling network will cover the area around villages and academic building. Apart from that, it is also conducted to observe the existing bicycle facilities and problem identification. Figure 9 shows the reconnaissance survey area.

3.1.4 *Proposed design*

After reconnaissance survey, the next task is to determine the new bicycle facilities to be proposed. Cycle track and shared cycle and pedestrian walkway is to be proposed parallel to (but not on) the existing road while segregated cycle path is to be proposed within the new campus area. Cycle lane is not appropriate because the road provided in UTP is only 2 lanes with unpaved shoulder and also without shoulder and this will make cycling dangerous. Cycle racks are to be proposed at the entrance of academic building in order to ease the bicyclers to park their bicycle and encourage students to use bicycle as their main mode of transport to travel within UTP.

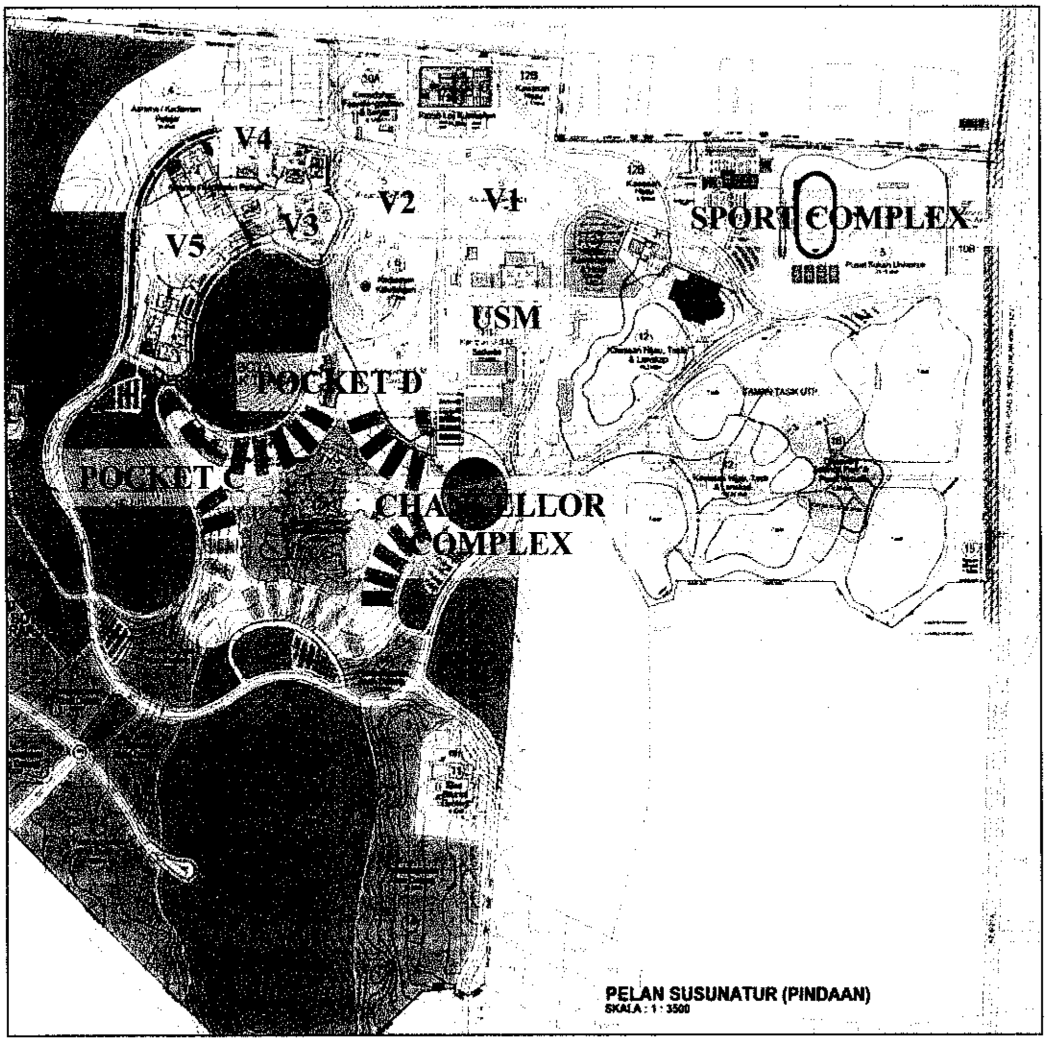

Figure 9: Reconnaissance survey area

.1.5 *Data Analysis*

The questionnaires will be analysed in order to get the trips generated and attracted (OD survey). After determine the OD, the next step is to do the trip matrix to get the 2005 base year trip matrix to be used as an input in EMME2 software under traffic assignment. Trip matrix indicates the number of trips between each origin-destination pair, and the row and column totals indicate the total number of origins and destinations respectively in each zone.

3.1.6 *Traffic Modelling (traffic assignment)*

A traffic model is used for forecasting traffic flows on a transport network as outcomes of future development. Software package used is EMME2 traffic software. This software package is considered to be the most appropriate analytical tool because of its transparency, in that all the key functions and assumptions of the computer model are user friendly and readily audited and replicated.

The traffic models are developed essentially in two stages which are the base year traffic model and future year models. The base year traffic model incorporates both existing and newly collected data for year 2005. The future year models (2010) incorporate assumptions regarding total population.

The trip matrixes were split into car and bicycle trips. EMME2 software was used to assign travel demand (trip matrix) onto the transport network. The traffic assignments results from the EMME2 model runs were analysed to determine the performance of various links. The software will run for seven (7) scenarios which are:

1. **Scenario 1**: Bicycle 2005 base year
2. **Scenario 2**: Car 2005 base year
3. **Scenario 3**: Bicycle 2010 do SOMETHING
4. **Scenario 4**: Car 2010 do SOMETHING
5. **Scenario 5**: Bicycle 2010 do NOTHING
6. **Scenario 6**: Car 2010 do NOTHING
7. **Scenario 7**: Bicycle 2010 do NOTHING (shifted matrix)

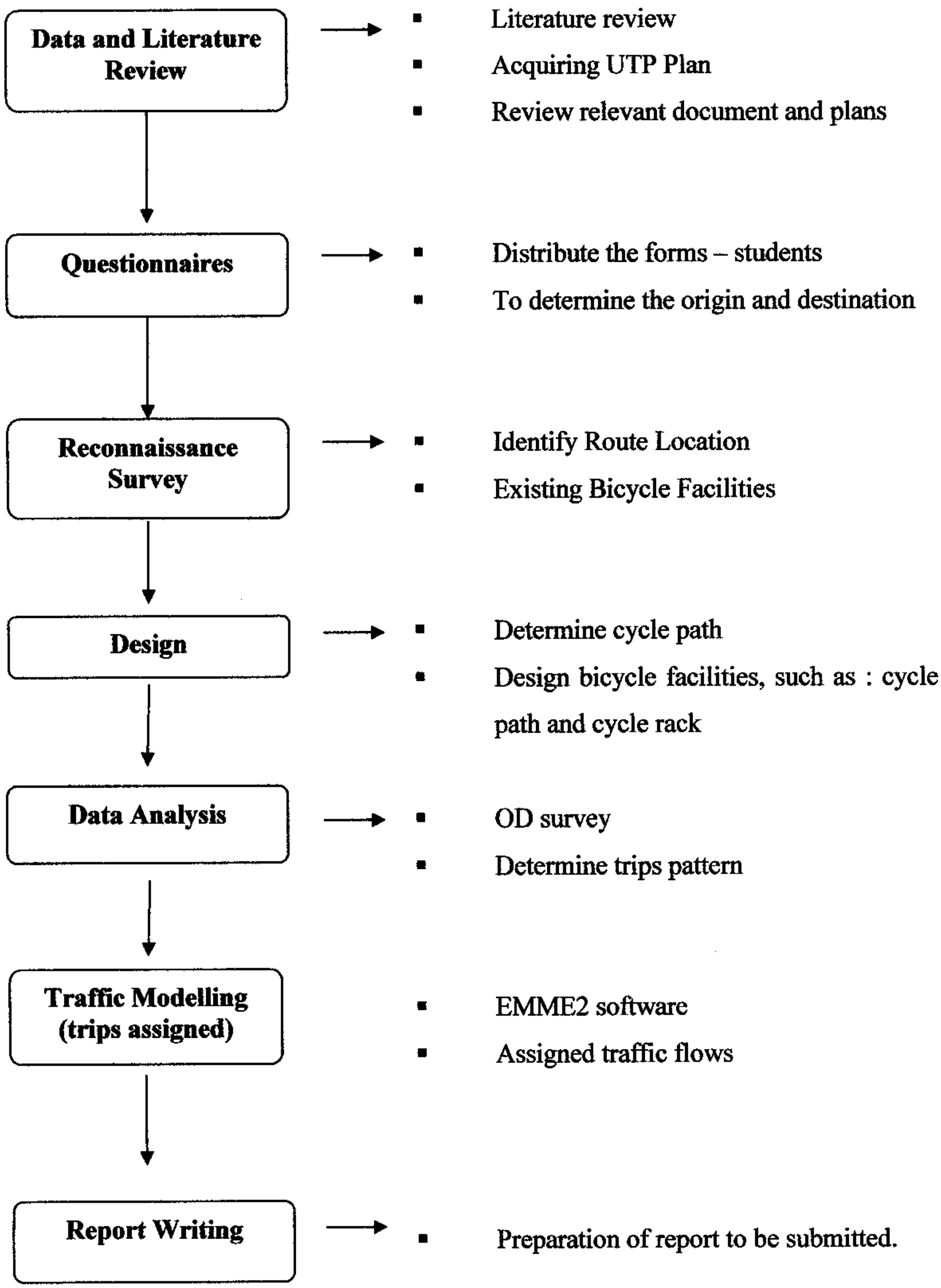

Figure 10: Procedures identification flow chart

.0 RESULT AND DISCUSSION

.1 Findings

.1.1 *Travel demand*

Travel demand is expressed as the number of persons or vehicles per unit time that can be expected to travel on a given segment of a transportation system under a set of given landuse, socio-economic and environmental conditions. The total population of UTP students in 2005 base year is 4400 and for 2010, total population for fully developed is 6600. The approach that is commonly used to forecast travel demand is the 'four-step process' of:

1. **Trip Generation and Attraction** determines the number of trips by persons and vehicles.
2. **Trip Distribution** determines the distribution of the trips throughout the area.
3. **Modal Choice** determines the type of mode, usually private or public, used for the trip.
4. **Traffic Assignment** determines the highway or transit route that the trips take. EMME/2 traffic software is used in order to determine the trips assigned.

I.1.2 *Trip Generation and Distribution*

The questionnaire is divided into 2 sections and distributed to all blocks with 40 copies each. The first section asked about the trip origin and destination generated by the students from 6am to 7pm based on their typical day. The purpose of this survey is to know the number of trips produced and attracted respectively by each traffic zones. Only 50% of the questionnaires distributed were successfully collected. Figure 11 shows the 2005 base year matrix for all mode of transport.

MATRIX FOR ALL MODES OF TRANSPORT			DESTINATION											TOTAL TRIP GENERATION
			V1	V2	V3	V4	V5	USM	SPORT COMPLEX	NEW CAMPUS	POCKET C	POCKET D	OUTSIDE UTP	
			1	2	3	4	5	6	7	8	9	10	11	
ORIGIN	V1	1	-	0	1	1	0	40	19	10	12	29	6	118
	V2	2	1	-	2	18	0	83	32	9	34	102	8	289
	V3	3	1	7	-	6	27	9	14	16	28	34	1	143
	V4	4	0	31	4	-	15	3	8	10	12	20	0	103
	V5	5	0	0	22	19	-	37	48	36	75	113	29	379
	USM	6	33	75	16	10	30	-	1	9	6	21	3	204
	SPORT COMPLEX	7	15	32	11	4	48	0	-	0	1	0	0	111
	NEW CAMPUS	8	9	12	15	4	39	7	0	-	8	14	0	108
	POCKET C	9	6	38	23	9	62	11	1	11	-	28	0	189
	POCKET D	10	17	67	37	24	72	29	0	24	40	-	1	311
	OUTSIDE UTP	11	5	8	1	0	28	1	0	0	0	0	-	43
TOTAL TRIP ATTRACTION			87	270	132	95	321	220	123	125	216	361	48	1998

Figure 11: 2005 base year matrix for all mode of transport

After cleaning and transposing all the survey data into a matrix format, it is necessary to expand them in order to make up the total number of trips as per the collected traffic counts. Before expanding the data, the zonal trip value must be filled with some value. Trip values equal to zero is not logic because rationally from one zone to one zone, there must be at least one trip generated. It would have required a significant number of extra samples resulting in much additional cost and time to observe all movement on the ground. The factor of 0.45 was selected because when the zonal trip value multiplies with 0.45, the answer will still be zero. Another reason was when the 0.45 value is rounded to an even number, the value will still be zero. Thus, 0.45 is the best option.

The in-filling is defined as below:

$$\text{Samples in-filling} = 0.45 \times \frac{\text{total trips per zone}}{\text{total trips all zones}}$$

In order to build up a full complete through picture that is representative of all students' population, the questionnaire sample was expanded to full volume counts. This is achieved by computing sample expansion factors for each origin and destination by their respective residence.

The factor is defined as below:

$$\text{Samples expansion factor} = \frac{\text{Total of students' population}}{\text{Survey samples}}$$

Based on the modified matrix, the total trips generated and attracted by all means of transport mode in year 2005 is 22000 person-trips per day, equivalent to 5 trips per person per day. Figure 12 shows the 2005 base year modified matrix for all mode of transport.

MATRIX FOR ALL MODES OF TRANSPORT			Destination													TOTAL TRIP GENERATION
			V1	V2	V3	V4	V5	USM	SPORT	CHANS	POCKET C	POCKET D	V4 FIELD	MOSQUE	OUTSIDE	
			1	2	3	4	5	14	21	11	13	12	23	22	31	
Origin	V1	1	0	5	16	21	6	125	89	26	78	202	3	89	82	743
	V2	2	5	0	17	99	5	407	162	47	169	500	55	55	43	1564
	V3	3	12	55	0	148	203	223	544	160	615	699	88	55	493	3295
	V4	4	25	166	127	0	145	311	395	229	577	507	95	120	401	3097
	V5	5	6	5	176	137	0	263	340	253	526	790	58	53	205	2813
	USM	14	270	368	292	246	207	0	19	54	57	116	5	6	26	1667
	SPORT	21	108	161	492	171	339	11	0	8	17	11	6	7	9	1341
	CHANS	11	74	62	205	173	268	108	10	0	37	110	3	4	6	1059
	POCKET C	13	72	188	549	182	443	55	17	125	0	186	4	5	7	1832
	POCKET D	12	176	329	696	343	504	179	11	172	230	0	4	5	12	2661
	V4 FIELD	23	3	55	88	90	58	4	6	3	5	6	0	2	4	323
	MOSQUE	22	89	55	55	115	53	5	7	3	6	6	2	0	4	400
	OUTSIDE	31	64	42	476	374	199	12	10	5	7	8	3	4	0	1203
TOTAL TRIP ATTRACTION			903	1491	3189	2098	2431	1704	1608	1085	2325	3142	328	404	1292	22000

Figure 12: 2005 base year modified matrix for all mode of transport

.1.3 Modal Choice

The trip matrixes were split into four (4) which are car, motorcycle, walking and bicycle trips. But under this study, only matrixes for car and bicycle were analysed. Figure 13 and 14 shows the 2005 base year modified matrix for car and bicycle respectively.

.1.4 Traffic Assignment

The purpose of running EMME2 software is to determine the trips assigned for each trip generated. To run the Emme/2 software, 3 inputs needed;

1. Nodes and links
   - Distance from node-to-node (length of the link)
   - Road hierarchy
   - Number of lane
   - Type of VDF
2. Trip matrix
3. VDF (Volume Delay Function) = (Length / Speed)

The nodes and the length of the link are determined by using AUTOCAD software from the plan acquired through KLCC Project Team. In UTP, the road is two lanes for both ways and the hierarchy is the same. EMME2 input for nodes and links is shown in appendix. There are two (2) type of VDF, which is car and bicycle. For car, the speed limit is 20kph. The link type is local road and landuse type is CBD. From Highway Capacity Manual (HCM 2000), the speed limit for American cyclist is 400min per meter, thus Malaysian people the speed limit is assumed to be 200min per meter. The VDF equation is shown in appendix.

MATRIX FOR CAR			Destination													TOTAL TRIP GENERATION
			V1	V2	V3	V4	V5	USM	SPORT	CHANS	POCKET C	POCKET D	V4 FIELD	MOSQUE	OUTSIDE	
			1	2	3	4	5	14	21	11	13	12	23	22	31	
Origin	V1	1	0	2	3	3	2	18	10	2	45	69	1	1	79	234
	V2	2	1	0	2	7	1	74	35	1	50	25	0	20	17	234
	V3	3	3	22	0	4	3	169	236	17	170	34	2	51	489	1199
	V4	4	5	19	6	0	29	169	141	140	365	4	4	84	365	1330
	V5	5	2	1	3	3	0	133	133	70	71	42	1	2	155	617
	USM	14	35	59	202	62	140	0	9	2	23	25	1	1	22	581
	SPORT	21	9	35	202	57	133	2	0	1	3	1	1	1	3	448
	CHANS	11	29	1	2	84	63	15	2	0	16	1	0	1	3	218
	POCKET C	13	44	40	152	117	78	23	2	15	0	6	1	1	4	483
	POCKET D	12	35	25	7	3	35	18	1	8	18	0	0	1	8	158
	V4 FIELD	23	1	0	2	2	1	1	1	1	2	1	0	0	3	15
	MOSQUE	22	1	20	51	84	2	2	1	1	2	1	0	0	3	169
	OUTSIDE	31	62	22	472	365	162	8	4	3	4	3	2	3	0	1111
TOTAL TRIP ATTRACTION			227	244	1104	792	649	632	574	261	769	212	15	167	1151	6799

Figure 13: 2005 base year modified matrix for Car

MATRIX FOR BICYCLE			Destination													TOTAL TRIP GENERATION
			V1	V2	V3	V4	V5	USM	SPORT	CHANS	POCKET C	POCKET D	V4 FIELD	MOSQUE	OUTSIDE	
			1	2	3	4	5	14	21	11	13	12	23	22	31	
Origin	V1	1	0	1	2	3	1	2	3	0	1	0	0	0	0	13
	V2	2	1	0	2	4	1	7	27	1	6	1	1	1	1	50
	V3	3	1	2	0	5	2	18	53	17	51	2	1	1	2	155
	V4	4	3	4	5	0	4	28	29	3	4	3	3	3	3	94
	V5	5	1	1	3	4	0	3	23	1	8	1	1	1	7	53
	USM	14	2	7	18	28	3	0	5	2	19	2	2	2	2	93
	SPORT	21	3	27	53	29	23	5	0	3	4	3	3	3	3	159
	CHANS	11	1	1	50	4	1	18	4	0	2	1	1	1	1	84
	POCKET C	13	1	1	51	4	8	3	4	1	0	22	1	1	1	97
	POCKET D	12	0	5	2	4	7	2	3	17	1	0	0	0	1	44
	V4 FIELD	23	0	1	2	0	1	0	1	0	1	0	0	0	0	6
	MOSQUE	22	0	1	2	0	1	0	1	0	1	0	0	0	0	6
	OUTSIDE	31	0	1	2	3	1	2	3	0	1	0	0	0	0	13
TOTAL TRIP ATTRACTION			13	50	191	88	53	90	157	48	97	36	13	13	21	868

Figure 14: 2005 base year modified matrix for Bicycle

The EMME2 software will forecast the travel demand for two mode of transport, which is car and bicycle for 2 times horizon; 2005 and 2010. The reason is to get the pattern of travel demand in year 2005 and 2010 and do the comparison between 2010 do nothing (existing condition) and 2010 do something (provided well designed cycling facilities). The estimated students population for year 2005 is 4400 and for year 2010, the total population of fully developed is 6600. Thus the growth factor for year 2010 is 1.5. There were only two (2) new zones in year 2010, which is zone 5 (additional new population) and zone 19. The additional new population for zone 5 is 936, thus make the total population in year 2010 to be 2328. While all trip generated and attracted from zone 14 is assumed to be totally shifted to zone 19 in year 2010.

The software will run for seven (7) scenarios:

1. **Scenario 1: bicycle 2005 base year**

a) UTP is not yet fully developed
b) Bicycle facilities are not 100% provided
c) Matrix = bicycle 2005 base year matrix.

2. **Scenario 2: car 2005 base year**

a) UTP is not yet fully developed
b) Bicycle facilities are not 100% provided
c) Matrix = car 2005 base year matrix.

3. **Scenario 3: bicycle 2010 do SOMETHING**

a) UTP is assumed to be fully developed
b) Well-designed bicycle facilities are provided
c) Matrix = bicycle 2010 matrix + additional shift matrix (car-to-bicycle)

4. **Scenario 4: car 2010 do SOMETHING**

a) UTP is assumed to be fully developed
b) Well-designed bicycle facilities are provided
c) Matrix = car 2010 matrix - additional shift matrix (car-to-bicycle)

5. **Scenario 5: bicycle 2010 do NOTHING**
a) UTP is assumed to be fully developed
b) Well-designed bicycle facilities are NOT provided
c) Matrix = bicycle 2010 matrix

6. **Scenario 6: car 2010 do NOTHING**
a) UTP is assumed to be fully developed
b) Well-designed bicycle facilities are NOT provided
c) Matrix = car 2010 matrix

7. **Scenario 7: bicycle 2010 do NOTHING (shifted matrix)**
a) UTP is assumed to be fully developed
b) Well-designed bicycle facilities are NOT provided
c) Matrix = bicycle 2010 matrix + additional shift matrix (car-to-bicycle)

The increases of cycling demand in year 2010 do something will be based on the questionnaires analysis of how many students are willing to change their mode of transport from car to bicycle if enough and well designed cycling facilities are provided. The increases in cycling demand will reduce the demand for traveling with car in 2010. In 2005 base year and 2010 do nothing, the cycling path will follow the road network. As for 2010 do something, it is assumed that UTP is full provided with cycling facilities, which means that bicycle will follow its own path.

From the survey, total number of students willing to change their mode of transport if well designed bicycle facilities are provided is 57.3% while the remaining students who do not want to change is 42.7%. The trips matrix for all scenarios is shown in appendix. Figure 15 shows the zoning system in EMME2 road network. Figure 16 to figure 29 show the EMME2 output for each scenario. The detail auto volume for each link for all scenarios is shown in appendix.

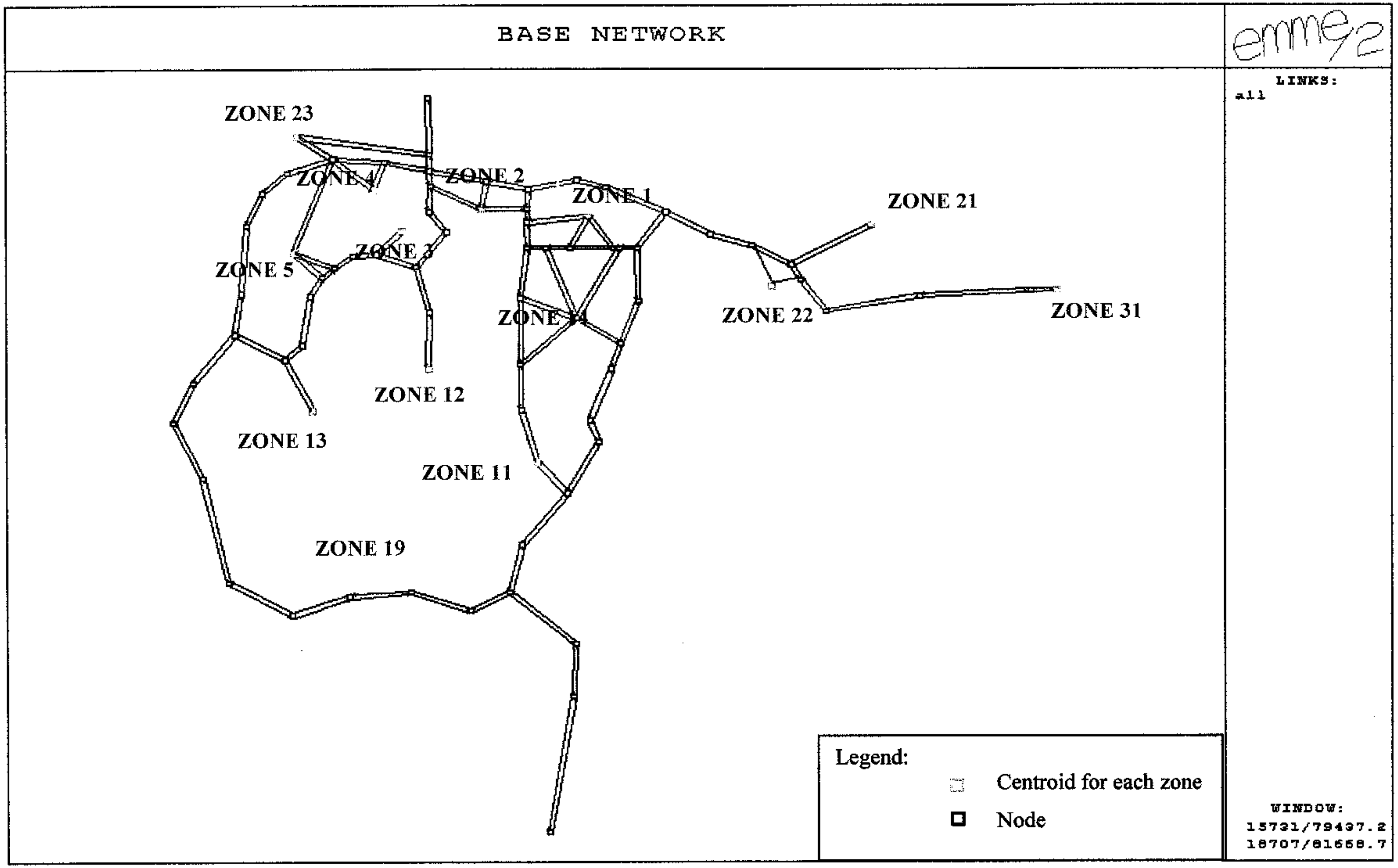

Figure 15: EMME2 output zoning system

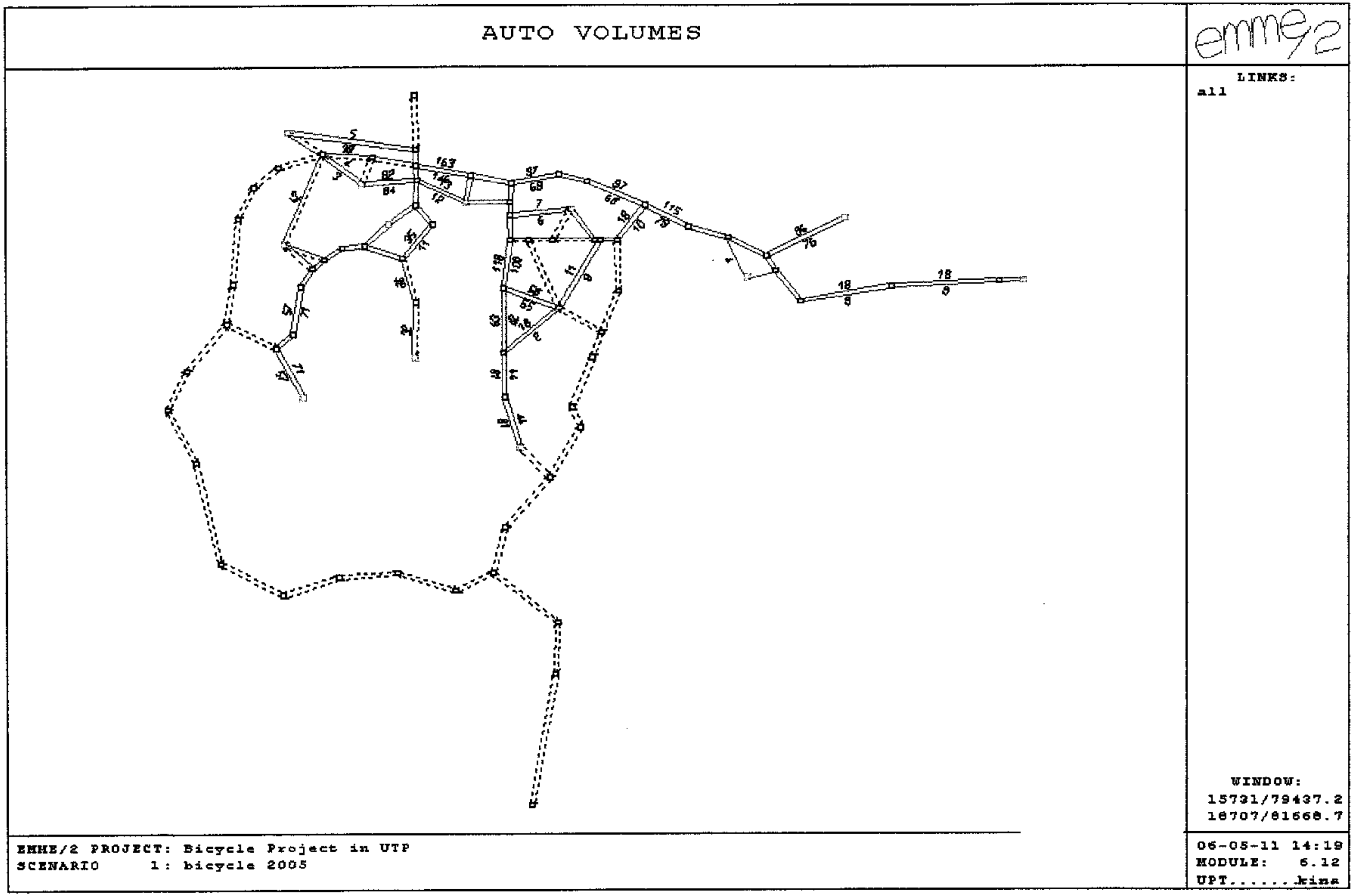

Figure 16: Scenario 1 bicycle 2005 base year (Numeric value)

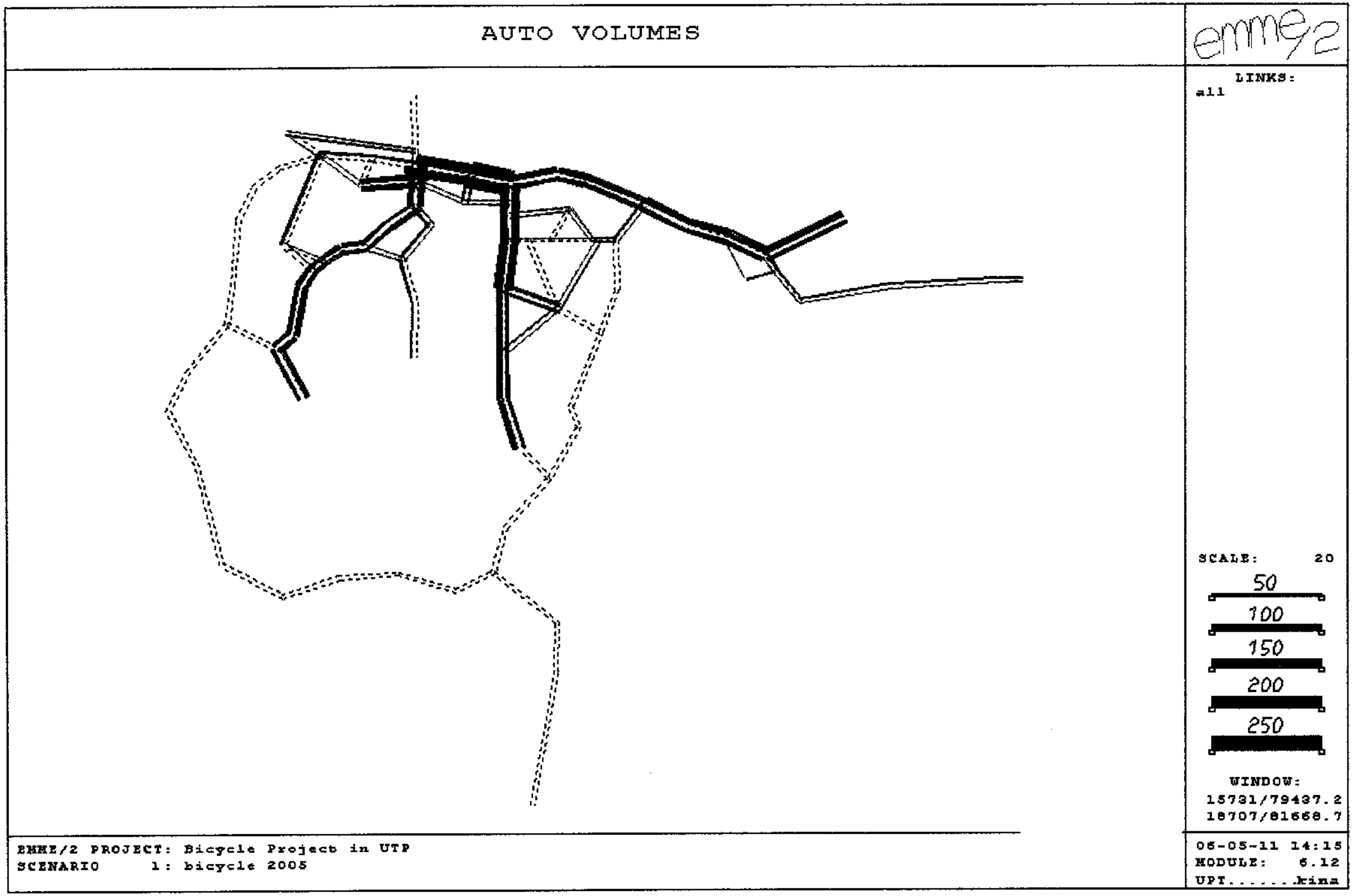

Figure 17: Scenario 1 bicycle 2005 base year (Bar plot)

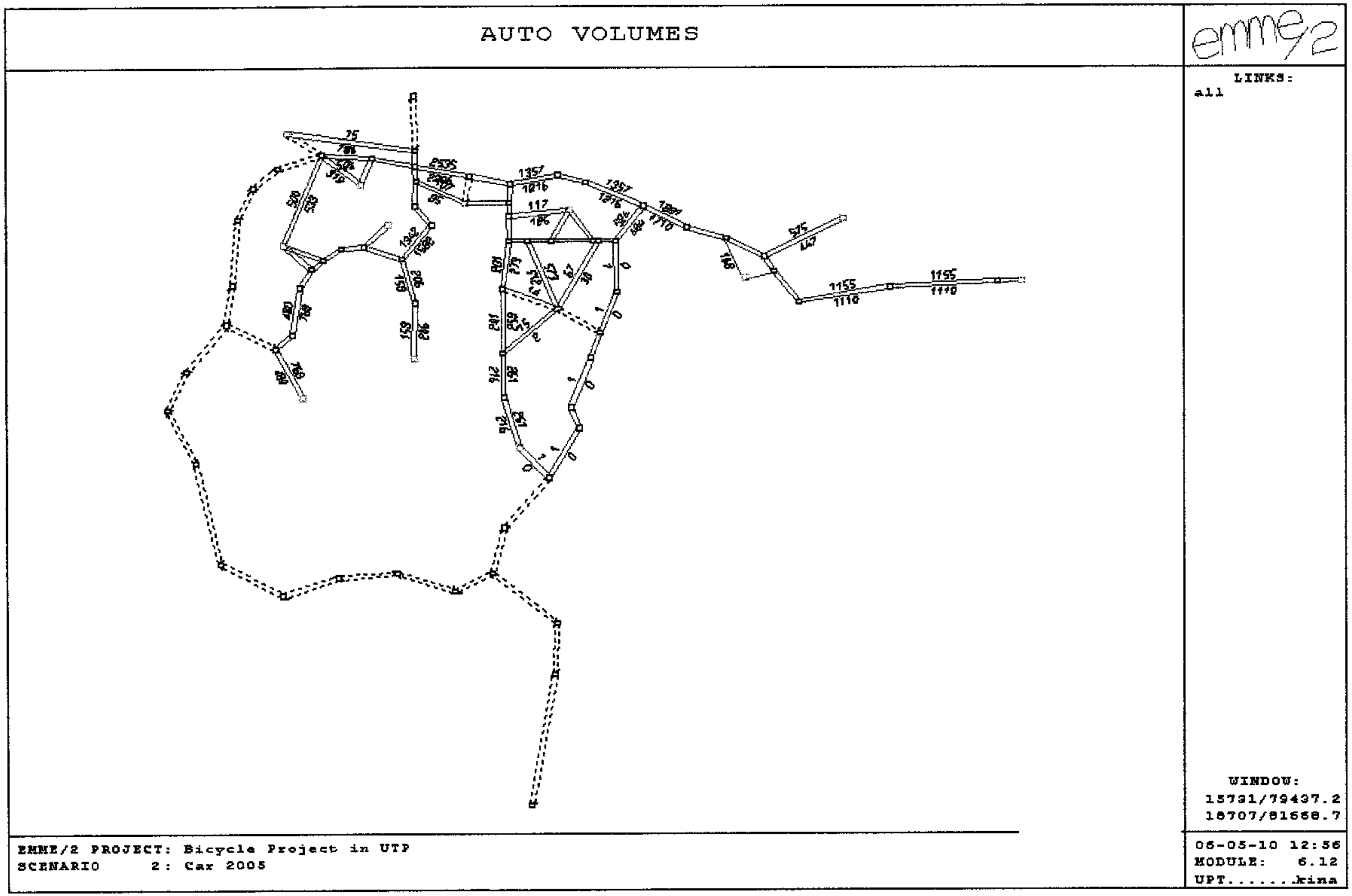

Figure 18: Scenario 2 car 2005 base year (Numeric value)

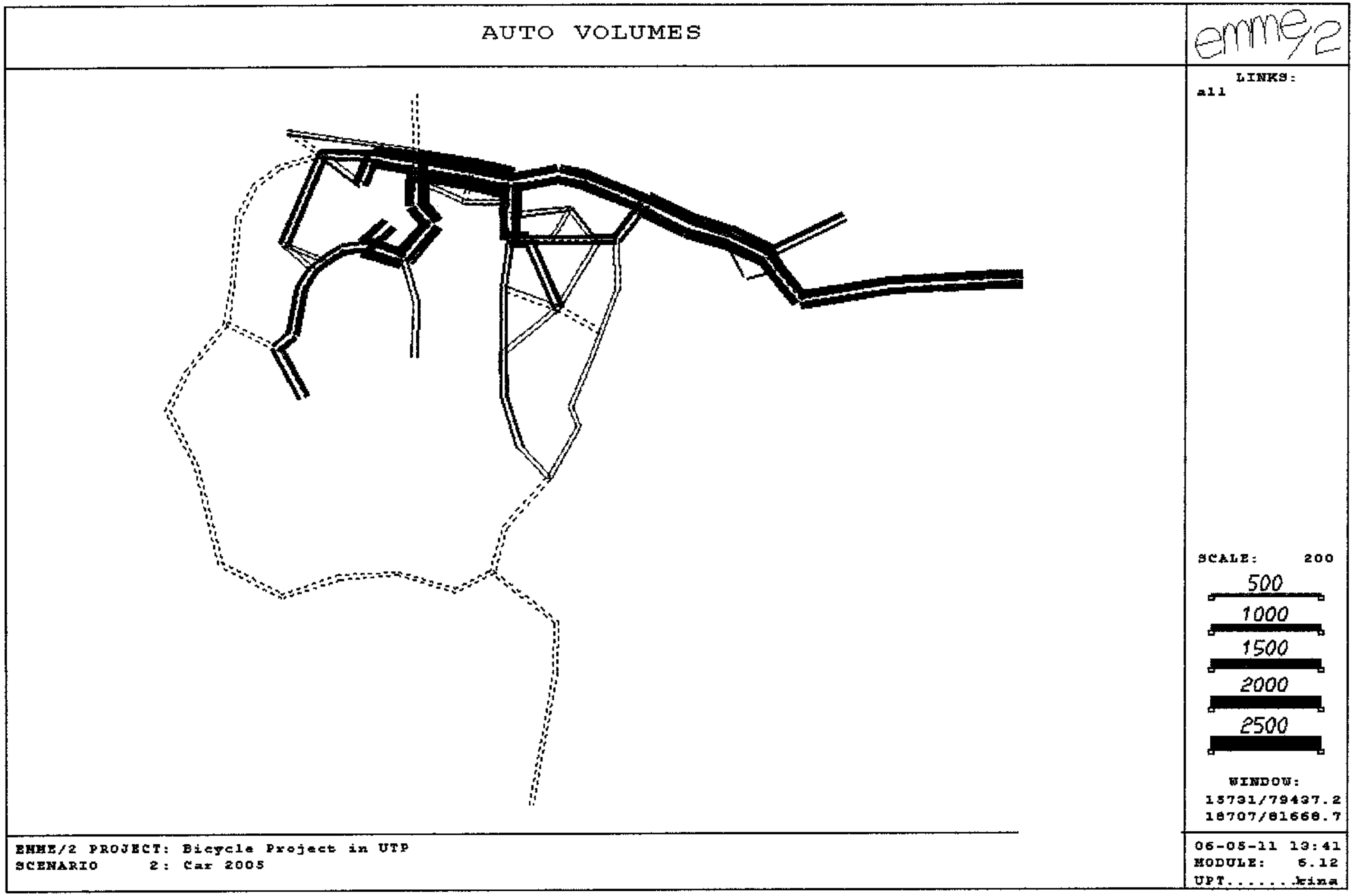

Figure 19: Scenario 2 car 2005 base year (Bar plot)

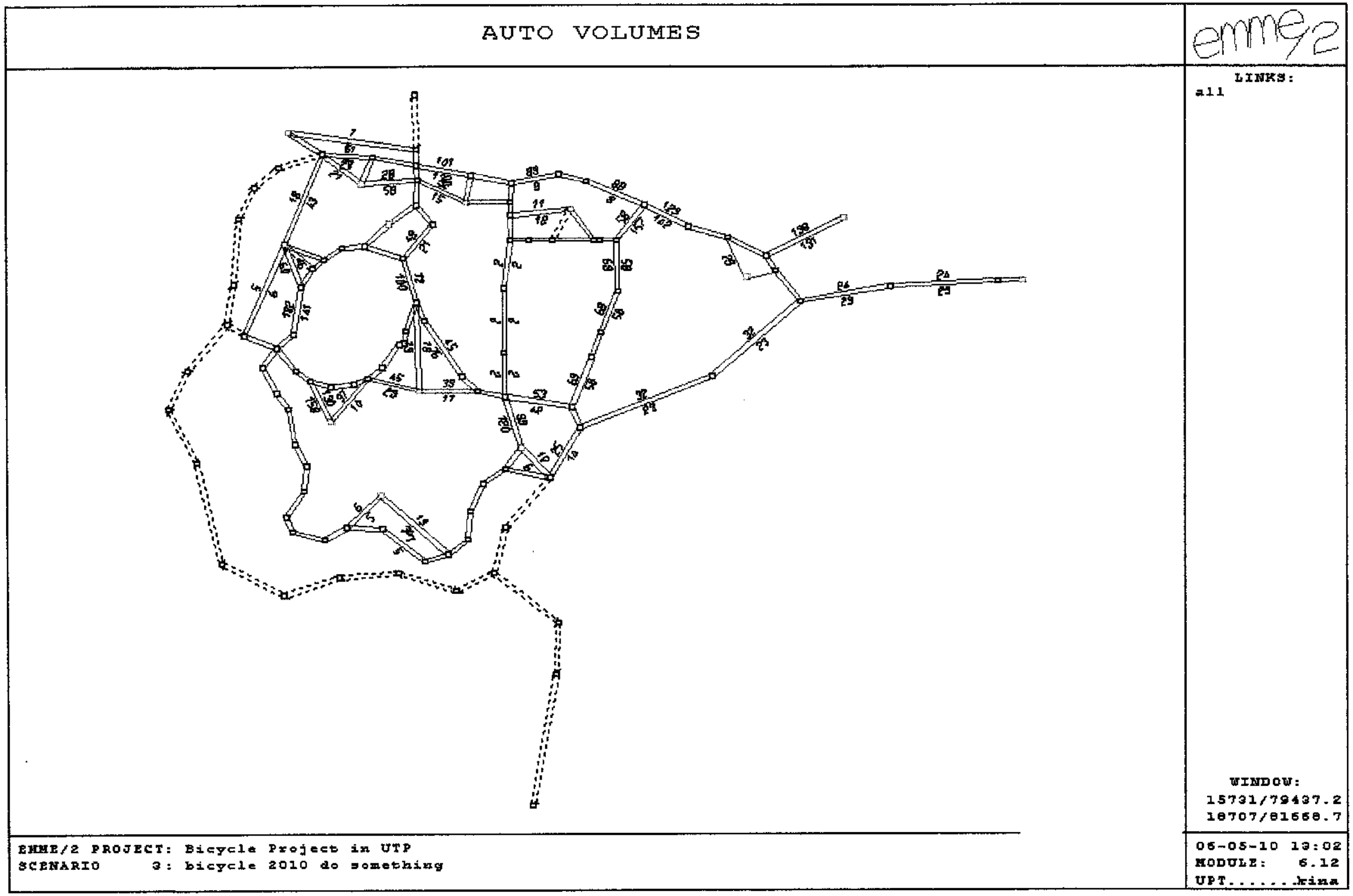

Figure 20: Scenario 3 bicycle 2010 do SOMETHING (Numeric value)

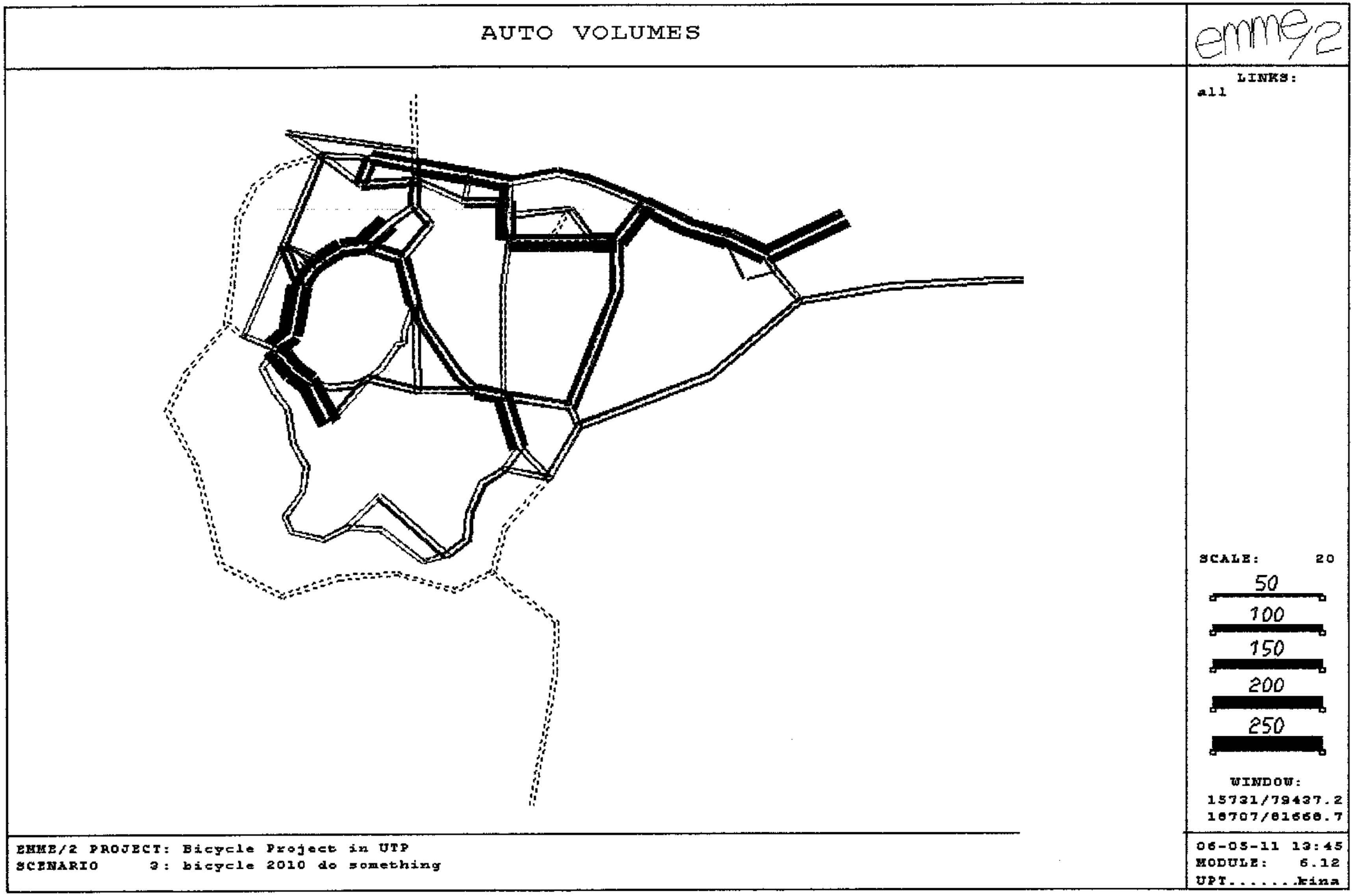

Figure 21: Scenario 3 bicycle 2010 do SOMETHING (Bar plot)

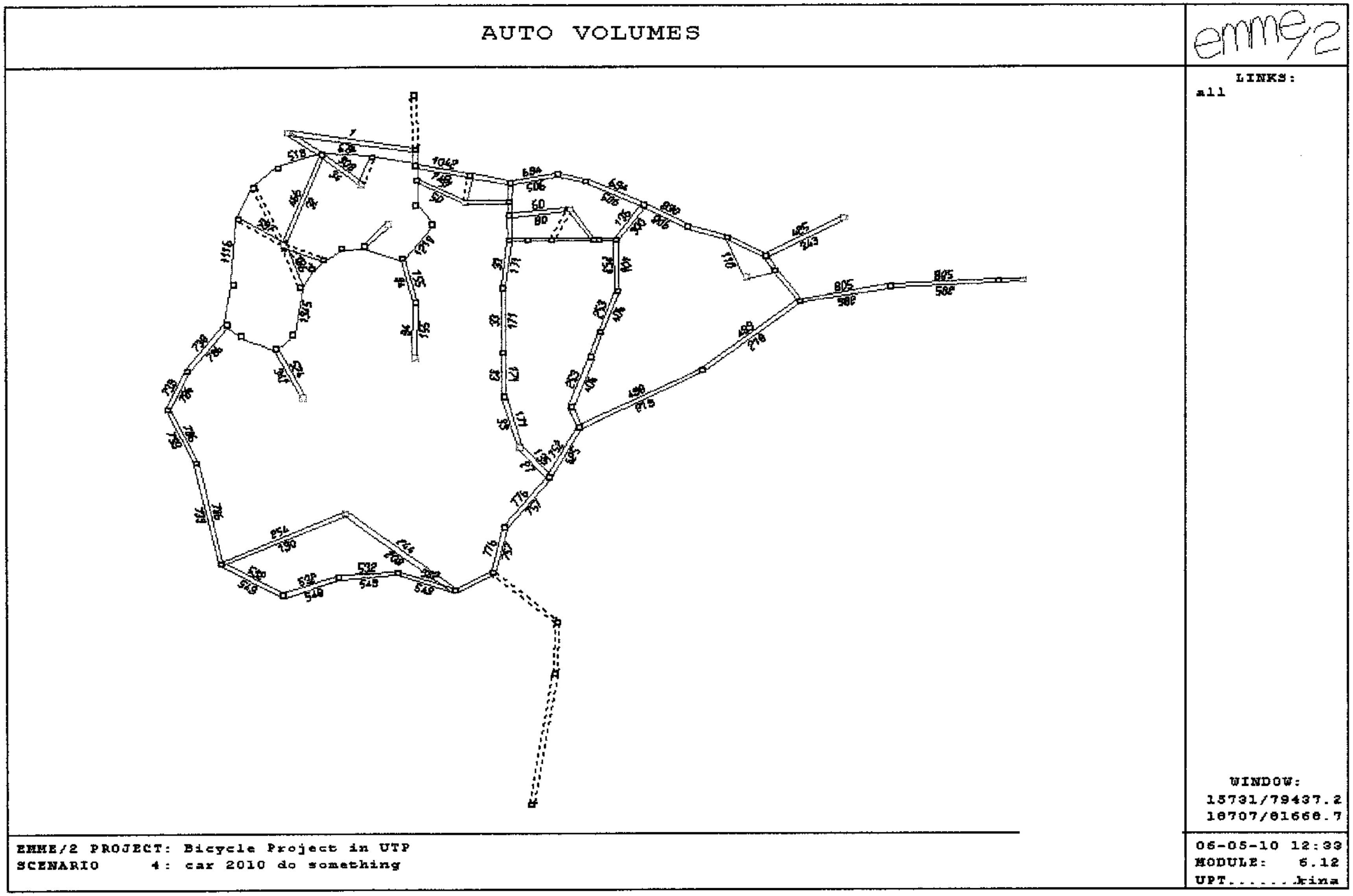

Figure 22: Scenario 4 car 2010 do SOMETHING (Numeric value)

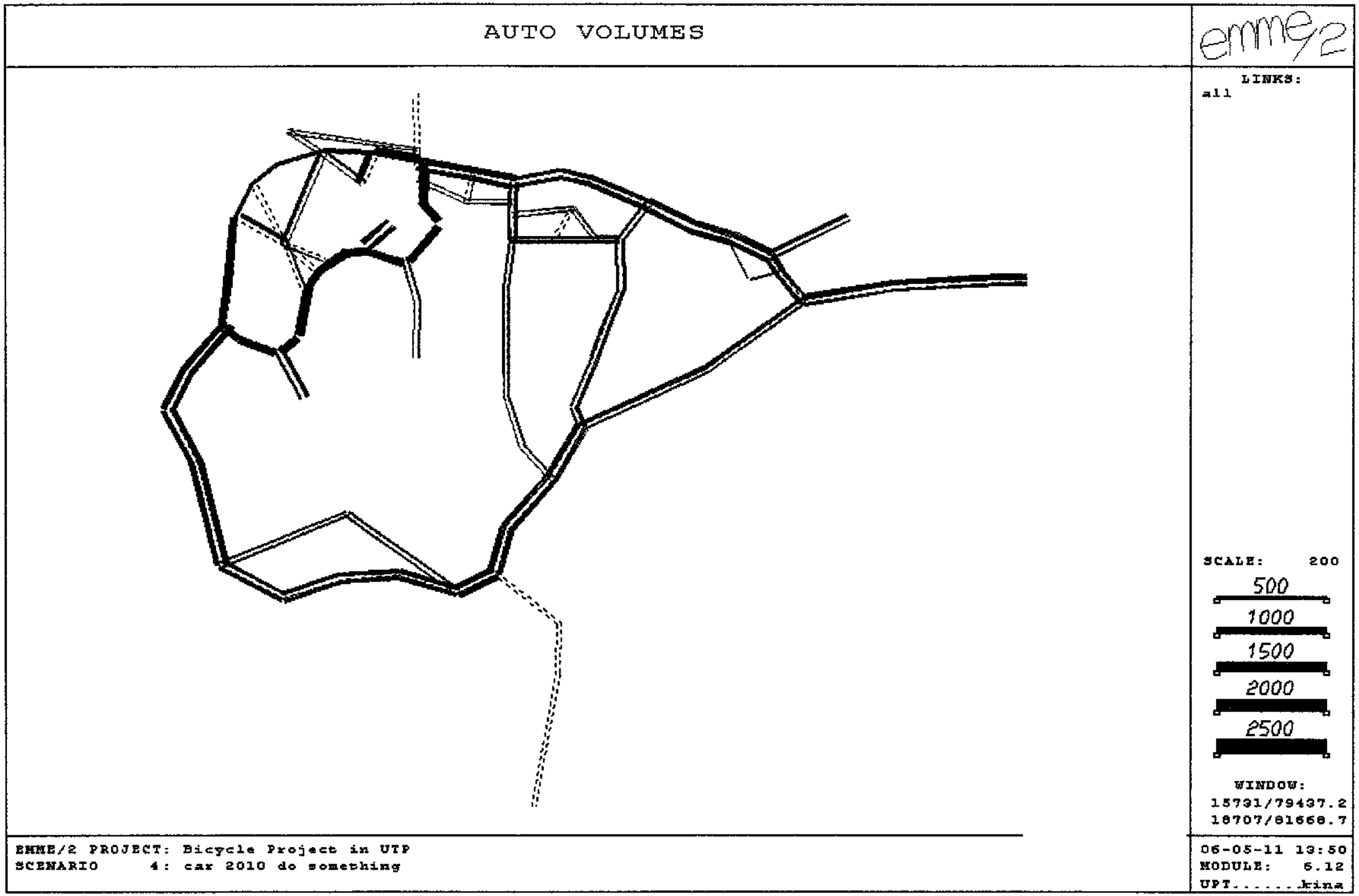

Figure 23: Scenario 4 car 2010 do SOMETHING (Bar plot)

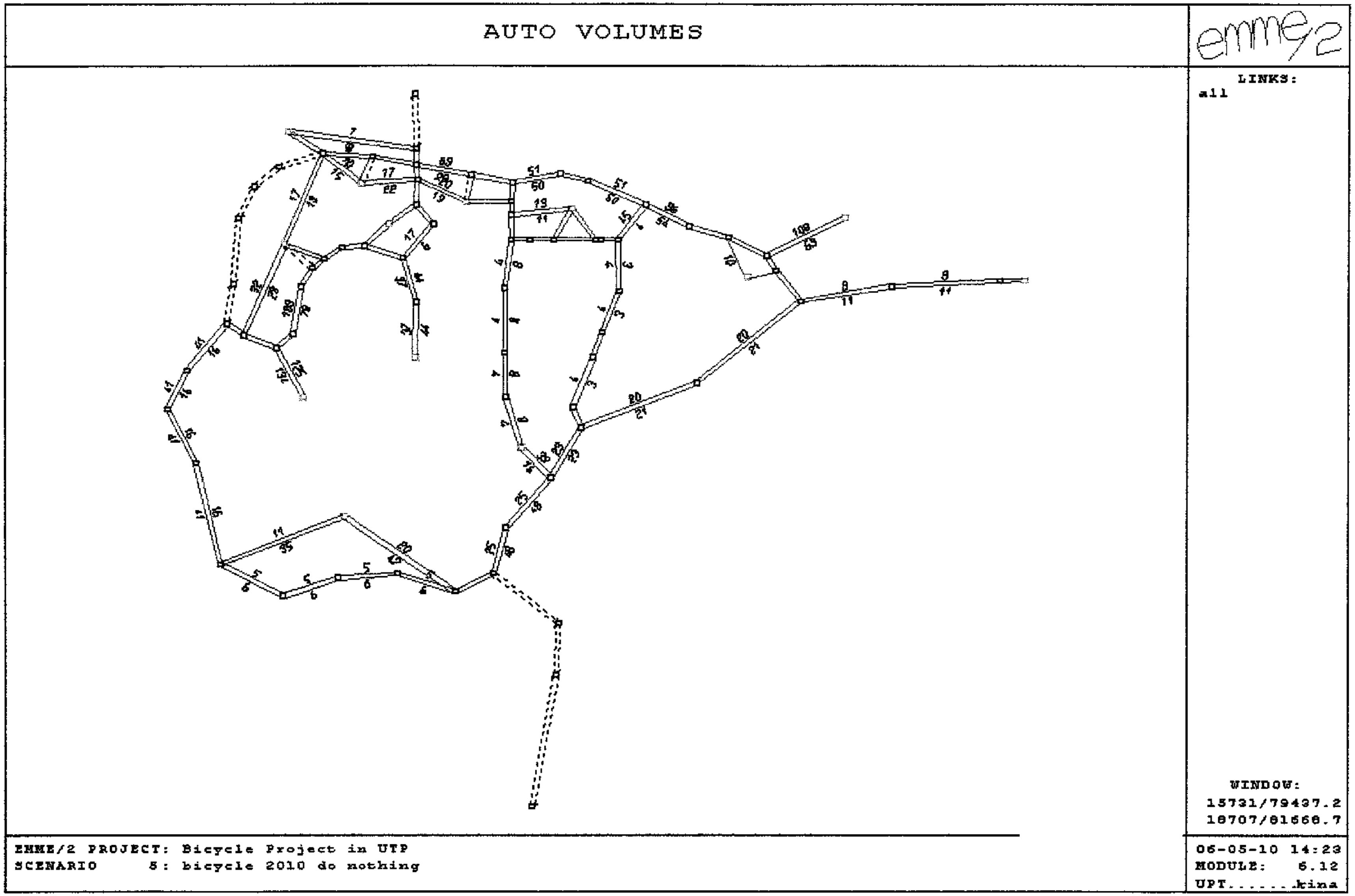

Figure 24: Scenario 5 bicycle 2010 do NOTHING (Numeric value)

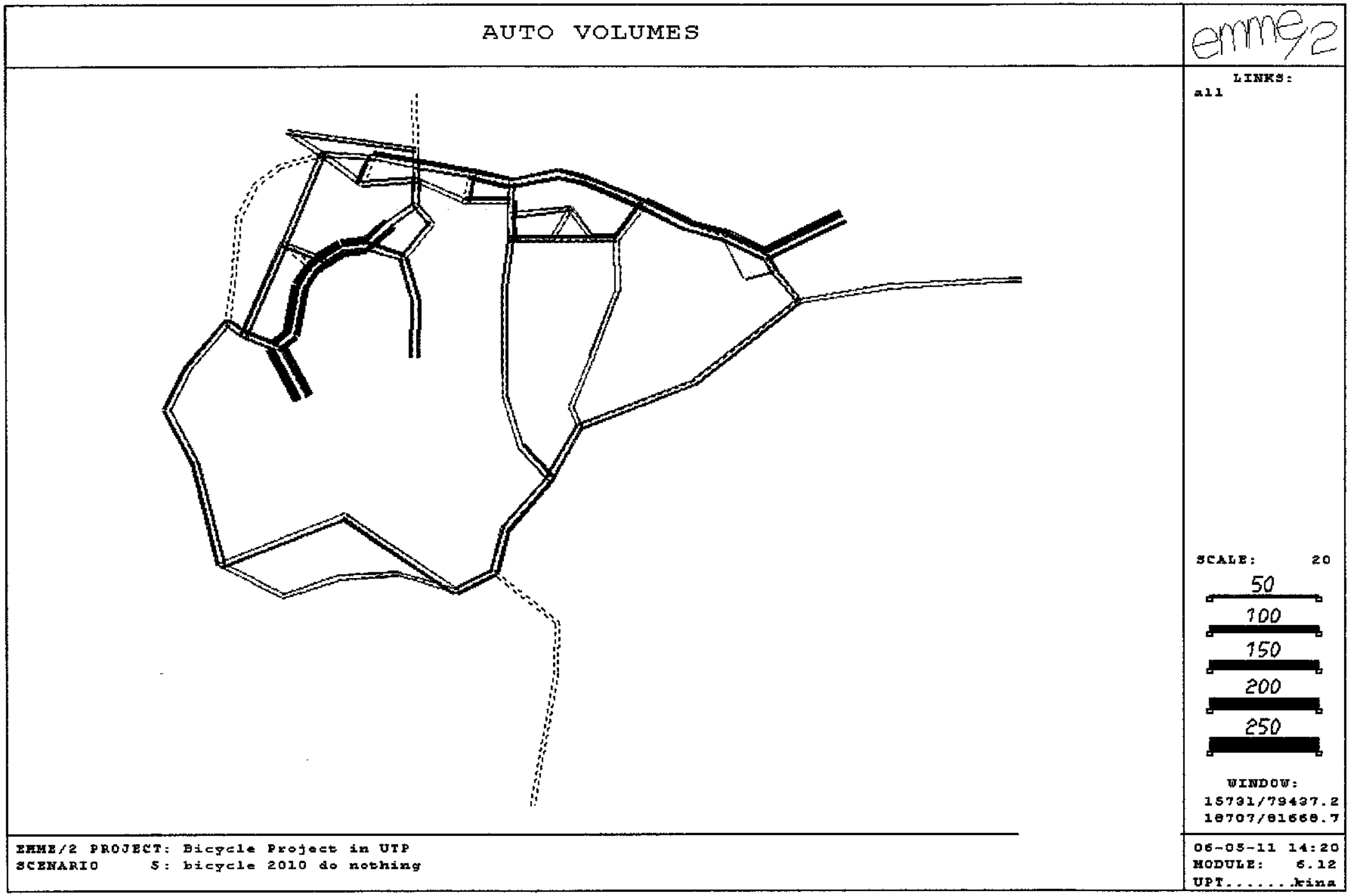

Figure 25: Scenario 5 bicycle 2010 do NOTHING (Bar plot)

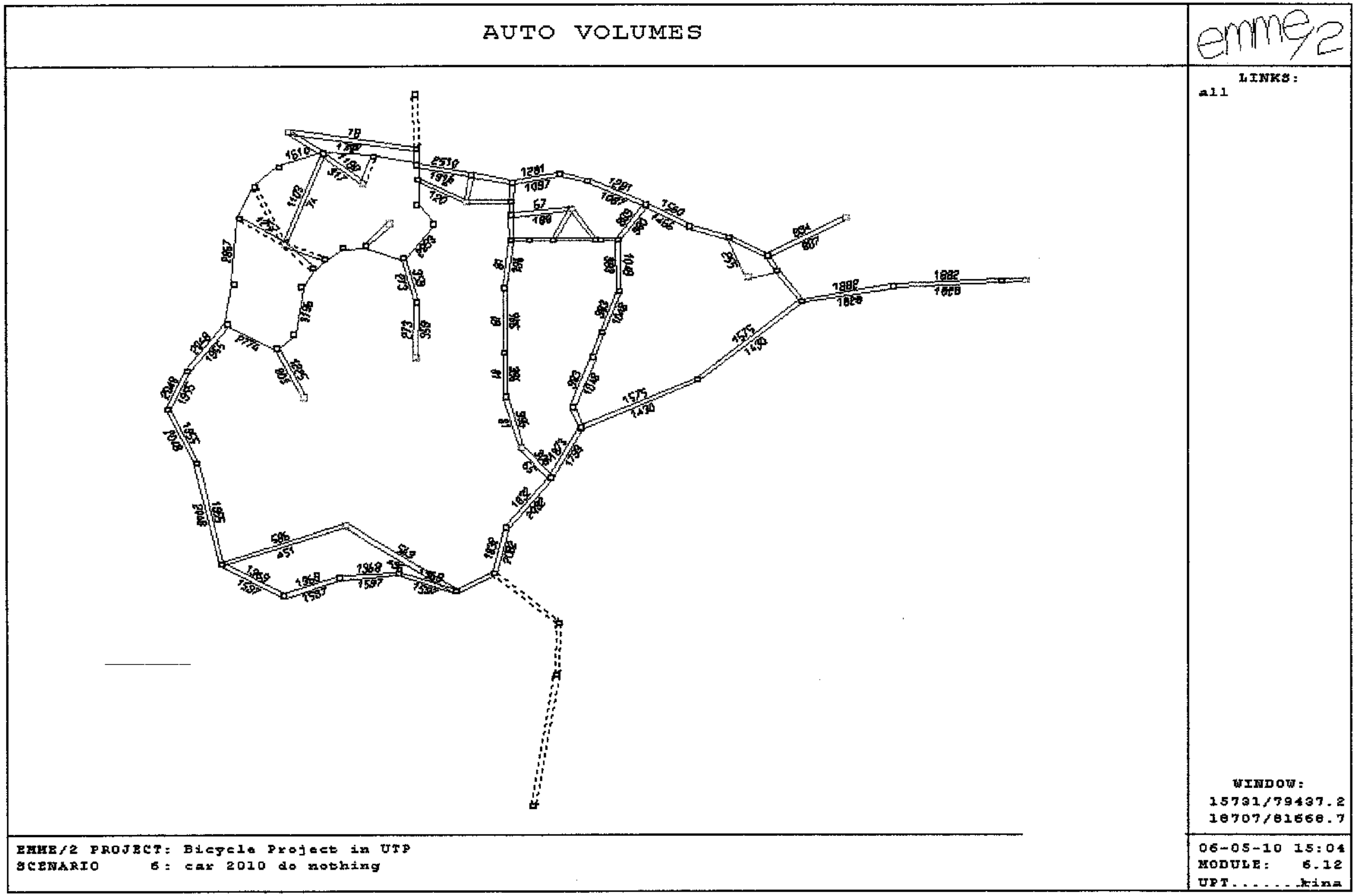

Figure 26: Scenario 6 car 2010 do NOTHING (Numeric value)

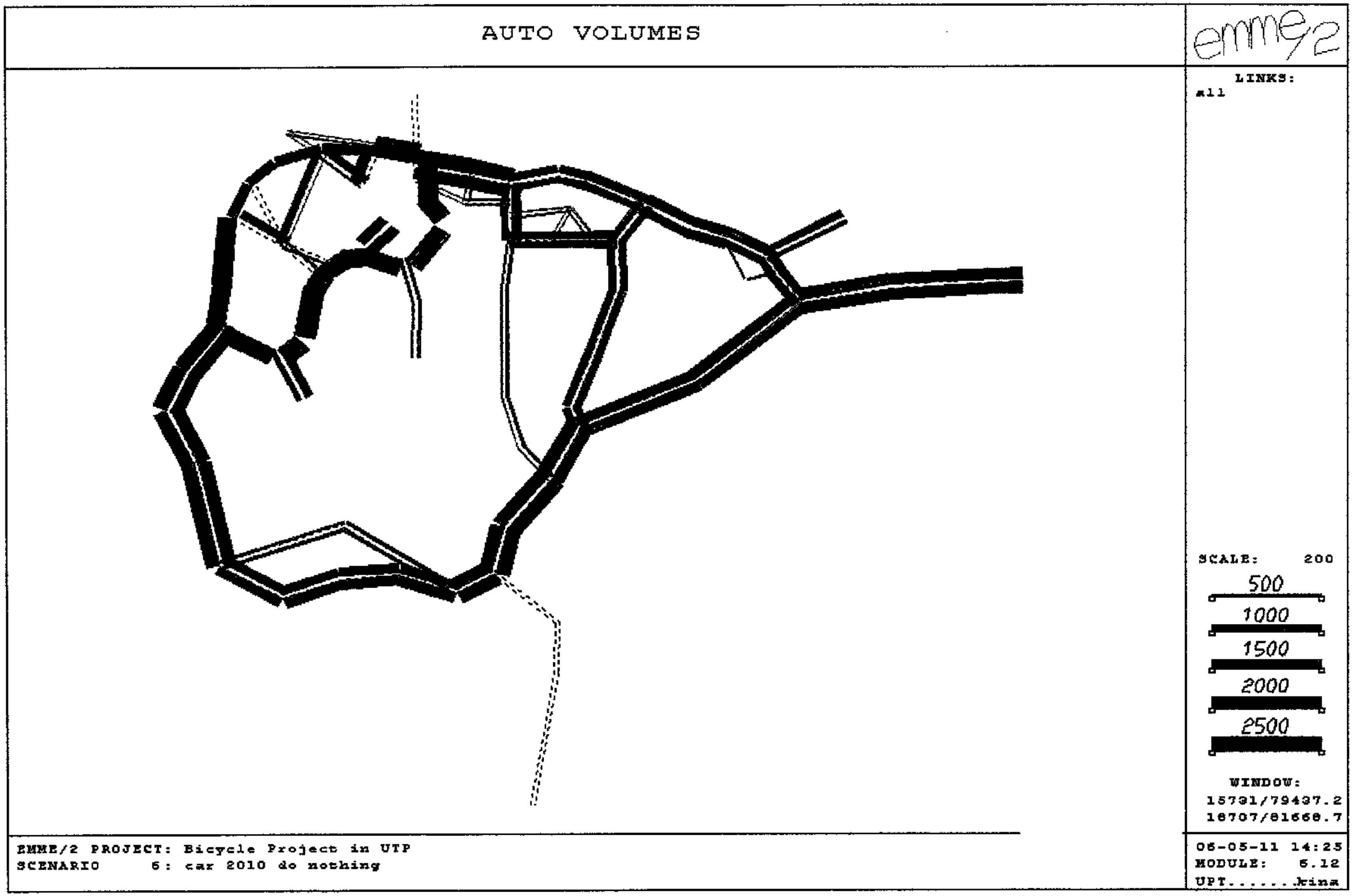

Figure 27: Scenario 6 car 2010 do NOTHING (Bar plot)

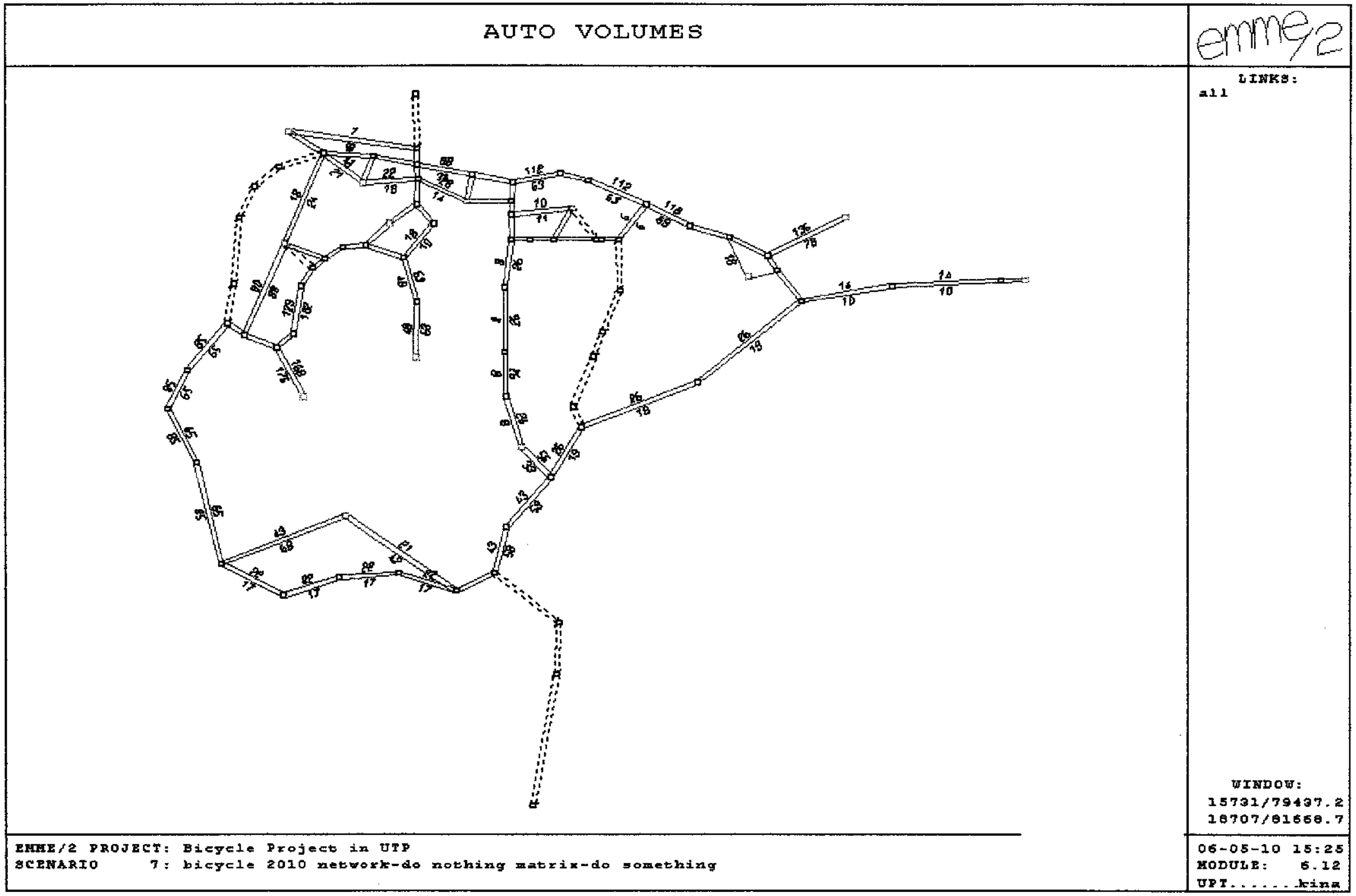

Figure 28: Scenario 7 bicycle 2010 do NOTHING (shifted matrix) (Numeric value)

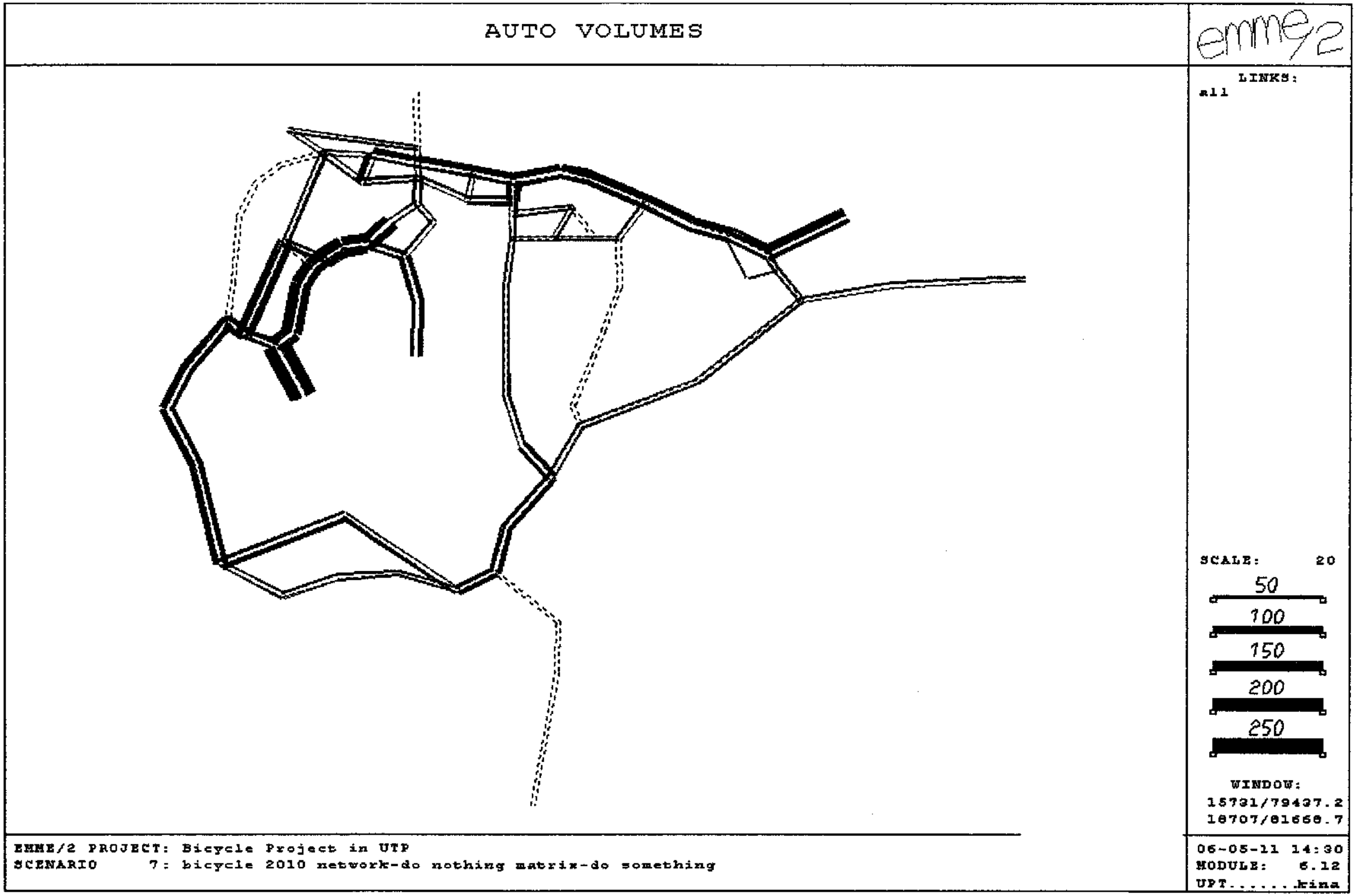

Figure 29: Scenario 7 bicycle 2010 do NOTHING (shifted matrix) (Bar plot)

.2 Discussion

.2.1 *Problems and issues*

Bicycle facilities are important in order to increase the level of cycling in UTP. The existing facilities in UTP are not well provided. There were cycle rack and cycle ramp provided at V3, V4 and V5 except for V1 and V2. Students at V1 and V2 have to park their bicycle anywhere suitable. Cycle rack is also not provided at USM building, new campus (Pocket C, Pocket D and Chancellor Hall) and sport complex.

The existing walkways are not provided with cycle ramp, except the covered walkway at V5. Thus, cyclists cannot use the walkway but to share the road with car user. This can cause cycling to be dangerous since the road provided in UTP is only 2 lanes for both ways with unpaved shoulder. Sign board and road crossing for both pedestrian and cyclist are also not provided. An interview was conducted with the cyclist regarding their opinion with the existing cycling facilities in UTP. Most of them have problems with parking since there was no cycle rack provided near academic blocks. Thus, the bicyclers have to park their bicycle with no secure. They also requested cycle rack to be provided near the entrance of any academic building. Figure 30 to figure 32 show the existing bicycle facilities in UTP. Figure 33 to figure 36 show the inappropriate bicycle parking in UTP.

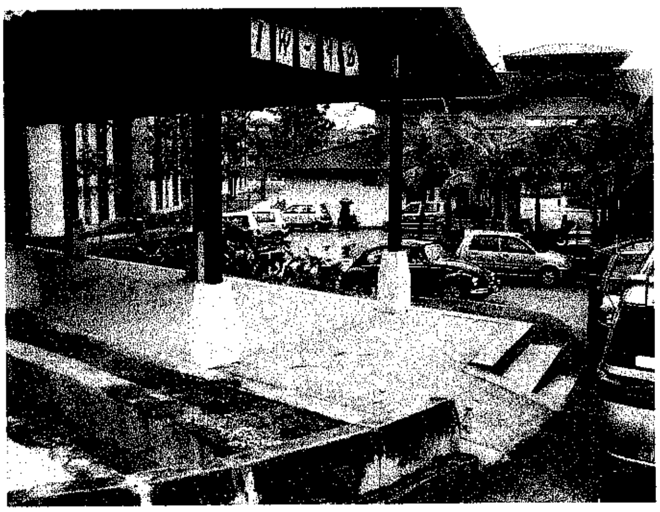

Figure 30: Shared covered walkway and cycle from V3 to pocket C.

Figure 31: Cycle rack provided at V5.

Figure 32: Cycle rack provided at V3 and V4.

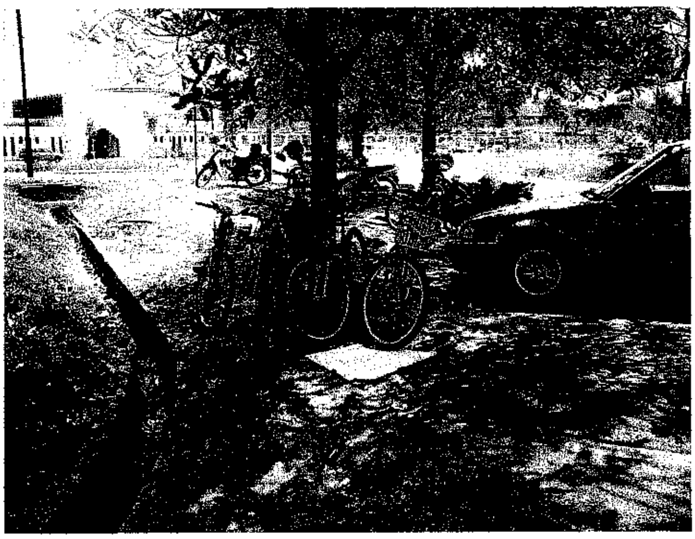

Figure 33: Bicycle parking at sport complex.

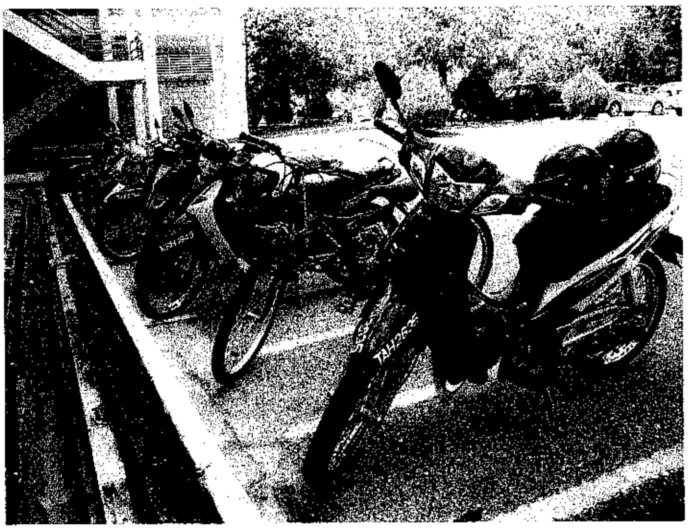

Figure 34: Bicycle parking at old USM blocks.

Figure 35: Bicycle parking at old USM Lecture Hall

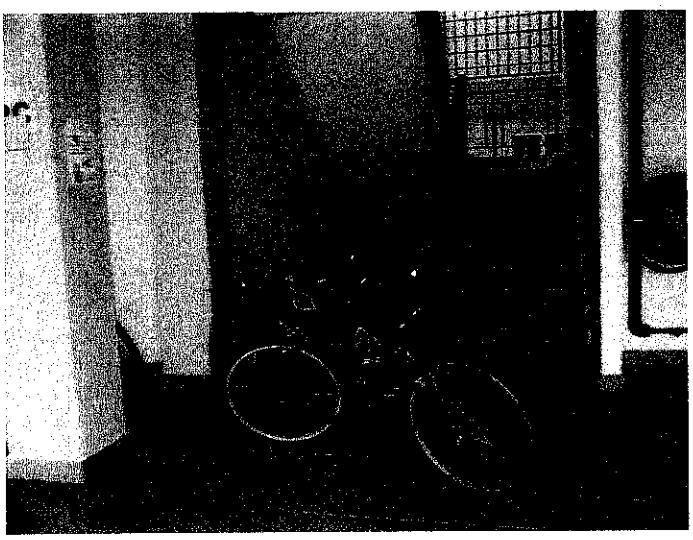

Figure 36: Bicycle parking at V2.

.2.2 *Demand and Supply*

.2.2.1 Car

Most of the students prefer to use car as their main mode of transport. Car pool is a very popular mode of transport in UTP. Total number of student own a car in UTP for year 2005 is 734. Figure 37 shows the EMME2 output for year 2005 (scenario 2) and 2010 do nothing (scenario 6).

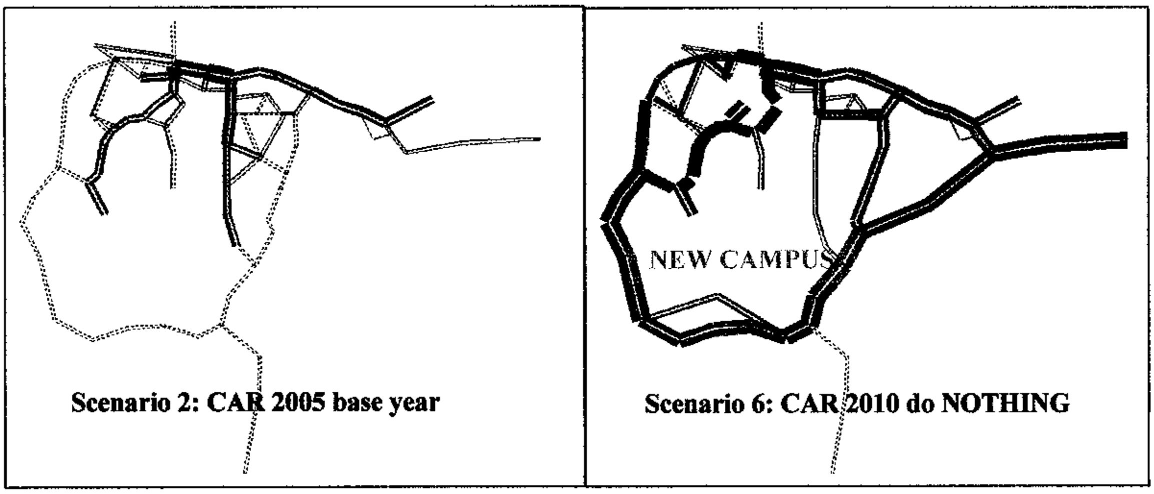

Figure 37: Car auto volume (Bar plot) do NOTHING

From figure 37, it is obviously shows that in year 2010, UTP will experience great traffic congestion if no early action is taken. The thicker the bar, the higher the traffic volume will be. In year 2010, the volume can reach up to 2000 trips per day (refer appendix for clearer auto volume numeric value). The area that will experience high congestion is new campus. Noted that road in UTP is only two lanes for both ways. Distance also plays a major role in determining mode of transport. Based on Putrajaya Transport Action Plan Study, people are willing to walk up to 300m [6]. More than that, people will choose to use another mode of transport. For bicycle, people are willing to cycle up to 1500m [6]. Hence, cycle is the best mode of transport to choose because this transport of travel requires less road space per user and cheaper. UTP is also a cycling distance area.

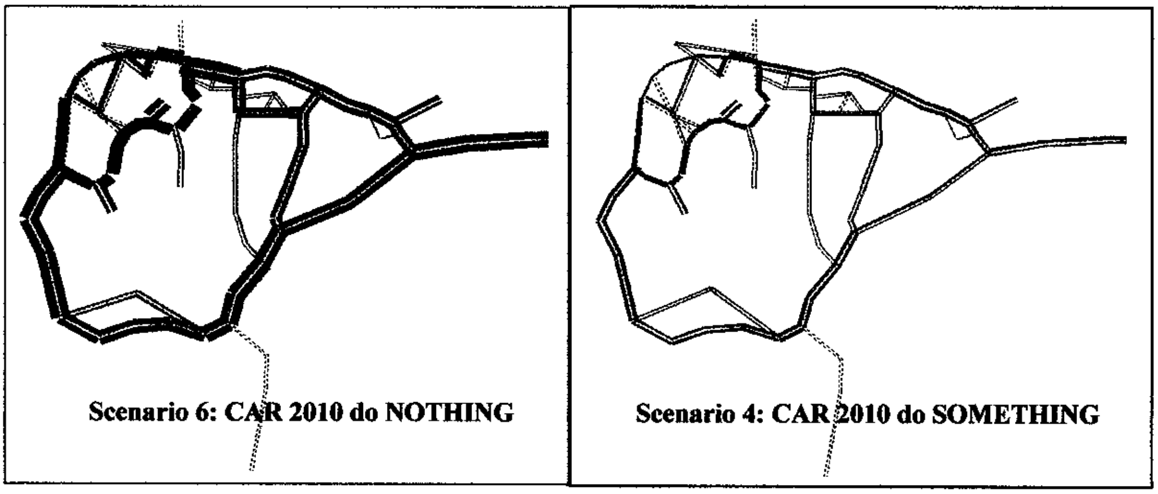

Figure 38: Car auto volume (Bar plot) do SOMETHING

Figure 38 shows the result of traffic volume if an early measure is taken (scenario 6 and 4). Based on the survey, more than 50% students are willing to change their mode of transport from car to bicycle if enough bicycle facilities are provided resulting in reducing the number of cars traveled in UTP. Most of them said that bicycle is not a very popular mode of transport in UTP because there were not enough bicycle facilities provided. Hot weather is one of the main factors they avoid cycling in UTP because there were no covered walkway is provided. If no cycle lane is provided, the bicyclers can still shared the cover walkway with pedestrian. A shared use path is one which can be used by cyclists as well as pedestrians. On such paths, cyclists must give way to pedestrians.

.2.2.2 Bicycle

Bicycle is not a very popular mode of transport in UTP. Figure 39 indicates the comparison between bicycle volumes in 2005 base year (scenario 1) and 2010 do NOTHING. In year 2010, the trips generated and attracted from zone 14 were shifted to zone 19. The trips pattern has change. The highest volumes on link in year 2010 is up to 130 trips per day (refer appendix for clearer auto volume numeric value). Noted that both car and bicycle is using different bar scale.

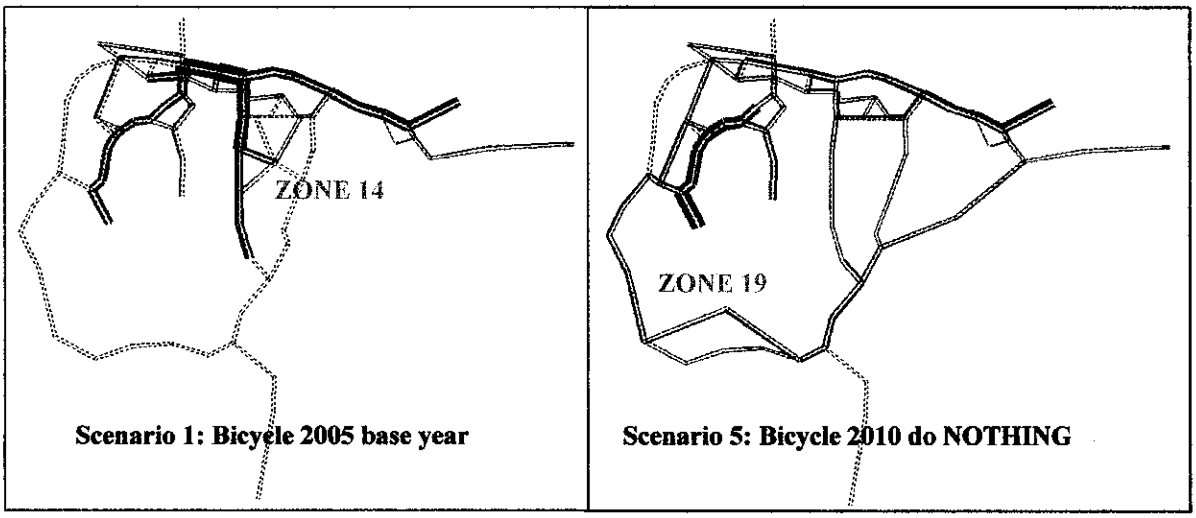

Figure 39: Bicycle auto volume (Bar plot) do NOTHING

Figure 40 shows the result for 2010 for three (3) scenarios which is scenario 3, scenario 5 and scenario 7. Scenario 5 and 7 show no different in term of trip pattern, only the volume is increases since the matrix used for scenario 7 is shifted matrix (car-to-bicycle). The bicyclers have to use a long route to move from zone to zone and yet have to share the road with other road user.

.2.3 *Solution*

.2.3.1 Well-designed bicycle facilities

In UTP, the existing cycling facilities are not well provided. The cyclist has to share the facilities with pedestrian and sometimes with the other road user. Sharing the facilities with other road user could cause cycling to be dangerous. No cycle racks are provided for students to keep or park their bicycle.

The idea is to proposed new cycle path for cyclist. Reconnaissance survey was conducted to provide an assessment of the physical features in the study area. Figure 42 shows the proposed cycle network in UTP. The cycle network was identified where the distance to travel was kept to minimum. Shared cycle and walkway is to be proposed at both side of the road following the existing. A few short-cut was identified during the reconnaissance survey and two-way segregated cycle path is to be proposed. The minimum width is 3meter for both sides. The proposed cycle network will focus in the region of villages and academic buildings because based on the survey most of the trips destination concentrate at academic blocks (Pocket C, Pocket D and USM Building).

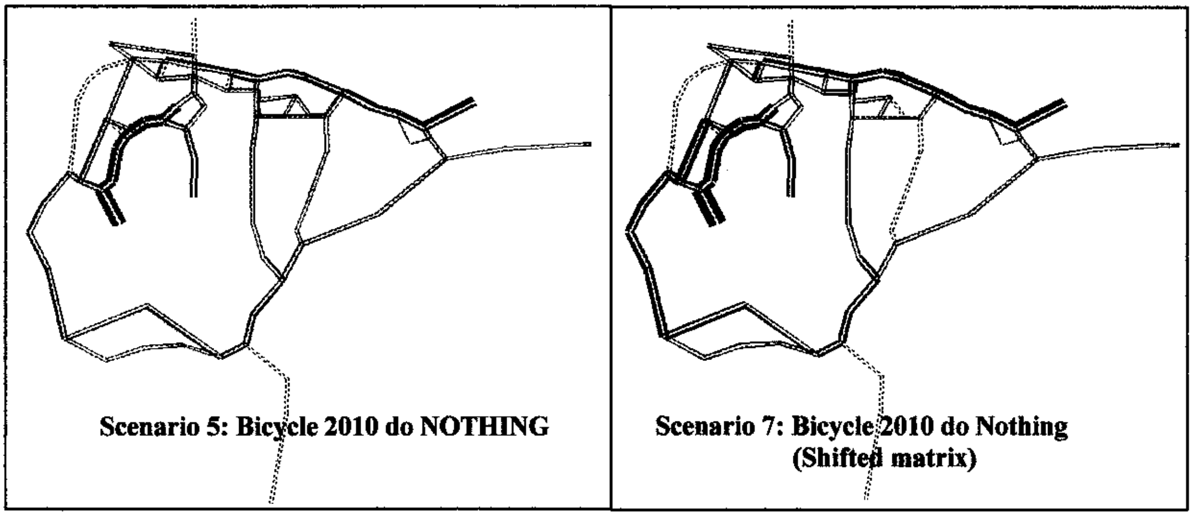

Figure 40: Bicycle auto volume for year 2010 do NOTHING.

Figure 41 shows the trip pattern for scenario 3, where new cycle network is proposed within the new campus area. By proposing the shortcut through the hostel and new campus, bicyclers do not have to ride along the long route to get to their destination.

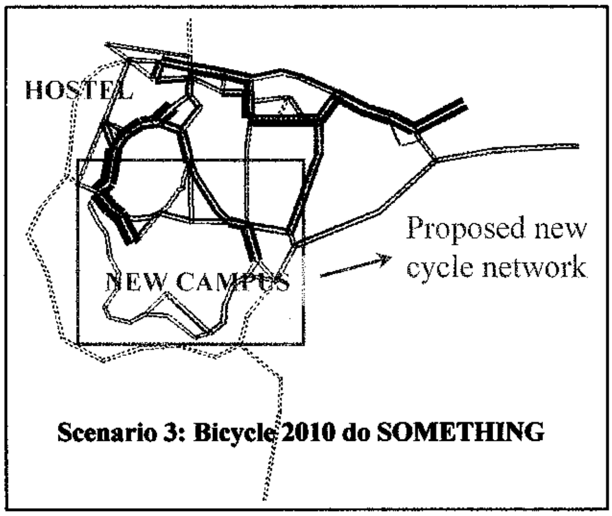

Figure 41: Bicycle auto volume for year 2010 do something.

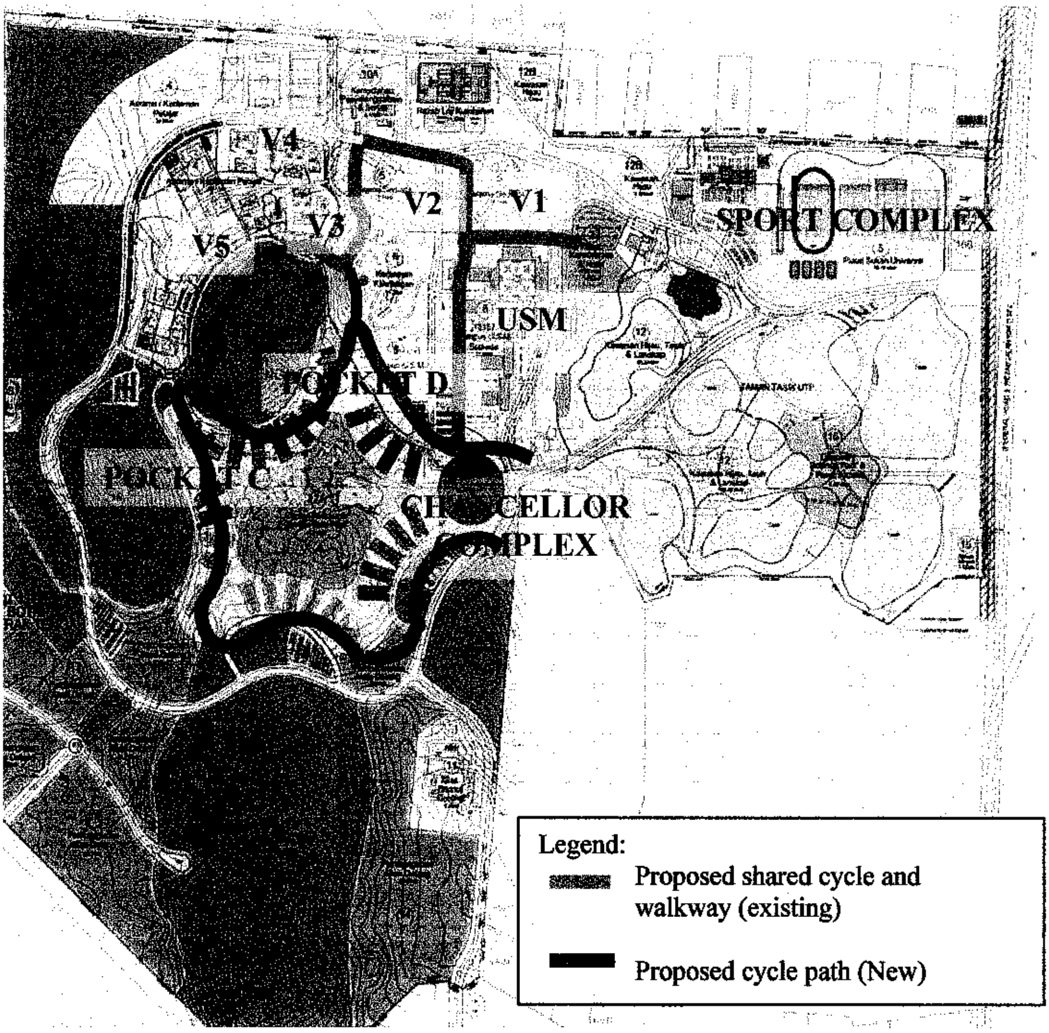

Figure 42: Proposed cycle network in UTP

During the reconnaissance survey, the data were captured in digital photography. Figure 43 to figure 51 show some of the pictures taken during the reconnaissance survey.

Pictures taken near village 3, village 4 and village 5.

Figure 43: Existing walkway near V3 heading to Pocket D

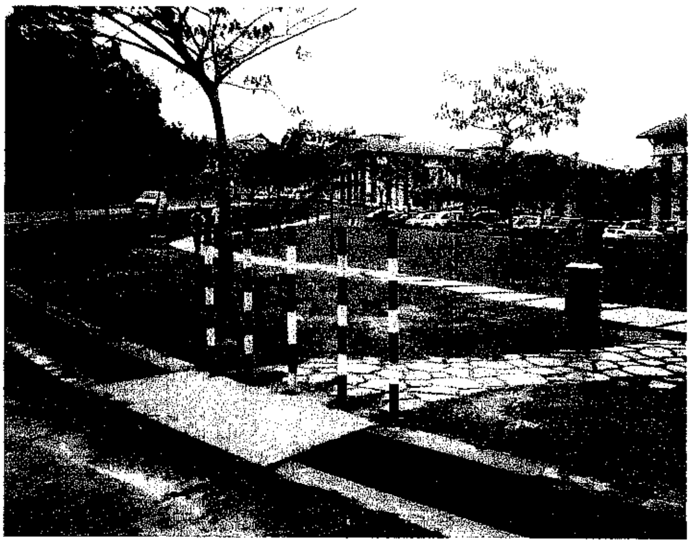

Figure 44: Existing walkway from Pocket D heading to V5

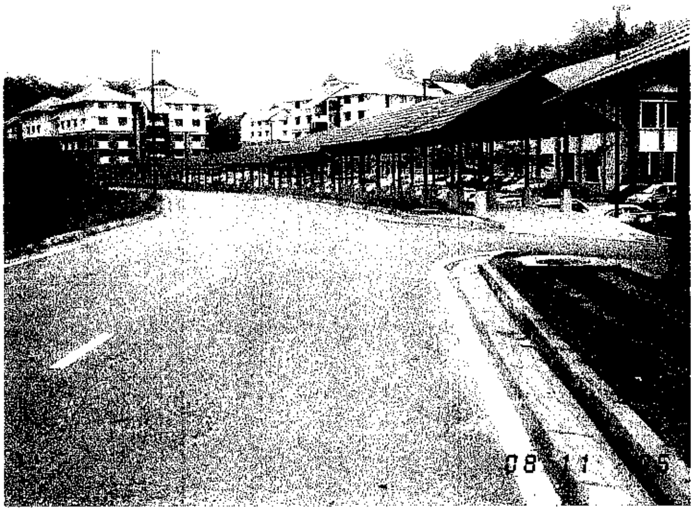

Figure 45: existing walkway from V5 heading to Pocket C

Pictures taken near Pocket C, Pocket D and Chancellor Complex

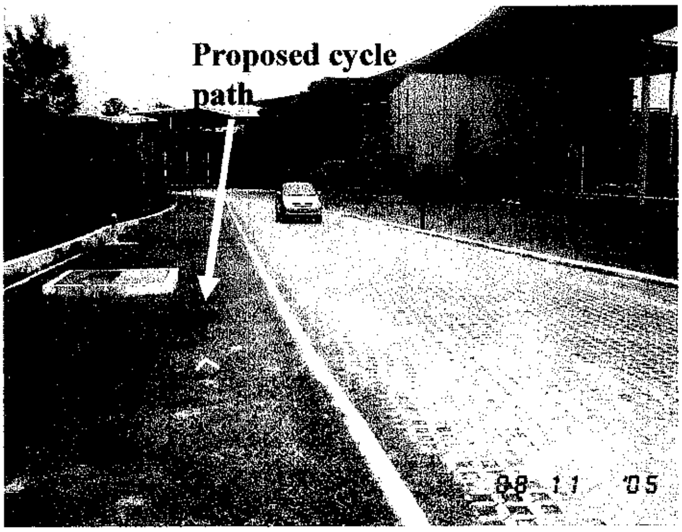

Figure 46: Proposed route for cycle path from Pocket C heading to Pocket D

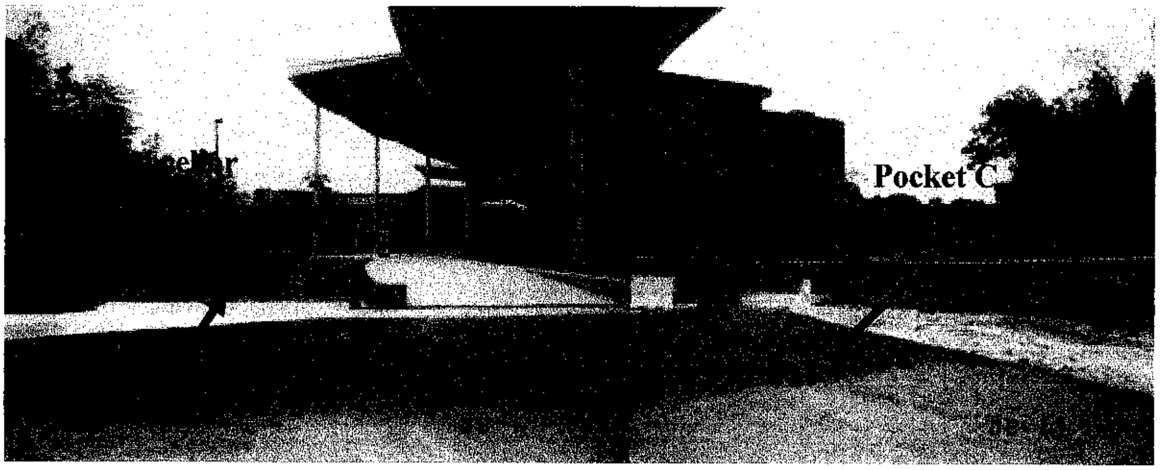

Figure 47: Proposed route for cycle path connecting Pocket C – Pocket D – Chancellor Complex.

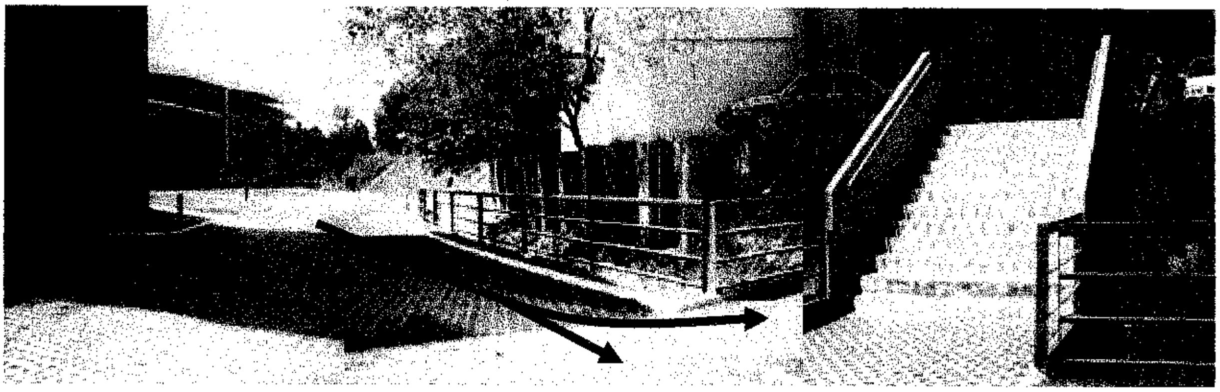

Figure 48: Proposed route from Pocket D to USM Campus. A step with cycle ramp is to be proposed.

Figure 49: Proposed route for cycle path from Pocket D to Chancellor Complex

Pictures taken at Chancellor Complex

Figure 50: proposed route for cycle path at Chancellor Complex

Pictures taken at Sport Complex

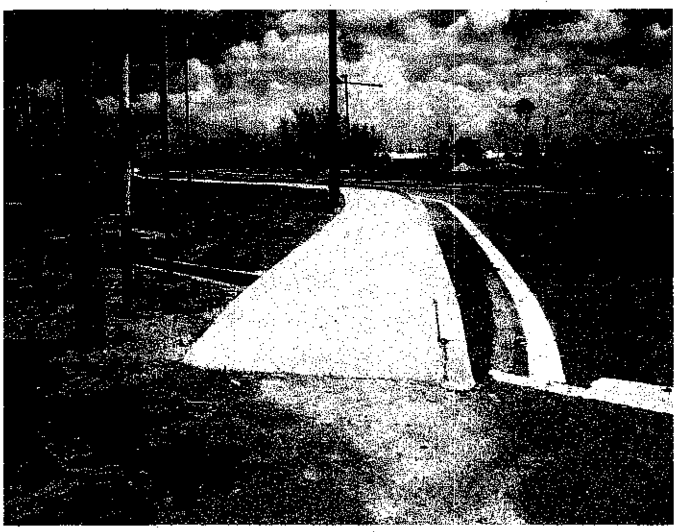

Figure 51: Walkway with cycle ramp at sport complex

Cycle rack is to be proposed at the entrance of academic building in order to ease the bicyclers to park their bicycle and encourage the students to use bicycle as their main mode of transport to travel within UTP. Figure 52 and figure 53 show the proposed location for cycle rack. More sign board and road crossing for both pedestrian and cyclist are also to be provided. Figure 54 to Figure 57 shows an example of bicycle facilities.

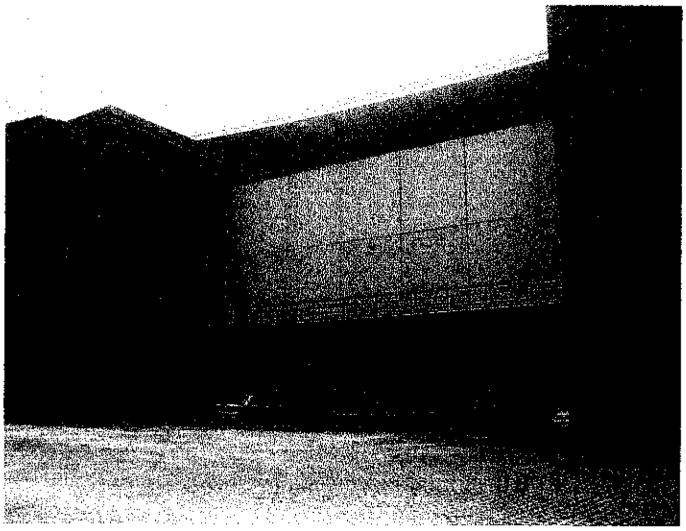

Figure 52: Proposed location for cycle rack near lecture hall

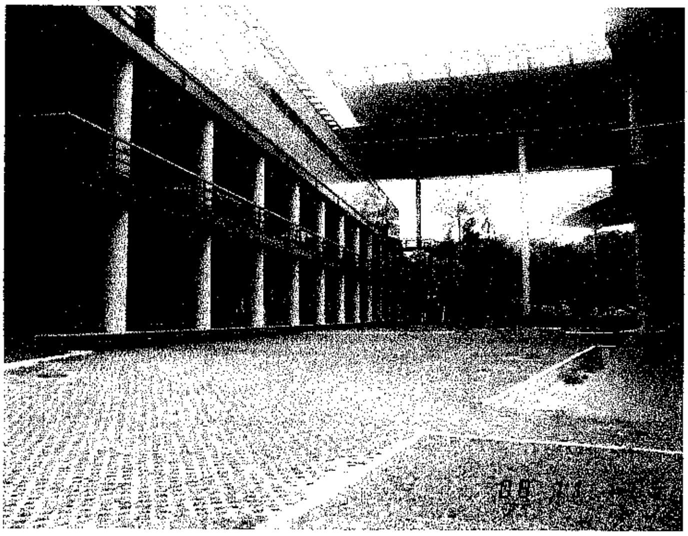

Figure 53: Proposed location for cycle rack near academic building

Figure 54: Bicycle racks facility at University of Southampton, UK.

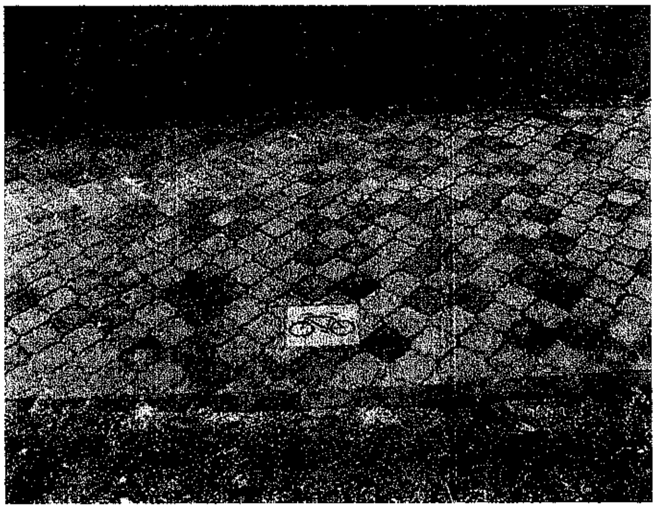

Figure 55: Bicycle road signing facility at Putrajaya

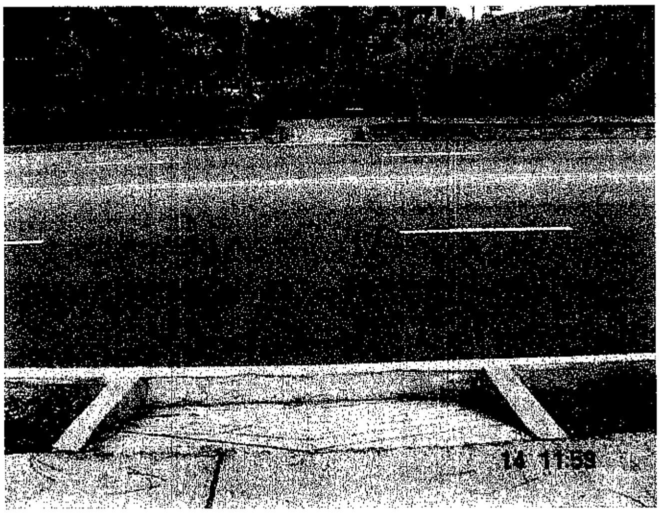

Figure 56: Bicycle ramp facility at Putrajaya

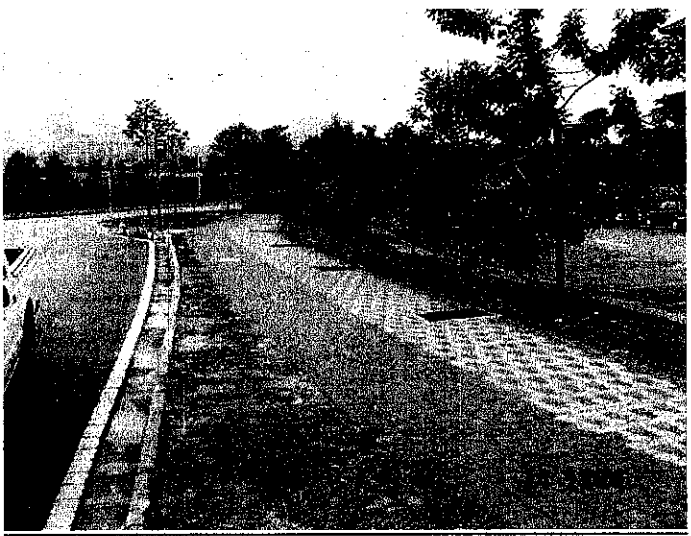

Figure 57: Shared cycle and pedestrian walkway at Putrajaya

2.3.2 <u>Cycling to the future</u>

After finish with determining the cycle network and demand forecasting, the next step is to find a way to encourage cycling in UTP. Policy measure is needed in order to restraint the car use and encourage bicycle in UTP. Sometime policy need to be harsh and spartan. But if the benefits are very convincing, people will later appreciate it. The policies are:

1. *Decrease car ownership*

   Only 3rd year student and above can bring car in UTP. For now, all UTP students are allowed to bring their car. By proposing this, a large number of cars can be decreased.

2. *Parking Control*

   Higher parking charges near villages. If students do not want to pay for the parking charges, they can park their car in front of the Main Hall about 300m to 400m from villages. This can encourage the use of travel with car in UTP.

3. *Closing street*

   The street is open for cyclist and pedestrian precincts only. No cars are allowed to use that particular street.

The strategies to encourage cycling in UTP are based on the literature review and student's opinion in order to increase the level of cycling:

1. *Bicycle loan*

   UTP to provide students with bicycle loan to buy bicycle, identical to the computer loan.

2. *Bicycle club*

   Every university should have bicycle club. Cycling is a good activity for students. UTP should support bicycle club by promoting activities in order to increase the students' participation.

3. *Bicycle rent*

   The idea is adapted from Bristol Transport Action Plan. In Bristol, the concept was applied for car. By proposing this concept in UTP, students do not have to own a bicycle to cycle. There will be a bicycle rent stations placed at a certain place where the student can rent and return the bicycle at anytime and any place. This will also promoting combine trip.

4. *Provide bicycle shop*

   Bicycle shop should be provided so as the students do not have to go outside UTP for maintenance. Most of the students stop cycling because their bicycle was broken and do not know where to repair.

5. *Encourage student to use bicycle from foundation level*

   It is important to encourage students from the lower level because as they were adapted to the culture from the beginning, it is easy to encourage and promote cycling as a mode of transport to travel within UTP in future years.

0 CONCLUSIONS AND RECOMMENDATIONS

1 Conclusions

The main expectation of proposing well designed cycling facilities is to increase the level of cycling and reduce traffic in UTP. Questionnaires will gather information about the trip generation and attraction produced by students and to know many percent of students are willing to shift their mode of transport from car to bicycle if well designed bicycle facilities are provided.

From EMME2 analysis, UTP will experience great traffic congestion if no early action is taken in year 2010. The volume on link can reach up to 2000 trips per day (refer appendix for clearer auto volume numeric value). The area that will experience high traffic congestion is new campus. Road provided in UTP is only two lanes for both ways.

In UTP, the existing cycling facilities are not well provided. The cyclist has to share the facilities with pedestrian and sometimes with the other road user. Sharing the facilities with other road user could cause cycling to be dangerous. Sign board and road crossing for both pedestrian and cyclist are also not provided.

The cycle network was identified where the distance to travel was kept to minimum. Shared cycle and walkway is to be proposed at both side of the road following the existing. A few short-cut was identified during the reconnaissance survey and two-way segregated cycle path is to be proposed. The minimum width is 3meter for both sides. The proposed cycle network will focus in the region of villages and academic buildings because based on the survey, most of the trips destination concentrate at academic blocks (Pocket C, Pocket D and USM Building). Cycle racks are also to be proposed at the entrance of academic building in order to ease the bicyclers to park their bicycle.

? Recommendations

?.1 *Level of service*

The volume output from EMME2 software can be used as an input in aaSIDRA traffic analysis in order to determine the Level of Service (LOS) of each junction. aaSIDRA is a traffic tools use to determine the junction performance. By knowing the LOS, the condition of each junction is identified. This is important in order to determine which priority junction will experience high LOS and delayed in traffic in both present and future year. If the LOS in 2005 is low but will experience high LOS in 2010, an early measure should be performed. One of the actions that can be executed is by improving the junction's parameters.

?.2 *Detail design*

Author did not come out with the details design about the new bicycle facilities to be proposed. For example details design for cycle path, material to be used that suit UTP's environment, sheltered cycle track and location for sign board and road crossing for both pedestrian and cyclist. In the future design, the aesthetical value should also be taken into consideration

) REFERENCES

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APPENDICES

Questionnaires

UTP Traffic Circulation Study (FOR FYP)

Programme: ____________ Village: ____________

Year: ____________ Block: ____________

Fill in the survey table based on your typical day for all purposes (e.g.: to class, to meal, to sport, to bank)

Note:
1. Please fill in the table according to your normal routine, neglect the Ramadhan.
2. If you went to the sport complex in the evening or going out for supper at night, please note too.

Time		Purpose	Origin (from where)	Destination	Mode of Transport (eg: walk,car,bicycle)
from	to				
0600	0700				
0700	0800				
0800	0900				
0900	1000				
1000	1100				
1100	1200				
1200	1300				
1300	1400				
1400	1500				
1500	1600				
1600	1700				
1700	1800				
1800	1900				
1900	2000				
2000	2100				
2100	2200				
2200	2300				
2300	2400				
2400	0100				
0100	0200				
0200	0300				

*For origin and destination, state the area nearby

Village 1

Village 2

Village 3

Village 4

Village 5

USM Building

Sport Complex

Chansellor Complex

Pocket C

Pocket D

Outside UTP

Questionnaires –section 1

SECTION 2

1) Do u own a bicycle?

____

2) If yes, what are the purposes (eg: attend class, sports)

____

3) What is your opinion about cycling in UTP?

____

____

4) Would you use bicycle as your main mode of transport to travel in UTP? Why?

____

____

5) If enough and well-design cycling facilities are provided in UTP, would you change your mind? (eg: covered cycle lane, cycle rack near the academic block)

____

____

6) How do you rate the present cycling facilities in UTP?
   a) Very Poor
   b) Poor
   c) Moderate
   d) Good
   e) Very Good

7) Was it easy to find parking for your bicycle when travel within UTP area?
   a) Yes
   b) No

8) Do you feel safe cycling within UTP?
   a) Yes
   b) No

9) How far do you willing to cycle?

____

10) Do you intrested in joining a cycling club in UTP? Why?

____

____

11) What is your suggestion in order to increase the level of cycling in UTP?

____

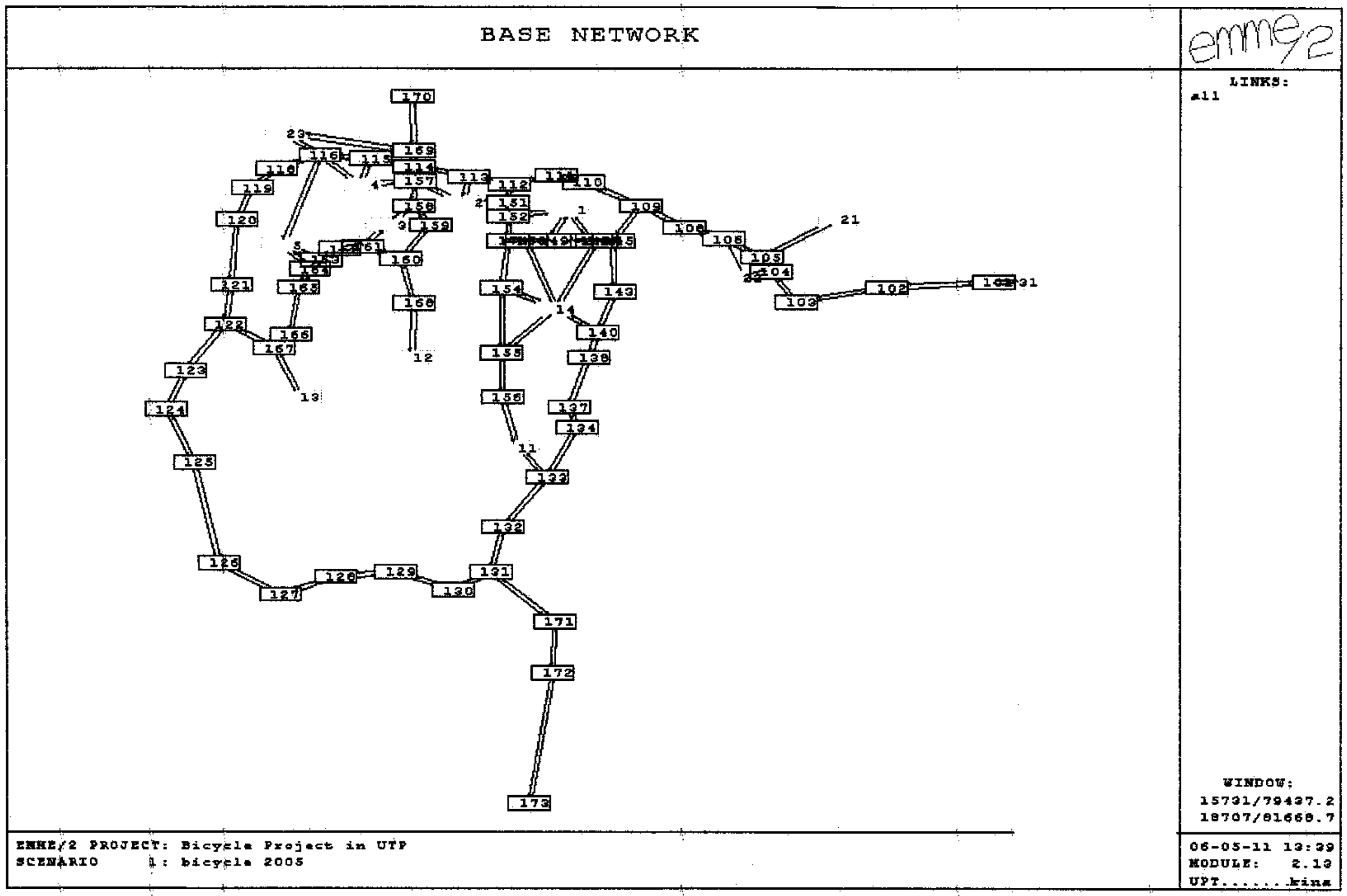
____

Questionnaires –section 2

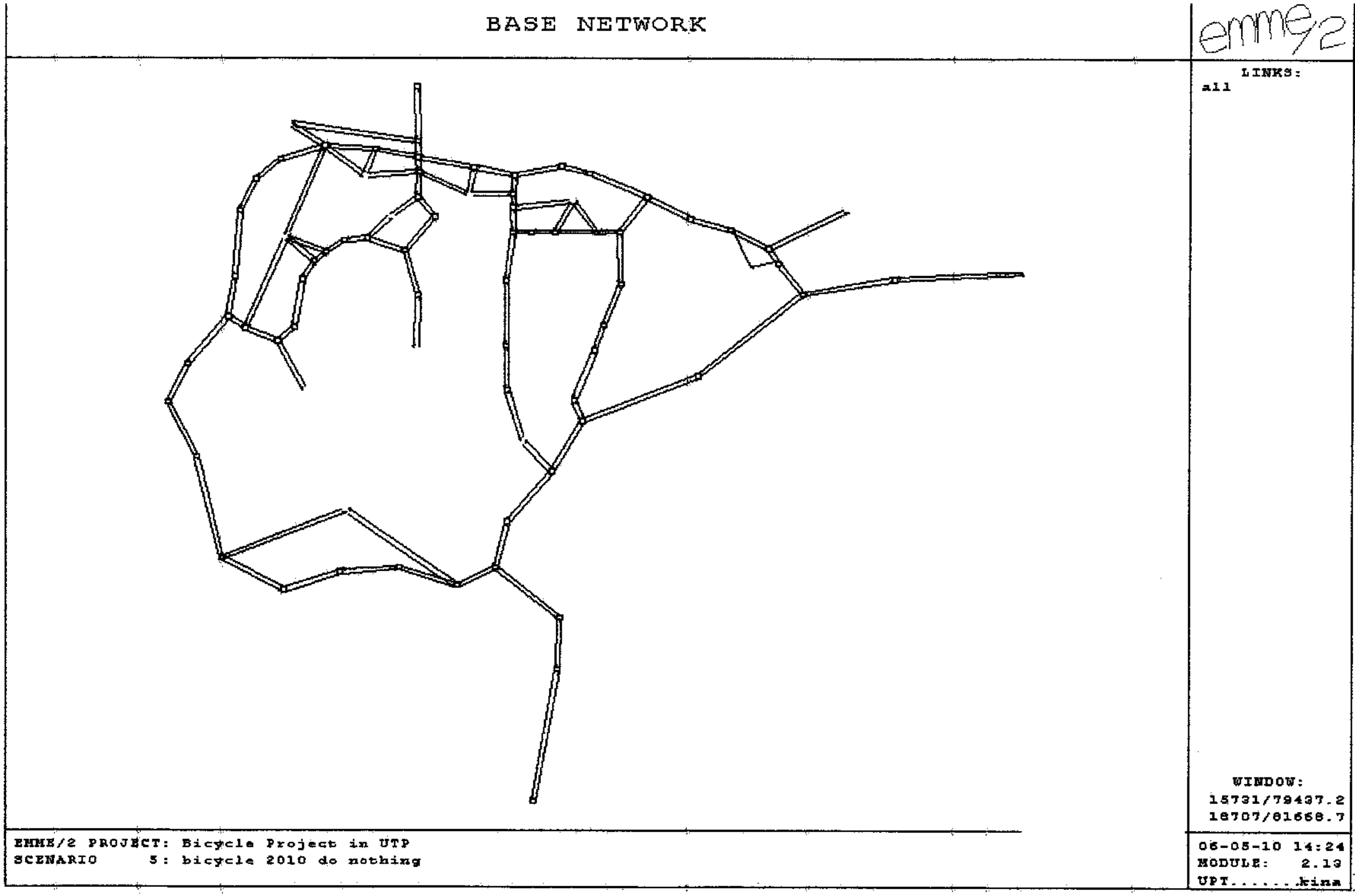
EMME2 input

Mode of transport	Volume Delay Function (VDF)
Car (fd1)	length * 60 / ((volau .le.put(lanes * 500)) * (20 + ((15 - 20) * volau / get(1)))) + (volau .gt. put(lanes * 1000)) * 10 / (1 + (10 *(volau - get(2)) / (8 * length * get(2)))) + (volau .gt.get(1) .and. volau .lt. get(2)) * (15 + (10 - 15) * (volau - get(1)) / (lanes * (1000 - 500))))
Bicycle (fd2)	length / (((volau .le. put(lanes * 1200 / 60))) * 200) + (((volau .gt. put(lanes * 1600 / 60))) * 100) + ((volau .gt. get(1) .and. volau .lt. get(2)) * 150)

VDF Equations for EMME2 Output

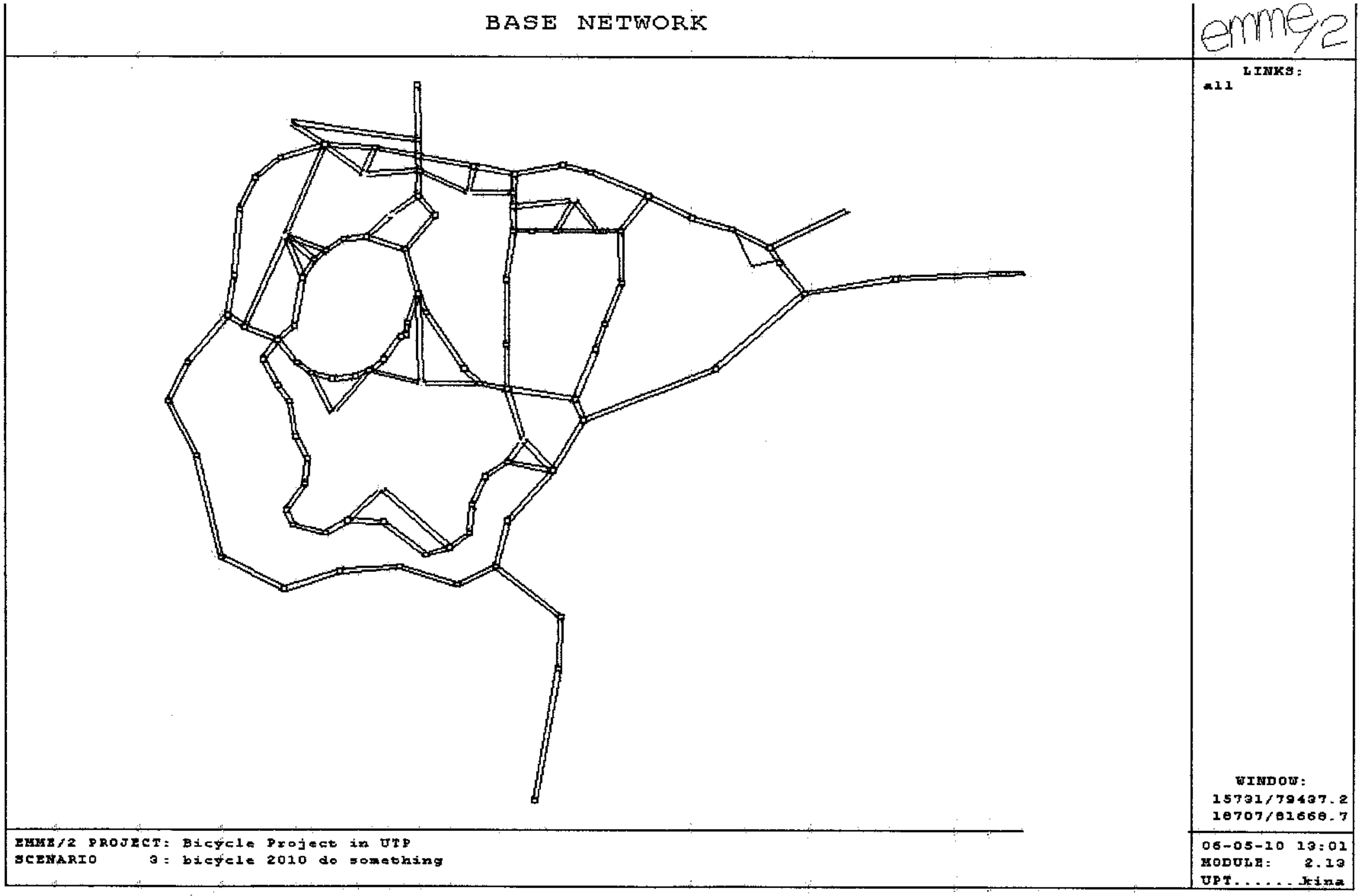


Nodes and Centroid number for UTP road network

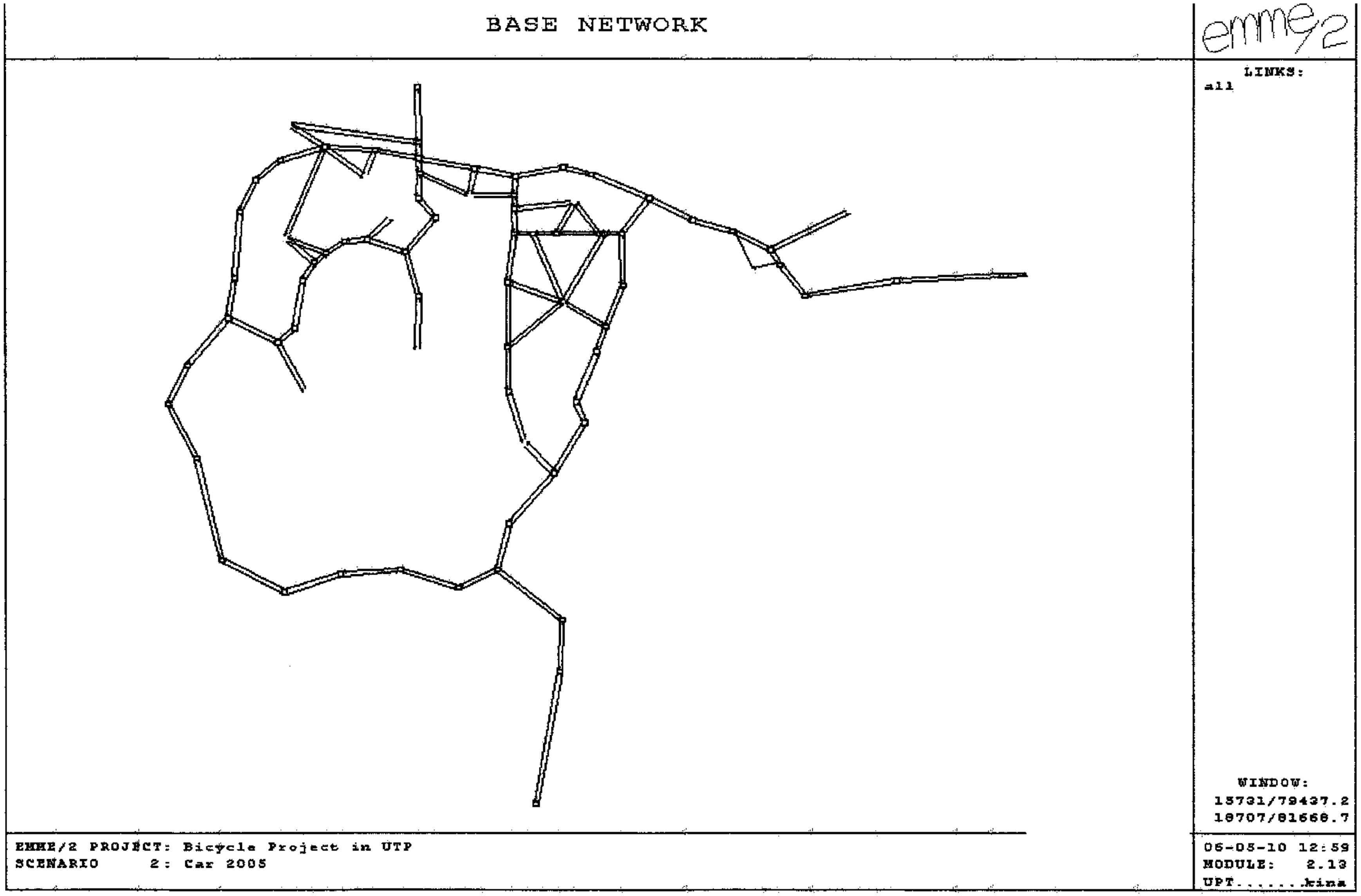


B

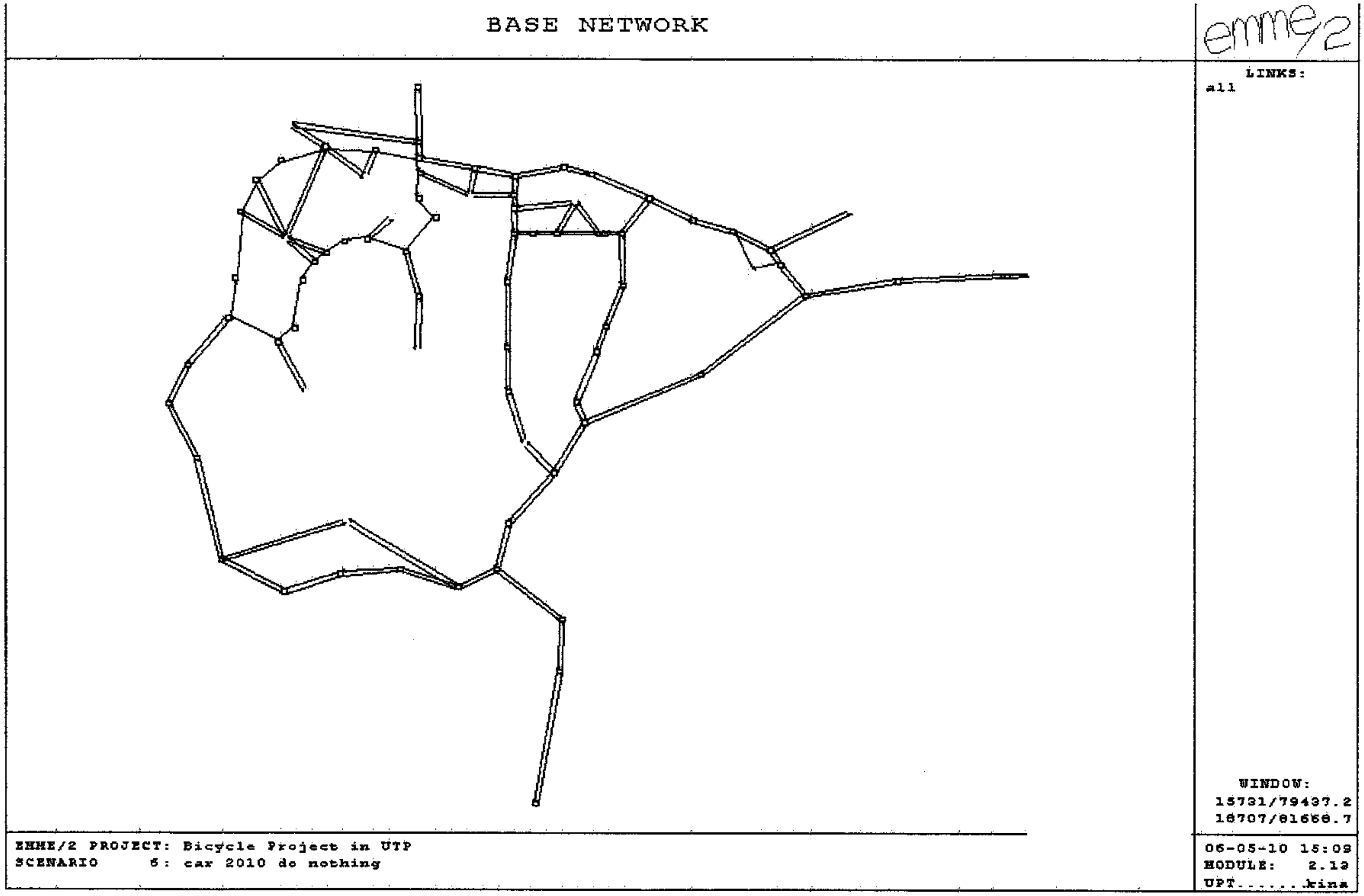
Bicycle network for 2005 and 2010 do nothing



Bicycle network for 2010 do something



Car road network for 2005



Car road network for 2010 do nothing and 2010 do something

EMME/2 Module: 3.12 Date: 06-05-04 09:41 User: EB17/UPT......kina
Project: Bicycle Project in UTP
Matrix mf02:

origin	dest:	..value	dest:	..value	dest:	..value	dest:	..value	dest:	..value
1	1:	0	2:	1	3:	2	4:	3	5:	1
1	11:	0	12:	0	13:	1	14:	2	21:	3
1	22:	0	23:	0	31:	0				
2	1:	1	2:	0	3:	2	4:	4	5:	1
2	11:	1	12:	1	13:	6	14:	7	21:	27
2	22:	1	23:	1	31:	1				
3	1:	1	2:	2	3:	0	4:	5	5:	2
3	11:	17	12:	0	13:	51	14:	18	21:	53
3	22:	1	23:	1	31:	2				
4	1:	3	2:	4	3:	5	4:	0	5:	4
4	11:	3	12:	3	13:	4	14:	28	21:	29
4	22:	3	23:	3	31:	3				
5	1:	1	2:	1	3:	3	4:	4	5:	0
5	11:	1	12:	1	13:	8	14:	3	21:	23
5	22:	1	23:	1	31:	7				
11	1:	1	2:	1	3:	50	4:	4	5:	1
11	11:	0	12:	1	13:	2	14:	18	21:	4
11	22:	1	23:	1	31:	1				
12	1:	0	2:	5	3:	2	4:	4	5:	7
12	11:	17	12:	0	13:	1	14:	2	21:	3
12	22:	0	23:	0	31:	1				
13	1:	1	2:	1	3:	51	4:	4	5:	8
13	11:	1	12:	22	13:	0	14:	3	21:	4
13	22:	1	23:	1	31:	1				
14	1:	2	2:	7	3:	18	4:	28	5:	3
14	11:	2	12:	2	13:	19	14:	0	21:	5
14	22:	2	23:	2	31:	2				
21	1:	3	2:	27	3:	53	4:	29	5:	23
21	11:	3	12:	3	13:	4	14:	5	21:	0
21	22:	3	23:	3	31:	3				
22	1:	0	2:	1	3:	2	4:	0	5:	1
22	11:	0	12:	0	13:	1	14:	0	21:	1
22	22:	0	23:	0	31:	0				
23	1:	0	2:	1	3:	2	4:	0	5:	1
23	11:	0	12:	0	13:	1	14:	0	21:	1
23	22:	0	23:	0	31:	0				
31	1:	0	2:	1	3:	2	4:	3	5:	1
31	11:	0	12:	0	13:	1	14:	2	21:	3
31	22:	0	23:	0	31:	0				

mf02 : Bicycle 2005 base year matrix

```
EMME/2 Module:   3.12        Date: 06-05-04 10:00        User: EB17/UPT......kina
Project:         Bicycle Project in UTP
Matrix    mf01:
```

origin	dest:	..value	dest:	..value	dest:	..value	dest:	..value	dest:	..value
1	1:	0	2:	2	3:	3	4:	3	5:	2
1	11:	2	12:	69	13:	45	14:	18	21:	10
1	22:	1	23:	1	31:	79				
2	1:	1	2:	0	3:	2	4:	7	5:	1
2	11:	1	12:	25	13:	50	14:	74	21:	35
2	22:	20	23:	0	31:	17				
3	1:	3	2:	22	3:	0	4:	4	5:	3
3	11:	17	12:	34	13:	170	14:	169	21:	236
3	22:	51	23:	2	31:	489				
4	1:	5	2:	19	3:	6	4:	0	5:	25
4	11:	140	12:	4	13:	365	14:	169	21:	141
4	22:	84	23:	4	31:	365				
5	1:	2	2:	1	3:	3	4:	3	5:	0
5	11:	70	12:	42	13:	71	14:	133	21:	133
5	22:	2	23:	1	31:	155				
11	1:	29	2:	1	3:	2	4:	84	5:	63
11	11:	0	12:	1	13:	16	14:	15	21:	2
11	22:	1	23:	0	31:	3				
12	1:	35	2:	25	3:	7	4:	3	5:	35
12	11:	8	12:	0	13:	18	14:	18	21:	1
12	22:	1	23:	0	31:	8				
13	1:	44	2:	40	3:	152	4:	117	5:	78
13	11:	15	12:	0	13:	18	14:	23	21:	2
13	22:	1	23:	0	31:	8				
14	1:	35	2:	59	3:	202	4:	62	5:	140
14	11:	2	12:	25	13:	23	14:	0	21:	9
14	22:	1	23:	1	31:	22				
21	1:	9	2:	35	3:	202	4:	57	5:	133
21	11:	1	12:	1	13:	3	14:	2	21:	0
21	22:	1	23:	0	31:	3				
22	1:	1	2:	20	3:	51	4:	84	5:	2
22	11:	1	12:	1	13:	2	14:	2	21:	1
22	22:	0	23:	0	31:	3				
23	1:	1	2:	0	3:	2	4:	2	5:	1
23	11:	1	12:	1	13:	2	14:	1	21:	1
23	22:	0	23:	0	31:	3				
31	1:	62	2:	22	3:	472	4:	365	5:	162
31	11:	3	12:	3	13:	4	14:	8	21:	4
31	22:	3	23:	2	31:	0				

mf01 : Car 2005 base year matrix

```
EMME/2 Module:   3.12        Date: 06-05-10 14:23        User: EB17/UPT......kina
Project:         Bicycle Project in UTP
Matrix    mf06:
```

origin	dest:	..value	dest:	..value	dest:	..value	dest:	..value	dest:	..value
1	1:	0	2:	1	3:	3	4:	5	5:	2
1	11:	1	12:	0	13:	1	19:	3	21:	4
1	22:	0	23:	0	31:	0				
2	1:	1	2:	0	3:	3	4:	5	5:	3
2	11:	1	12:	1	13:	9	19:	10	21:	40
2	22:	1	23:	1	31:	1				
3	1:	2	2:	3	3:	0	4:	7	5:	5
3	11:	25	12:	2	13:	76	19:	28	21:	79
3	22:	2	23:	2	31:	2				
4	1:	5	2:	5	3:	7	4:	0	5:	10
4	11:	5	12:	5	13:	6	19:	43	21:	44
4	22:	5	23:	5	31:	5				
5	1:	2	2:	3	3:	6	4:	10	5:	0
5	11:	3	12:	3	13:	19	19:	7	21:	59
5	22:	2	23:	2	31:	17				
11	1:	1	2:	2	3:	76	4:	6	5:	4
11	11:	0	12:	12	13:	13	19:	28	21:	5
11	22:	1	23:	1	31:	1				
12	1:	3	2:	8	3:	0	4:	5	5:	18
12	11:	26	12:	0	13:	2	19:	4	21:	5
12	22:	1	23:	1	31:	1				
13	1:	1	2:	2	3:	76	4:	6	5:	19
13	11:	2	12:	33	13:	13	19:	4	21:	6
13	22:	1	23:	1	31:	2				
19	1:	3	2:	10	3:	28	4:	43	5:	7
19	11:	4	12:	3	13:	28	19:	0	21:	7
19	22:	3	23:	3	31:	3				
21	1:	4	2:	40	3:	79	4:	44	5:	59
21	11:	5	12:	5	13:	6	19:	7	21:	0
21	22:	4	23:	4	31:	5				
22	1:	0	2:	1	3:	3	4:	0	5:	2
22	11:	1	12:	0	13:	1	19:	1	21:	2
22	22:	0	23:	0	31:	0				
23	1:	0	2:	1	3:	3	4:	0	5:	2
23	11:	1	12:	0	13:	1	19:	1	21:	2
23	22:	0	23:	0	31:	0				
31	1:	0	2:	1	3:	3	4:	5	5:	2
31	11:	1	12:	0	13:	1	19:	3	21:	4
31	22:	0	23:	0	31:	0				

mf06 : Bicycle 2010 do nothing

```
EMME/2 Module:   3.12        Date: 06-05-10 15:08        User: EB17/UPT......kina
Project:         Bicycle Project in UTP
Matrix    mf07:
```

origin	dest:	..value	dest:	..value	dest:	..value	dest:	..value	dest:	..value
1	1:	0	2:	2	3:	4	4:	5	5:	5
1	11:	2	12:	103	13:	67	19:	27	21:	14
1	22:	2	23:	2	31:	119				
2	1:	2	2:	0	3:	3	4:	11	5:	3
2	11:	2	12:	37	13:	75	19:	111	21:	52
2	22:	30	23:	1	31:	26				
3	1:	4	2:	32	3:	0	4:	6	5:	7
3	11:	26	12:	51	13:	254	19:	253	21:	354
3	22:	76	23:	3	31:	733				
4	1:	7	2:	28	3:	9	4:	0	5:	72
4	11:	210	12:	7	13:	547	19:	253	21:	211
4	22:	126	23:	6	31:	548				
5	1:	4	2:	3	3:	6	4:	8	5:	0
5	11:	176	12:	106	13:	179	19:	334	21:	334
5	22:	6	23:	2	31:	390				
11	1:	43	2:	1	3:	3	4:	126	5:	158
11	11:	0	12:	1	13:	24	19:	23	21:	2
11	22:	1	23:	1	31:	4				
12	1:	52	2:	37	3:	10	4:	4	5:	88
12	11:	12	12:	0	13:	28	19:	27	21:	2
12	22:	1	23:	1	31:	11				
13	1:	66	2:	60	3:	228	4:	176	5:	195
13	11:	23	12:	9	13:	0	19:	34	21:	3
13	22:	2	23:	2	31:	5				
19	1:	53	2:	89	3:	304	4:	92	5:	352
19	11:	2	12:	37	13:	35	19:	0	21:	13
19	22:	2	23:	2	31:	33				
21	1:	14	2:	52	3:	303	4:	85	5:	334
21	11:	2	12:	2	13:	4	19:	3	21:	0
21	22:	2	23:	1	31:	5				
22	1:	2	2:	30	3:	76	4:	126	5:	6
22	11:	1	12:	1	13:	3	19:	3	21:	2
22	22:	0	23:	1	31:	4				
23	1:	1	2:	1	3:	3	4:	3	5:	2
23	11:	1	12:	1	13:	3	19:	2	21:	2
23	22:	1	23:	0	31:	4				
31	1:	93	2:	33	3:	708	4:	548	5:	407
31	11:	4	12:	4	13:	6	19:	12	21:	5
31	22:	4	23:	4	31:	0				

mf07 : Car 2010 do nothing

```
EMME/2 Module:   3.12        Date: 06-05-10 13:03        User: EB17/UPT......kina
Project:         Bicycle Project in UTP
Matrix   mf04:
------------------------------------------------------------------------------------
```

origin	dest:	..value	dest:	..value	dest:	..value	dest:	..value	dest:	..value
1	1:	0	2:	1	3:	3	4:	5	5:	2
1	11:	1	12:	9	13:	7	19:	5	21:	6
1	22:	0	23:	0	31:	10				
2	1:	1	2:	0	3:	4	4:	6	5:	4
2	11:	1	12:	4	13:	15	19:	20	21:	45
2	22:	3	23:	1	31:	3				
3	1:	2	2:	6	3:	0	4:	7	5:	6
3	11:	27	12:	7	13:	98	19:	49	21:	109
3	22:	9	23:	2	31:	65				
4	1:	5	2:	8	3:	8	4:	0	5:	16
4	11:	23	12:	6	13:	53	19:	64	21:	62
4	22:	16	23:	5	31:	52				
5	1:	2	2:	3	3:	7	4:	11	5:	0
5	11:	18	12:	12	13:	35	19:	36	21:	87
5	22:	2	23:	2	31:	51				
11	1:	5	2:	2	3:	76	4:	17	5:	17
11	11:	0	12:	2	13:	4	19:	30	21:	6
11	22:	1	23:	1	31:	2				
12	1:	4	2:	11	3:	0	4:	6	5:	26
12	11:	27	12:	0	13:	4	19:	6	21:	5
12	22:	1	23:	1	31:	2				
13	1:	7	2:	7	3:	95	4:	21	5:	36
13	11:	4	12:	34	13:	0	19:	7	21:	6
13	22:	2	23:	2	31:	2				
19	1:	8	2:	18	3:	54	4:	51	5:	37
19	11:	4	12:	7	13:	31	19:	19	21:	8
19	22:	3	23:	3	31:	6				
21	1:	6	2:	45	3:	105	4:	51	5:	87
21	11:	5	12:	5	13:	6	19:	8	21:	0
21	22:	5	23:	4	31:	5				
22	1:	0	2:	3	3:	9	4:	11	5:	2
22	11:	1	12:	0	13:	2	19:	1	21:	2
22	22:	0	23:	0	31:	1				
23	1:	0	2:	1	3:	3	4:	0	5:	2
23	11:	1	12:	0	13:	2	19:	1	21:	2
23	22:	0	23:	0	31:	1				
31	1:	8	2:	4	3:	63	4:	52	5:	37
31	11:	1	12:	1	13:	2	19:	4	21:	5
31	22:	0	23:	0	31:	0				

mf04 : Bicycle do something

```
EMME/2 Module:  3.12        Date: 06-05-10 12:40        User: EB17/UPT......kina
Project:        Bicycle Project in UTP
Matrix   mf05:
------------------------------------------------------------------------------------
```

origin	dest:	..value	dest:	..value	dest:	..value	dest:	..value	dest:	..value
1	1:	0	2:	1	3:	2	4:	2	5:	2
1	11:	1	12:	44	13:	29	19:	12	21:	6
1	22:	1	23:	1	31:	51				
2	1:	1	2:	0	3:	1	4:	5	5:	1
2	11:	1	12:	16	13:	32	19:	47	21:	22
2	22:	13	23:	0	31:	11				
3	1:	2	2:	14	3:	0	4:	3	5:	3
3	11:	11	12:	22	13:	109	19:	108	21:	151
3	22:	32	23:	1	31:	313				
4	1:	3	2:	12	3:	4	4:	0	5:	31
4	11:	90	12:	3	13:	234	19:	108	21:	90
4	22:	54	23:	3	31:	234				
5	1:	2	2:	1	3:	3	4:	3	5:	0
5	11:	75	12:	45	13:	76	19:	143	21:	143
5	22:	3	23:	1	31:	167				
11	1:	19	2:	1	3:	1	4:	54	5:	68
11	11:	0	12:	1	13:	10	19:	10	21:	1
11	22:	1	23:	0	31:	2				
12	1:	4	2:	16	3:	0	4:	2	5:	38
12	11:	5	12:	0	13:	12	19:	11	21:	1
12	22:	0	23:	0	31:	5				
13	1:	28	2:	25	3:	97	4:	75	5:	83
13	11:	10	12:	4	13:	0	19:	15	21:	1
13	22:	1	23:	1	31:	2				
19	1:	23	2:	38	3:	130	4:	39	5:	150
19	11:	1	12:	16	13:	15	19:	0	21:	6
19	22:	1	23:	1	31:	14				
21	1:	6	2:	22	3:	129	4:	36	5:	142
21	11:	1	12:	1	13:	2	19:	1	21:	0
21	22:	1	23:	0	31:	2				
22	1:	1	2:	13	3:	32	4:	54	5:	3
22	11:	1	12:	1	13:	1	19:	1	21:	1
22	22:	0	23:	0	31:	2				
23	1:	1	2:	0	3:	1	4:	1	5:	1
23	11:	0	12:	0	13:	1	19:	1	21:	1
23	22:	0	23:	0	31:	2				
31	1:	40	2:	14	3:	302	4:	34	5:	174
31	11:	2	12:	2	13:	3	19:	5	21:	2
31	22:	2	23:	2	31:	0				

mf05 : Car do something

EMME2 output

AUTO VOLUMES

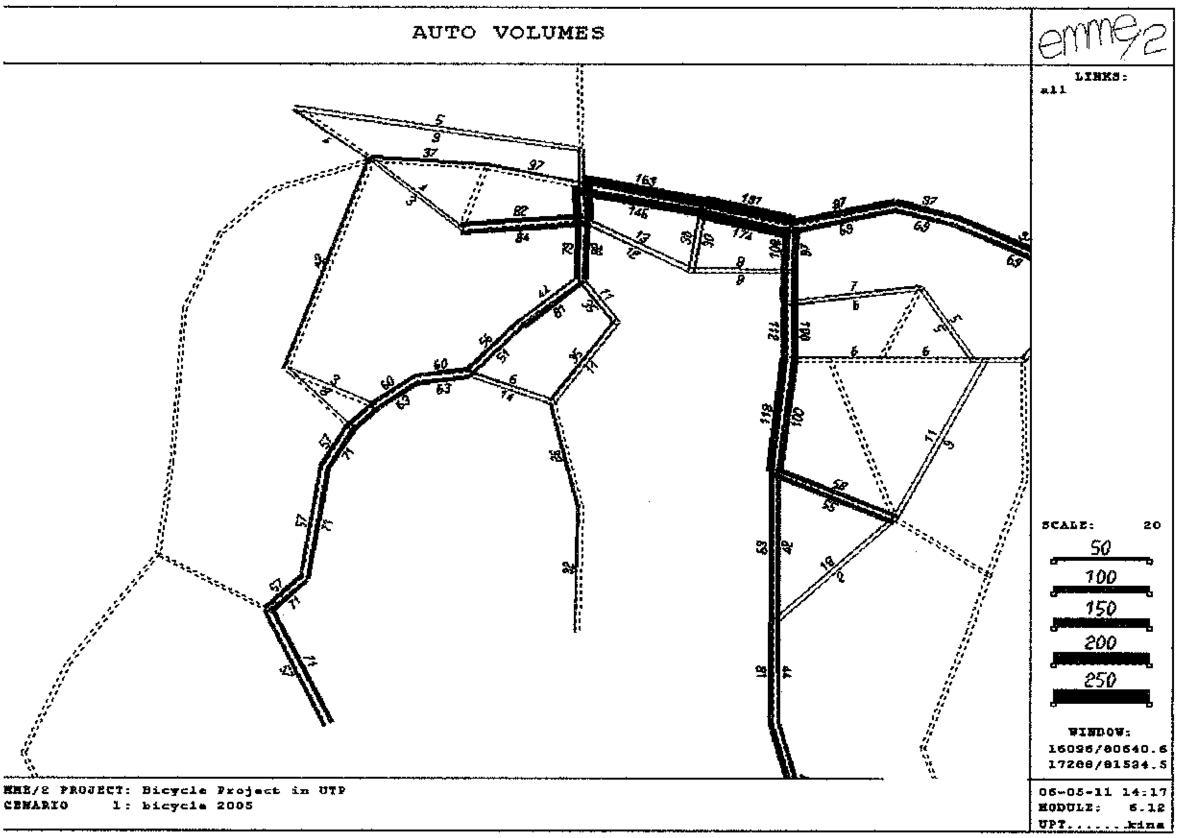
emme/2

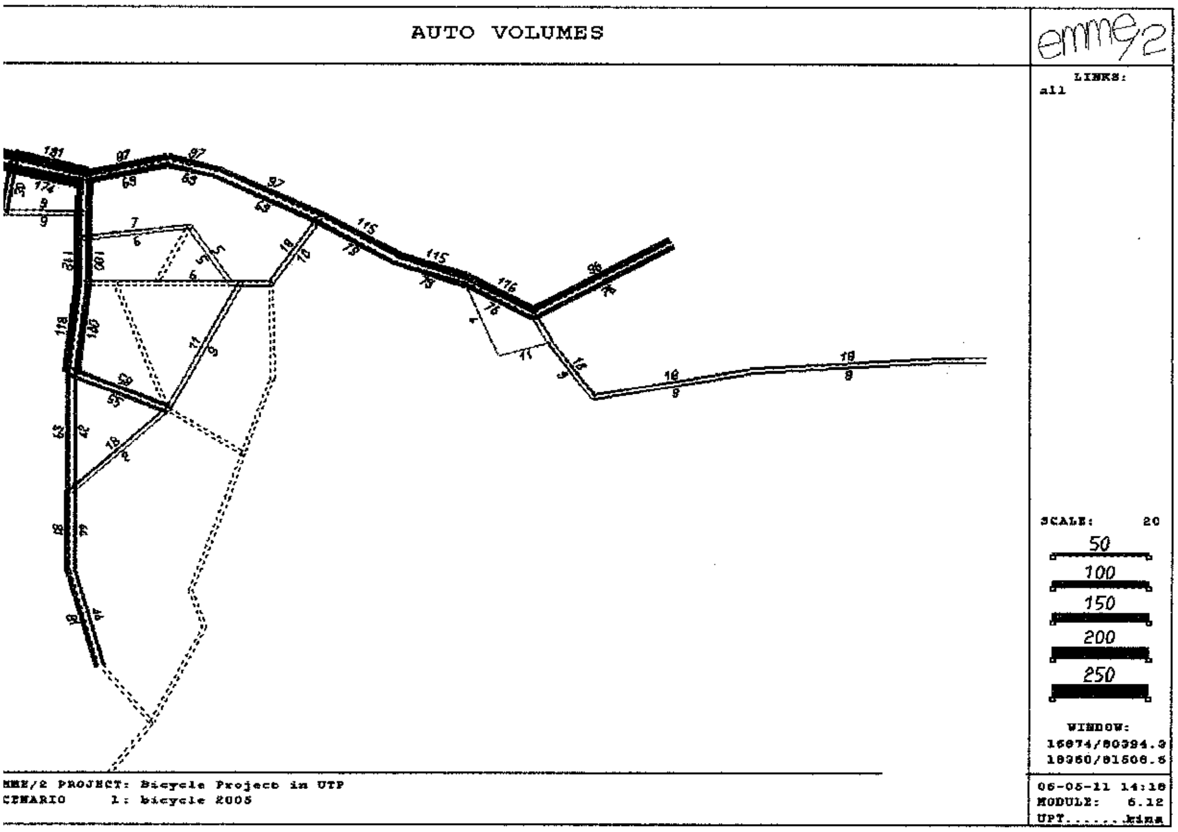
LINKS:
all

WINDOW:
15731/79437.2
18707/81668.7

EMME/2 PROJECT: Bicycle Project in UTP
SCENARIO 1: bicycle 2005

06-05-11 14:19
MODULE: 6.12
UPT......kina


AUTO VOLUMES
emme/2
LINKS:
all
SCALE: 20
50
100
150
200
250
WINDOW:
16096/80640.6
17208/81534.5
EME/2 PROJECT: Bicycle Project in UTP
CENARIO 1: bicycle 2005
06-05-11 14:17
MODULE: 6.12
UPT......kina


AUTO VOLUMES
emme/2
LINKS:
all
SCALE: 20
50
100
150
200
250
WINDOW:
16874/80394.3
18960/81506.5
EME/2 PROJECT: Bicycle Project in UTP
CENARIO 1: bicycle 2005
06-05-11 14:18
MODULE: 6.12
UPT......kina

AUTO VOLUMES

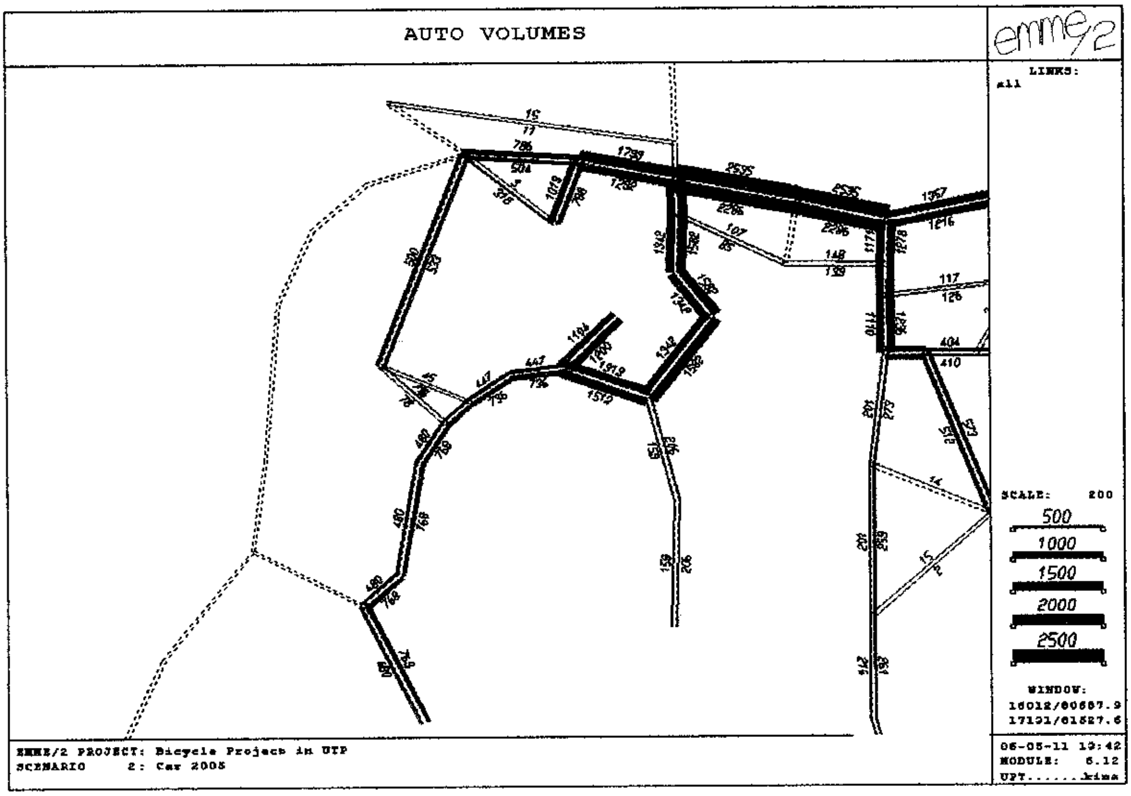
emme/2

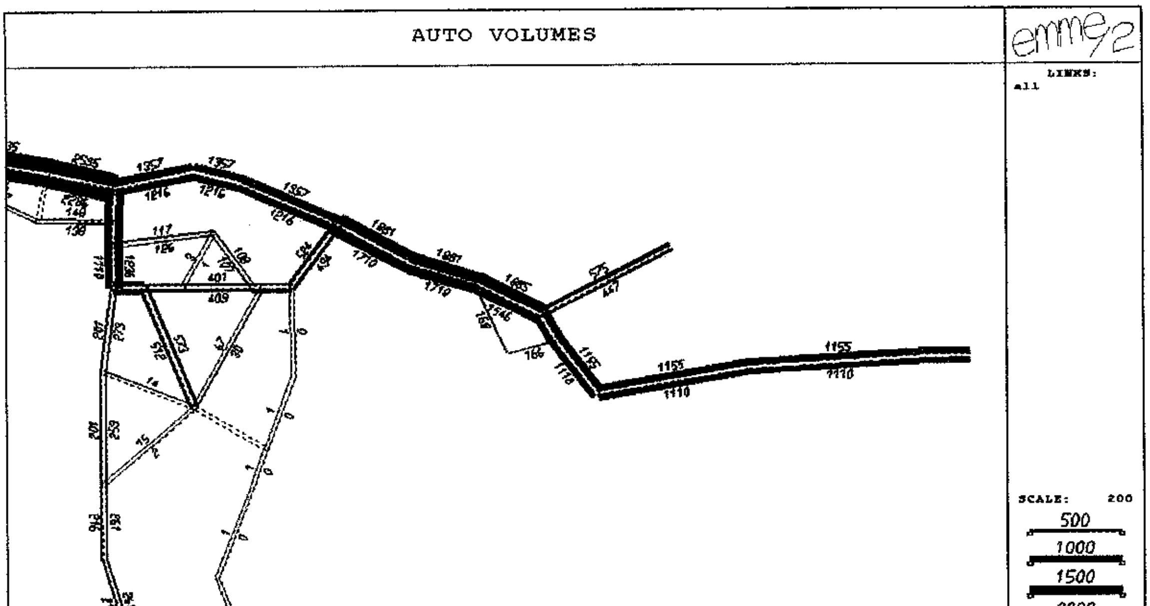
LINKS:
all

WINDOW:
15731/79437.2
18707/81668.7

EMME/2 PROJECT: Bicycle Project in UTP
SCENARIO 2: Car 2005

06-05-10 12:56
MODULE: 6.12
UPT......kina

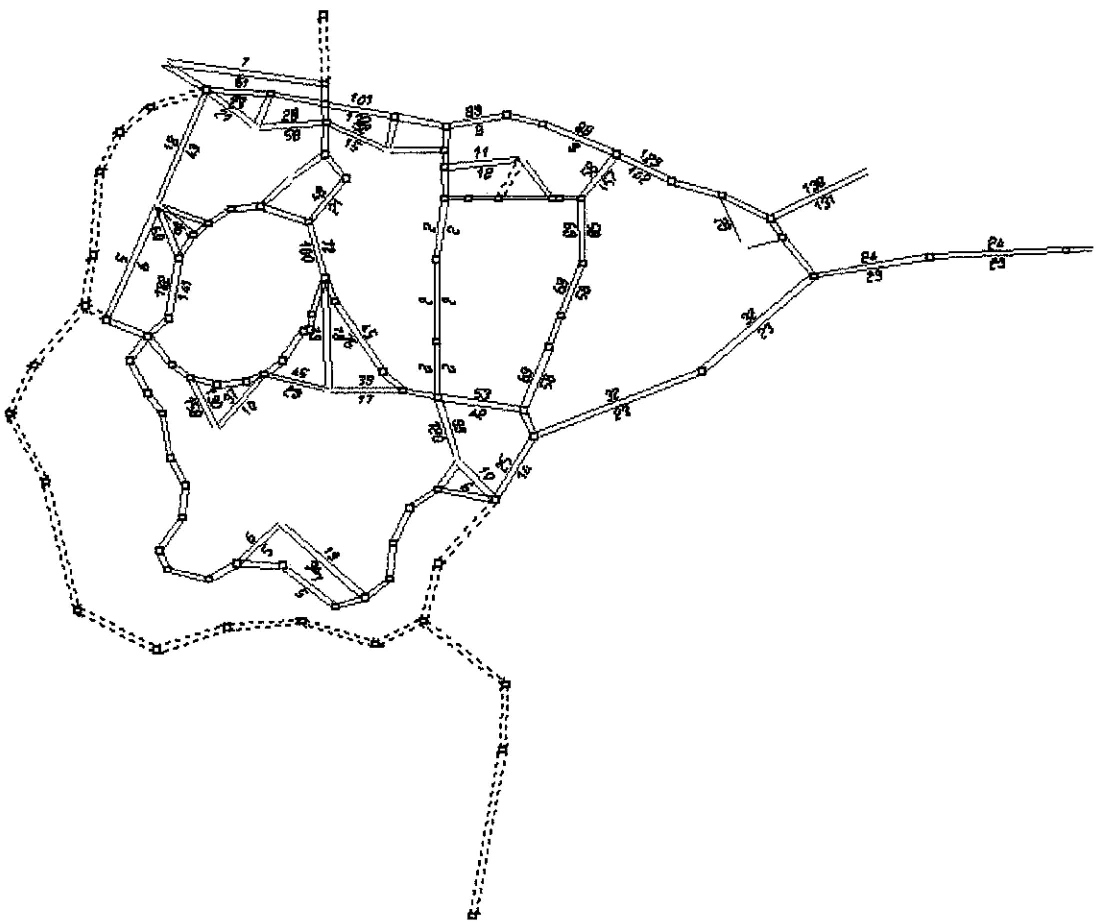

AUTO VOLUMES
emme/2
LINKS:
all
SCALE: 200
500
1000
1500
2000
2500
WINDOW:
16012/60657.9
17191/61527.6
EMME/2 PROJECT: Bicycle Project in UTP
SCENARIO 2: Car 2005
06-05-11 13:42
MODULE: 6.12
UPT......kina


AUTO VOLUMES
emme/2
LINKS:
all
SCALE: 200
500
1000
1500
2000
2500
WINDOW:
16851/60402.5
18353/61529.2
EMME/2 PROJECT: Bicycle Project in UTP
SCENARIO 2: Car 2005
06-05-11 13:43
MODULE: 6.12
UPT......kina

AUTO VOLUMES

emme/2

LINKS:
all



WINDOW:
15731/79437.2
16707/81668.7

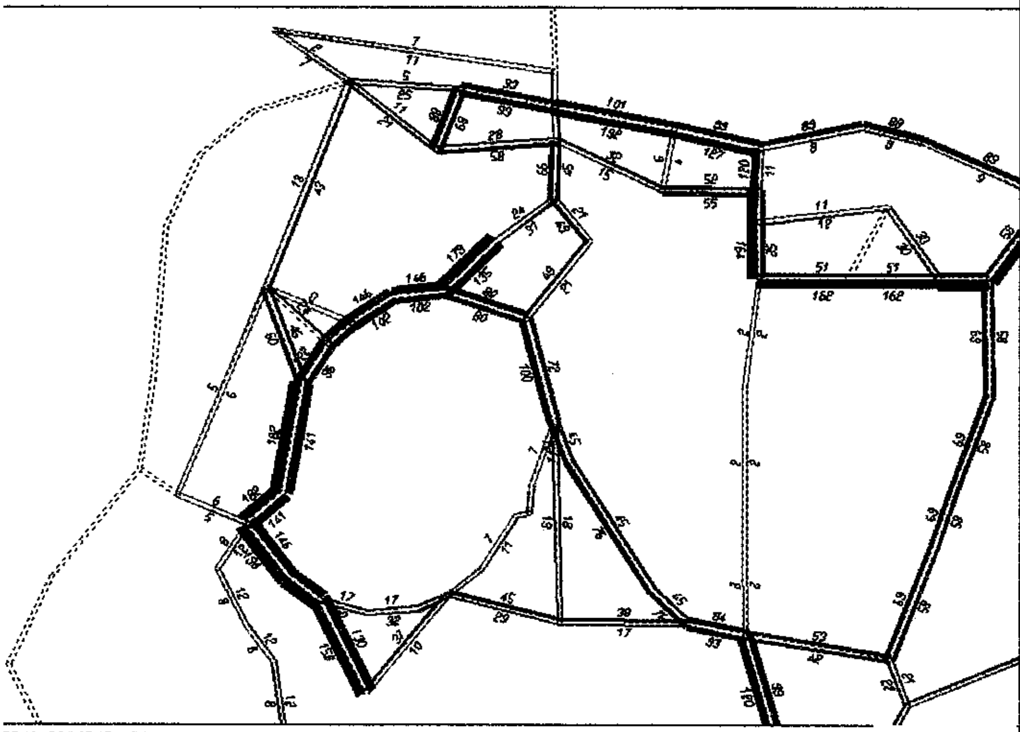
EMME/2 PROJECT: Bicycle Project in UTP
SCENARIO 3: bicycle 2010 do something

06-05-10 13:02
MODULE: 6.12
UPT.......kina

AUTO VOLUMES

emme/2

LINKS:
all



SCALE: 20

50
100
150
200
250

WINDOW:
16099/60594.9
17317/61507.9

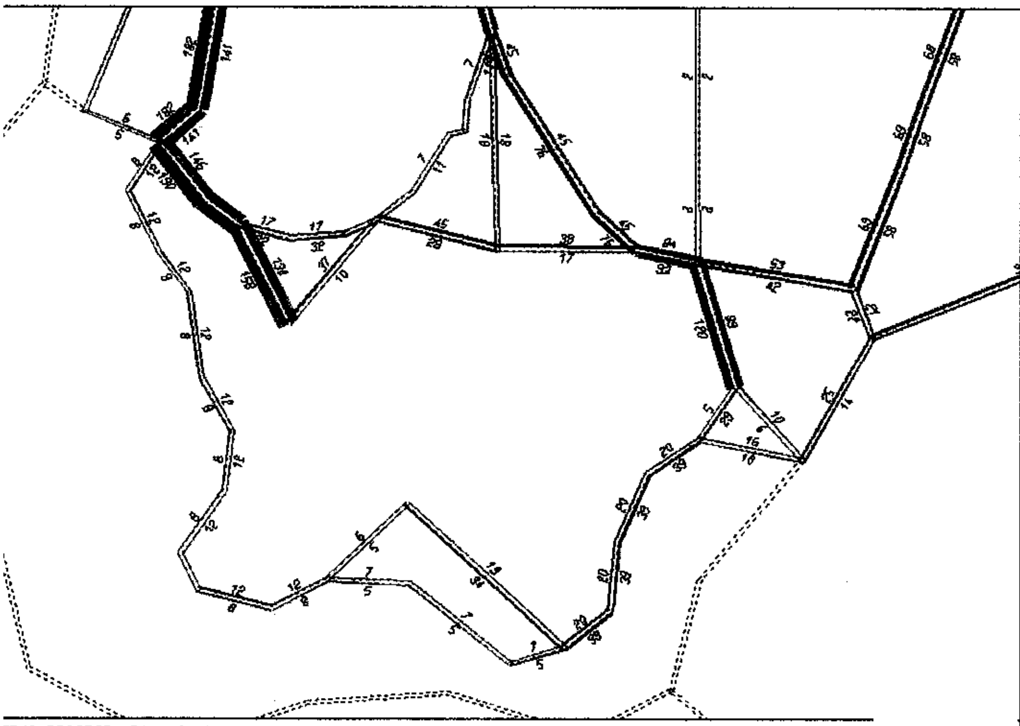
EE/2 PROJECT: Bicycle Project in UTP
ENARIO 9: bicycle 2010 do something

06-05-11 12:46
MODULE: 6.12
UPT.......kina

AUTO VOLUMES

emme/2

LINKS:
all



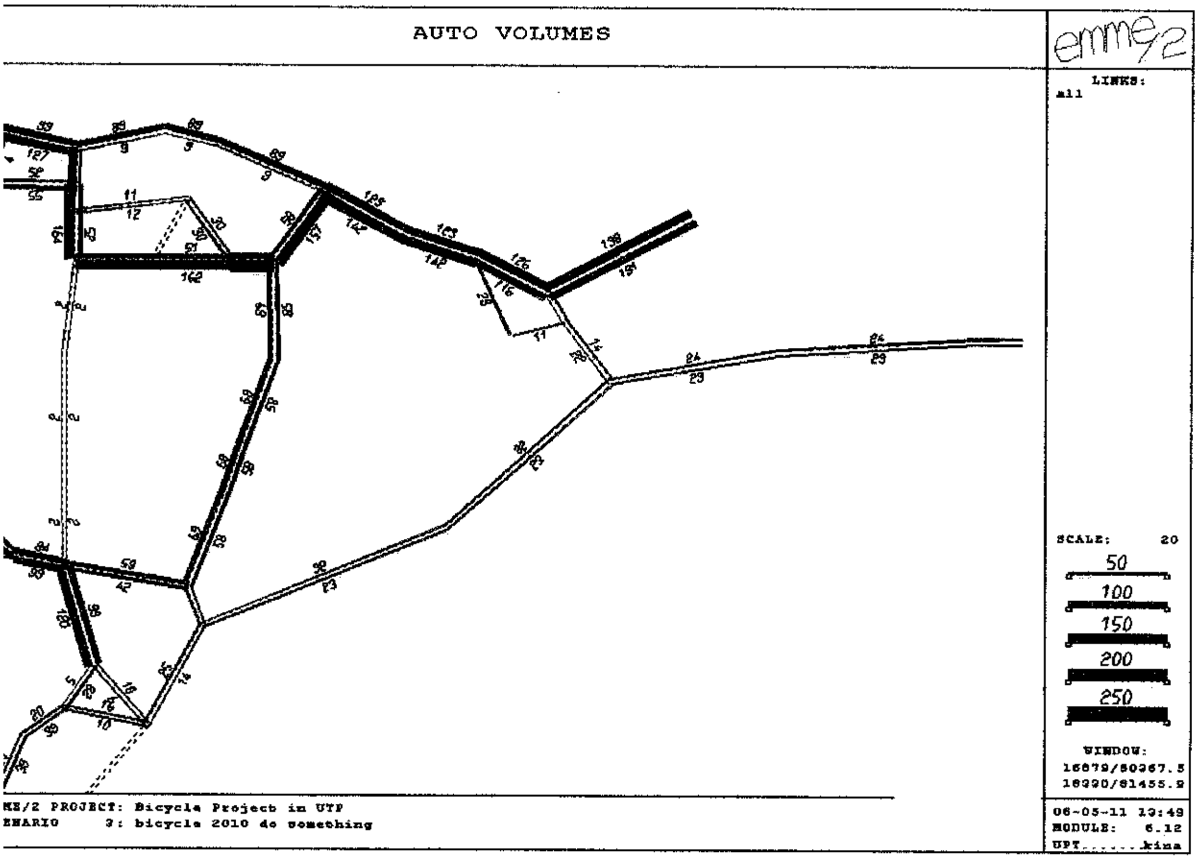
SCALE: 20

50
100
150
200
250

WINDOW:
16216/60162.9
17346/61010.7

EE/2 PROJECT: Bicycle Project in UTP
ENARIO 9: bicycle 2010 do something

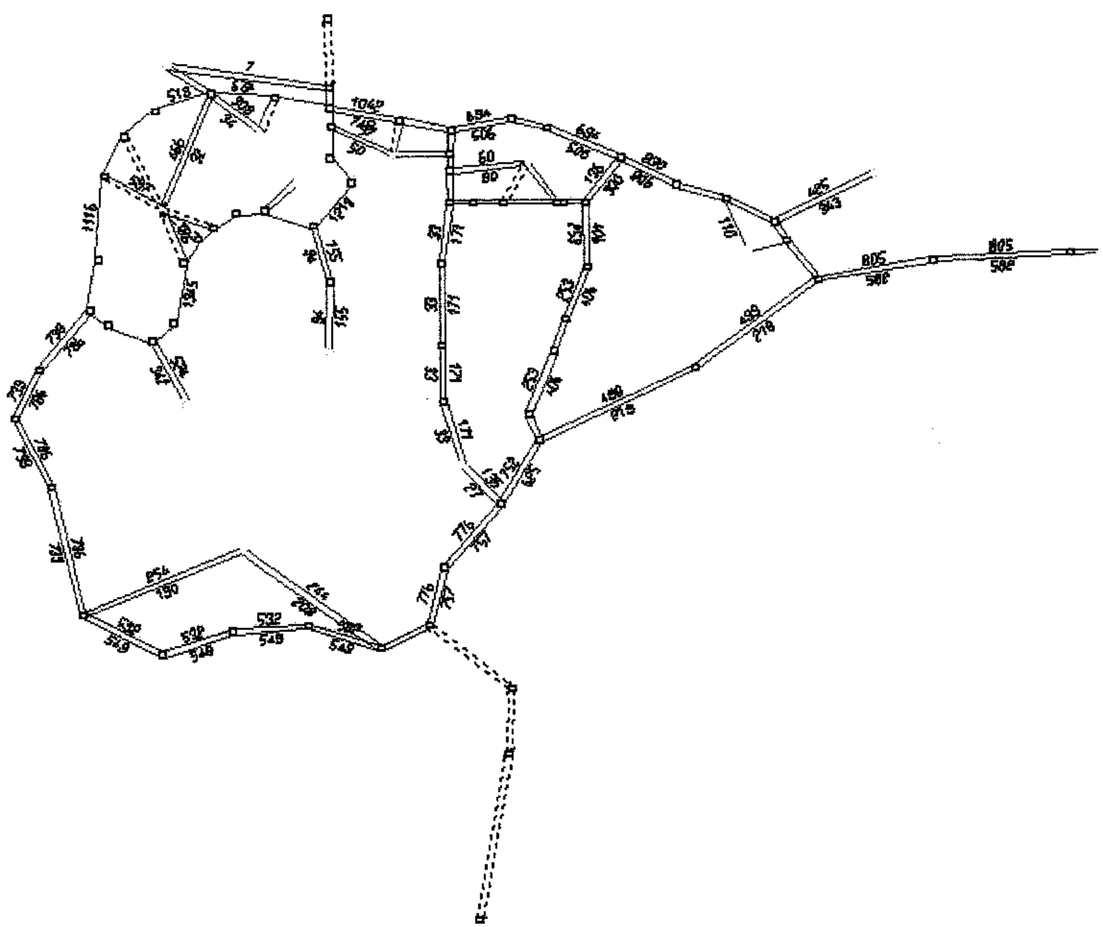
06-05-11 12:47
MODULE: 6.12
UPT.......kina


AUTO VOLUMES
emme/2
LINKS:
all
SCALE: 20
50
100
150
200
250
WINDOW:
16879/80367.5
18990/81455.9
06-05-11 13:49
MODULE: 6.12
UPT.......kina
ME/2 PROJECT: Bicycle Project in UTP
ENARIO 3: bicycle 2010 do something

AUTO VOLUMES

emme/2

LINKS:
all

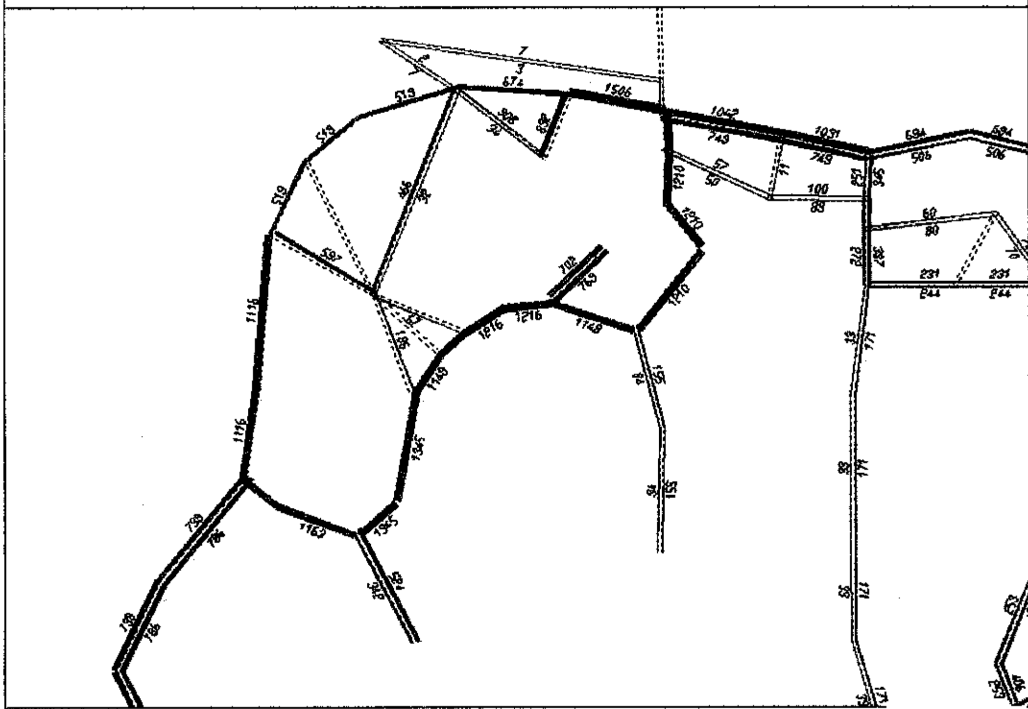


WINDOW:
15731/79437.2
18707/81668.7

06-05-10 12:33
MODULE: 6.12
UPT.......kina

EMME/2 PROJECT: Bicycle Project in UTP
SCENARIO 4: car 2010 do something

AUTO VOLUMES



LINKS:
all

SCALE: 200

500
1000
1500
2000
2500

WINDOW:
16007/80624.1
17202/81520.6

EMME/2 PROJECT: Bicycle Project in UTP
SCENARIO 4: car 2010 do something

06-05-11 13:52
MODULE: 6.12
UPT......kina

AUTO VOLUMES

LINKS:
all

SCALE: 200

500
1000
1500
2000
2500

WINDOW:
15965/79987.5
17575/81164.8

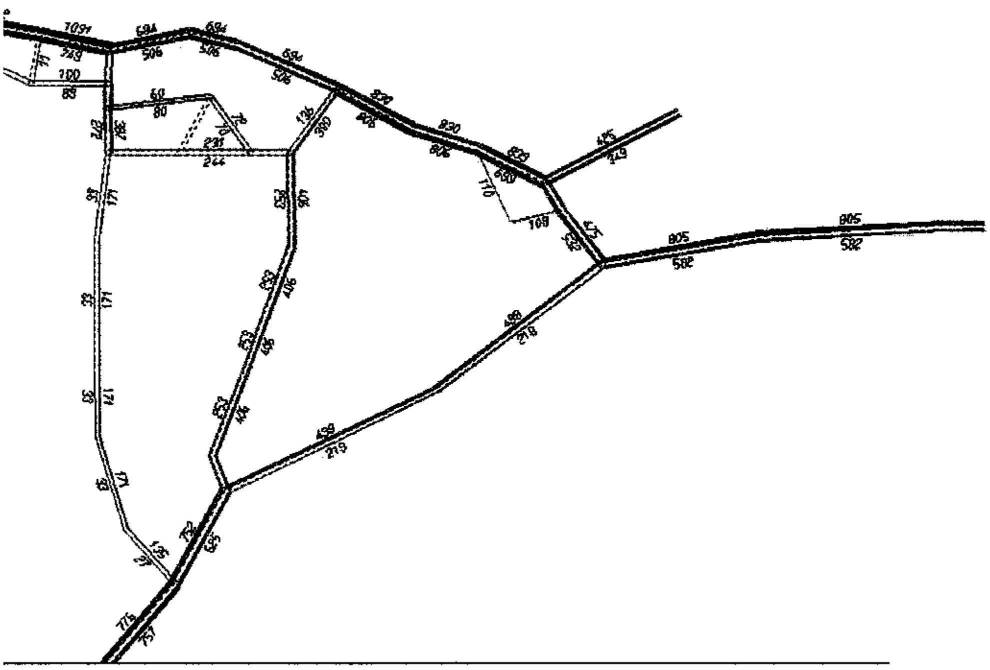
EMME/2 PROJECT: Bicycle Project in UTP
SCENARIO 4: car 2010 do something

06-05-11 13:54
MODULE: 6.12
UPT......kina

AUTO VOLUMES

emme/2

LINKS:
all



SCALE: 200

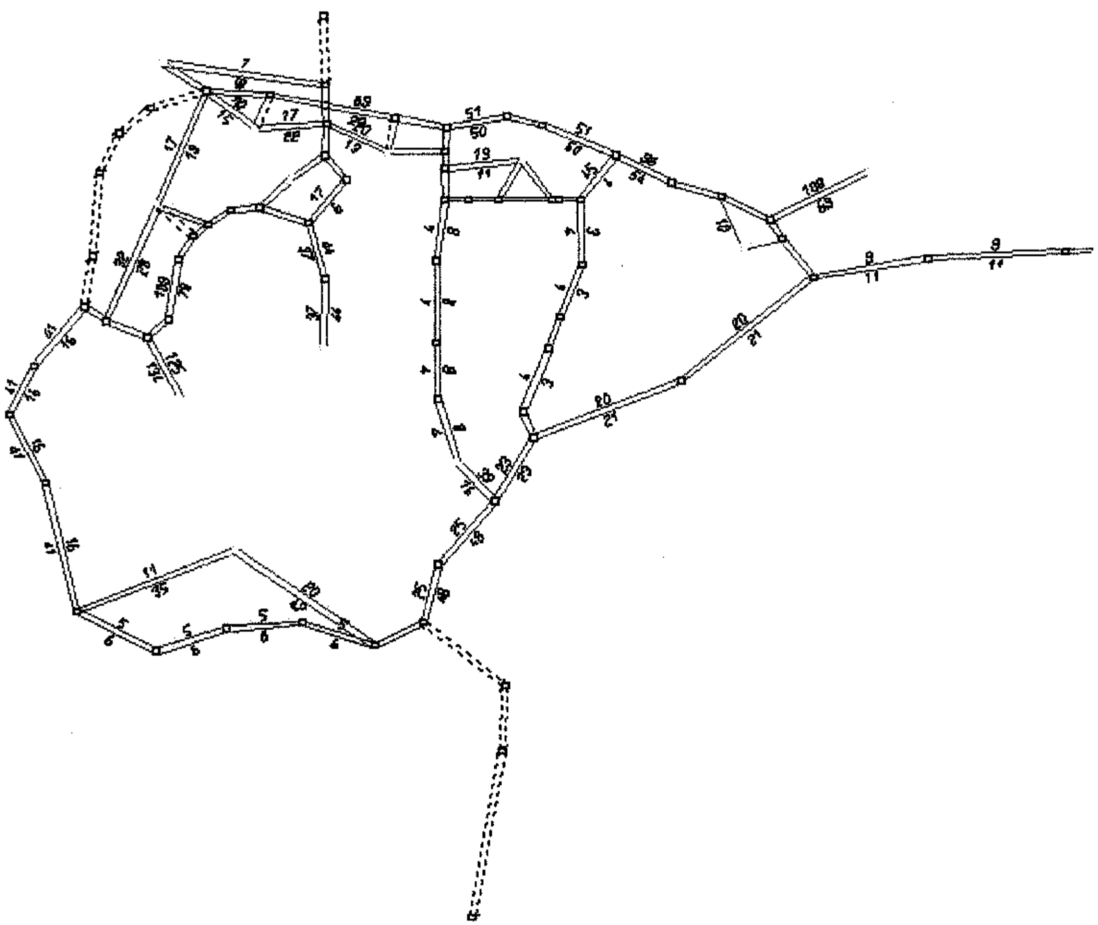
500
1000
1500
2000
2500

WINDOW:
16835/80344.1
18374/81498.1

EMME/2 PROJECT: Bicycle Project in UTP
CENARIO 4: car 2010 do something

06-05-11 13:55
MODULE: 6.12
UPT.......kina

AUTO VOLUMES



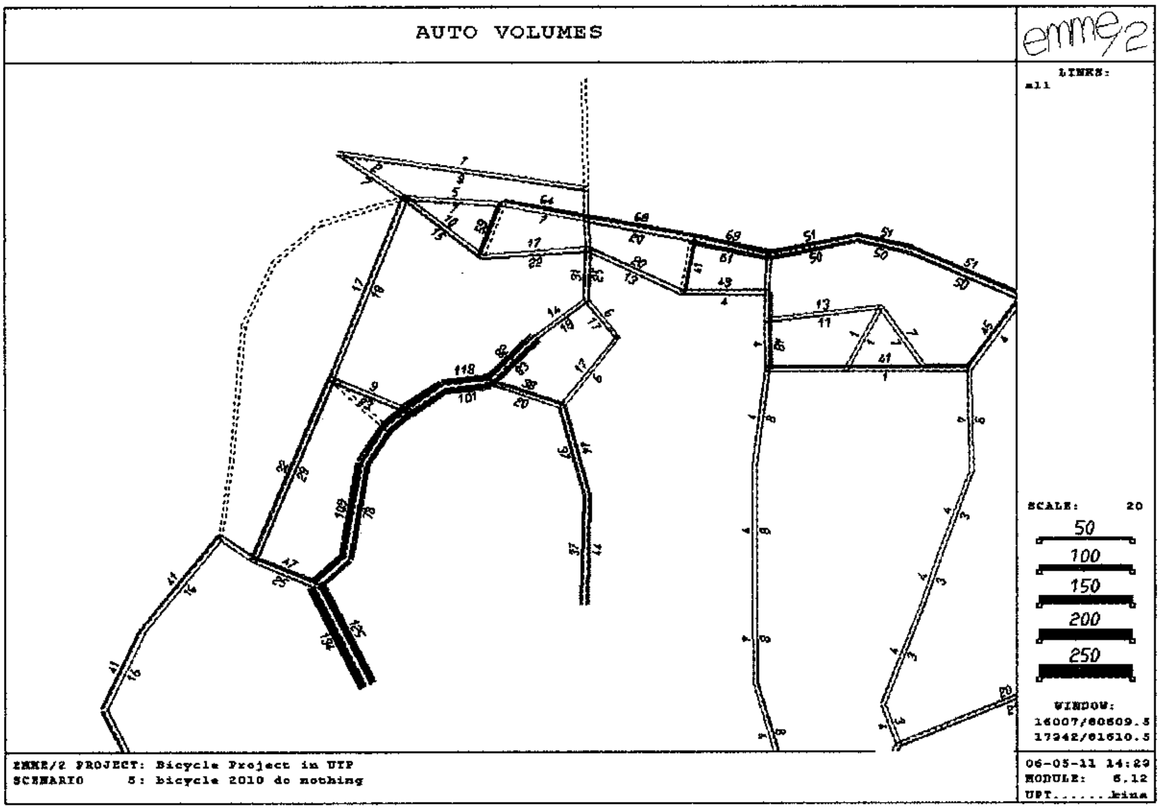
emme/2

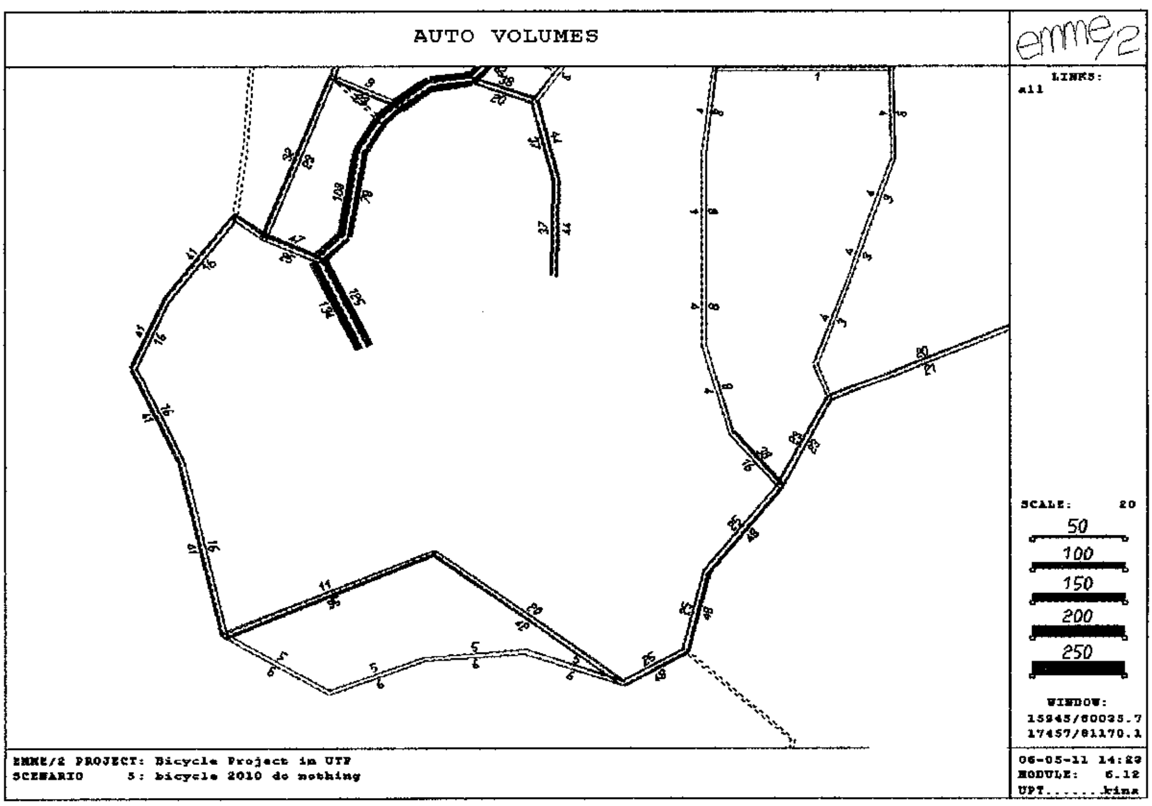
LINKS:
all

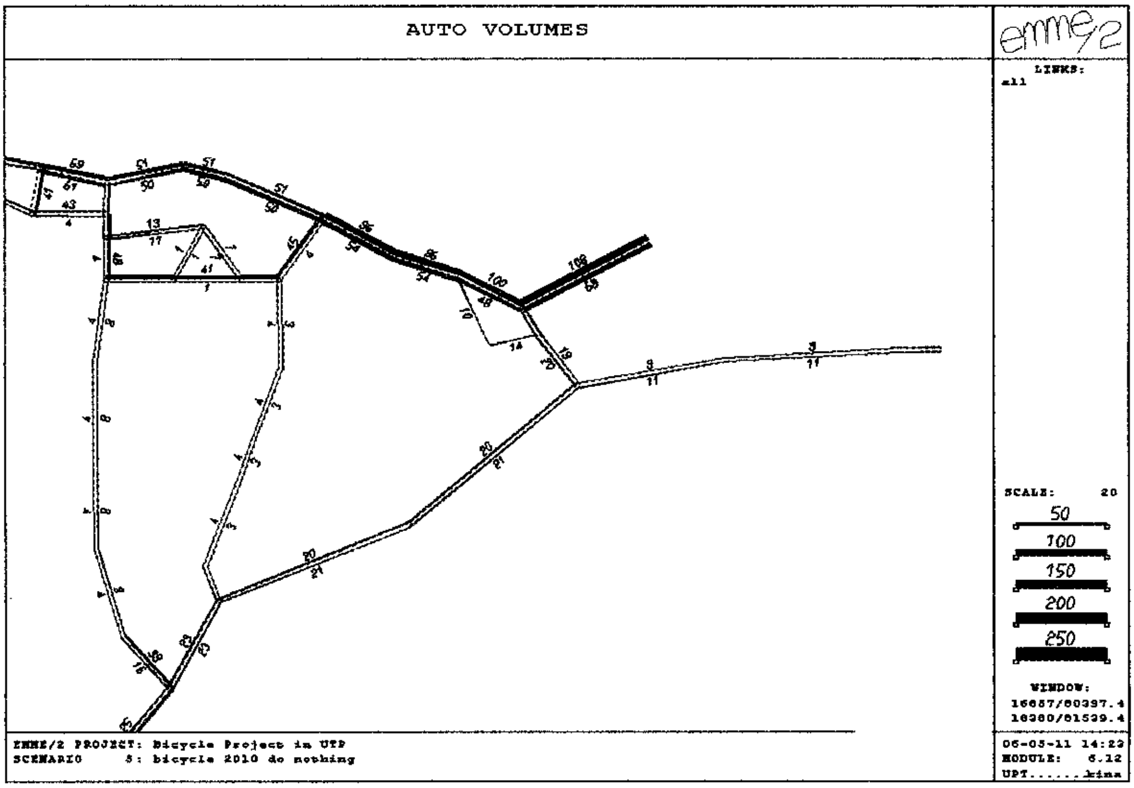
WINDOW:
15731/79437.2
18707/81668.7

EMME/2 PROJECT: Bicycle Project in UTP
SCENARIO 5: bicycle 2010 do nothing

06-05-10 14:23
MODULE: 6.12
UPT......kina


AUTO VOLUMES
emme/2
LINKS:
all
SCALE: 20
50
100
150
200
250
WINDOW:
16007/60609.5
17242/61610.5
EMME/2 PROJECT: Bicycle Project in UTP
SCENARIO 5: bicycle 2010 do nothing
06-05-11 14:29
MODULE: 6.12
UPT.......kina

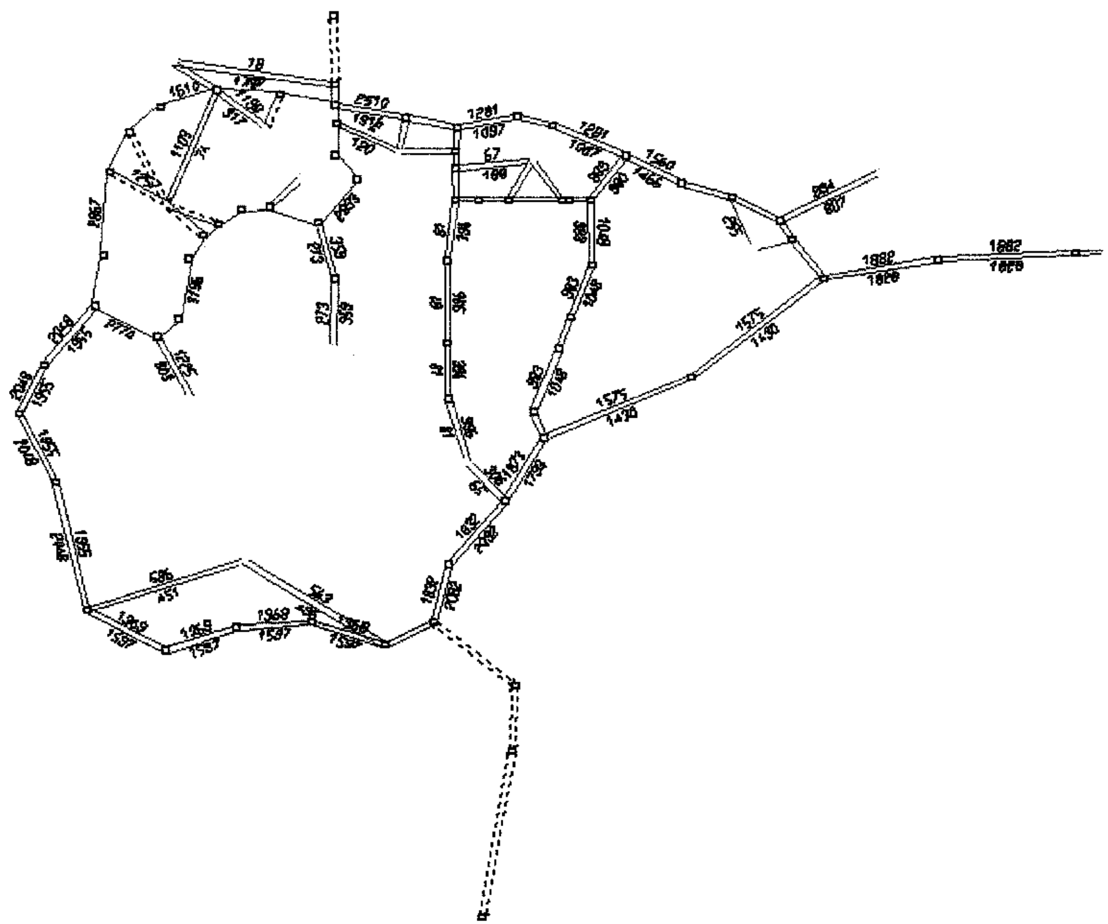

AUTO VOLUMES
emme/2
LINKS:
all
SCALE: 20
50
100
150
200
250
WINDOW:
15945/60035.7
17457/61170.1
EMME/2 PROJECT: Bicycle Project in UTP
SCENARIO 5: bicycle 2010 do nothing
06-05-11 14:29
MODULE: 6.12
UPT.......kina


AUTO VOLUMES
emme/2
LINKS:
all
SCALE: 20
50
100
150
200
250
WINDOW:
16657/60397.4
16380/61539.4
EMME/2 PROJECT: Bicycle Project in UTP
SCENARIO 5: bicycle 2010 do nothing
06-05-11 14:23
MODULE: 6.12
UPT......kina

AUTO VOLUMES

emme/2

LINKS:
all

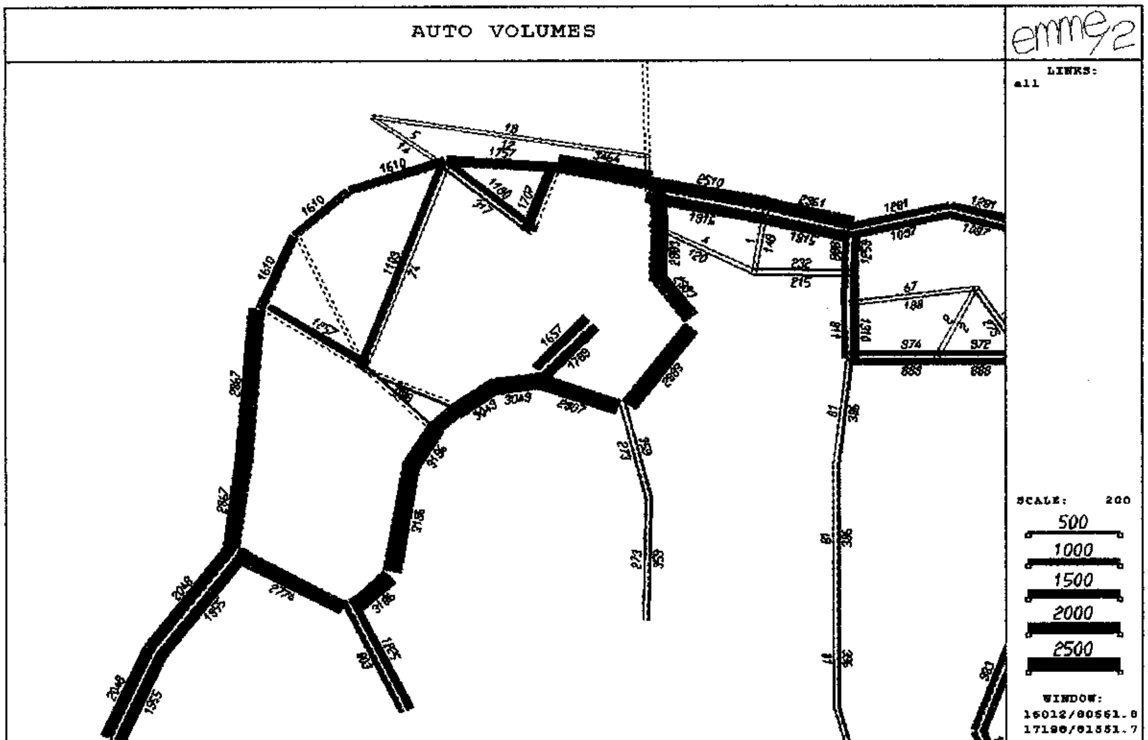


WINDOW:
15731/79437.2
18707/81668.7

EMME/2 PROJECT: Bicycle Project in UTP
SCENARIO 6: car 2010 do nothing

06-05-10 15:04
MODULE: 6.12
UPT.......kina

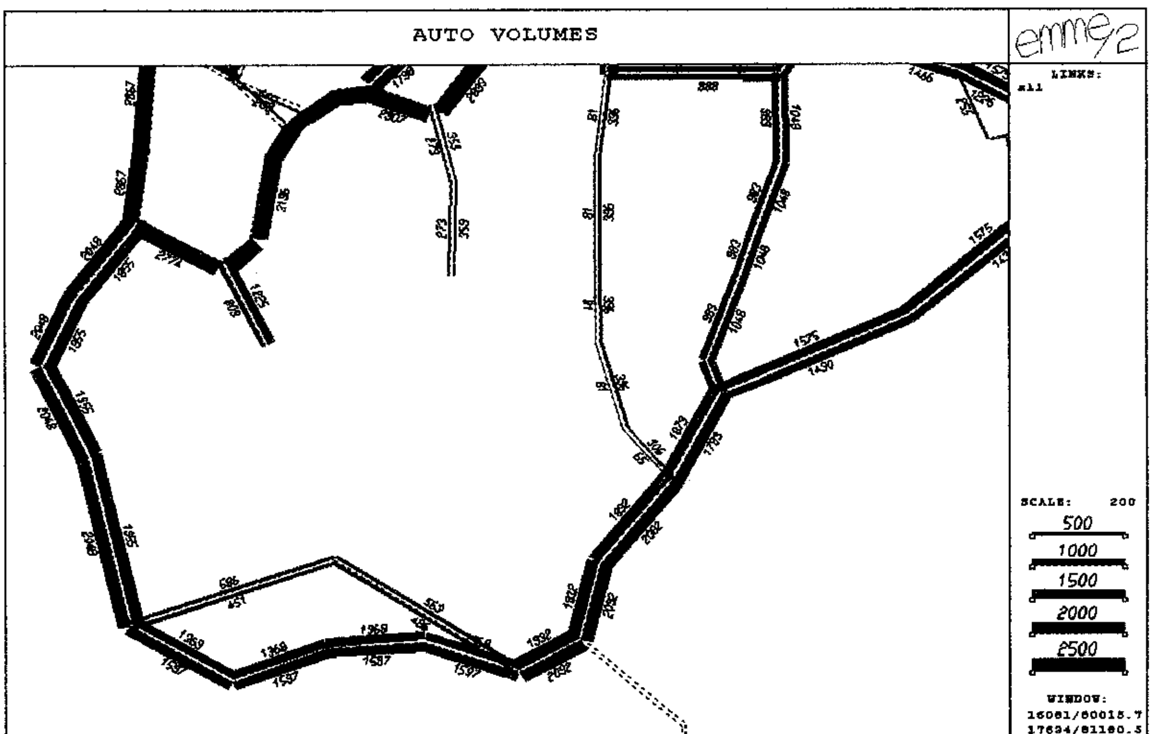
AUTO VOLUMES



EMME/2 PROJECT: Bicycle Project in UTP
SCENARIO 6: car 2010 do nothing

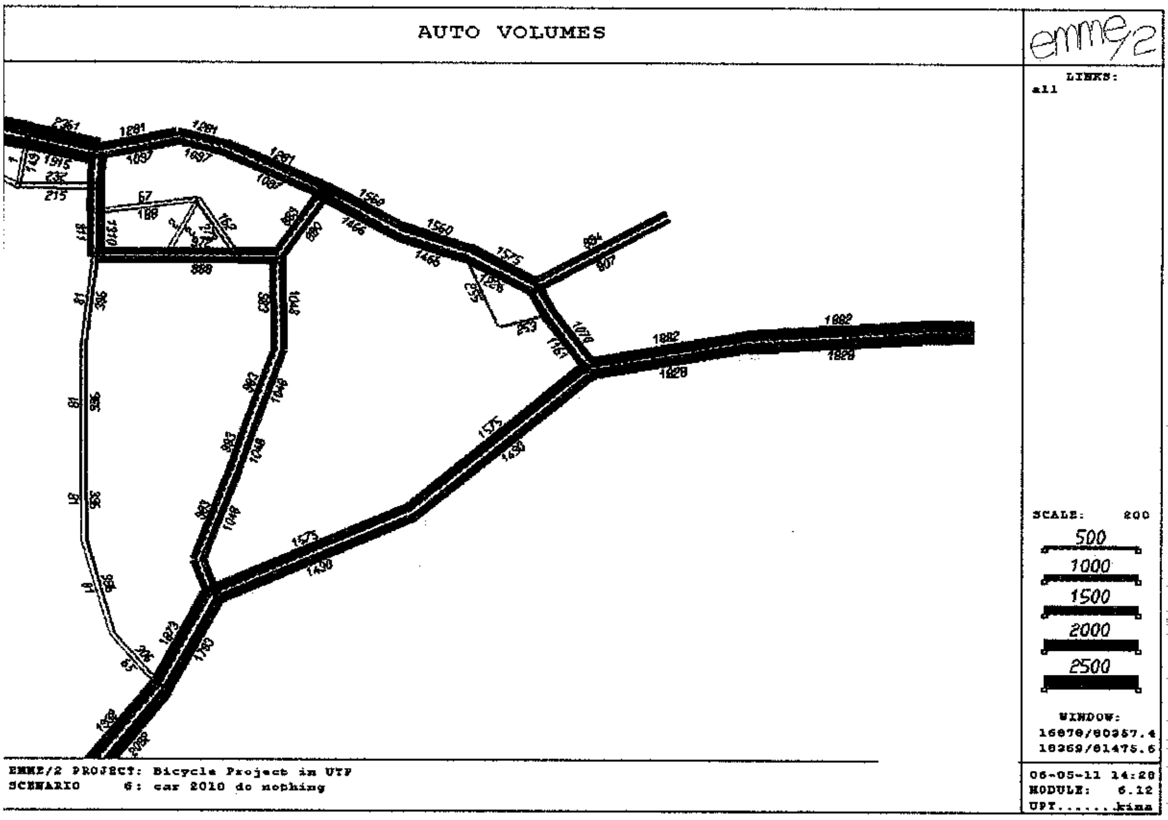
06-05-11 14:27
MODULE: 6.12
UPT.......kina

AUTO VOLUMES



EMME/2 PROJECT: Bicycle Project in UTP
SCENARIO 6: car 2010 do nothing

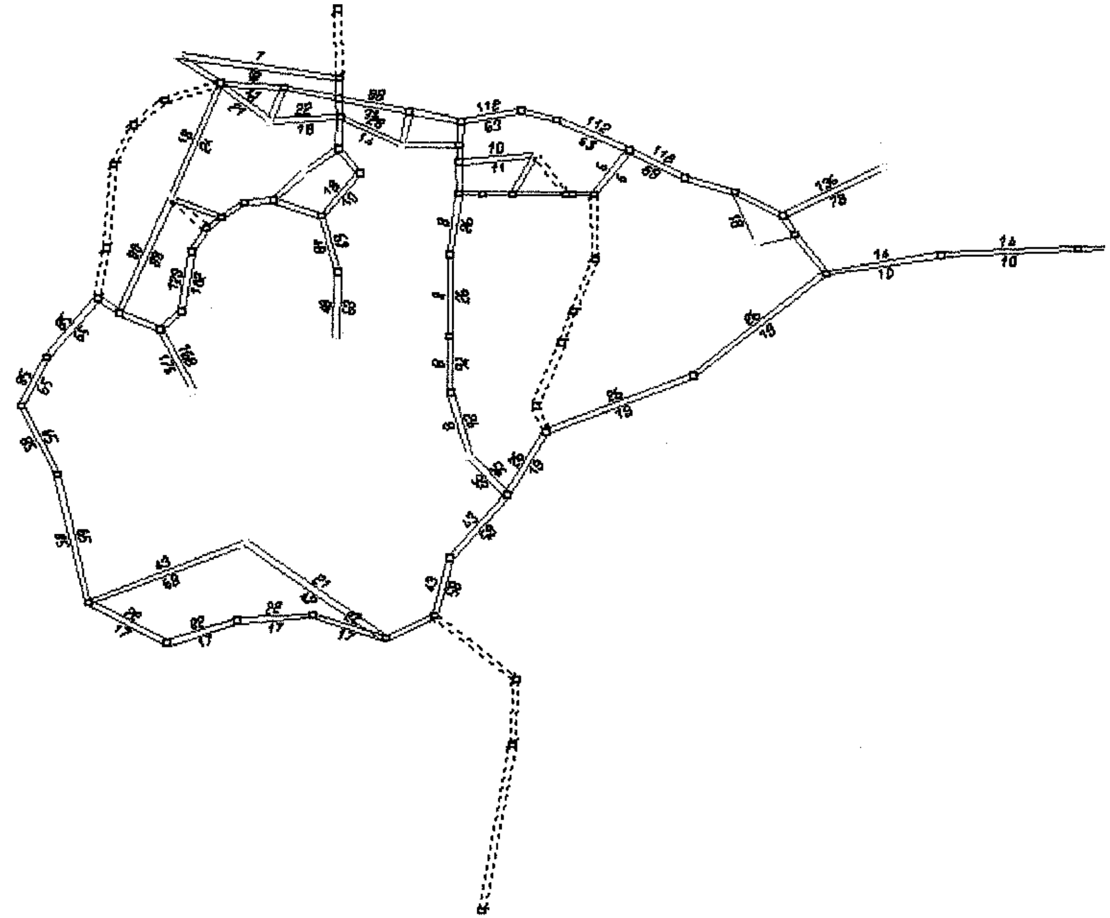
06-05-11 14:28
MODULE: 6.12
UPT.......kina


AUTO VOLUMES
emme/2
LINKS:
all
SCALE: 200
500
1000
1500
2000
2500
WINDOW:
16870/80357.4
18269/81475.6
EMME/2 PROJECT: Bicycle Project in UTP
SCENARIO 6: car 2010 do nothing
06-05-11 14:28
MODULE: 6.12
UPT.......kina

AUTO VOLUMES

emme/2

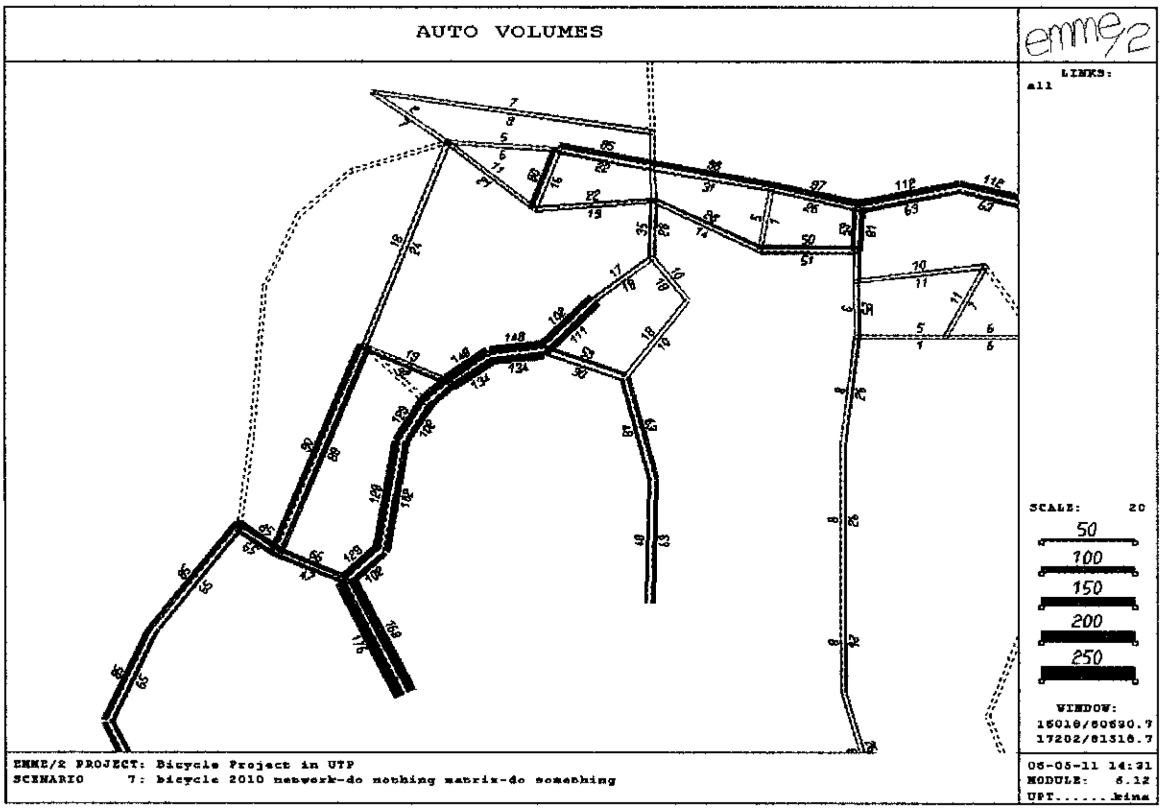
LINKS:
all

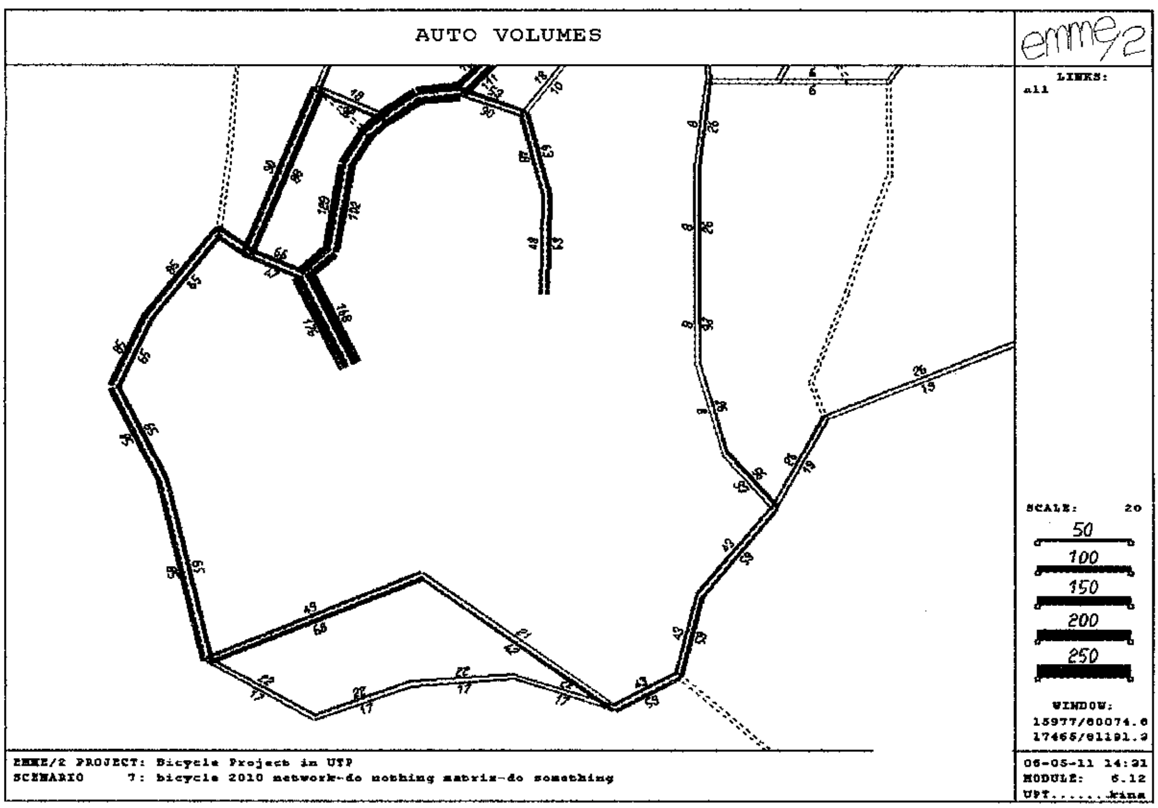


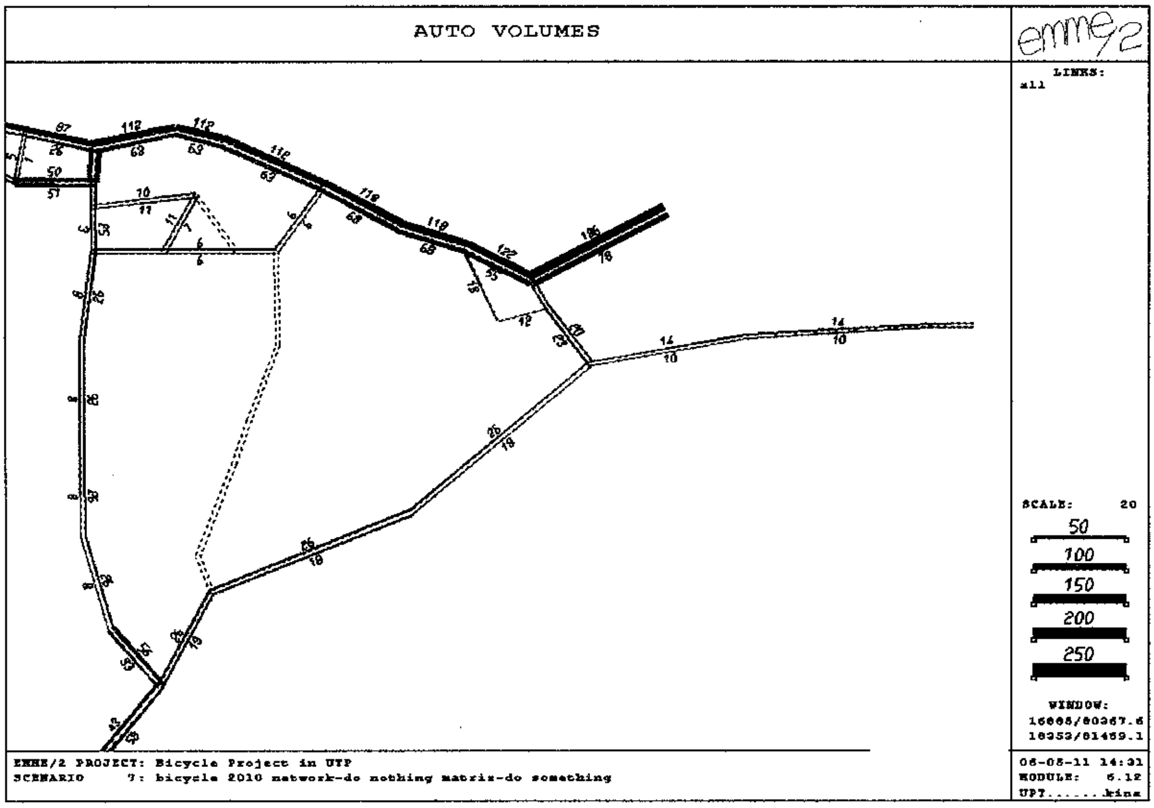
WINDOW:
15731/79437.2
18707/81668.7

EMME/2 PROJECT: Bicycle Project in UTP
SCENARIO 7: bicycle 2010 network-do nothing matrix-do something

06-05-10 15:25
MODULE: 6.12
UPT.......kina


AUTO VOLUMES
emme/2
LINKS:
all
SCALE: 20
50
100
150
200
250
WINDOW:
15018/60690.7
17202/61318.7
EMME/2 PROJECT: Bicycle Project in UTP
SCENARIO 7: bicycle 2010 network-do nothing matrix-do something
06-05-11 14:31
MODULE: 6.12
UPT.......kina


AUTO VOLUMES
emme/2
LINKS:
all
SCALE: 20
50
100
150
200
250
WINDOW:
15977/60074.6
17465/61191.9
EMME/2 PROJECT: Bicycle Project in UTP
SCENARIO 7: bicycle 2010 network-do nothing matrix-do something
06-05-11 14:31
MODULE: 6.12
UPT.......kina


AUTO VOLUMES
emme/2
LINKS:
all
SCALE: 20
50
100
150
200
250
WINDOW:
16668/80367.6
18353/81469.1
EMME/2 PROJECT: Bicycle Project in UTP
SCENARIO 7: bicycle 2010 network-do nothing matrix-do something
06-05-11 14:31
MODULE: 6.12
UPT.......kina