Iqra National University

Mid Term Exam Paper

Subject: Transportation Planning and Management

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Question 1:

<u>What is planning?</u>

<u>Transportation Planning Studies:</u>

<u>1-Planning:</u>

- An activity or process that examines the potential of future actions to guide a situation or system toward a future goals.
  Or
  Planning is the fundamental management function, which involves **deciding beforehand**, what is to be done, when is it to be done, how it is to be done and who is going to do it. It is an **intellectual process** which **lays down** an **organization's objectives and develops various courses of action**, by which the organization can achieve those objectives. It chalks out exactly, how to attain a specific goal.
  Planning is nothing but **thinking before the action takes place**. It helps us to take a **peep into the future** and decide in advance the way to deal with the situations, which we are going to encounter in future. It involves logical thinking and rational decision making.

- **Transportation planning** is a preparation planning to move/transfer human, animal or other item to some place to another place. This planning will related to the operation of the highway system, geometry, and operation of traffic facilities.

  In the *Transportation Planning Handbook*, 3rd Edition, transportation planning practice is defined as improving coordination between land use and transportation system planning; providing cooperative interaction between planning, design, and operation of transportation services; maintaining a balance between transportation-related energy use, clean air and water, and encouraging alternative modes of transportation that will enhance efficiency while providing high levels of mobility and safety.
  Or
  Transport planning is defined as planning required in the operation, provision and management of facilities and services for the modes of transport to achieve safer, faster, comfortable, convenient, economical and environment-friendly movement of people and goods.

2-Technical Report of Transportation Planning:

1-Overview:

The preceding section traced tile evolution of a formalized transportation planning process, by which transportation plans are produced, revised, and selected for implementation.

It also identified tile groups of participants in tile process and the factors that were deemed relevant to the proper execution of the planning function, the participating groups include bodies of elected officials, public agencies that having Leading and supportive roles in the process, officially appointed citizen advisory commissions and committees, private and public transportation system operator, voluntary citizen. And professional associations, and _interested individuals

2-Methodology:

2.1- Antecedent to Transportation Planning:

The first step toward the development of tile contemporary transportation planning methodology may be traced to the conduct of land surveys that supported the layouts of , cities and towns and the locations of turnpikes, canals, and, later, railroads.

The second step was the need to conduct facility inventories, such as the first national inventory of .1807.

The third step commenced when tile Office of Road Inquiry, toward the end of the nineteenth .century, extended data collection efforts to include information relating to facility use, that is, traffic levels, trip lengths, and user costs

2.2-Strategic Transport planning

In strategic transport planning we consider cross effects between different forms of transport, as well as the cross effects between traffic and socio-economic developments. The product »city transport« is right at the heart of the communal strategic transport planning as an inherent precondition for a sustainable development and for the securing of access to environment friendly mobility for all parts of society.

Cars, motorcycles, public transport, bicycles and walking are not considered as competing forms of transport, but rather as indispensable parts of an integrated master plan. For example, it would be impossible to avoid gridlocks in accumulation centers without a functioning short-distance public transport system.

We do not consider strategic transport planning as a reaction to an unavoidable development, but as the conscious design of the development process. To judge possible options, we have developed tools to depict the effects of different scenarios. This allows us to give the relevant policymakers the necessary decision aids. Examples of our criteria to determine the various scenarios are:

Ease of access to all existing and planned housing and trading areas,

Avoiding travel, through a better town planning (for example by reducing distances between home, the workplace and school)

Providing the necessary capacity in the whole transport network for the demands of both the population and the economy

Macro-economically sensible division of the demand to the various forms of transport, while taking into account the various needs,

Compliance with environmental standards and the sustainable financing of the road network and short-distance public transport.

As part of our research project »local use of public transport, we have researched the effects of different strategies on the future development of the traffic system as a whole, consisting of the road network and public Transport with regards to controlling measures for several reference areas.

2.3-Transportation planning process:

In most of the countries transport planning is treated as a part of general economic planning and no special attention has been paid, but now not only developed countries but developing countries have also realized the need for separate planning for the transportation, not only for the existing system but for the future development also.

The study of development and planning is basically a study of interaction between man, land and activity in the form of spatial organization of economy. After industrial revolution and rapid growth of urbanization, development in the field of transport is enormous both in infrastructures, speed as well as in transport technology. Nowadays every country of the world is having its own national transport system, not in isolation but as a part of international system of transportation. Transport now has, as ever, become an integral and essential part of the economy and requires a planned growth, which should be 'sustainable'.

In fact, transport planning is the process of regulating and controlling the provision of transport to facilitate the efficient operation of the economic, social and political life of the country at the lowest social cost. In practice, this means assuring adequate transport capacity and efficient operations to meet the needs generated by the nation's geographical array of activities.

Planning process:

The primary aim of transport planning is the identification and evaluation of the future transport needs.

The four main stages of the transportation planning process are:

(i) Transportation survey, data collection and analysis;

(ii) Use of transportation model;

(iii) Future land use forecasts and alternative policy strategies; and

(iv) Policy evaluation.

Survey and Data Collection:

The entire planning process of transportation, may be local, regional or national, is based on survey and data collection. This includes all types of literature and data (both government and non-government) available on transportation, journey behavior patterns, nature and intensity of traffic, freight structure, cost and benefits, i.e., income, employment estimates, etc.

The comprehensive knowledge of traffic flows and patterns within a defined area is essential. In addition to traffic data, planners also require land use and population data for their study area. In this connection West Midlands Transportation Study (1968) provides a format, which is useful for transport survey and data collection.

The survey should be well defined and be divided in 'zones' so that origins and destinations of trips can be geographically monitored. The data collection regarding existing travel patterns is time consuming as well as a costly affair. It involves both 'roadside-interview' and 'home-interview'.

The details-of existing transport network are an important source of information. In some cases, a very detailed description of links and nodes in terms of vehicle speed, carriage-way width and nodal type is collected. Travel times and network characteristics of public transport networks are simultaneously collected. Finally, data processing should be done. When this has been completed, planners can begin their data analysis.

Some assumptions and limitations of transportation planning are as below:

Assumptions:

First developed in the late 1950s

Helps make decision on future development of (urban) transport systems

Forecasts travel patterns 15-25 years ahead

A clear understanding of the modeling process and assumptions is essential to understanding transportation plans.

Limitations of Urban Transport Modeling:

Only considers factors and alternatives explicitly included in the equations.

If models are not sensitive to certain factors, they will not show any effect of them.

This could lead to a conclusion that the factors are ineffective. E.g., bicycle or pedestrian

It is therefore critical to consider the assumptions before decisions are made.

2.4-The Transportation Model:

The second stage of the transportation planning process is to use the collected data to build up a transportation model. This model is the key to predicting future travel demands and network needs and is derived in four recognized stages, i.e., trip generation, trip distribution, traffic assignment and model split.

Preliminary Model Scoping within Terms of Reference

The scoping stage is generally the first stage in a transport modelling project. Whilst the full detail of scoping might not be required prior to tendering, it is generally necessary for the contracting authority to have formed a view on what type of transport model is necessary, and its required functionality. Tendering in the absence of some preliminary scoping should be avoided, as it places an incentive to adopt the least-cost approach to transport modelling. The terms of reference should therefore set out basic requirements, such as:

If an existing transport model can be modified/adapted for use;

If a network model is desired/required;

Transport modes to be included;

The modelled Study Area;

Whether variable demand responses are to be modelled;

The number of user classes and journey purposes; and

Time periods and the number of forecast years.

Transport modelling projects should be fully scoped to the point where it is possible to use a fixed-price contract specifying technical terms of reference and a defined project program.

Reporting Requirements:

It is crucial that any transport model is not a "black box" for project justification. The modelling process, input data, assumptions and outputs should be transparently justified and documented to allow external review and understanding. The anticipated deliverables from a Transport
Modelling exercise are summarized as follows:

A Transport Modelling Report;

A copy of the Transport Models, plus a shape file version of all modelled scenarios where network models are employed; and The Model Manual.

Note that the above deliverables should be prepared in addition to any Feasibility Study or Cost Benefit Analysis reports that may be produced as part of the project preparation.

2.5- Planning for the future needs:

A major breakthrough of the needs studies of the 1930s and 1940s was the. Recognition that planning highway network extensions should not be based merely on the static criterion of connectivity but also on continuous efforts to anticipate future demands 'for travel.

Initially this was accomplished by projecting current traffic measurements into the future using traffic growth factors based on discerned relationships between population and economic growth on one hand and traffic levels on the other.

For example, based on annual rates of growth in the gross national product (GNP), traffic growth factors in the range of 3 to 4% were considered to be reasonable. The projected traffic levels could then be checked against the capacity of existing highways to anticipate future capacity deficiencies and, within financial constraints, to plan and schedule capacity improvements accordingly.

2.6-Transporation Survey:

The first stage in the formulation of a transportation plan is to collect data on all factors are likely to influence travel pattern. The work involves a number of surveys so as to have:

1. An inventory of existing travel pattern.
2. An inventory of existing transport facilities.
3. An inventory of existing land use and economic activities.

Definition of the study area:

The study area for which transportation facilities are being planned is first of all defined. Transportation planning can be at the national level, the regional level or at the urban area level.

For planning at the urban level, the study area should embrace the whole contribution containing the existing and potential continuously built up areas of the city. The imaginary line representing the boundary of the study area is termed as the external cordon line the area inside the external cordon line determines the travel pattern to a large extent and as such, it is surveyed great detail. The land use pattern and the economic activities are studied intensively and detailed survey (such as the home-interview) are conducted in this area to determine the travel characteristics. On the other hand, the area outside the cordon line is not studied in such details

Large-Scale Urban Travel Survey:

Significant differences in the patterns of urban travel necessitated the development of more refined techniques. An important difference was (and still is) the fact that in urban areas, street capacities between various parts of the city involved multiple rather than single routes. If needed, capacity enhancements should consider this combined supply of road Ways.

A desire line diagram, which shows the region divided into smaller sectors, or traffic (analysis) zones, and the flows between these zones irrespective of individual roadway links are preferable. To obtain this type of information, new travel survey and data reduction methods were developed during the 1940s, including the origin-and-destination (0-D) surveys consisting of home interviews, Truck interviews, taxi interviews, and parking surveys.

The data on travel habits obtained from interviewing a sample consisting of 4 to 5% of the total households in the region and about 20% of the truck and taxi companies were expanded to the overall population by computer-based statistical techniques, and the actual traffic counts crossing selected screen lines were used to check the accuracy of the statistical expansion of the sample data.

The first large-scale travel survey of this type was conducted in Detroit. At the present time travel surveys have become an indispensable tool for planning. In 1996 the Travel Survey Manual authored by Cambridge Systematics, Inc. was released. The manual is a product of the Travel Model Improvement Program (TMIP) and was sponsored by the FHWA and the EPA.

2.7-Travel Demand Forecast:

Initially the projection of the interzonal trip distribution toward the target year was accomplished by applying simple growth factors to the base-year travel desire volumes in a manner that was similar to rural highway practice. Gradually, however, it became evident that the need for added capacity and parking facilities' in urban areas was not uniform. The first computer-based quantitative land use and socioeconomic projection models were developed by transportation planners in this connection and were later adopted eagerly by other urban planners.

Mathematical trip-generation models relating the trip-producing capability of residential areas and the trip-attracting potential of various types of nonresidential land-use classes were postulated, calibrated, and validated.

Thus trip-generation, trip-distribution, mode choice, and traffic assignment models evolved, each intended to describe and forecast a different component of travel behavior.

3- Conclusion:

In this report we defined strategic transportation planning to applicable for future improvement and modeling, described studies, planning process, principle planning stages, described the modeling studies, assumptions and limitation regarding to transportation model to prepare a comprehensive transportation plan to respondent for future improvement and models.

Question 2:

These are four steps of Conventional Transport Modeling:

Trip generation

Trip distribution

Mode choice

Trip assignments.

I will describes the process of the conventional four steps transportation modeling.

1-Introduction:

Travel forecasting models are used to predict changes in travel patterns and the utilization of the transportation system in response to changes in regional development, demographics, and transportation supply. Modeling travel demand is a challenging task, but one that is required for rational planning and evaluation of transportation systems [1].

Transportation planning involves the decision-making process for potential improvements to a community's roadway infrastructure. To aid in the decision-making process, several computer based and manual tools have been developed. Two of these key tools are [2]:

a) Travel demand forecasting models for implementing the four-step urban planning process

b) Travel rate indices for providing congestion and delay information for a community.

The four-step urban planning process is comprised of the following:

Trip Generation, Trip Distribution, Mode Split, and Traffic Assignment.

The objectives of this paper are to learn about the Urban Transport Modeling System, to gain a better understanding of the behavior of the traffic condition of the zonal basis and to prepare the Network Assignment through the Transport Modeling System.

The conventional four step transportation modeling system has been taken to achieve the objectives.

Step1-Trip Generation:

The trip-generation models strive to predict the number of trips generated by a zone. These models try to mathematically describe the *decision-to-travel* phase of the sequential demand analysis procedure. It may be mentioned here that typically the term trip-generation is used to mean *trip production -- generally the trips made from households* --and *trip attraction -- the trips made to a particular urban location or activity*. However, it is felt that analysis of trip attractions should not be within the purview of trip-generation models which attempt to quantify a populations urge or propensity to travel. Rather, trip attractions are an outcome of the *destination-choice* phase of travel behavior. In keeping with this, the present section discusses trip-generation primarily in the context of trip productions. Trip attractions are assumed to be an outcome of the destination-choice phase and are discussed in the section on *trip-distribution models*.

There are basically two different model structures for trip generation models -- the *cross-classification models* and the *regression models*. However, both these model structures incorporate the same basic factors which affect the trip generation of a zone; the models only differ in their characterization of these factors.

The factors (for any given trip purpose) which affect the trip generation of a zone are:

The number of potential trip-makers in the zone; this data could be captured by variables like residential density, average household occupancy, age distribution of occupants, and so forth.

The propensity of a potential trip-maker to make a trip; this is related to automobile ownership, accessibility to public transportation, and the like. For example, persons who own automobiles make more non-work trips than persons who do not own automobiles.

Accessibility of the zone to potential destinations for a given trip-purpose satisfaction; variables like distance to potential destinations can capture this factor. For example, persons who live close to various recreational facilities may make more number of recreational trips than persons who live in areas which do not have nearby recreational facilities.

Zonal-Based versus Household-Based Models:

A transportation planning study cannot possibly trace the travel patterns of every individual residing within a region. As a result, the. Geographical patterns of trip making are summarized by dividing the region into smaller travel-analysis zones and by associating the estimated trips

The rationale of household-based models is that households with similar characteristics tend to have ·similar travel propensities irrespective of their geographical, location within the region.

The calibration of household-based models employs a sample of households rather than a sample of zones. These models are known as disaggregate models because they decompose (or disaggregate) each zone into smaller units. However, this disaggregation is not geographical, as households of the various types may be interspersed throughout a zone. Consequently this decomposition is not necessarily equivalent to delineating smaller zones

Productions and Attraction:

Trips may be categorized as either Production and attraction (P-A) or origin and destination (O-D)

Origin and destination are defined on the base of the direction of a given inter zonal trip of origin and one destination.

To understand this difference, consider the two zones I and J Typically each of these zones will contain residences as well as nonresidential land uses, such as places of business, schools, and commercial establishments.

The terms production and attraction, on the other hand, are\ not defined in terms of the directions of trips but in terms of the land use associated with each trip end.

A trip production is defined .as a trip end connected with a residential land use in a zone, and a trip, attraction is defined as a trip end connected to a nonresidential land use in a zone Different models are. **Regression models, trip-rate analysis models, and cross_-classification models**.

Step 2-Trip Distribution:

Trip distribution is the second component in the traditional 4-step transportation planning (or forecasting) model. This step matches trip makers' origins and destinations to develop a "trip table" a matrix that displays the number of trips going from each origin to each destination.
Trip distribution step is going to be started by introducing an origin-destination matrix for all the zones

Total trip attraction/ destinations must be equal to total trip productions. As trip production is considered to be exact. For this reason the trip attraction for different zones is multiplied by an adjustment factor. The factor can be stated as:

Adjustment Factor=Total Production/Total Attraction

Adjustment trip attraction= Total Production/ Total Attraction ×Trip attraction of any zone

Step 3-Mode Choice:

Mode choice analysis is the third step in the conventional four-step transportation planning model. Trip distribution's zonal interchange analysis yields a set of origin destination tables which tells where the trips will be made; mode choice analysis allows the modeler to determine what mode of transport will be used.
Mode choice is one of the most critical parts of the travel demand modeling process. It is the step where trips between a given origin and destination are split into trips using transit, trips by car pool or as automobile passengers and trips by automobile drivers. A utility function measures the degree of satisfaction that people derive from their choices and a disutility function represents the generalized cost that is associated with each choice. The most commonly used process for mode split is to use the 'Logit' model. This involves a comparison of the "disutility" or "utility" of travel between two points for the different modes that are available. Disutility is a term used to represent a combination of the travel time, cost and convenience of a mode between an origin and a destination. It is found by placing multipliers (weights) on these factors and adding them together.
Disutility calculations may contain a "mode bias factor" which is used to represent other characteristics or travel modes which may influence the choice of mode (such as a difference in privacy and comfort between transit and automobiles). The mode bias factor is used as a constant in the analysis and is found by attempt to fit the model to actual travel behavior data. Generally, the disutility equations do not recognize differences within travel modes. For example, a bus system and a rail system with the same time and cost characteristics will have the same disutility values. There are no special factors that allow for the difference in attractiveness of alternative technologies. Once disutility are known for the various mode choices between an origin and a destination, the trips are split among various modes based on the relative differences between disutility. The logit equation is used in this step. A large advantage in disutility

will mean a high percentage for that mode. Mode splits are calculated to match splits found from actual traveler data. Sometimes a fixed percentage is used for the minimum transit use (percent captive users) to represent travelers who have no automobile available or are unable to use an automobile for their trip.
In this step the matrix for travel time and travel cost is given to calculate the utilities for three modes- Car, Bus and Rickshaw

4-Trip Assignment:

Trip assignment, traffic assignment or route choice concerns the selection of routes (alternative called paths) between origins and destinations in transportation networks. It is the fourth step in the conventional transportation planning model. Mode choice analysis tells which travelers will use which mode. To determine facility needs and costs and benefits, we need to know the number of travelers on each route and link of the network.
Once trips have been split into highway and transit trips, the specific path that they use to travel from their origin to their destination must be found. These trips are then assigned to that path in the step called traffic assignment. The process first involves the calculation of the shortest path from each origin to all destinations (usually the minimum time path is used). Trips for each O-D pair are then assigned to the links in the minimum path and the trips are added up for each link.
The assigned trip volume is then compared to the capacity of the link to see if it is congested. If a link is congested the speed on the link needs to be reduced to result in a longer travel time on that link. Changes in travel times mean that the shortest path may change. Hence the whole process is repeated several times (iterated) until there are equilibrium between travel demand and travel supply. Trips on congested links will be shifted to uncontested links until this equilibrium, condition occurs. Traffic assignment is the most complex calculation in the travel modeling sequence and there are a variety of ways in which it is done to keep computer time to a minimum.
At first a network is assumed and then we calculate the Generalized Travel Cost (GTC) factor for each mode.

The procedure for calculating GTC is shown below:

$GTC = TC + (a1/a2) \times TT$

Where, TC=Travel Cost
TT=Travel time

$a1$ = Co-efficient of the Travel Time factor

$a2$ = Co-efficient of the Travel Cost factor

Traffic assignment is typically done for peak hour travel while forecasts of trips are done on a daily basis. A ratio of peak hour travel to daily travel is needed to convert daily trips to peak hour travel (for example it may be assumed that ten percent of travel occurs in the peak hour).

Question 3:

Calculation of Trips Generation and Attractions for each Zone:

Land Use Category		Area(ha)						
		Peshawar	Charsadda	Mardan	Nowshera	Swabi	Abbottabad	Kohat
Residential		7740	24900	17064	40204	29317	576416	53445
Commercial	Retail	6972	5688	26220	6172	126091	15270	1290
	wholesale	14940	10744	20976	7715	90065	7635	1935
	Service	5976	2528	1748	6172	162117	10180	1720
Manufacturing		1290	4980	1264	1748	4629	36026	12725
Transportation		1935	8964	5688	5244	4629	90065	10180
Public Buildings		2580	9960	4424	6992	3086	252182	30540
Public open space		3010	22908	15800	71668	92580	468338	114525

Table 2 Person trips per hectare by land use and zone.										
	Personal trips per hectare									
Zone	Residential	Commercial			Manufacturing	Transportation	Public buildings	Public Open space	Average	
		Retail	Wholesale	Services					Used land	All Land
1	128	850	135	445	353	73	595	5	128	100
2	108	423	90	258	183	25	265	3	75	50
3	93	563	115	505	83	35	375	10	80	55
4	75	670	73	385	73	25	245	5	65	43
5	55	463	60	365	55	13	90	5	43	20
6	45	485	48	338	53	18	48	3	35	13
7	38	380	40	328	35	15	10	3	28	8
Average	60	565	328	78	65	23	115	5	50	23

According to the table 2 Person trips per hectare by land use and zone

Trips Generation and attractions for Residential land:

Zone 1:

Person trip per hectare in residential land use is 128, and given area in zone1 (Peshawar) is 7740 hectare

So trip generation and attraction in Peshawar is 7740×128= 990720

Zone2:

Person trip per hectare in residential land use is =108, Area=24900 ha

Trips=24900×108=2689200

Zone3:

Person trip per hectare in residential land use =93, Area=17064 ha

Trips=17064×93=1586952

Zone4:

Person trip per hectare in residential land use =75, Area=40204 ha

Trips=40204×75=3015300

Zone5:

Person trip per hectare in residential land use =55, Area=29317 ha

Trips=29317×55=1612435

Zone6:

Person trip per hectare in residential land use =45, Area=576416 ha

Trips=576416×45=25938720

Zone7:

Person trip per hectare in residential land use 38, Area=53445 ha

Trips=53445×38=2030910

Trips Generation and attractions for Retail:

Zone1:

Land use: Retail, Person trip per hectare=850, Area=6972 ha

Trips=6972×850=5926200

Zone2:

Land use: Retail, Person trip per hectare=423, Area=5688 ha

Trips=5688×423=2406024

Zone3:

Land use: Retail, Person trip per hectare=563, Area=26220ha

Trips=26220×563=14761860

Zone4:

Land use: Retail, Person trip per hectare=670, Area=6172ha

Trips=6172×670=4135240

Zone5:

Land use: Retail, Person trip per hectare=463, Area=126091ha

Trips=126091×463=58380133

Zone6:

Land use: Retail, Person trip per hectare=485, Area= 15270ha

Trips=15270×485=7405950

Zone7:

Land use: Retail, Person trip per hectare=380, Area=1290 ha

Trips=1290×380=490200

Trips Generation and attractions for Wholesale:

Zone1:

Land use: wholesale, Person trip per hectare=135, Area=14940 ha

Trips=14940×135=2016900

Zone2:

Land use: wholesale, Person trip per hectare=90, Area=10744 ha

Trips=10744×90=966960

Zone3:

Land use: wholesale, Person trip per hectare=115, Area=20967 ha

Trips=20967×115=2411205

Zone4:

Land use: wholesale, Person trip per hectare=73, Area=7715 ha

Trips=7715×73=563195

Zone5:

Land use: wholesale, Person trip per hectare=60, Area=90065 ha

Trips=90065×60=5403900

Zone6:

Land use: wholesale, Person trip per hectare=48, Area=7635 ha

Trips=7635×48=366480

Zone7:

Land use: wholesale, Person trip per hectare=40, Area=1935 ha

Trips=1935×40=77400

Trips Generation and attractions for Service:

Zone1:

Land use: Service, Person trip per hectare=445, Area=5976 ha

Trips=5976×445=2659320

Zone2:

Land use: Service, Person trip per hectare=258, Area=2528 ha

Trips=2528×258=652224

Zone3:

Land use: Service, Person trip per hectare=505, Area=1748 ha

Trips=1748×505=882740

Zone4:

Land use: Service, Person trip per hectare=385, Area=6172 ha

Trips=6172×385=2376220

Zone5:

Land use: Service, Person trip per hectare=365, Area=162117 ha

Trips=162117×365=59172705

Zone6:

Land use: Service, Person trip per hectare=338, Area=10180 ha

Trips=10180×338=2440840

Zone:7

Land use: Service, Person trip per hectare=328, Area= 1720ha

Trips=1720×328=564160

Trips Generation and attractions for Manufacturing:

Zone1:

Land use: Manufacturing, Person trip per hectare=353, Area=1290ha

Trips=1290×353=455370

Zone2:

Land use: Manufacturing, Person trip per hectare=183, Area=4980ha

Trips=4980*183=911340

Zone#3:

Land use: Manufacturing, Person trip per hectare=83, Area=1264ha

Trips=1264×83=104912

Zone4:

Land use: Manufacturing, Person trip per hectare=73, Area=1748ha

Trips=1748×73=127604

Zone5:

Land use: Manufacturing, Person trip per hectare=55, Area=4629ha

Trips=4629×55=254595

Zone6:

Land use: Manufacturing, Person trip per hectare=53, Area=36026ha

Trips=36026×53=1909378

Zone7:

Land use: Manufacturing, Person trip per hectare=35, Area=12725ha

Trips=12725×35=445375

Trips Generation and attractions for Transportation:

Zone1:

Land use: Transportation, Person trip per hectare=73, Area=1935ha

Trips=1935×73=141255

Zone2:

Land use: Transportation, Person trip per hectare=25, Area=8964ha

Trips=8964×25=224100

Zone3:

Land use: Transportation, Person trip per hectare=35, Area=5688ha

Trips=5688×35=199080

Zone4:

Land use: Transportation, Person trip per hectare=25, Area=5244ha

Trips=5244×25=131100

Zone5:

Land use: Transportation, Person trip per hectare=13, Area=4629ha

Trips=4629×13=60177

Zone6:

Land use: Transportation, Person trip per hectare=18, Area=90065ha

Trips=90065×18=1621170

Zone7:

Land use: Transportation, Person trip per hectare=15, Area=10180ha

Trips=10180×15=152700

Trips Generation and attractions for Public Building:

Zone1:

Land use: Public building, Person trip per hectare=595, Area=2580ha

Trips=2580×595=2474220

Zone2:

Land use: Public building, Person trip per hectare=265, Area=9960ha

Trips=9960×265=2639400

Zone3:

Land use: Public building, Person trip per hectare=275, Area=4424ha

Trips=4424×275=1216600

Zone4:

Land use: Public building, Person trip per hectare=245, Area=6992ha

Trips=6992×245=1713040

Zone5:

Land use: Public building, Person trip per hectare=90, Area=3086ha

Trips=3086×90=277740

Zone6:

Land use: Public building, Person trip per hectare=48, Area=252182ha

Trips=252182×48=12104736

Zone7:

Land use: Public building, Person trip per hectare=10, Area=30540ha

Trips=30540×10=305400

Trips Generation and attractions for Public open space:

Zone1:

Land use: Public open space, Person trip per hectare=5, Area=3010ha

Trips=3010×5=15050

Zone2:

Land use: Public open space, Person trip per hectare=3, Area=22908ha

Trips=22908×3=68724

Zone3:

Land use: Public open space, Person trip per hectare=10, Area=15800ha

Trips=15800×10=158000

Zone4:

Land use: Public open space, Person trip per hectare=5, Area=71668ha

Trips=71668×5=358340

Zone5:

Land use: Public open space, Person trip per hectare=5, Area=92580ha

Trips=92580×5=462900

Zone6:

Land use: Public open space, Person trip per hectare=3, Area=468338ha

Trips=468338×3=1405014

Zone7:

Land use: Public open space, Person trip per hectare=3, Area=114525ha

Trips=114525×3=343575