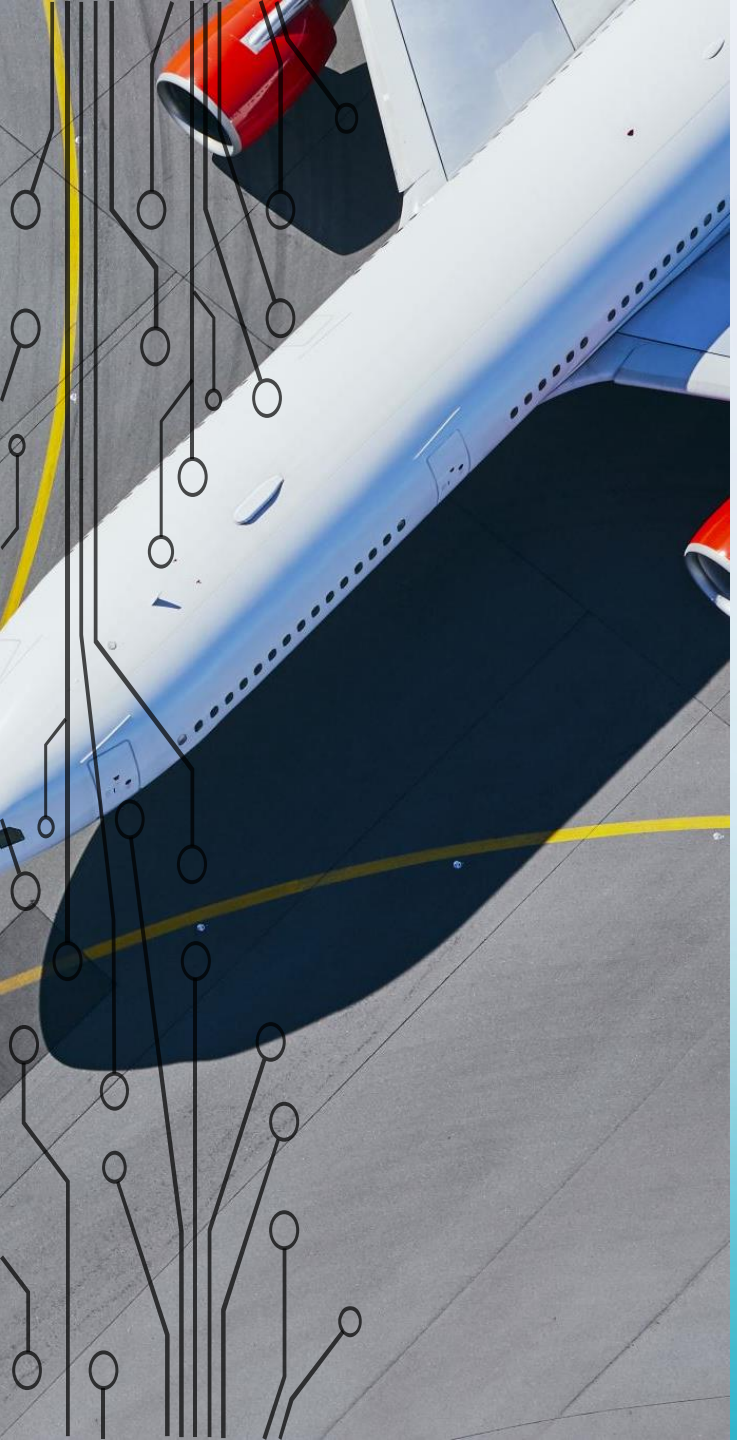


# TRIP GENERATION

## USING MALAYSIAN TRIP GENERATION MANUAL (MTGM) 2010

## (HIGHWAY PLANNING DIVISION, MINISTRY OF WORKS MALAYSIA)

Mohd Fikri bin Hassan

Bahagian Kejuruteraan Trafik

Cawangan Jalan

JKR Malaysia

(8 Februari 2021)

# TERMINOLOGIES

- **Trip Generation** - The total number of INBOUND (trip attraction) and OUTBOUND (trip production) vehicle trips from a site over a given period.

- Consider a typical terrace house in a residential estate. In the morning, trips are **generated out** of the housing development primarily for the purpose of journey to workplace or going to school. The generated trip out is termed as **trip production** or quite simply referred to as **OUT** trip in the manual.

- The reverse takes place in the evening when journey back home is made or trip is attracted into the residential estate. This generated trip is known as **trip attraction** or generally referred to as **IN** trip.

- All IN and OUT trips will pass through one or more access points at the housing estate that lead onto one or more thoroughfare road.

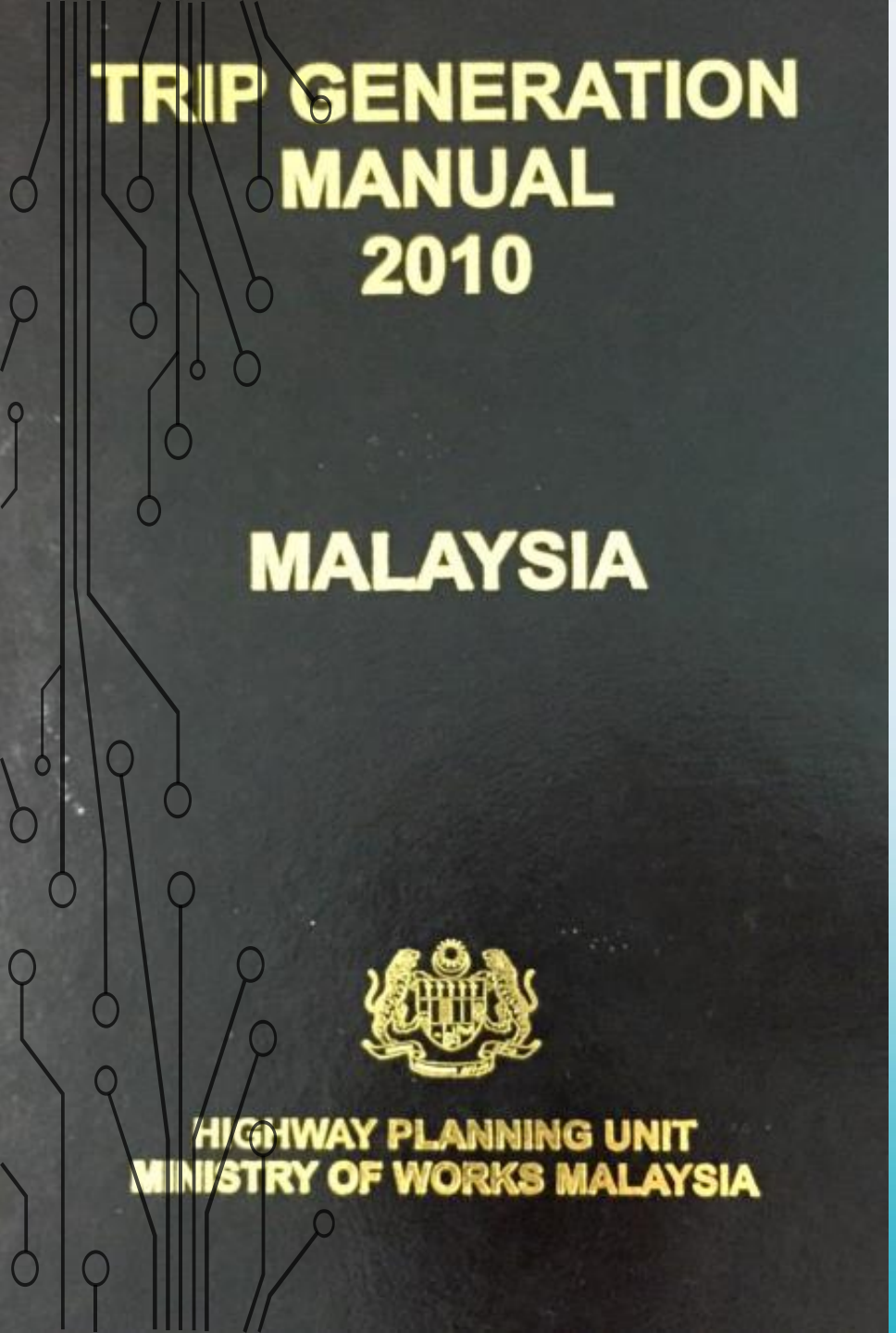
# OVERVIEW OF TRIP GENERATION STUDIES

- **Trip Generation Phase I (Pilot Study)**

- Ranhill Bersekutu Sdn. Bhd.
- Data collection commenced in 1995 (212 sites)
- 1st edition of MTGM published in 1997
- Manual lacks data sufficiency
- Did not truly reflect Malaysian trip behaviour (small data range, etc)
- However, it laid the framework for subsequent studies (land use types/definition, data collection methods)

**Trip Generation Phase II**

- Collaborators: USM Civil Engineering and Perunding Atur
- Data enrichment phase (296 additional sites)
- 2nd edition of the Malaysian Trip Generation Manual published in year 2000




**Trip Generation Phase III**

- School of Civil Engineering, USM as the sole consultant
- 315 new sites from 9 land use types and 105 subcategories
- 3rd Edition MTGM published in year 2005

**Trip Generation Phase IV**

- Sole consultant: School of Civil Engineering, USM
- 278 new sites and 77 resurveyed sites to enhance manual accuracy
- 4th Edition MTGM published in year 2010

# OBJECTIVE

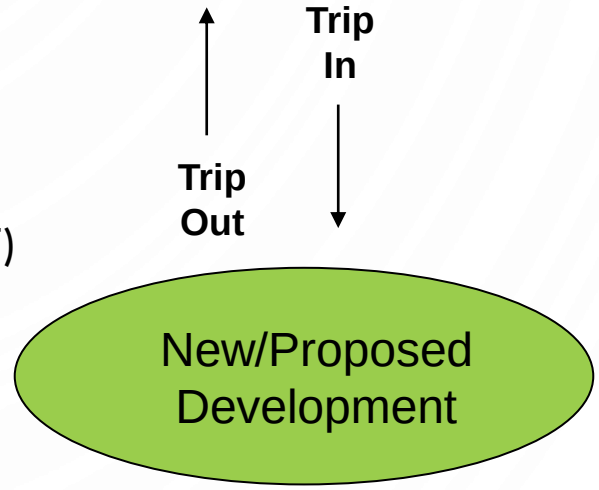
- Enables practitioners/consultants to make an estimate of vehicular traffic that will be generated by a particular land use type
- Assist local authorities and other government agencies in the decision making of future land use planning involving the traffic system.
- Environmental assessment: Traffic impacts on air and noise
- Impact fee determination

# OBJECTIVE

- To estimate the INGRESS and EGRESS trip that would be expected to be generated by a new/proposed development or expansion of an existing project during the peak hour
- Generated traffic is divided into trip attraction (IN) and trip production (OUT)

*Generated Ingress Trip = Trip Attraction (IN)

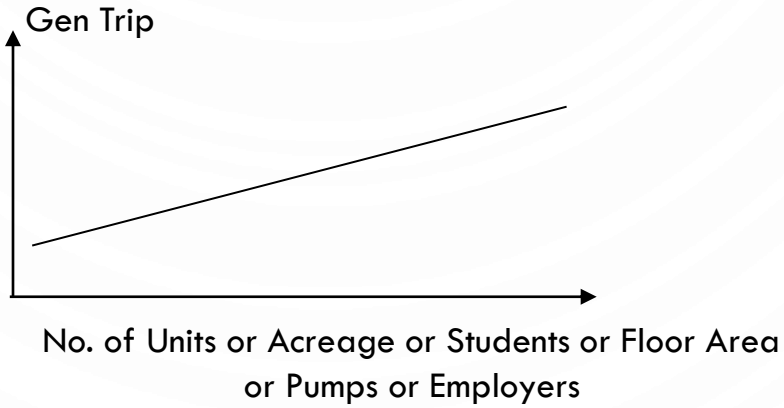
Generated Egress Trip = Trip Production (OUT)



# BASIS

- Trip Generation Manual 2010 (HPD, KKR)
- Traffic Count : Collect data on existing ingress, egress trip of developments.
- Weekdays: Monday – Thursday ;

  Weekend: Saturday- Sunday
- Data is plotted to produce a regression equation / multiplier factor
- Then, used to estimate generated trips



# IMPORTANT TERMS

**Peak Hour: Highest one-hour flow of traffic during a defined period. It is defined by the highest volume of consecutive counts (ie: 7.30-8.30am) rather than clock-hour (7-8am)**

**Commuter Peak: when commuter traffic (traffic flows on a street adjacent to a survey site) is highest.**

**AM: 7.00am-10.00am**

**PM: 4.00pm-7.00pm**

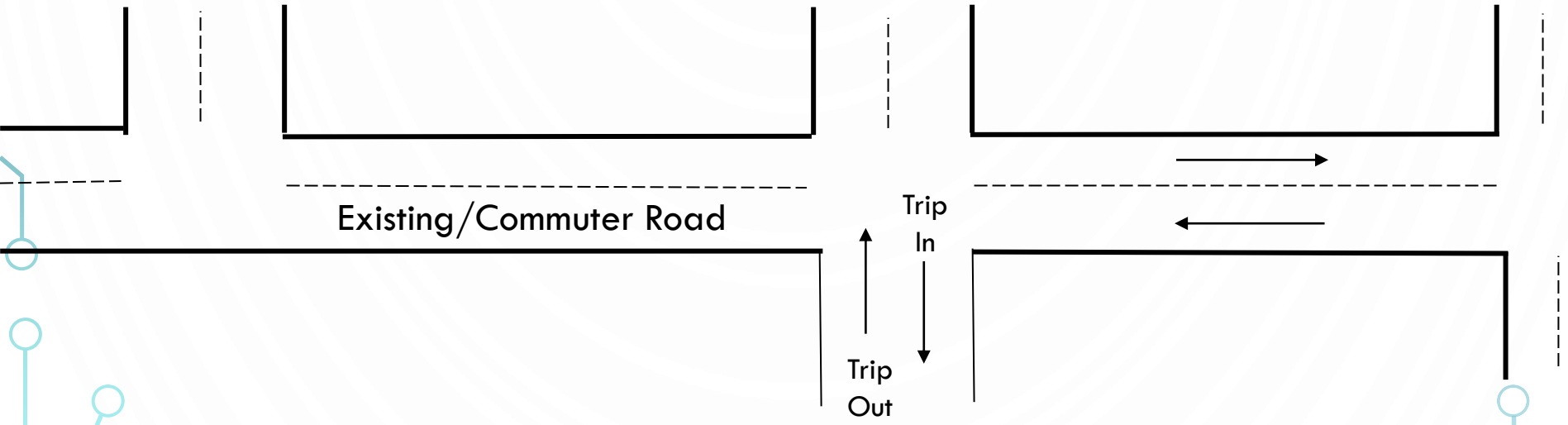
**Generator Peak: when traffic entering and exiting a site is highest. It may or may not correspond to the peak period of adjacent street.**

**AM: before noon**

**PM: afternoon**

# WHY MTGM

Generated trip also impact road link (study area).
May require upgrading from single to dual carriageway.
If developer lacks financial resources, advice to scale down development so that level of generated trips just sufficient not to exceed existing road capacity. But new junction still required.




Developer proposes to convert 3-leged into 4-legged junction

New/Proposed Development

# PASSENGER CAR UNIT (PCU)

- PCU: a measure of the impact of a vehicle on the capacity of a road, measured as an equivalent number of passenger cars.
- PCU factor used in the manual:

| Vehicle Type | PCU factor |
|---|---|
| Car / Taxi | 1.00 |
| Van | 1.00 |
| Light Lorry (2 axles) | 1.75 |
| Heavy Lorry (>2 axles) | 2.25 |
| Bus | 2.25 |
| Motorcycle | 0.33 |

# TIA TRIGGER LEVEL

| No. | Criteria | Trigger Levels |
|---|---|---|
| 1. | Peak Hour Trip Generation (Commuter peak) | 150 added vehicles per hour (2-Way) |
| 2. | Off-Peak Hour Trip Generation (Generator peak occurs at the off-peak period) | 200 added vehicles per hour (2-way) |
| 3. | Size of Residential Development | 200 dwelling units |
| 4. | Size of Commercial Development | 45,000 sq.ft. (gross floor area) |
| 5. | Requirement of Approving Authority | May impose specific trigger levels as deemed necessary |

# CATEGORIES OF LAND USE

- Residential
- Institutional
- Religious
- Educational
- Burial
- Community Facilities and Recreational
- Commercial
- Industrial
- Agriculture / Forestry / Fishery
- Terminals

# LAND USE TYPES

| Major land use | Sub-categories |
|---|---|
| Residential | Terrace & Link, Town House |
| | Semi-Detached, Detached |
| | Flat, Apartment, Condominium |
| | Low Cost Housing |
| | Site & Services |
| | Institutional Quarters |
| Institutional | Government Office Complex |
| | Syariah, Magistrate, Session, High Court, Court Complex |
| | General, Referral, Specialist, Nuclues, District, Private Hospital |
| | Polyclinic, Government Health Centre, Clinic |
| | Police Station |
| | Police Field Force |
| | Fire Station |
| | Research Centre, Training Centre |
| | Public Library |

# LAND USE TYPES

| Major land use | Sub-categories |
|---|---|
| Religious | Mosque |
| | Surau, Madrasah |
| | Church |
| Educational | University & College,Private University & College, Teachers College |
| | Polytechnic |
| | Primary School |
| | Secondary School |
| | Private - Combined Primary and Secondary |
| Burial | Cemetery & Memorial Park |
| | Crematorium |
| Community | National & State, Public, Botanical Parks, Open Space, Playground, Recreational Forest |
| | Public Beach |
| | Sport Complex, Clubs, Tennis, Squash Court Centre, Badminton Halls, Public Swimming Pool |
| | Golf Course |
| | Stadium |
| | Polo Ground, Horse Race Track & Turf Club, Racing Track |
| | Amusement Park, Zoo, Aquarium, Bird Park, Science Park |
| | Community Hall |

# DATA SHEET FORMAT

- There are 5 graphs shown for each sub-category:
  - AM Peak Hour of Commuter
  - PM Peak Hour of Commuter

  } In one page

  - AM Peak Hour of Generator
  - PM Peak Hour of Generator

  } In one page

  - Daily Trip Generation

- Each graph shows:
  - A plot of surveyed data points
  - A best fitted linear regression equation
  - A weighted average linear rate equation
- Average rate or regression equation?
- Parameter(s):
  - No. of Sites
  - Percent In/Out
  - Average Rate
  - Regression Equation
  - R-squared
  - PCU Conversion Factor

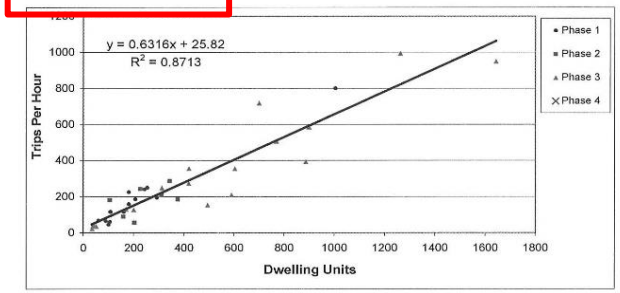
# EXAMPLES OF DATA SHEET



**Residential**
**Terrace Link, Town House**
**Trips per Dwelling Units**

**CODE**
**01 01 01/02**

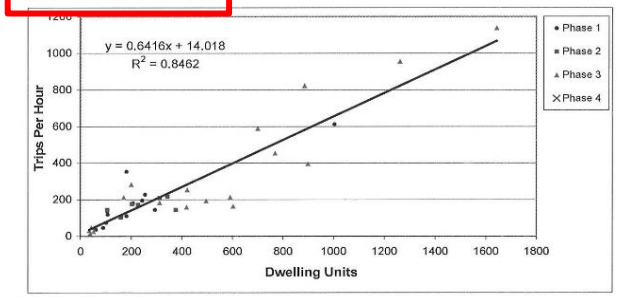
**AM Peak Hour Of Commuter**




| | | | |
|---|---|---|---|
| Number Of Sites : | 38 | Percent In/Out : | 30 / 70 |
| Average Rate : | 0.78 | Regression Equation: | y = 0.6316x + 25.82 |
| Minimum Rate : | 0.29 | | |
| Maximum Rate : | 1.73 | R-Squarred: | 0.8713 |
| Standard Deviation : | 0.2812 | | |

| Vehicle Type | Vehicle Composition | PCU Factor | PCU Conversion Factor |
|---|---|---|---|
| Car/Taxi | 62.35 | 1.00 | 0.62 |
| Motorcycle | 28.13 | 0.33 | 0.09 |
| Small Lorry | 7.48 | 1.75 | 0.13 |
| Big Lorry | 0.33 | 2.25 | 0.01 |
| Bus | 1.71 | 2.25 | 0.04 |
| **Total** | **100.00%** | | **0.89** |

**PM Peak Hour Of Commuter**




| | | | |
|---|---|---|---|
| Number Of Sites : | 38 | Percent In/Out : | 59 / 41 |
| Average Rate : | 0.76 | Regression Equation: | y = 0.6416x + 14.018 |
| Minimum Rate : | 0.27 | | |
| Maximum Rate : | 1.96 | R-Squarred: | 0.8462 |
| Standard Deviation : | 0.3532 | | |

| Vehicle Type | Vehicle Composition | PCU Factor | PCU Conversion Factor |
|---|---|---|---|
| Car/Taxi | 60.40 | 1.00 | 0.60 |
| Motorcycle | 31.85 | 0.33 | 0.11 |
| Small Lorry | 6.48 | 1.75 | 0.11 |
| Big Lorry | 0.27 | 2.25 | 0.01 |
| Bus | 1.01 | 2.25 | 0.02 |
| **Total** | **100.00%** | | **0.85** |

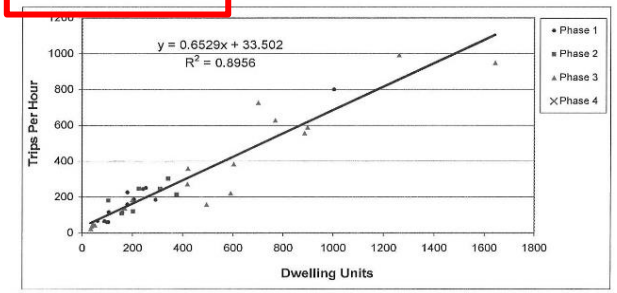
**Figure 1-2(a): Example of Summary Sheet (Peak Hour of Commuter)**

Malaysian Trip Generation Manual
Highway Planning Unit
Ministry of Works Malaysia

**Residential**
**Terrace Link, Town House**
**Trips per Dwelling Units**

**CODE**
**01 01 01/02**

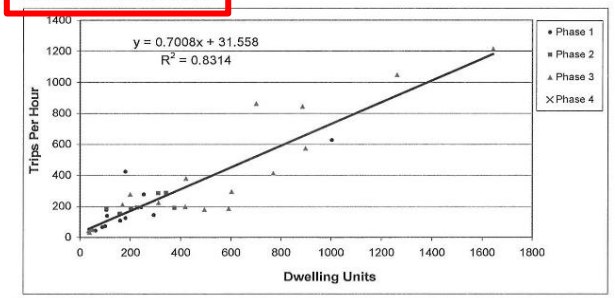
**AM Peak Hour Of Generator**




| | | | |
|---|---|---|---|
| Number Of Sites : | 38 | Percent In/Out : | 30 / 70 |
| Average Rate : | 0.83 | Regression Equation: | y = 0.6529x + 33.502 |
| Minimum Rate : | 0.32 | | |
| Maximum Rate : | 1.73 | R-Squarred: | 0.8956 |
| Standard Deviation : | 0.2609 | | |

| Vehicle Type | Vehicle Composition | PCU Factor | PCU Conversion Factor |
|---|---|---|---|
| Car/Taxi | 63.49 | 1.00 | 0.63 |
| Motorcycle | 26.88 | 0.33 | 0.09 |
| Small Lorry | 7.39 | 1.75 | 0.13 |
| Big Lorry | 0.36 | 2.25 | 0.01 |
| Bus | 1.87 | 2.25 | 0.04 |
| **Total** | **100.00%** | | **0.90** |

**PM Peak Hour Of Generator**




| | | | |
|---|---|---|---|
| Number Of Sites : | 38 | Percent In/Out : | 59 / 41 |
| Average Rate : | 0.92 | Regression Equation: | y = 0.7008x + 31.558 |
| Minimum Rate : | 0.32 | | |
| Maximum Rate : | 2.36 | R-Squarred: | 0.8314 |
| Standard Deviation : | 0.4128 | | |

| Vehicle Type | Vehicle Composition | PCU Factor | PCU Conversion Factor |
|---|---|---|---|
| Car/Taxi | 61.67 | 1.00 | 0.62 |
| Motorcycle | 29.65 | 0.33 | 0.10 |
| Small Lorry | 7.01 | 1.75 | 0.12 |
| Big Lorry | 0.23 | 2.25 | 0.01 |
| Bus | 1.44 | 2.25 | 0.03 |
| **Total** | **100.00%** | | **0.88** |

**Figure 1-2(b): Example of Summary Sheet (Peak Hour of Generator)**

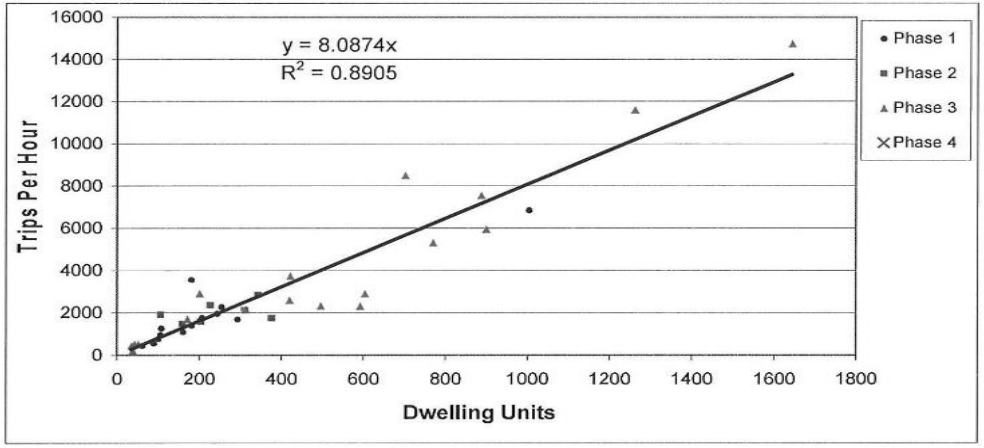
# EXAMPLES OF DATA SHEET



**Residential**
**Terrace Link, Town House**
**Trips per Dwelling Units**

**CODE**
**01 01 01/02**

**Daily Trip Generation**




| | | | |
|---|---|---|---|
| Number Of Sites : | 38 | Percent In/Out : | 49 / 51 |
| Average Rate : | 8.85 | Regression Equation: | y = 8.0874x |
| Minimum Rate : | 3.94 | | |
| Maximum Rate : | 19.79 | R-Squarred: | 0.8905 |
| Standard Deviation : | 3.4391 | | |

| Vehicle Type | Vehicle Composition | PCU Factor | PCU Conversion Factor |
|---|---|---|---|
| Car/Taxi | 59.99 | 1.00 | 0.60 |
| Motorcycle | 30.45 | 0.33 | 0.10 |
| Small Lorry | 7.83 | 1.75 | 0.14 |
| Big Lorry | 0.31 | 2.25 | 0.01 |
| Bus | 1.42 | 2.25 | 0.03 |
| **Total** | **100.00%** | | **0.88** |

**Figure 1-2(c): Example of Summary Sheet (Daily Trip)**

# STEP BY STEP

1. Identify the appropriate land use category
2. Select the most appropriate independent variable predictor
3. Find the relevant trip generation rates or equations
4. Multiply the independent variable with average rate or regression equation
5. Convert the estimated vehicle trips into PCU Trips
6. Divide the PCU trips into ingress and egress trips

# STEP 1: IDENTIFY THE APPROPRIATE LAND USE CATEGORY

**Land use categories, sub categories and codes (after identifying landuse type - Section 3)**

Ie: Detached

- Major group – Residential (01)
- Minor group – Housing (01)
- Unit group – Detached (04)
- Code: 01 01 04

**Explanation of land use in detail (Section 4)**

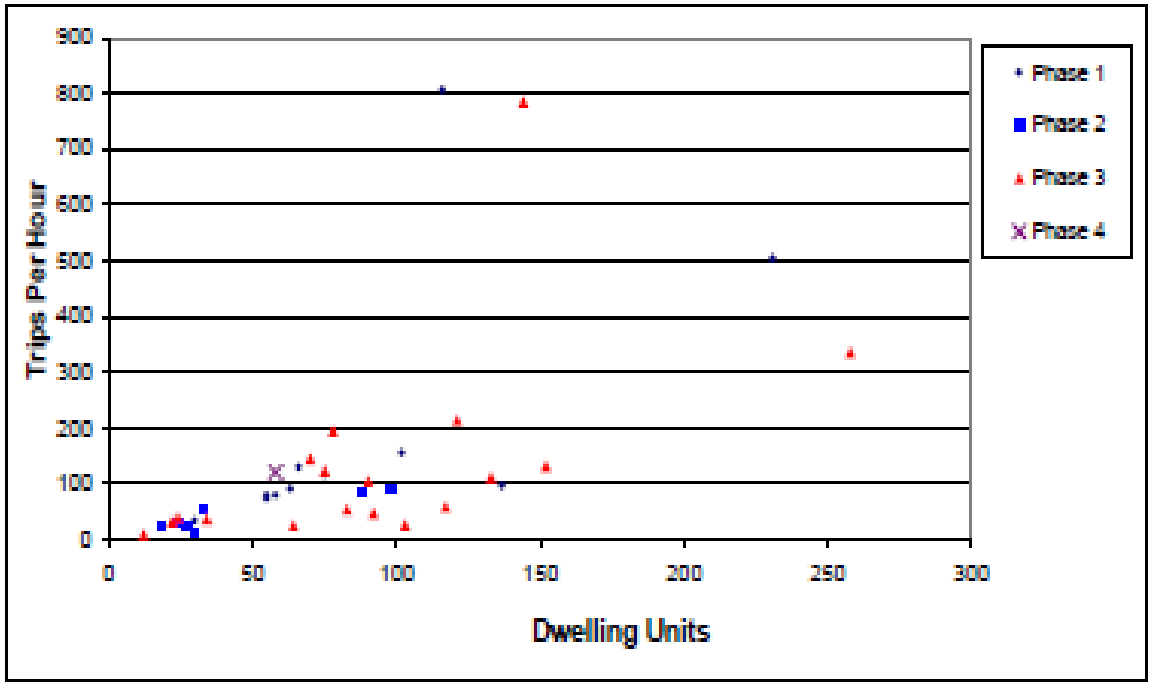
Ie: Detached: Detached Houses are free standing single buildings on individual lots. Recommended minimum lot size per unit is 50ft by 80ft with a range of 4,000ft$^2$ to ½ acre more. Detached houses are generally one or two storey structures.

***It is important to check section 4 for details when there is a confusion / dispute in land use description. Ie: Serviced Apartment**

**Residential**
**Semi-Detached, Detached**
**Trips per Dwelling Units**

**CODE**
**01 01 03/04**

**AM Peak Hour Of Commuter**




| | | | |
|---|---|---|---|
| Number Of Sites : | 37 | Percent In/Out : | 35 / 65 |
| Average Rate : | 1.51 | Use Trip Rates | |
| Minimum Rate : | 0.25 | | |
| Maximum Rate : | 6.96 | | |
| Standard Deviation : | 1.2732 | | |

| Vehicle Type | Vehicle Composition | PCU Factor | PCU Conversion Factor |
|---|---|---|---|
| Car/Taxi | 76.94 | 1.00 | 0.77 |
| Motorcycle | 15.11 | 0.33 | 0.05 |
| Small Lorry | 6.68 | 1.75 | 0.12 |
| Big Lorry | 0.02 | 2.25 | 0.00 |
| Bus | 1.24 | 2.25 | 0.03 |
| Total | 100.00% | | 0.96 |

# STEP 2: APPROPRIATE INDEPENDENT VARIABLE PREDICTOR

Example: Area (Thousand Square Feet), number of occupied beds, number of employees, dwelling units and etc.

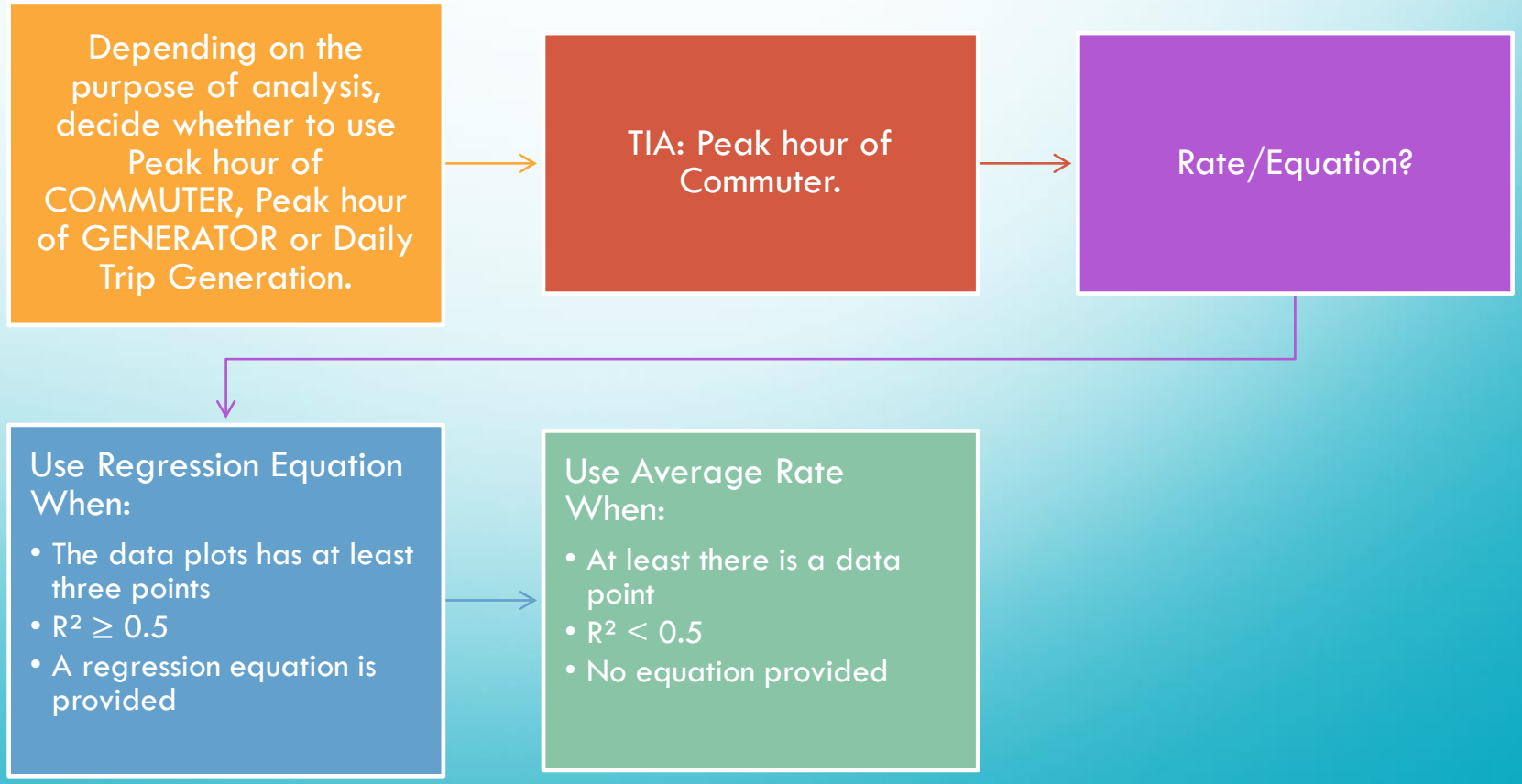
Check $R^2$ value or standard deviation to choose the best variable, when there are more than once choice. Higher value is preferable.

If the proposed development is only described in one term and not in other variable, best to use an already available variable rather than converting to other variable.

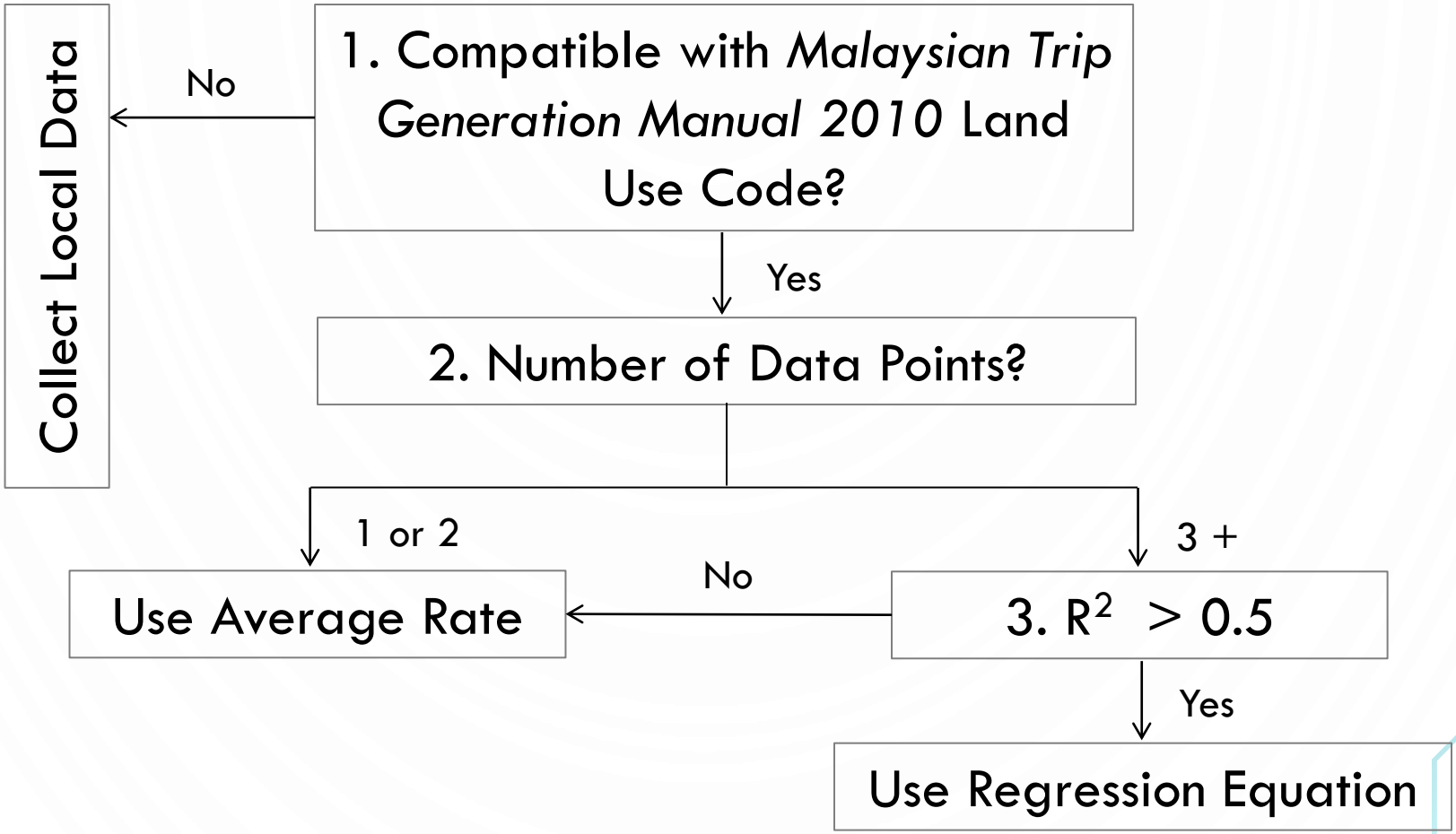
# SELECTION OF INDEPENDENT VARIABLE

| Land Use | Category | Independent Variables |
|---|---|---|
| Commercial | Office Complex | Thousand Square Feet (TSF), Acre, Number of Employees |
| | Shop House | Thousand Square Feet (TSF), Acre |
| | Retail Premises | Thousand Square Feet (TSF), Acre, Number of Employees |
| Institutional | Government Offices | Thousand Square Feet (TSF), Acre, Number of Staffs |
| | Medical Services | Thousand Square Feet (TSF), Acre, Number of Beds, Number of Doctors |
| Residential | Housing | Number of Dwelling Units |
| Community Facilities | Sport Facilities | Thousand Square Feet (TSF), Number of Courts, Acre, Number of Seats, Number of Visitors |
| Educational | Tertiary Education | Thousand Square Feet (TSF), Acre, Number of Students |
| | Secondary Education | |
| | Primary Education | |

# STEP 3: RELEVANT TRIP GENERATION RATE OR EQUATION



# RECOMMENDED PROCEDURE FOR SELECTING BETWEEN TRIP GENERATION AVERAGE RATE AND EQUATIONS



# SELECTION OF TIME PERIOD

Depends on purpose of TIA

Select relevant trip generation rates or equations from:

- AM commuter peak
- PM commuter peak

  Will give the estimated generated trips for the land use DURING THE TIME PERIOD when the adjacent main road is at its peak

- AM generator peak
- PM generator peak

  Will give the estimated trip generation for the land use DURING THE TIME PERIOD when the land use trip generation is at peak

- Daily rate

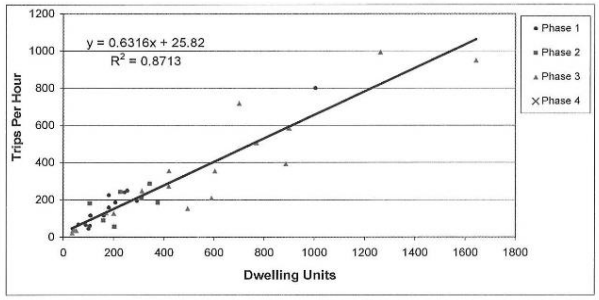
  Will give the total generated trips for the land use for 16 hours of a day

- Weekday/Weekend trips (for shopping complex, shop house, shop office, hypermarket, fast food)

**Residential**
**Terrace Link, Town House**
**Trips per Dwelling Units**

**CODE**
**01 01 01/02**

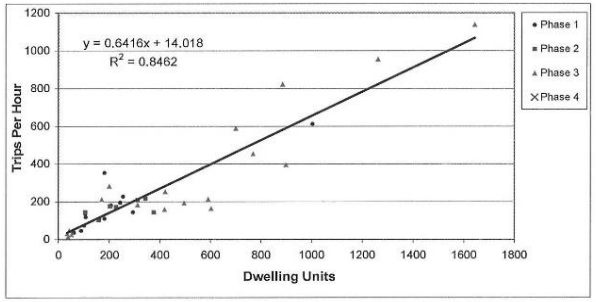
**AM Peak Hour Of Commuter**




| | | | |
|---|---|---|---|
| Number Of Sites : | 38 | Percent In/Out : | 30 / 70 |
| Average Rate : | 0.78 | Regression Equation: | y = 0.6316x + 25.82 |
| Minimum Rate : | 0.29 | | |
| Maximum Rate : | 1.73 | R-Squarred: | 0.8713 |
| Standard Deviation : | 0.2812 | | |

| Vehicle Type | Vehicle Composition | PCU Factor | PCU Conversion Factor |
|---|---|---|---|
| Car/Taxi | 62.35 | 1.00 | 0.62 |
| Motorcycle | 28.13 | 0.33 | 0.09 |
| Small Lorry | 7.48 | 1.75 | 0.13 |
| Big Lorry | 0.33 | 2.25 | 0.01 |
| Bus | 1.71 | 2.25 | 0.04 |
| **Total** | **100.00%** | | **0.89** |

**PM Peak Hour Of Commuter**




| | | | |
|---|---|---|---|
| Number Of Sites : | 38 | Percent In/Out : | 59 / 41 |
| Average Rate : | 0.76 | Regression Equation: | y = 0.6416x + 14.018 |
| Minimum Rate : | 0.27 | | |
| Maximum Rate : | 1.96 | R-Squarred: | 0.8462 |
| Standard Deviation : | 0.3532 | | |

| Vehicle Type | Vehicle Composition | PCU Factor | PCU Conversion Factor |
|---|---|---|---|
| Car/Taxi | 60.40 | 1.00 | 0.60 |
| Motorcycle | 31.85 | 0.33 | 0.11 |
| Small Lorry | 6.48 | 1.75 | 0.11 |
| Big Lorry | 0.27 | 2.25 | 0.01 |
| Bus | 1.01 | 2.25 | 0.02 |
| **Total** | **100.00%** | | **0.85** |

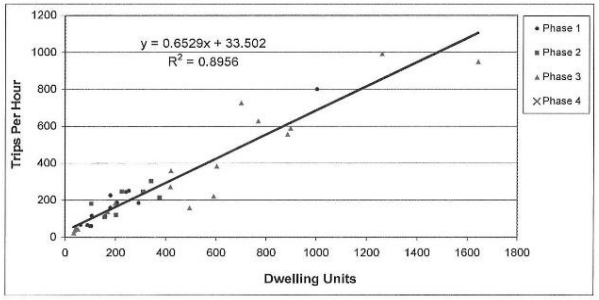
**Figure 1-2(a): Example of Summary Sheet (Peak Hour of Commuter)**



**Residential**
**Terrace Link, Town House**
**Trips per Dwelling Units**

**CODE**
**01 01 01/02**

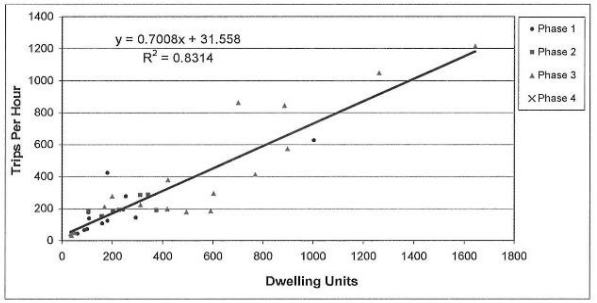
**AM Peak Hour Of Generator**




| | | | |
|---|---|---|---|
| Number Of Sites : | 38 | Percent In/Out : | 30 / 70 |
| Average Rate : | 0.83 | Regression Equation: | y = 0.6529x + 33.502 |
| Minimum Rate : | 0.32 | | |
| Maximum Rate : | 1.73 | R-Squarred: | 0.8956 |
| Standard Deviation : | 0.2609 | | |

| Vehicle Type | Vehicle Composition | PCU Factor | PCU Conversion Factor |
|---|---|---|---|
| Car/Taxi | 63.49 | 1.00 | 0.63 |
| Motorcycle | 26.88 | 0.33 | 0.09 |
| Small Lorry | 7.39 | 1.75 | 0.13 |
| Big Lorry | 0.36 | 2.25 | 0.01 |
| Bus | 1.87 | 2.25 | 0.04 |
| **Total** | **100.00%** | | **0.90** |

**PM Peak Hour Of Generator**




| | | | |
|---|---|---|---|
| Number Of Sites : | 38 | Percent In/Out : | 59 / 41 |
| Average Rate : | 0.92 | Regression Equation: | y = 0.7008x + 31.558 |
| Minimum Rate : | 0.32 | | |
| Maximum Rate : | 2.36 | R-Squarred: | 0.8314 |
| Standard Deviation : | 0.4128 | | |

| Vehicle Type | Vehicle Composition | PCU Factor | PCU Conversion Factor |
|---|---|---|---|
| Car/Taxi | 61.67 | 1.00 | 0.62 |
| Motorcycle | 29.65 | 0.33 | 0.10 |
| Small Lorry | 7.01 | 1.75 | 0.12 |
| Big Lorry | 0.23 | 2.25 | 0.01 |
| Bus | 1.44 | 2.25 | 0.03 |
| **Total** | **100.00%** | | **0.88** |

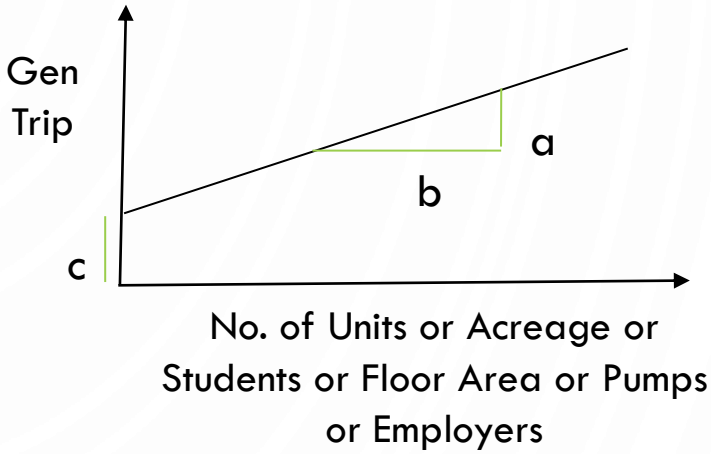
**Figure 1-2(b): Example of Summary Sheet (Peak Hour of Generator)**

# MTG EQUATION

MTG linear equation takes the form (R-square > 0.5):

$y = mx + c$

Where y = trip gen
m = slope of the line
x = independent variable
c = the y-axis intercept




MTG average equation takes the form (R-square < 0.5):

$y = Rx$

Where y = Trip gen
R = Average rate
x = independent variable

Slope m = a/b
Y-intercept = c
For avg rate, c = 0

# STEP 4: CALCULATING VEHICLE TRIPS

Once trip generation rates are selected, multiply trip rate with independent variable or plug-in values into trip gen equation

Trips from the equations or rates are give in vehicles per hour

Convert the estimated vehicle trips into pcu trips

# STEP 5: CONVERT INTO PCU TRIPS

- Each graph has its own PCU conversion factor
  - Ie: Condominium

| Vehicle Type | Vehicle Composition | PCU Factor | PCU Conversion Factor |
|---|---|---|---|
| Car/Taxi/Van | 71.01 | 1.00 | 0.71 |
| Motorcycle | 21.99 | 0.33 | 0.07 |
| Small Lorry | 5.67 | 1.75 | 0.10 |
| Big Lorry | 0.02 | 2.25 | 0.00 |
| Bus | 1.31 | 2.25 | 0.03 |
| **Total** | **100%** | | **0.91** |

# STEP 5: CONVERT INTO PCU TRIPS (CONT')

- Multiply the vehicle trips with PCU Conversion Factor to obtain trips in PCU.

Example: 215 units of terrace houses

- Using equation:
  - y = 0.6529x + 33.5021
    = 0.6529 (215) + 33.5021
    = 174 trips/hr (veh/hr)
  - converting to pcu
    y = 0.91(174) = 159 pcu/hr

- Using rates:
  - y = 0.83x
    = 0.83 (215)
    = 178 trips/hr (veh/hr)
  - converting to pcu
    y = 0.91(178) = 162 pcu/hr

# EXAMPLE:

Permohonan Kebenaran Merancang Untuk Mendirikan:

a) 1 Blok Pejabat 4 Tingkat
b) 1 Blok Bangunan 5 Tingkat yang Mengandungi Hotel 4 Tingkat (144 Bilik) dan 2 Tingkat Basmen Tempat Letak Kenderaan
c) 1 Blok Hotel 5 Tingkat (16 Bilik)

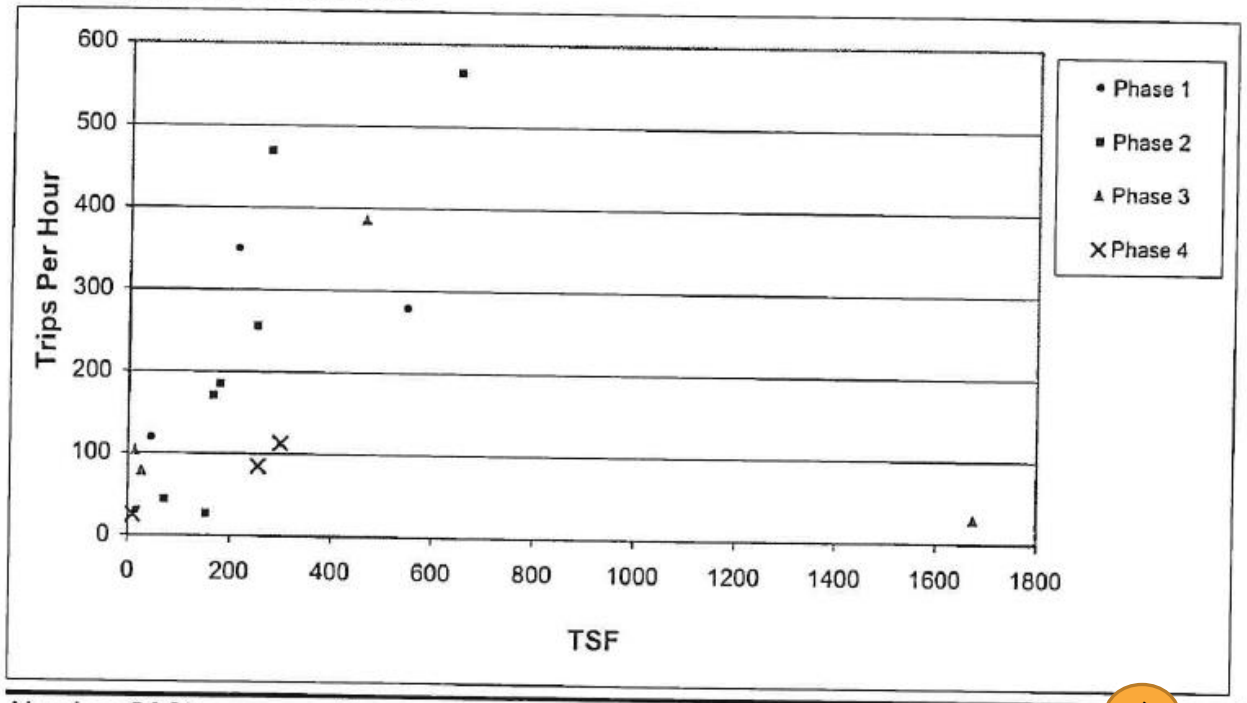
# SCHEDULE OF ACCOMMODATION (SOA)

| Cadangan Pembangunan | Paras | Kegunaan Ruang | Keluasan Lantai (mp) | Keluasan Lantai (kp) | Keluasan Lantai (1000kp) | Jumlah unit |
|---|---|---|---|---|---|---|
| Pejabat 4 Tingkat | Tingkat Bawah | Ruang Legar & Lobi Lif | 103.00 | 1,108.68 | 1.11 | |
| | Tingkat 1 | Ruang Legar & Lobi Lif | 103.00 | 1,108.68 | 1.11 | |
| | Tingkat 2 | Ruang Servis dan M&E | - | - | - | |
| | Tingkat 3 | Pejabat | 868.00 | 9,343.07 | 9.34 | |
| | **Jumlah** | | **1,074.00** | **11,560.44** | **11.56** | |
| Hotel 4 Tingkat (144 Bilik) | Tingkat 1 | Podium Hotel & 21 Bilik Hotel | 2,298.00 | 24,735.47 | 24.74 | 21 |
| | Tingkat 2, 3 & 4 | 123 Bilik Hotel | 6,412.00 | 69,018.19 | 69.02 | 123 |
| | Tingkat Servis/ Bumbung | Bilik Lif Motor & Servis | - | - | - | |
| | **Jumlah** | | **10,339.00** | **111,288.07** | **111.29** | **144** |
| Hotel 5 Tingkat (16 Bilik) | Paras 1 | Kemudahan Hotel | 272.00 | 2,927.78 | 2.93 | |
| | Paras 2 | Bilik Hotel (4 Bilik) | 281.35 | 3,028.43 | 3.03 | 4 |
| | Paras 3 - 5 | Bilik Hotel (4 Bilik x 3 = 12 Bilik) | 844.05 | 9,085.28 | 9.09 | 12 |
| | Tingkat Servis/ Bumbung | Bilik Lif Motor & Servis | - | - | - | |
| | **Jumlah** | | **1,397.40** | **15,041.49** | **15.04** | **16** |

Commercial
General Office
Trips per TSF

1 CODE 07 01 01

AM Peak Hour Of Commuter




2 Variable (x)

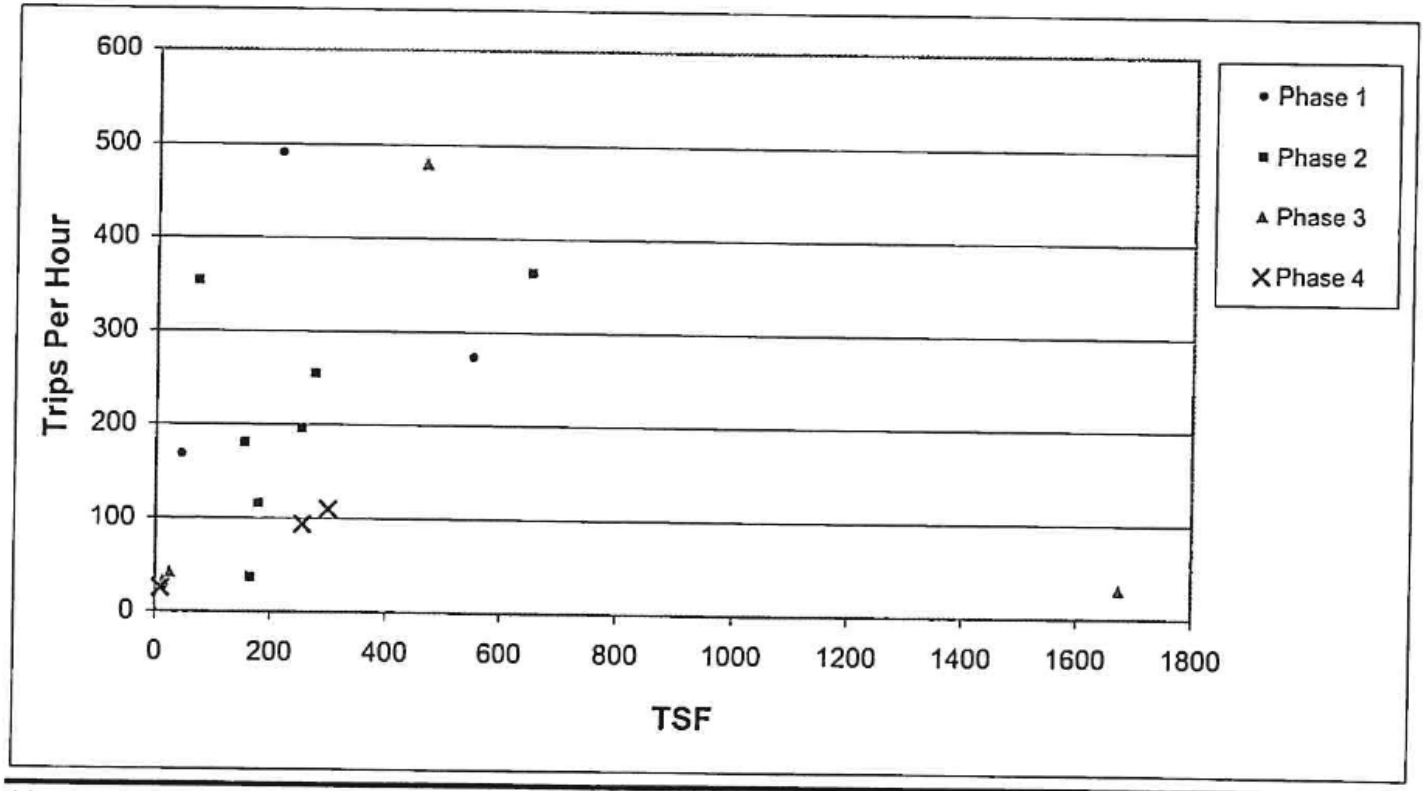
| | | | | |
|---|---|---|---|---|
| Number Of Sites : | 18 | | Percent In/Out : | 71 / 29 |
| Average Rate : | 1.54 | | Use Trip Rates | |
| Minimum Rate : | 0.02 | | | |
| Maximum Rate : | 7.58 | | | |
| Standard Deviation : | 1.7414 | | | |

3 4 3 4 6

| Vehicle Type | Vehicle Composition | PCU Factor | PCU Conversion Factor |
|---|---|---|---|
| Car/Taxi | 65.89 | 1.00 | 0.66 |
| Motorcycle | 31.85 | 0.33 | 0.11 |
| Small Lorry | 1.67 | 1.75 | 0.03 |
| Big Lorry | 0.00 | 2.25 | 0.00 |
| Bus | 0.60 | 2.25 | 0.01 |
| **Total** | **100.00%** | | **0.81** |

5

## PM Peak Hour Of Commuter




| | | | |
|---|---|---|---|
| Number Of Sites : | 18 | Percent In/Out : | 33 / 67 |
| Average Rate : | 1.43 | Use Trip Rates | |
| Minimum Rate : | 0.02 | | |
| Maximum Rate : | 5.03 | | |
| Standard Deviation : | 1.3251 | | |

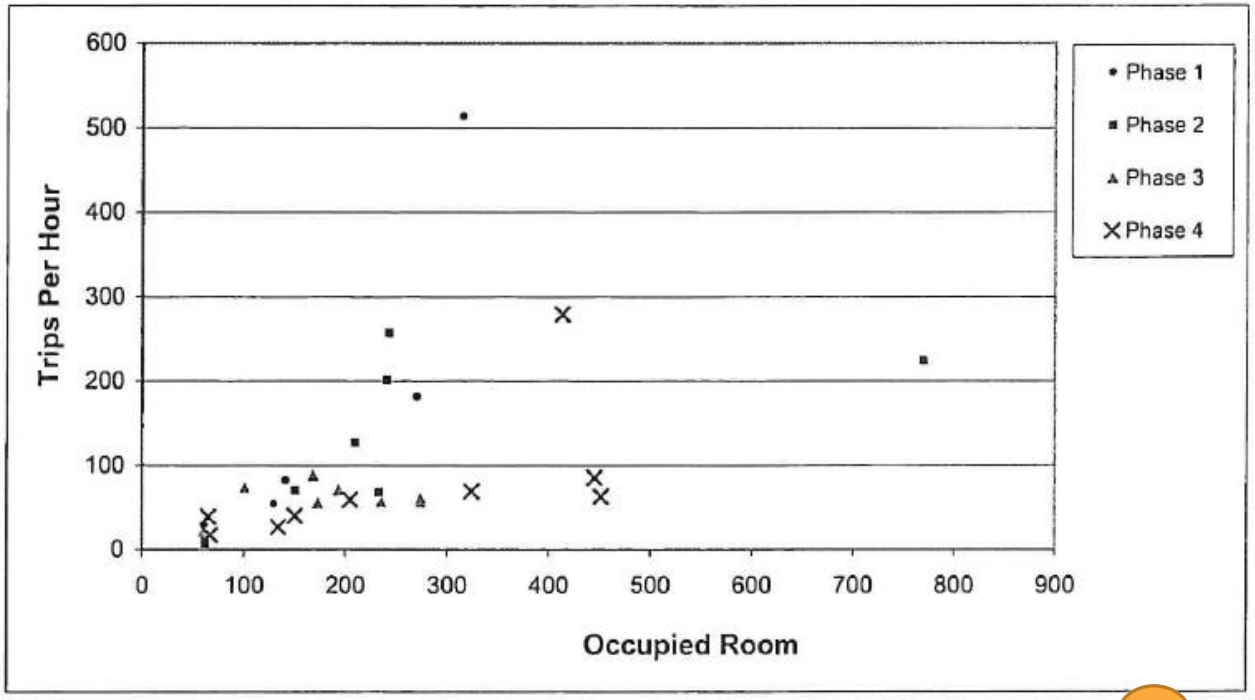
| Vehicle Type | Vehicle Composition | PCU Factor | PCU Conversion Factor |
|---|---|---|---|
| Car/Taxi | 69.42 | 1.00 | 0.69 |
| Motorcycle | 26.01 | 0.33 | 0.09 |
| Small Lorry | 4.14 | 1.75 | 0.07 |
| Big Lorry | 0.00 | 2.25 | 0.00 |
| Bus | 0.43 | 2.25 | 0.01 |
| **Total** | **100.00%** | | **0.86** |

Commercial
General, Beach Resort, Hill Resort Hotel
Trips per Occupied Room

CODE
07 04 01/10/11

1

AM Peak Hour Of Commuter

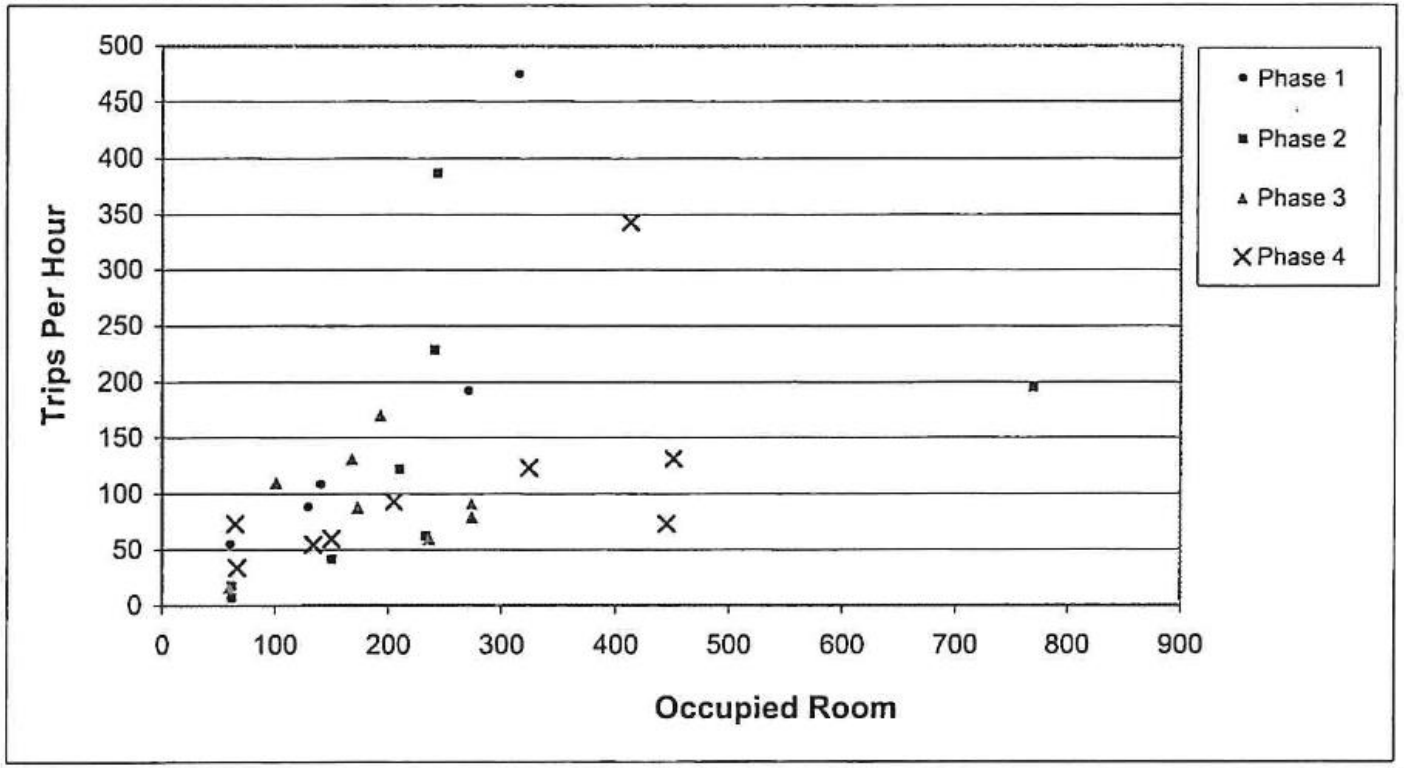



2 Variable (x)

| | | | | | |
|---|---|---|---|---|---|
| Number Of Sites : | 30 | | Percent In/Out : | 63 / 37 | 6 |
| 3 4 Average Rate : | 0.45 | 3 4 | Use Trip Rates | | |
| Minimum Rate : | 0.11 | | | | |
| Maximum Rate : | 1.63 | | | | |
| Standard Deviation : | 0.3173 | | | | |

| Vehicle Type | Vehicle Composition | PCU Factor | PCU Conversion Factor |
|---|---|---|---|
| Car/Taxi | 70.22 | 1.00 | 0.70 |
| Motorcycle | 21.06 | 0.33 | 0.07 |
| Small Lorry | 7.16 | 1.75 | 0.13 |
| Big Lorry | 0.23 | 2.25 | 0.01 |
| Bus | 1.34 | 2.25 | 0.03 |
| **Total** | **100.00%** | | **0.93** 5 |

## PM Peak Hour Of Commuter

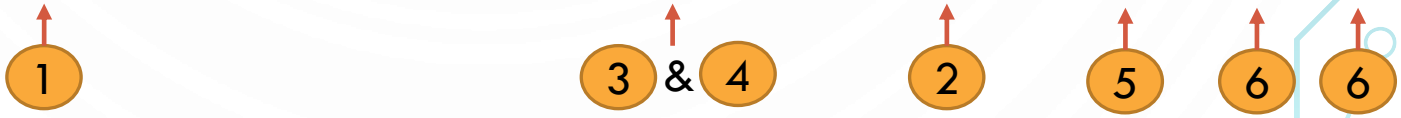



| | | | |
|---|---|---|---|
| Number Of Sites : | 30 | Percent In/Out : | 41 / 59 |
| Average Rate : | 0.59 | Use Trip Rates | |
| Minimum Rate : | 0.11 | | |
| Maximum Rate : | 1.59 | | |
| Standard Deviation : | 0.3803 | | |

| Vehicle Type | Vehicle Composition | PCU Factor | PCU Conversion Factor |
|---|---|---|---|
| Car/Taxi | 75.60 | 1.00 | 0.76 |
| Motorcycle | 18.20 | 0.33 | 0.06 |
| Small Lorry | 5.36 | 1.75 | 0.09 |
| Big Lorry | 0.00 | 2.25 | 0.00 |
| Bus | 0.84 | 2.25 | 0.02 |
| **Total** | **100.00%** | | **0.93** |

# LAND USE AND THE CORRESPONDING TRIP GENERATION EQUATIONS

| Sub-Categories | Code | Peak Hour | Equation/ rate | Variable | Pcu Factor | In (%) | Out (%) |
|---|---|---|---|---|---|---|---|
| General Office | 07 01 01 | AM Peak Hour Of Commuter | y = 1.54x | Tsf | 0.81 | 71 | 29 |
| | | PM Peak Hour Of Commuter | y = 1.43x | | 0.86 | 33 | 67 |
| General, Beach Resort, Hill Resort Hotel | 07 04 01/ 10/ 11 | AM Peak Hour Of Commuter | y = 0.45x | Occupied Room | 0.93 | 63 | 37 |
| | | PM Peak Hour Of Commuter | y = 0.59x | | 0.93 | 41 | 59 |



# EXAMPLE (4 Storey Office)

A Since $R^2 < 0.5$@null, use the following average rate for AM peak of the commuter:

B $y = 1.54x$
where; y is the number of trips (per) for AM peak hour of the commuter while x is the total area in thousand square foot (TSF).

C 11.56 TSF, then
Estimated trips (y) = 1.54*11.56
= 18 trips of the AM peak hour of the commuter

D Convert to pcu/hr = 18*0.81
= 14 pcu/hr

E From graph, percent IN/OUT is 71/29

F Hence, IN trips = 0.71*14 = 10 pcu/hr
OUT trips = 0.29*14 = 4 pcu/hr

# EXAMPLE (4 Storey Hotel)

A Since $R^2 < 0.5$ @null, use the following average rate for AM peak of the commuter:

B $y = 0.45x$
where; y is the number of trips (per) for AM peak hour of the commuter while x is the number of occupied room.

C 144 occupied rooms, then
Estimated trips (y) = 0.45*144
= 65 trips of the AM peak hour of the commuter

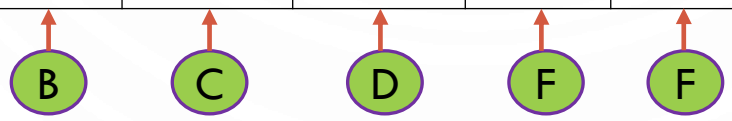
D Convert to pcu/hr = 65*0.93
= 60 pcu/hr

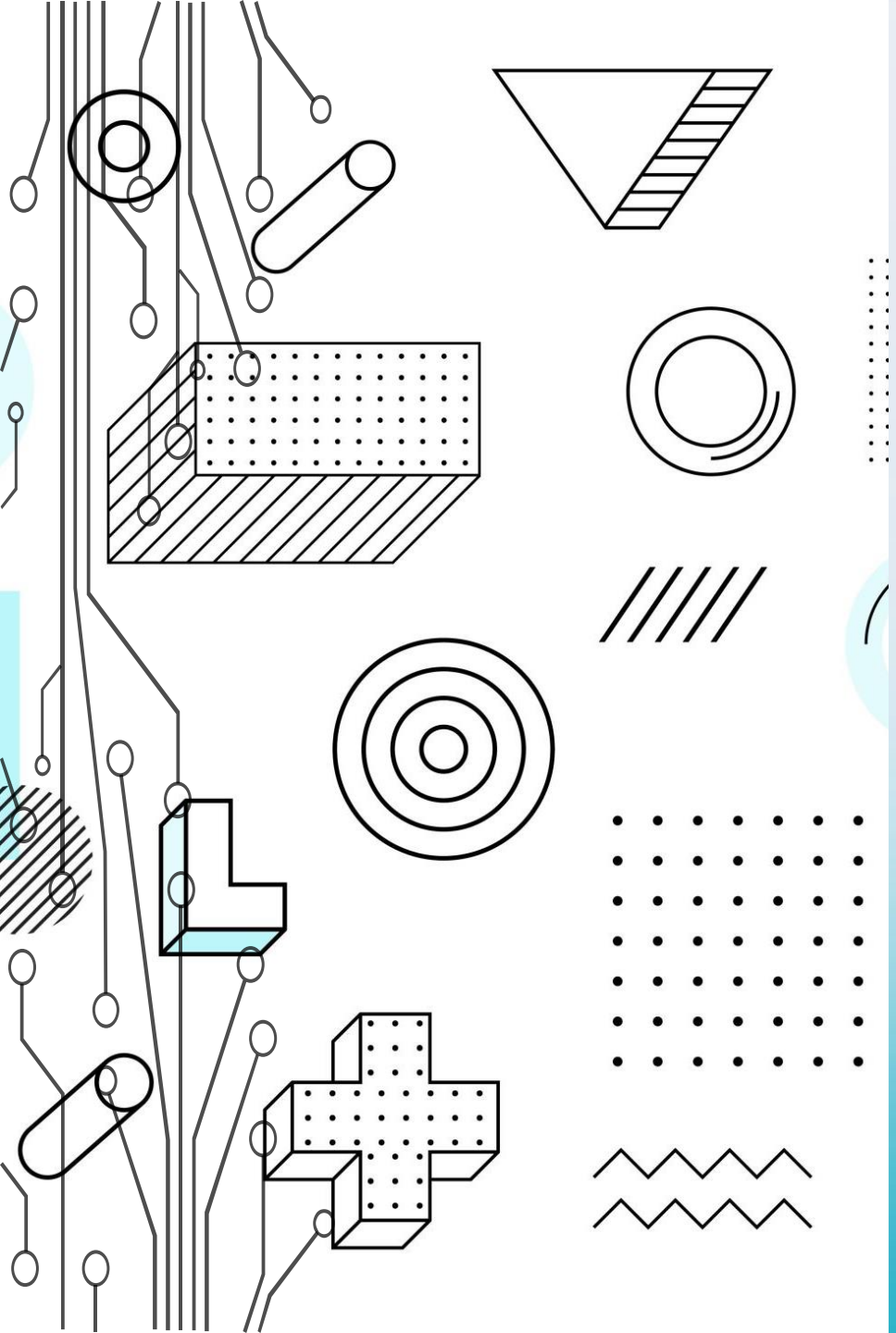
E From graph, percent IN/OUT is 63/37

F Hence, IN trips = 0.63*60 = 38 pcu/hr
OUT trips = 0.37*60 = 22 pcu/hr

# TOTAL GENERATED TRIPS BY THE DEVELOPMENT

| | | | AM Peak Hour | | | | PM Peak Hour | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **No.** | **Type of development** | **Unit** | **Trips (Veh/hr)** | **Trips (Pcu/hr)** | **Trips (In)** | **Trips (Out)** | **Trips (Veh/hr)** | **Trips (Pcu/hr)** | **Trips (In)** | **Trips (Out)** |
| 1 | 4-Storey Office | 11.56 | 18 | 14 | 10 | 4 | 17 | 15 | 5 | 10 |
| 2 | 4-Storey Hotel | 144 | 65 | 60 | 38 | 22 | 85 | 79 | 32 | 47 |
| 3 | 5-Storey Hotel | 16 | 7 | 7 | 4 | 3 | 9 | 9 | 4 | 5 |
| | Total | | | 81 | 52 | 29 | | 103 | 41 | 62 |





# EXERCISE

# CADANGAN PEMBANGUNAN YANG TERDIRI DARIPADA PANGSAPURI KOS SEDERHANA 18 TINGKAT (322 UNIT) DAN PANGSAPURI KOS RENDAH 17 TINGKAT (96 UNIT)

KELUASAN TAPAK KESELURUHAN = 9,932 MP ( 2.45 ekar )

CADANGAN PEMBANGUNAN YANG TERDIRI:

| BIL. | JENIS PEMBANGUNAN | KELUASAN PLOT | BIL UNIT |
|---|---|---|---|
| 1. | PANGSAPURI KOS SEDERHANA – 1 BLOK 18 TINGKAT TERMASUK ( 4 –TINGKAT PODIUM T.L.K ) | 900 K.P / UNIT | 322 UNIT |
| 2. | PANGSAPURI KOS RENDAH 17 TINGKAT TERMASUK ( 1 –TINGKAT T.L.K ) | 700 K.P / UNIT | 96 UNIT |
| 3. | SURAU( DALAM BANGUNAN ) | 217.55 M.P (2,341 K.P) | 1 UNIT |
| 4. | KEMUDAHAN MASYARAKAT ( DALAM BANGUNAN ) | 545.1 M.P (5,867 K.P) | 1 UNIT |
| 5. | PENCAWANG TNB (DOUBLE CHAMBER ) | – | 1 UNIT |
| 6. | DEPO SAMPAH | 16.67 M.P (179 K.P) | 1 UNIT |

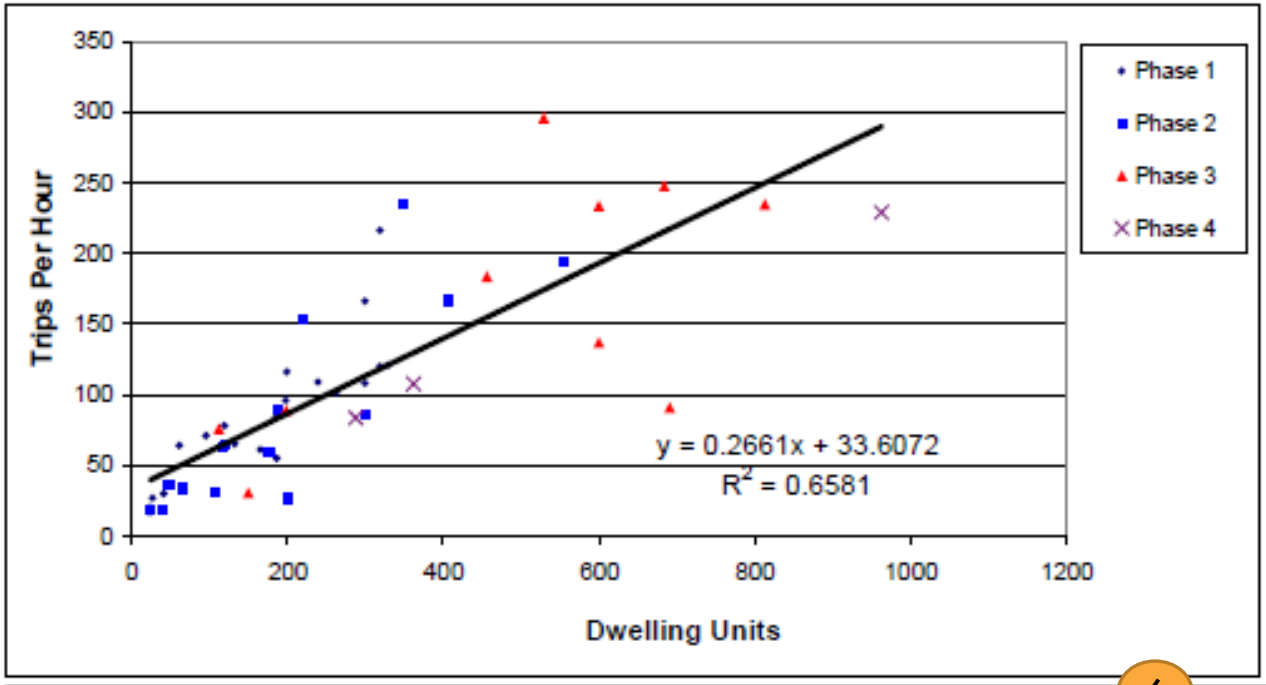
# STEP BY STEP

1. Identify the appropriate land use category
2. Select the most appropriate independent variable predictor
3. Find the relevant trip generation rates or equations
4. Multiply the independent variable with average rate or regression equation
5. Convert the estimated vehicle trips into PCU Trips
6. Divide the PCU trips into ingress and egress trips

**Residential**
**Flat, Apartment, Condominium**
**Trips per Dwelling Units**

1 CODE 01 01 05/06/07

AM Peak Hour Of Commuter

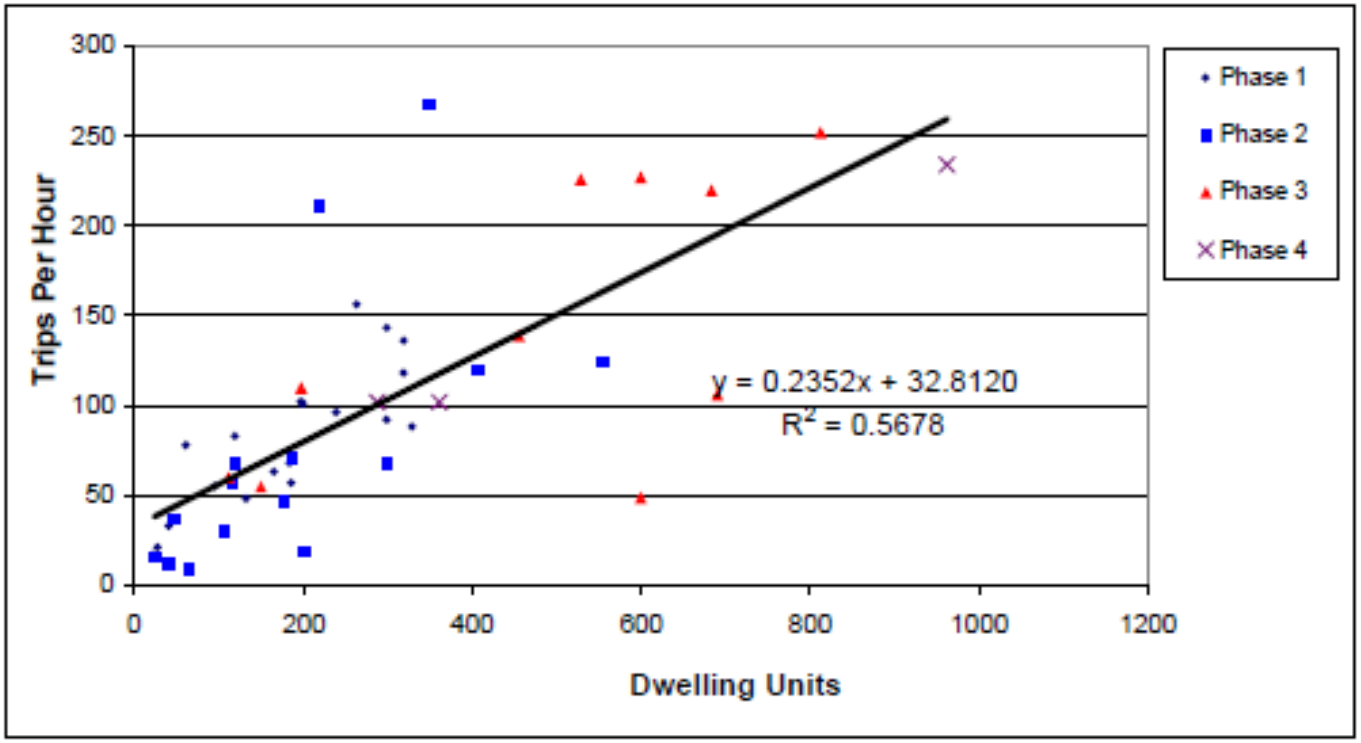



2 Variable (x)

| | | | |
|---|---|---|---|
| Number Of Sites : | 48 | Percent In/Out : | 27 / 73 (6) |
| 3 4 Average Rate : | 0.48 | 3 4 Regression Equation : | y = 0.2661x + 33.6072 |
| Minimum Rate : | 0.13 | *(T = Trips; X = Independent Variable)* | |
| Maximum Rate : | 1.03 | R-squared : | 0.6581 |
| Standard Deviation : | 0.2060 | | |

| Vehicle Type | Vehicle Composition | PCU Factor | PCU Conversion Factor |
|---|---|---|---|
| Car/Taxi | 71.58 | 1.00 | 0.72 |
| Motorcycle | 21.75 | 0.33 | 0.07 |
| Small Lorry | 5.57 | 1.75 | 0.10 |
| Big Lorry | 0.04 | 2.25 | 0.00 |
| Bus | 1.05 | 2.25 | 0.02 |
| **Total** | **100.00%** | | **0.91** (5) |

## PM Peak Hour Of Commuter



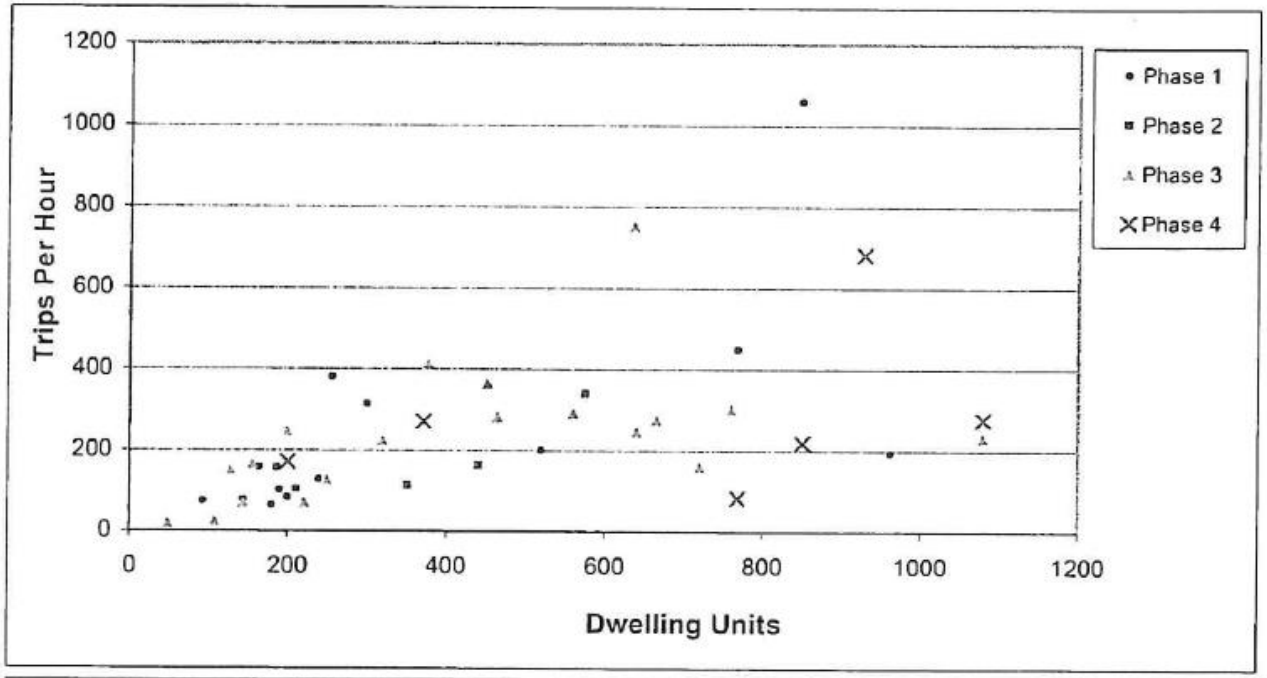

| | | | |
|---|---|---|---|
| Number Of Sites : | 48 | Percent In/Out : | 63 / 37 |
| Average Rate : | 0.45 | Regression Equation : | y = 0.2352x + 32.8120 |
| Minimum Rate : | 0.08 | *(T = Trips; X = Independent Variable)* | |
| Maximum Rate : | 1.26 | R-squared : | 0.5678 |
| Standard Deviation : | 0.2316 | | |

| Vehicle Type | Vehicle Composition | PCU Factor | PCU Conversion Factor |
|---|---|---|---|
| Car/Taxi | 71.35 | 1.00 | 0.71 |
| Motorcycle | 23.40 | 0.33 | 0.08 |
| Small Lorry | 4.82 | 1.75 | 0.08 |
| Big Lorry | 0.00 | 2.25 | 0.00 |
| Bus | 0.44 | 2.25 | 0.01 |
| **Total** | **100.00%** | | **0.88** |

# Residential
# Low Cost Housing
# Trips per Dwelling Units

CODE
01 01 20

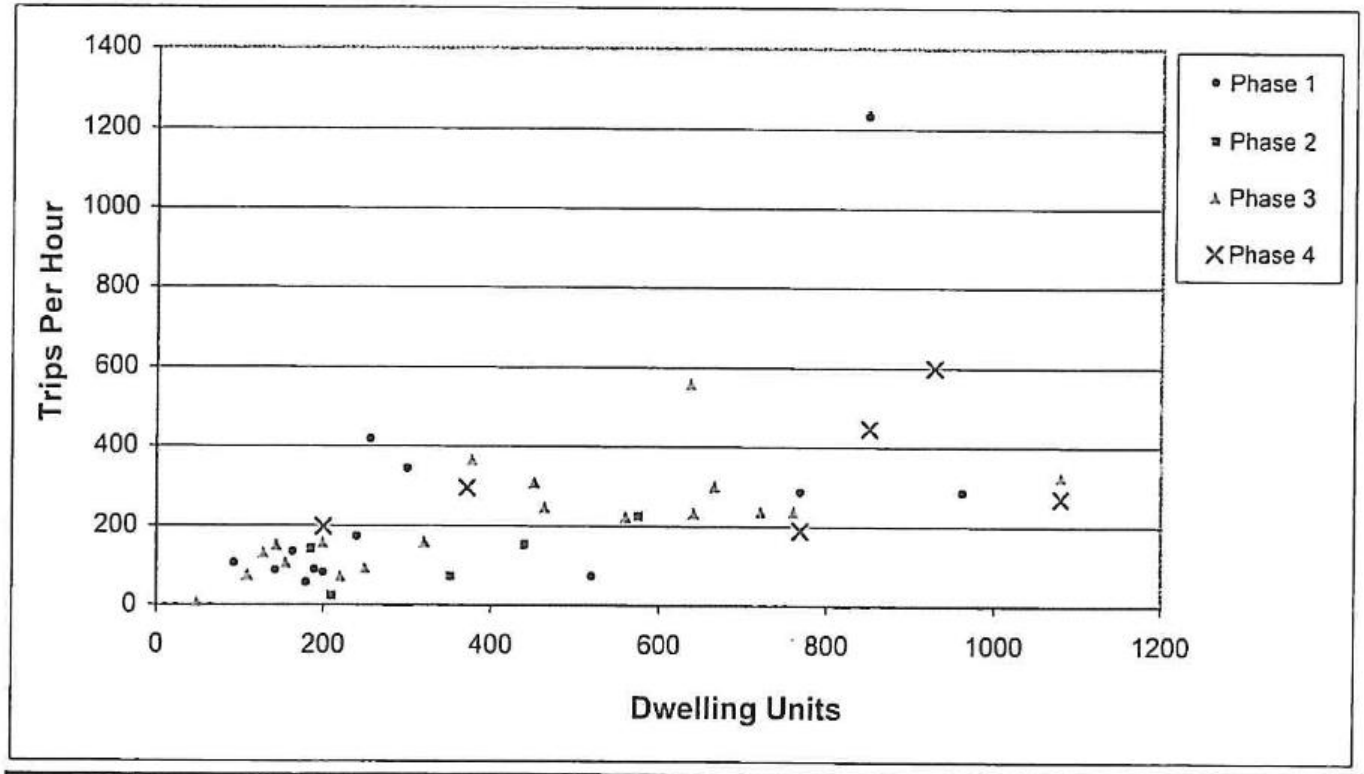
## AM Peak Hour Of Commuter




| | | | |
|---|---|---|---|
| Number Of Sites : | 43 | Percent In/Out : | 35 / 65 |
| Average Rate : | 0.62 | Use Trip Rates | |
| Minimum Rate : | 0.11 | | |
| Maximum Rate : | 1.48 | | |
| Standard Deviation : | 0.3426 | | |

| Vehicle Type | Vehicle Composition | PCU Factor | PCU Conversion Factor |
|---|---|---|---|
| Car/Taxi | 45.87 | 1.00 | 0.46 |
| Motorcycle | 44.63 | 0.33 | 0.15 |
| Small Lorry | 7.74 | 1.75 | 0.13 |
| Big Lorry | 0.26 | 2.25 | 0.01 |
| Bus | 1.48 | 2.25 | 0.03 |
| **Total** | **100.00%** | | **0.78** |

PM Peak Hour Of Commuter




| | | | |
|---|---|---|---|
| Number Of Sites : | 43 | Percent In/Out : | 57 / 43 |
| Average Rate : | 0.60 | Use Trip Rates | |
| Minimum Rate : | 0.11 | | |
| Maximum Rate : | 1.63 | | |
| Standard Deviation : | 0.3529 | | |

| Vehicle Type | Vehicle Composition | PCU Factor | PCU Conversion Factor |
|---|---|---|---|
| Car/Taxi | 44.50 | 1.00 | 0.45 |
| Motorcycle | 47.77 | 0.33 | 0.16 |
| Small Lorry | 6.82 | 1.75 | 0.12 |
| Big Lorry | 0.18 | 2.25 | 0.00 |
| Bus | 0.72 | 2.25 | 0.02 |
| **Total** | **100.00%** | | **0.74** |

# LAND USE AND THE CORRESPONDING TRIP GENERATION EQUATIONS

| Sub-Categories | Code | Peak Hour | Equation/ rate | Variable | Pcu Conversion Factor | % Trips (In) | % Trips (Out) |
|---|---|---|---|---|---|---|---|
| Flat, Apartment, Condominium | 01 01 05/06/07 | AM Peak Hour Of Commuter | | | | | |
| | | PM Peak Hour Of Commuter | | | | | |
| Low Cost Housing | 01 01 20 | AM Peak Hour Of Commuter | y = 0.62x | 96 unit | 0.78 | 35 | 65 |
| | | PM Peak Hour Of Commuter | y = 0.60x | | 0.74 | 57 | 43 |

# LAND USE AND THE CORRESPONDING TRIP GENERATION EQUATIONS

| Sub-Categories | Code | Peak Hour | Equation/ rate | Variable | Pcu Conversion Factor | % Trips (In) | % Trips (Out) |
|---|---|---|---|---|---|---|---|
| Flat, Apartment, Condominium | 01 01 05/06/07 | AM Peak Hour Of Commuter | y = 0.2661x + 33.6072 | 322 unit | 0.91 | 27 | 73 |
| | | PM Peak Hour Of Commuter | y = 0.2352x + 32.8120 | | 0.88 | 63 | 37 |
| Low Cost Housing | 01 01 20 | AM Peak Hour Of Commuter | y = 0.62x | 96 unit | 0.78 | 35 | 65 |
| | | PM Peak Hour Of Commuter | y = 0.60x | | 0.74 | 57 | 43 |

# TOTAL GENERATED TRIPS BY THE DEVELOPMENT

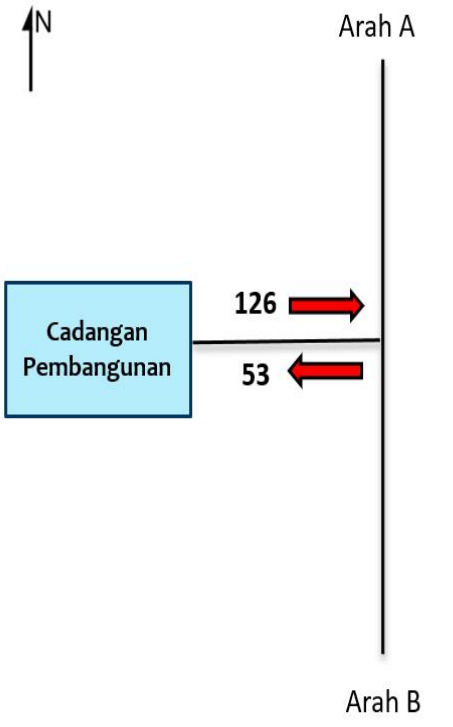
| | | | AM Peak Hour | | | | PM Peak Hour | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **No.** | **Type of development** | **Unit** | **Trips (Veh/hr)** | **Trips (Pcu/hr)** | **Trips (In)** | **Trips (Out)** | **Trips (Veh/hr)** | **Trips (Pcu/hr)** | **Trips (In)** | **Trips (Out)** |
| 1 | Medium cost apartment | 322 | | | | | | | | |
| 2 | Low cost apartment | 96 | | | | | | | | |
| | Total | | | | | | | | | |

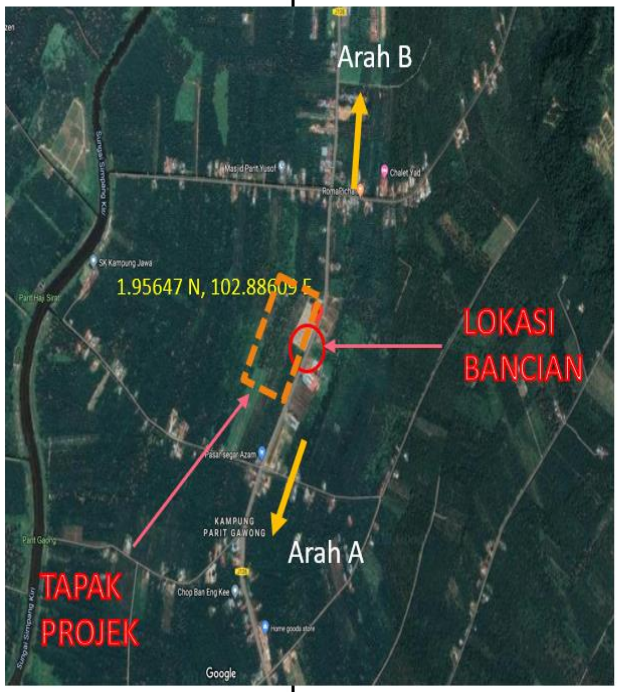
# TOTAL GENERATED TRIPS BY THE DEVELOPMENT

| | | | AM Peak Hour | | | | PM Peak Hour | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **No.** | **Type of development** | **Unit** | **Trips (Veh/hr)** | **Trips (Pcu/hr)** | **Trips (In)** | **Trips (Out)** | **Trips (Veh/hr)** | **Trips (Pcu/hr)** | **Trips (In)** | **Trips (Out)** |
| 1 | Medium cost apartment | 322 | 139 | 126 | 33 | 93 | 137 | 125 | 75 | 50 |
| 2 | Low cost apartment | 96 | 66 | 53 | 20 | 33 | 71 | 55 | 31 | 24 |
| | Total | | | 179 | 53 | 126 | | 180 | 106 | 74 |

**AM PEAK**

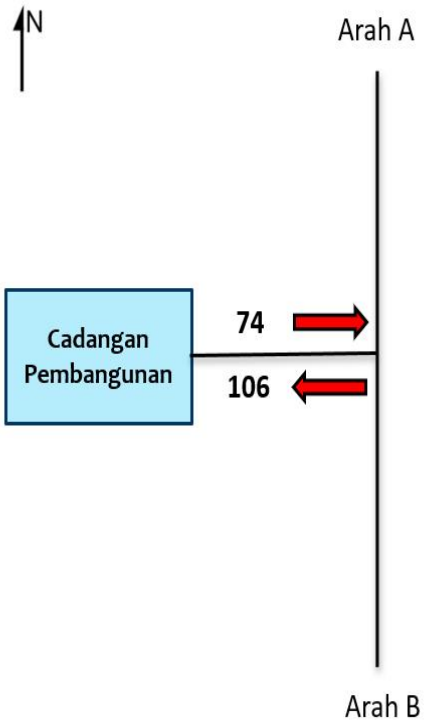
**TAHUN 2032**




**PM PEAK**

**TAHUN 2032**




**JUMLAH TRIP YANG DIJANA DARIPADA PEMBANGUNAN**

**(*TRIP GENERATION*)** - *AM PEAK HOUR & PM PEAK HOUR*

**PETUNJUK**

➡ : Arah Trafik

100 : Jumlah Trafik *(pcu)*

**Exercise 1**

# STEP 6: INGRESS AND EGRESS TRIP (FOR TIA)

- Distribute the Generated trips (total trips) to ingress (In) and egress (Out) trips based on Percent In/Out

# Q & A

~ THANK YOU ~