CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF STUDY

Speeding is a problem on most roads and highways. Today's vehicles are powerful and reliable and are very stable and quiet even at very high speeds. Accordingly, many drivers push their vehicles and go well beyond the speed that is appropriate for the setting within which the vehicle is operating.

One area where speeding vehicles are of particular concern is the special traffic zone such as a school zone or a road construction site. In a school zone, a large number of students are released in a small time frame, flooding the area with these students. A speeding driver can easily hit a student who, due to being young and inexperienced makes a mistake, or who trips and falls or is pushed by another student and lands on the roadway. A small childhood mistake can lead to very serious consequences.

Therefore, there exists a need in the art for a device that helps control the speed of vehicles through a special speed zone such as a school zone or a road construction site. Such a device needs to be able to automatically perform its function in order to complement the finite availability of law enforcement officers. Such a speed control device must be of relatively simple construction and operation and must provide a sufficient level of deterrence to the would be speeder. As increased speed of a vehicle through a special zone correlates with increased danger, the device should be able to increase its level of deterrence to higher speed vehicles.

1.2 PROBLEM STATEMENT

Local authorities know that speed humps have disadvantages. Based on research made by the city of Modesto in California, United States they found out several setback ; Slow response time of emergency vehicles; May divert traffic to parallel residential streets; There is a possibility of increased noise and pollution for residents living immediately adjacent to the speed bumps.

The project is very significant in reducing the major problems done by the implementations of the normal speed breakers. Despite its higher cost and operational maintenance, it theoretically will solve the current problem fetch by the accomplishment of the current speed breakers.

1.3 OBJECTIVE AND SCOPE OF STUDY

The objective of this project is to:

- Design a retractable speed breaker which must rooms on the road at the peak hours only at the predefined time schedule.
- To study the mechanism needed for retractable mechanism.
- To come up with working model that meets the criteria and constraint defined.

The scope of study of this project is limited by certain factors; which is

- Focus on one type of speed breakers and on normal type of road (Class C)
- Manufacture working prototype, not a full scale model based on research.
- Limit by the borne cost which is RM250.

CHAPTER 2

LITERATURE REVIEW AND THEORY

An early implementation of what might be considered to be speed humps was reported on June 7, 1906 in the New York Times. It reported that the U.S. town of Chatham, New Jersey planned to raise its crosswalks five inches above the road level, adding, "This scheme of stopping automobile speeding has been discussed by different municipalities, but Chatham is the first place to put it in practice”. The average automobile's top speed at the time was around 30 MPH. According to a publication by the Institute of Transportation Engineers, the first speed bump in Europe was built in 1970 in the city of Delft in the Netherlands

Speed breakers can be classified in several types which are based on the speed regulating and the standard use by certain country. Types of speed breakers available are jiggle bars, rumble strips; speed bump, speed humps and speed tables

	**Jiggle Bars.** Series of pre-cast concrete blocks 50 to 100mm wide, projecting 15mm above the road surface. Produce a rumbling noise and a jolt to the driver

	**Rumble Strips**. A road safety feature that alerts drivers both by causing a tactile vibration and the namesake audible rumbling
	**Speed Bump.** Designed to slow traffic or reduce through traffic. A speed bump is a bump in a roadway with heights typically ranging between 3 to 4 inches (7 to 10 cm). The length of speed bumps are typically less than or near to 1 foot (30 cm)
	**Speed Humps.** Similar to speed bump except longer and are typically 10 to 14 feet (3 to 4 m) in length
	**Speed tables.** Long speed humps with a flat section in the middle. They are generally long enough for the entire wheelbase of a passenger car to rest on top. The long, flat design allows cars to pass without slowing as significantly as with speed humps or cushions.
	The design of **speed cushions** forces cars to slow down as they ride with one or both wheels on the humps. However, the wider axle of emergency vehicles such as fire engines and ambulances allows them to straddle the cushions without slowing down or increasing response times.

Table 1: Type of speed breakers

The implementation of speed breakers really affected by the road types. Roads designs are based on the predicted weight of the traffic and the location of the roads being built. There are 3 classes of roads which include; **Low capacity roads (Class C)** are generally low speed local roads serving a particular village, town, neighborhood, or city. They often also serve the broadest variety of road users. **High speed roads (Class B);** most countries have major roads of medium capacity that connect cities, places, other routes, or other significant points of interest. **High speed restricted access roads (Class A)**; most high capacity roads are built to a higher standard than general purpose roads. Access is restricted to certain categories of motorized vehicles

Roads are constructed from many materials. The material used depends on local conditions and other factors such as the amount of traffic the road is designed for and the weight of the vehicles allowed using the road. Some of the materials used to build roads include: Asphalt concrete; Brick; Cobblestone; Concrete; Gravel road and Ice road.

CHAPTER 3

METHODOLOGY AND PROJECT WORK

3.1 ENGINEERING DESIGN PROCESS

This project will be based on the following project design.. The details of every stage will be identified. Researches will be done from time to time so that the best methods and formula could be determined. Best methods used will contribute to the best result. The methods have been break into 2 parts; for FYP I and FYP II *(refer figure 1)*

3.2 TOOLS AND MATERIALS

- Mechanical designing software (CATIA, AUTOCAD or SOLIDWORKS)
- Manufacturing facilities for prototype building (CNC machines, fabrication machine, rapid prototyping machine), Programmable Logic Controller (PLC) for machine control.
- Materials will be discussed in chapter 4.

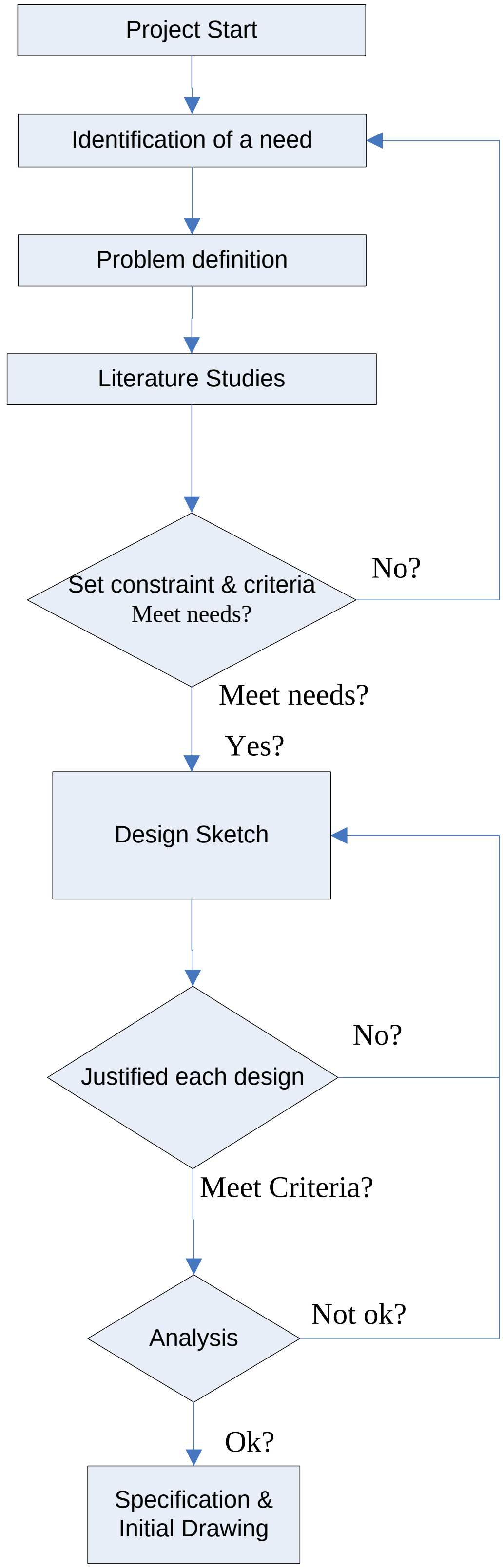


Figure 1: Flowchart of Design Process for FYP I

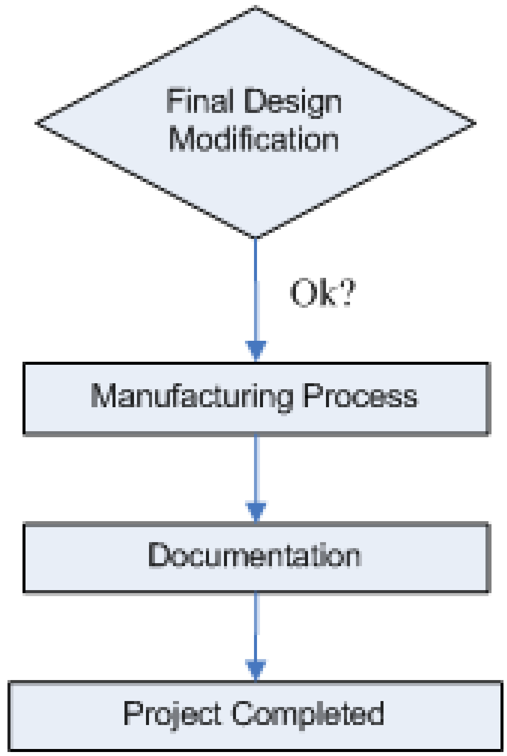


Figure 2: Flowchart of Design Process for FYP II

CHAPTER 4

RESULTS AND DISCUSSION

4.1 ROAD WIDTH STANDARDS

These Standards are for use by individuals who as a result of the land development process desire to have the JKR accept road construction into the County's system of maintained public roads

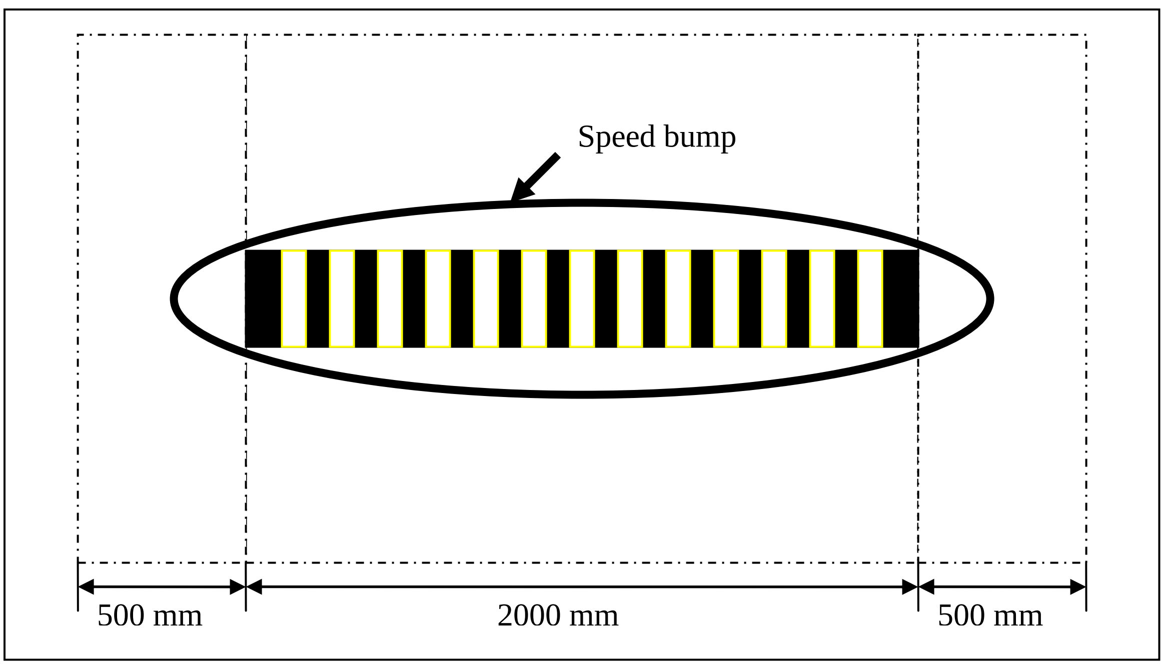


Figure 3: Malaysia Standard Road Width

The standard length for class C roads it 3000mm which 2000mm is reserved to the road while the rest is divided into 2 equal parts which is the sideways. The retractable speed bump is installed at the middle part of the road, as the wider wheelbase vehicle (such as ambulance, fire trucks) can pass thru by straddle the cushions without slowing down or increasing response times.

4.2 SPEED BUMP STANDARDS

A speed bump works by transferring an upward force to a vehicle, and its occupants, as it traverses the bump. The force induces a front-to-back pitching acceleration in vehicles having a wheelbase shorter to the length of the bump that increases as the vehicle travels faster. This differs from a speed hump, which induces a lower vertical acceleration at low speeds compare with the speed bump because it is significantly wider than the wheelbase of a vehicle. The acceleration decreases with higher speeds due to absorption of the impact by the vehicle suspension.

For this reason length is a critical geometric- design parameter. Experiments have shown that as lengths increase peak accelerations tend to occur at higher speeds, and more linear dynamic effects are created. In general, longer humps exhibit better characteristics for speed reduction.

There are several types of bumps (where the larger one call humps) which are available based on Institute of Transportation Engineers (ITE) standards which consist of 3 major types. (Refer to Figure 3)

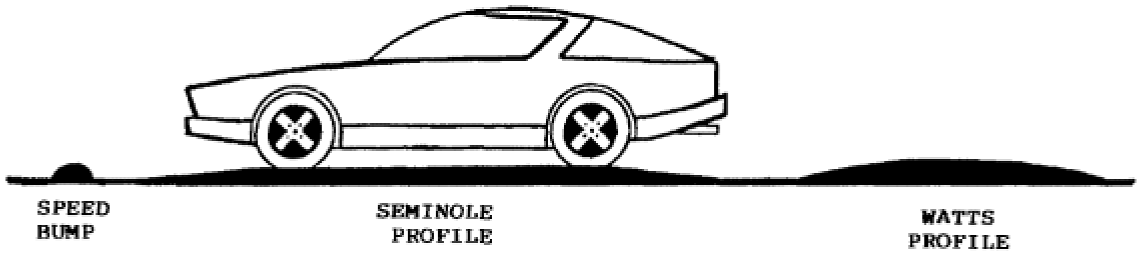


Figure 3: Type of speed bumps*

*P. Moinat. Étude, *Simulation du Passaged'un Véhicule Sur un Dos d'Âne: Prédiction de l'Inconfort (A Study and Simulation of Vehicle* Passage on Speed Humps: Prediction of *Discomfort), Master of Engineering Thesis, Université de Sherbrooke, Canada, 1991*

Speed breaker design	**Traffic 85% speed (km/h)**
100mm – 75 mm Speed bump	< 25
100 mm Watts Profile	25
75 mm Watts Profile	29
100 mm Seminole Profile	40
75 mm Seminole Profile	44

Table 2: Speed breaker crossing speed

The table above show the 85% traffic speed which provided by ITE. It shows that the higher the slope and height of the speed breaker will eventually reduce the 85% speed of the oncoming traffic. In this case, the project constraint will only focused on the speed bump, which because the use of speed bumps is widespread around the world, and they are most commonly found where prevailing vehicle speeds are expected to be low. Although speed bumps are very effective in keeping vehicle speed down, their use is sometimes controversial as they can cause noise and possibly vehicle damage if taken at too great a speed. Poorly designed speed bumps often found in private car parks (too tall, too sharp an angle for the expected speed) can be hard to negotiate in vehicles with low ground clearance, such as sports cars, even at very slow speeds. Speed bumps can also pose serious hazards to motorcyclists and bicyclists should they fall to the ground

4.3 RETRACTING MECHANISM

During research there a several consideration of mechanism used; which is hydraulic, pneumatic and mechanical.

4.3.1 Hydraulic/Pneumatic Actuators

Both pneumatics and hydraulics are applications of fluid power. Pneumatics uses air, which is compressible, while hydraulics uses relatively incompressible liquid media such as oil or water. Most industrial pneumatic applications use pressures of about 80 to 100 pounds per square inch (psi) (500 to 700 kilopascals). Hydraulics applications commonly use from 1,000 to 5,000 psi (7 to 35 MPa), but specialized applications may exceed 10,000 psi (70 MPa).

Hydraulic	Pneumatic
Higher energy density owing to the much higher working pressures usually employed. The hydraulic working fluid is basically incompressible, leading to a minimum of spring action. When hydraulic fluid flow is stopped, the slightest motion of the load releases the pressure on the load; there is no need to "bleed off" pressurized air to release the pressure on the load.	The working fluid is very light in weight so supply hoses are not heavy. Because the working fluid is (mostly) just air, there is usually no need for a return line for the working fluid and leaks of the working fluid tend not to be messy. Air is compressible; the equipment is less likely to be damaged by shock. Air in pneumatics absorbs excessive force, while hydraulics directly transfers force.

Table 3: Comparison between hydraulic and pneumatic

Hydraulic/pneumatic systems operate according to Pascals law. The law of Blaise Pascal says: 'The pressure, in a static hydraulic fluid in a closed system is everywhere the same'. However, when the velocity of the flow is constant one may apply Pascals Law as well.

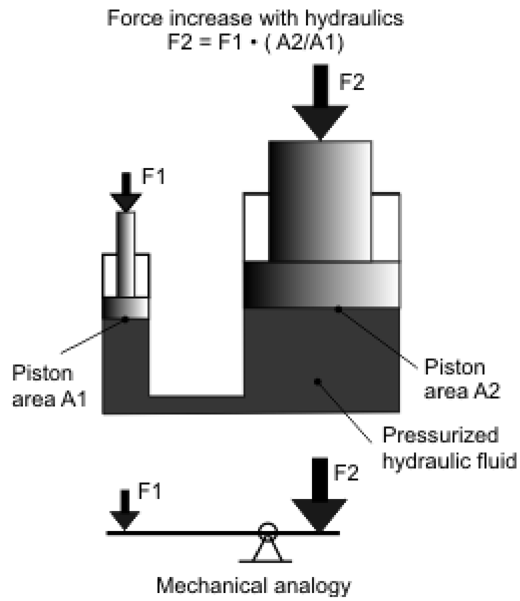


Figure 4: Hydraulic concepts

The pressure can be calculated with the formula:

$$p = \frac{F}{A}$$

where:

* p = pressure (psi)
* F = force (pound)
* A = area (square inch)

4.3.2 Mechanical (Motor)

Electrical motors are widely used in the field of motion control in factory automation. The control target can be position, speed, or force, among others. For this project, the electric motor will be control by PLC.

A programmable logic controller, PLC, or programmable controller is a small computer used for automation of real-world processes, such as control of machinery on factory assembly lines. The PLC usually uses a microprocessor. The program can often control complex sequencing and is written by skilled engineers. The program is stored in battery-backed memory and/or EPROM's (An **EEPROM** or **E**lectrically-**E**rasable **P**rogrammable **R**ead-**O**nly **M**emory is a non-volatile storage chip used in computers and other devices (such as USB flash drives, in its flash memory version)).

The main difference from other computers is the special input/output arrangements. These connect the PLC to sensors and actuators. PLCs read limit switches, dual-level devices, temperature indicators and the positions of complex positioning systems. Some even use machine vision. On the actuator side, PLCs drive any kind of electric motor, pneumatic or hydraulic cylinders or diaphragms, magnetic relays or solenoids. The input/output arrangements may be built into a simple PLC, or the PLC may have external I/O modules attached to a proprietary computer network that plugs into the PLC.

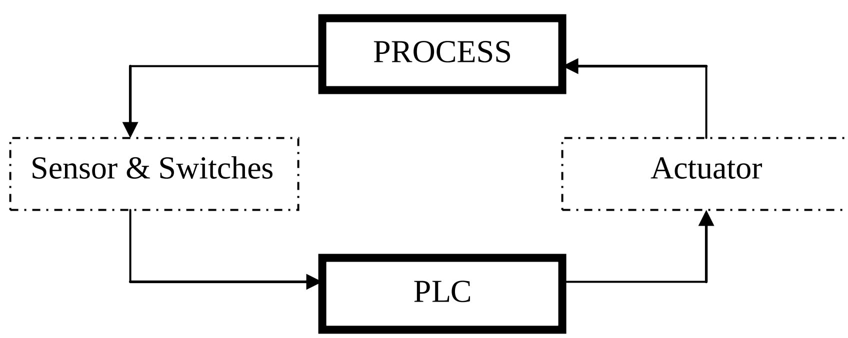


Figure 5: PLC control system

4.4 MECHANISM JUSTIFICATION

Electric motor gives better control compare to the hydraulic and pneumatic. It offers variable control when combine with PLC which is essential to the project. It accommodate sensors and switches to react and activate itself without human interaction..

Hydraulic and pneumatic systems have to equip with numerous equipment to make it runs well. It include tanks (for hydraulic), actuators, control valve, safety valve and etcetera.

But, the PLC also has its own complexity. The knowledge of programming is essential to create the command for the PLCs to work. In spite of everything, electric motor combines with PLC control offer balance advantage which both pneumatic and hydraulic does not offer.

4.5 DESIGN SKETCH

4.5.1 First Design

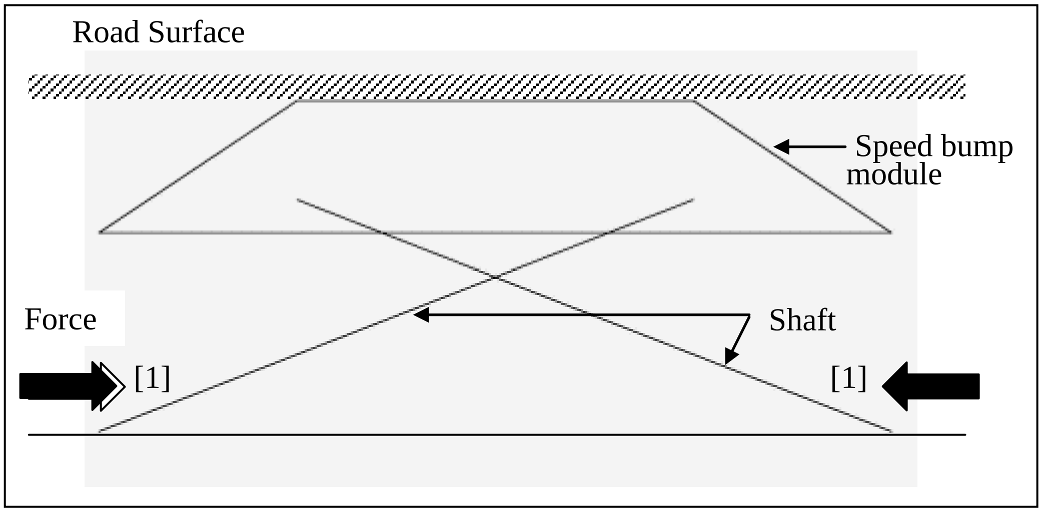


Figure 6: First speed bump design in “sleep” position

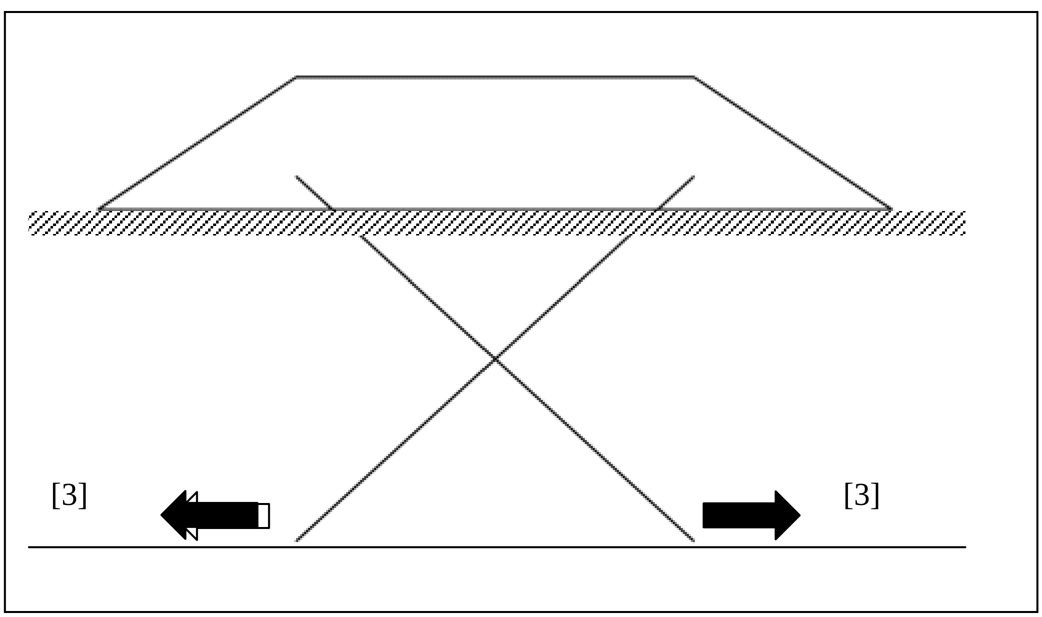


Figure 7: First speed bump design “wake” position

For first design, the movement of the speed bumps is controlled by the force supplied via hydraulic/pneumatic actuator which is applied at [1]. The actuator will push the shaft interconnecting to the speed bumps module. The shaft will move along the bottom of the module casing. The shaft will be pushed until the speed module completely above the road surface [2].

When the speed regulations does not need, the actuators will retract to position [3] until the whole speed bump module is hidden under the road surface.(refer figure below)

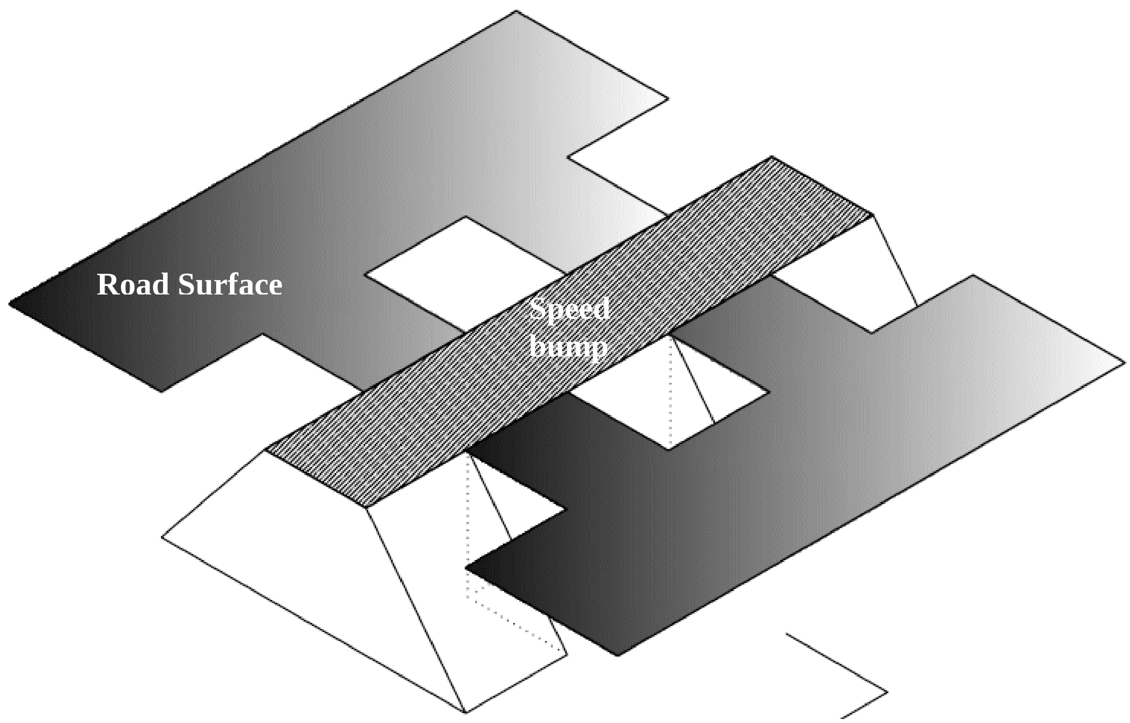


Figure 8: Isometric drawing for first design in “sleep” position.

4.5.2 Second design

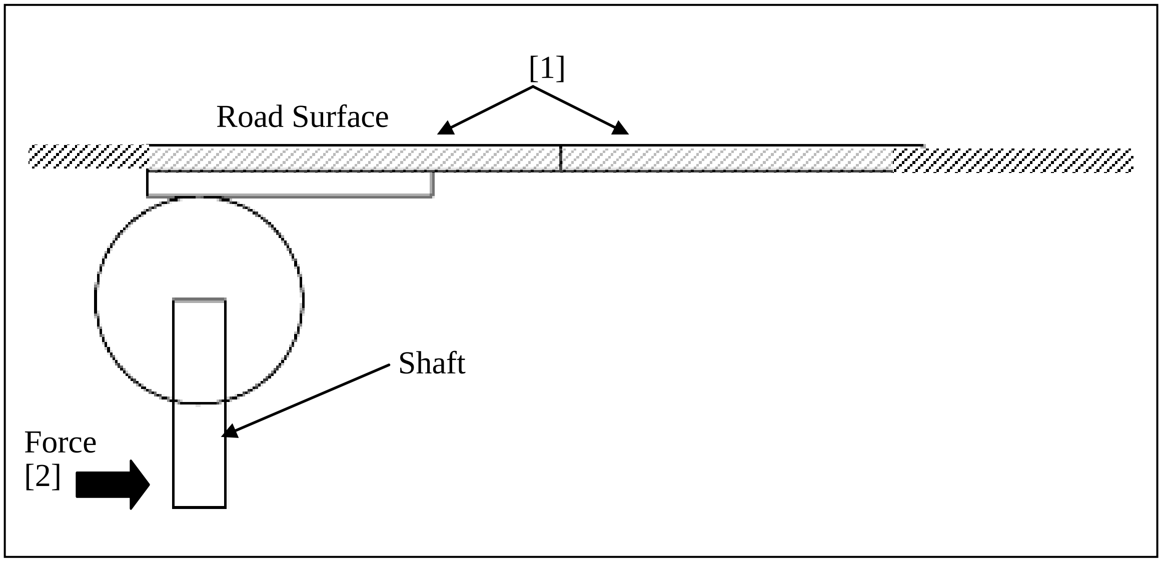


Figure 9: Second speed bump design in "sleep" position

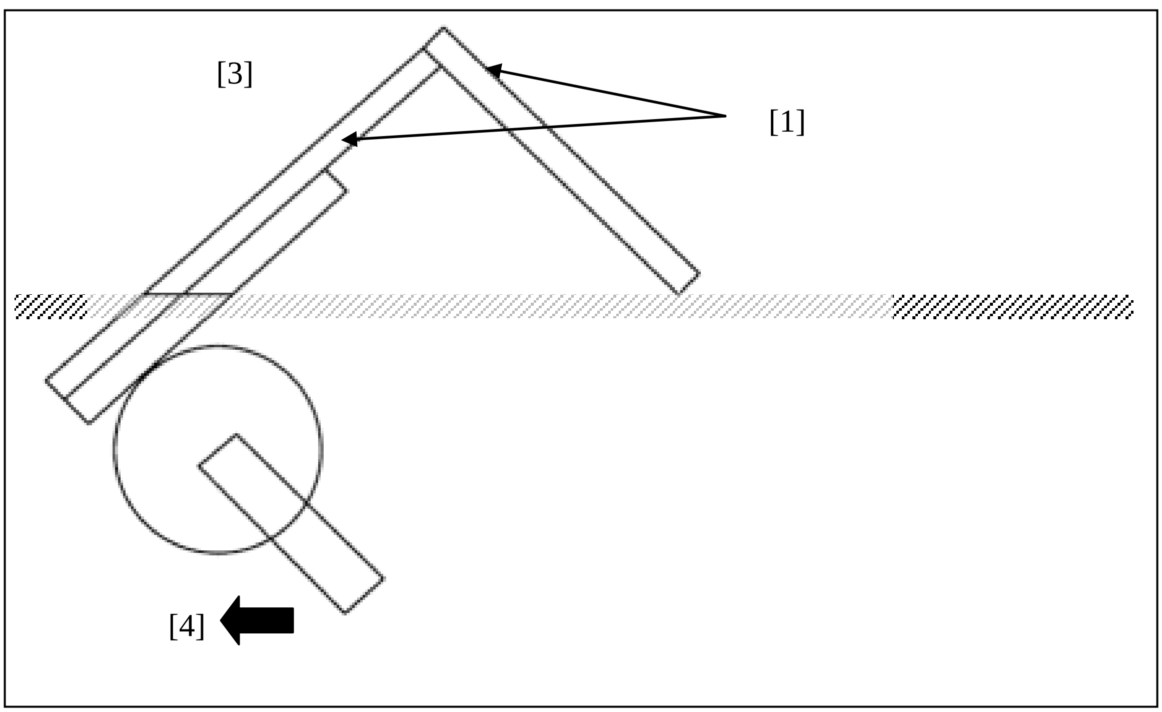


Figure 10: Second speed bump design "wake" position

Second design is an automatic traffic-calming device, which provides non-impeding and impeding conditions on demand. Multiple means of initiating action of the unit provide a wide variety of applications for the retractable speed bump.

It is also employs the uses of hydraulics/pneumatics mechanism for rising and lowering of the retractable speed bump. The retractable speed bump, is comprised of bi-folding hinged plates [1], these retractable plates are elevated to present a visible obstruction to motor vehicles and act as a speed limiting devices. In figure 9 it shows the speed bump in "sleep" position which is the speed bump module is under the road surface. When traffic regulating needed, the actuators will push from position [2] until certain point where the speed bump fully deployed on the road surface (refer figure 10). The traffic regulated when the surface of the speed bump is fully loaded on the road surface at point [3].

When there is no traffic calming needed, the hydraulic/pneumatic will be retract back into its original position [4].

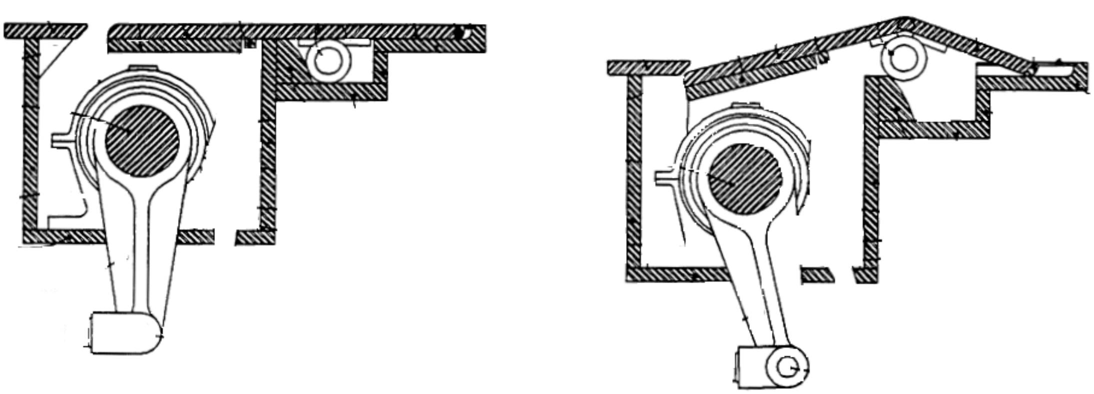


Figure 11 : Picture of second design in "sleep" position (left) and "wake" position (right)

4.5.3 Third Design

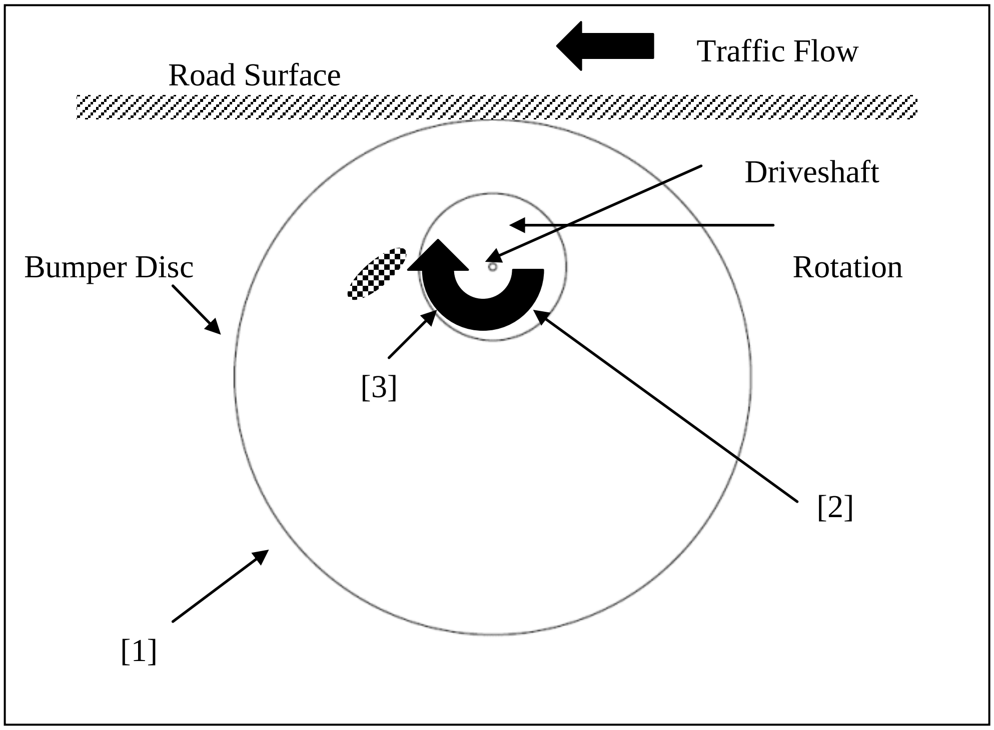


Figure 12: Third speed bump design in “sleep” position

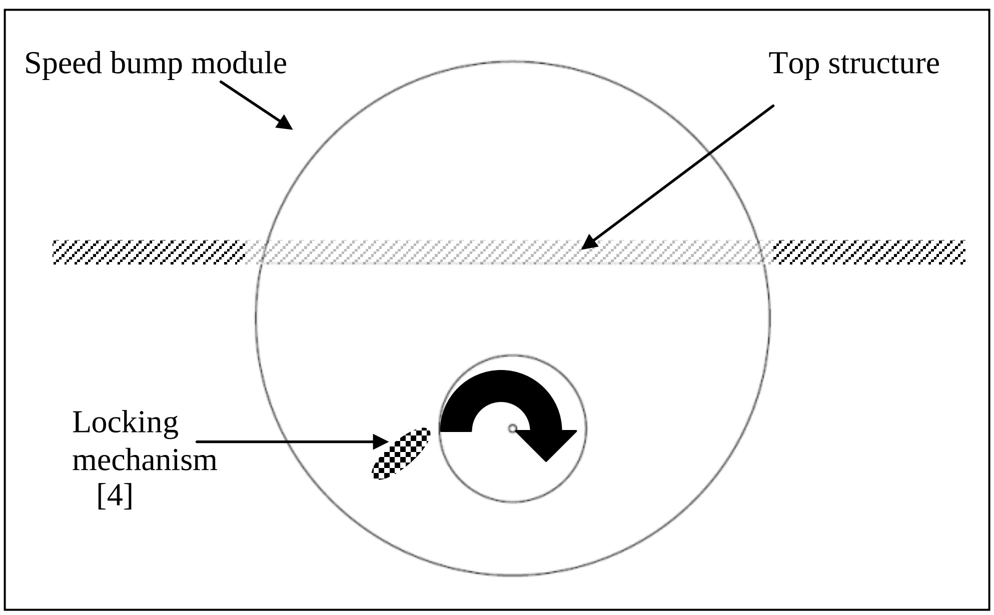
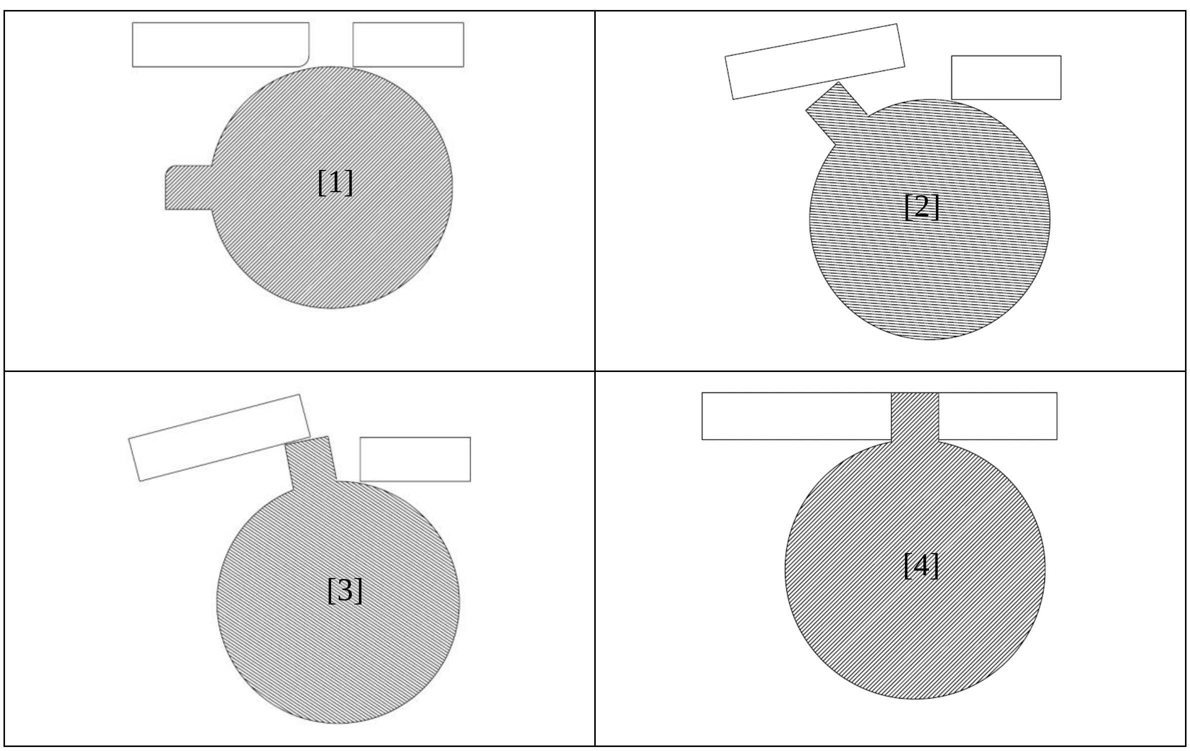


Figure 13: Third speed bump design in “wake” position

The third design was a concept borrowed from engine crankshaft mechanism. The concept also put into practice on the construction of Burj Al-Arab Hotel for controlling the thermal expansion of their steel structure. Thus it is proved to be capable to handle as a retractable speed bump. The design basis consists of a plate which is arranged in order that it can be added as many plate as the road width. The round plate is divided by smaller round plate which acts as a divider [2]. The third design concept using a round plate, which in certain thick and the shaft is put offset from the original centre thus given variable length when its rotate (refer figure 13 When it operates, the motor will turn [3] clockwise for 180° reveal its speed bump mechanism**.** Then, the locking mechanism [4] will lock the speed breaker from rotate when the traffic is flowing.

The design of this speed breaker allows the traffic to flows even though the retraction of the speed bump is in progress. There is a lot of difference between slow and stop when the traffic is approaching this kind of speed bump. Locking Mechanism for the third design is located at the smaller disc. The locking mechanism function is to lock the retractable speed breaker into the current position and to avoid position change during the operation period.



4.6 DESIGN JUSTIFICATION

Since there are three designs to select, the justifications have to be done in order to select the best design to be manufactured. The table below showed the advantage and disadvantage of the all design.

Design	**Mechanism**	**Design Approach**	**Cost**	**Safety Factor**	**TOTAL +**	**TOTAL -**
First	-	-	-	-	0	4
Second	-	-	+	+	2	2
Third	+	+	+	-	3	1

Scale to 5, the higher the better

Table 4: Design Decision Matrix

Mechanism - The complexity of the mechanism, which more complex design will require several manufacturing process.

Design Approach – Design approach is to verify the suitable of the design to the acceptable standard, which in this case the bump should be as round as possible as sudden gradient angle will lead to user discomfort. It also must be as manufacturing feasible as possible.

Cost – The cost be supposed to as low as possible. Therefore, the probability for the product to be manufacture is high.

Safety Factor – The potential for the design to fail must be considered. Since it involves the human lives, it is considered in design phase.

From the design decision matrix, the third designs outweigh the other two designs. The third design obtains most marks in every category which make it chosen for the project.

First Design	Second Design	Third Design
For both first and second design, it employs the uses of hydraulic or pneumatic mechanism. The employment of both mechanisms requires more equipment such as compressor, valve, and tank (hydraulic). The extra equipment utilizes more complex movement and requires a lot of maintenance.		The third design employ simple electric motor, which only uses electric. It control by small logic controller rather than directional valve.
The design itself it's not capable to handling moving traffic while retraction is in progress. Therefore traffic has to be stopped before the speed bump retracts.		Traffic can move even though the retraction mechanism is in progress. This is due to the smooth curve on the speed bump which allows traffic to flow even though the retraction is in progress.
The present of additional equipment lead to extra cost and extra space, which in the real life, the customers will try their best to avoid that.		Simple setup and equipment use, lead to more economic feasible and utilize smaller storage space.
Design quite complicated. Many fabrication and manufacturing process involved. Not be able to adapt to road width, have to make new parts if the width requirement not fit the needs.		The simple design which will have advantage when comes to manufacturing process. Its modular design allow the plate to be installed depends on the road with where the speed breaker need to be used.

Table 5: Advantage and disadvantage for all design..

4.7 MATERIAL SELECTION

4.7.1 Material selection by material requirement

The third design can de divides into 3 parts

- Round plate disc
- Shaft
- PLCs and control system
- Top Plate

Material justification will be based on the requirement of each part.

Component	Requirement	Material property	Alternatives
Round plate disc and shaft	High durability to withstand the environmental affect (eg worn by the hot weather and variety type of vehicle.)	• Lightweight • Strong	• Metal • Polymers
PLCs control system box	Must be installed in water tight box, which doesn’t allow moisture to form and protect electric circuit	• Durable and strong	• Polymers
Top Structure	Hard, must support loads without breaking,	• Strength • density	• Metal • Polymers

Table 6: Analysis on the suitable requirement for parts and its materials property.

But for this project, since the budget allocation is limited, material substitution will be use for prototype.

In order to choose the suitable requirement based on the analysis, the Ashby charts is being used to evaluate potential material based on strength, density and relative cost.

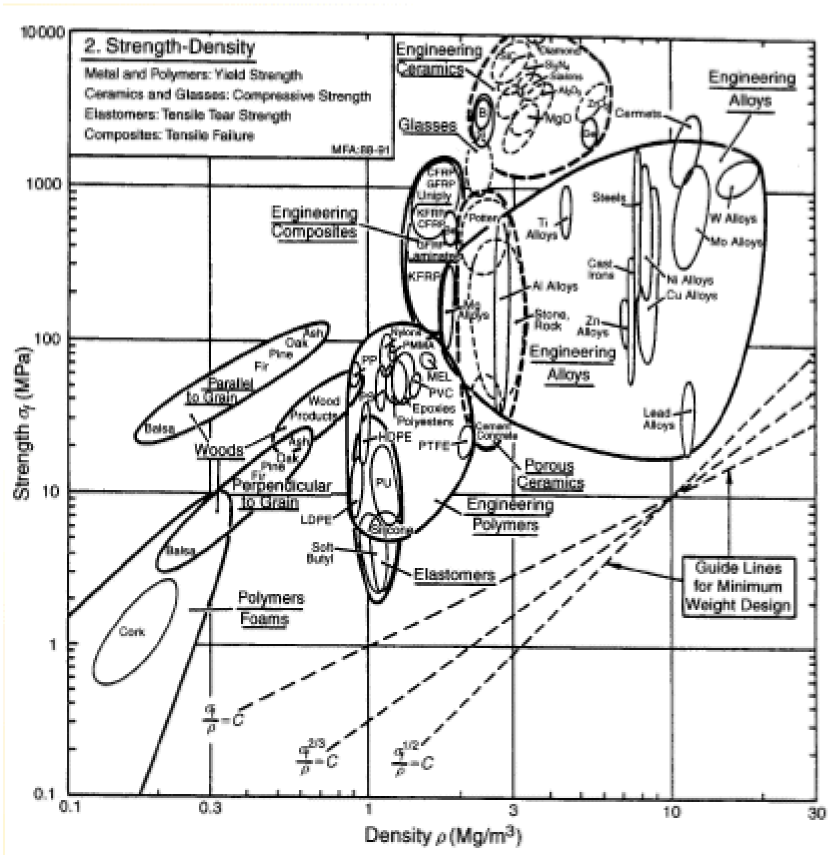


Figure 14: Strength-density chart

Based on above figure, the material that fits the requirement for the round plate disc, shaft and top structure were group of engineering alloys. There are lots of types of engineering alloys can be chosen but the relative cost of material will be justifies later.

For the PLC and control box, it should posses the durability and strong. The engineering polymers were suitable candidates' for this type of construction since the box doesn't need the ability to hold the load, just to protect the motor and control system mechanism

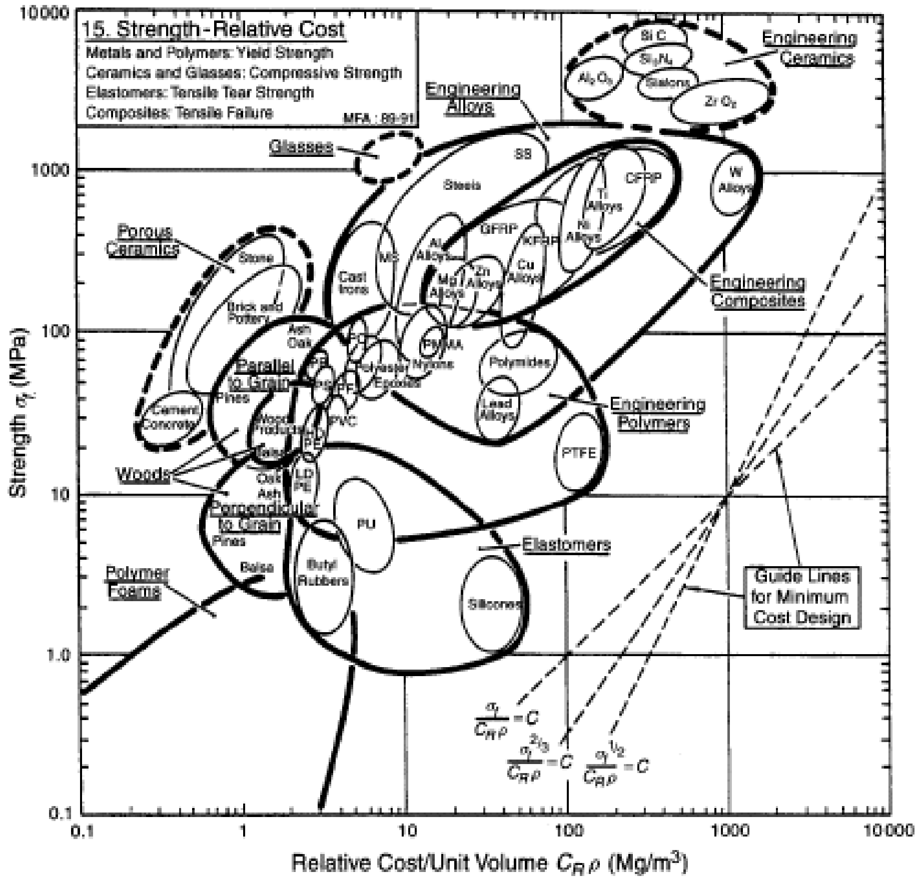


Figure 15: Strength- relative cost chart

In term of cost and strength, the most suitable material for round plate disc, shaft and top structure, steel give better strength to relative cost ratio. Instead using normal steel, the structure need special type of steel which is mild steel (ASTM A36) as it

For frame, motor and control system, HDPE (High Density Polyethylene) serves good strength to relatives cost ratio compare with other type of engineering polymers.

4.7.1 Material selection by manufacturing process

The purpose of this section is to provide a general guide as to what processes may be suitable targets for a component and Figure 5 shows the process selection flowchart. The principal intention is that the candidate processes are selected before the component design is finalised, so that any specific constraints and/or opportunities may be borne in mind.

To this end, a PRIMA selection matrix (see Figure 6) has been devised based on two basic variables:

- Material type
- Production quantity

As mentioned previously there are many cost drivers in process selection, not least component size, geometry, tolerances, surface finish, capital equipment and labour costs. The justification for basing the matrix on material and production quantity is that they mix PRIMA technological and economic issues of importance. The boundaries of economic production can be vague when so many factors are relevant, therefore, the matrix concentrates rather more on the use of materials.

By limiting itself in this way the matrix cannot be regarded as comprehensive and should not be Fabrication techniques are not included in the selection matrix due to their unique application in joining and assembly. Such processes can be used for all production quantities, including one-offs, and are used on many different types of material and the reader interested in fabrication techniques should refer to reference (1).

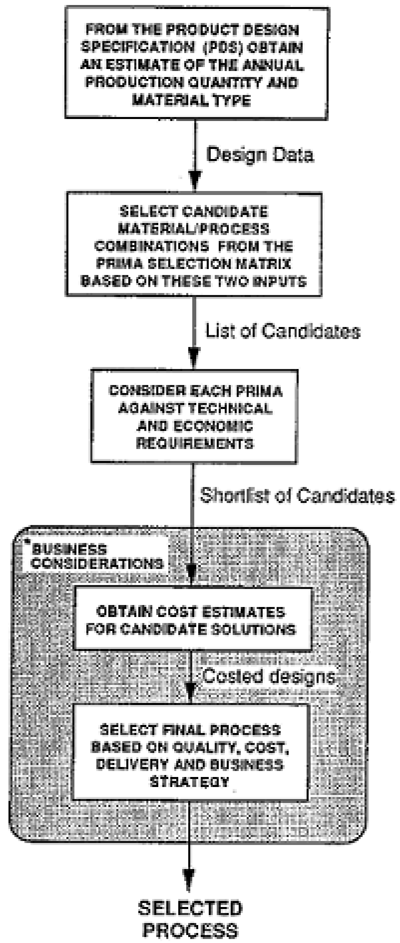


Figure 16: Process selection flowcharts

Note - The PRIMA selection matrix cannot be regarded as comprehensive and should not be taken as such. It represents the main common industrial practice but there will always be exceptions at this level of detail.

MATERIAL / QUANTITY	IRONS	STEEL (carbon)	STEEL (tool, alloy)	STAINLESS STEEL	COPPER & ALLOYS	ALUMINIUM & ALLOYS	MAGNESIUM & ALLOYS	ZINC & ALLOYS	TIN & ALLOYS	LEAD & ALLOYS	NICKEL & ALLOYS	TITANIUM & ALLOYS	THERMOPLASTICS	THERMOSETS	FR COMPOSITES	CERAMICS	REACTIVE METALS	PRECIOUS METALS
VERY SMALL 1 TO 100	[1.5] [1.6] [1.7] [4.M]	[1.5] [1.7] [3.6] [4.M] [5.1] [5.5] [5.6]	[1.1] [1.7] [3.6] [4.M] [5.1] [5.5] [5.6]	[1.7] [3.6] [4.M] [5.1] [5.5] [5.6]	[1.5] [1.7] [3.6] [4.M] [5.1]	[1.5] [1.7] [3.6] [4.M] [5.1] [5.5]	[1.6] [1.7] [3.6] [4.M] [5.1] [5.5]	[1.1] [1.7] [3.6] [4.M] [5.5]	[1.1] [1.7] [3.6] [4.M] [5.5]	[1.1] [3.6] [4.M] [5.5]	[1.5] [1.7] [3.6] [4.M] [5.1] [5.5] [5.6]	[1.1] [1.6] [4.M] [5.1] [5.5] [5.6]	[2.3] [2.5]		[2.6]	[5.6]		[5.6]
SMALL 100 TO 1,000	[1.2] [1.3] [1.5] [1.6] [1.7] [4.M] [5.3] [5.4]	[1.2] [1.3] [1.5] [1.7] [3.6] [4.M] [5.1] [5.3] [5.4] [5.5]	[1.1] [1.7] [3.6] [4.M] [5.1] [5.3] [5.4] [5.5] [5.6]	[1.2] [1.7] [3.6] [4.M] [5.1] [5.3] [5.4] [5.5]	[1.2] [1.3] [1.5] [1.7] [1.8] [3.3] [3.6] [4.M] [5.1] [5.3] [5.4]	[1.2] [1.3] [1.5] [1.7] [1.8] [3.6] [4.M] [5.3] [5.4] [5.5]	[1.3] [1.6] [1.7] [1.8] [3.6] [4.M] [5.5]	[1.1] [1.3] [1.7] [1.8] [3.6] [4.M] [5.5]	[1.1] [1.3] [1.7] [1.8] [3.6] [4.M] [5.5]	[1.1] [1.3] [1.8] [3.6] [4.M] [5.5]	[1.2] [1.3] [1.5] [1.7] [3.6] [4.M] [5.1] [5.3] [5.4] [5.5]	[1.1] [1.6] [4.M] [5.3] [5.4] [5.5] [5.6]	[2.2] [2.3] [2.5]	[2.2]	[2.2] [2.6]	[5.6]		[5.5]
SMALL TO MEDIUM 1,000 TO 10,000	[1.2] [1.3] [1.5] [1.6] [1.7] [3.7] [4.A] [5.2]	[1.2] [1.3] [1.5] [1.7] [3.1] [3.2] [3.7] [4.A] [5.2] [5.3] [5.4] [5.5]	[1.2] [1.7] [3.1] [3.2] [3.7] [4.A] [5.2] [5.3] [5.4] [5.5]	[1.2] [1.7] [3.1] [3.2] [3.7] [4.A] [5.2] [5.3] [5.4] [5.5]	[1.2] [1.3] [1.4] [1.5] [1.6] [3.1] [3.2] [3.7] [4.A] [5.2] [5.3] [5.4]	[1.2] [1.3] [1.4] [1.5] [1.6] [3.1] [3.2] [3.7] [4.A] [5.3] [5.4] [5.5]	[1.3] [1.4] [1.6] [1.8] [3.1] [3.2] [4.A] [5.5]	[1.3] [1.4] [1.8] [3.2] [4.A] [5.5]	[1.3] [1.4] [3.2] [4.A]	[1.3] [1.4] [3.2] [4.A]	[1.2] [1.3] [1.5] [1.7] [3.1] [3.2] [3.7] [4.A] [5.2] [5.3] [5.4] [5.5]	[3.1] [3.7] [4.A] [5.2] [5.3] [5.4] [5.5]	[2.1] [2.2] [2.3] [2.4]	[2.2]	[2.2]	[5.2]		[5.5]
MEDIUM TO HIGH 10,000 TO 100,000	[1.2] [1.3] [3.7] [4.A]	[3.1] [3.2] [3.3] [3.7] [3.8] [4.A] [5.5]	[3.2] [3.3] [3.8] [4.A] [5.2]	[3.1] [3.2] [3.3] [3.7] [3.8]	[1.2] [1.4] [3.1] [3.2] [3.3] [3.7] [3.8] [4.A]	[1.2] [1.3] [1.4] [3.1] [3.2] [3.3] [3.7] [3.8] [4.A] [5.5]	[1.3] [1.4] [3.1] [3.2] [3.3] [3.8] [4.A]	[1.4] [3.2] [3.8]	[1.4] [3.2] [3.8]	[1.4] [3.2] [3.3] [3.8] [4.A]	[3.3] [3.7] [3.8] [4.A] [5.2] [5.5]	[3.7] [3.8] [4.A] [5.2] [5.5]	[2.1] [2.3] [2.4] [2.7]	[2.1] [2.2] [2.7]	[2.2]	[3.7]		[3.3]
HIGH 100,000+	[1.2] [1.3] [3.7] [4.A]	[3.1] [3.2] [3.3] [3.8] [4.A]			[1.2] [3.2] [3.3] [3.7] [3.8] [4.A]	[1.2] [1.3] [1.4] [3.2] [3.3] [3.8] [4.A]	[1.3] [1.4] [3.1] [3.8] [4.A]	[1.4] [3.2]		[1.4] [3.2]			[2.1] [2.4] [2.7]	[2.1] [2.2] [2.7]		[3.7]		
ALL QUANTITIES	[1.1]	[1.1] [1.6] [3.4] [3.5]	[1.6]	[1.1] [1.6] [3.4] [3.5]	[1.1] [1.6] [3.4] [3.5] [5.5]	[1.1] [1.6] [3.4] [3.5]	[1.1] [3.4] [3.5]	[3.4] [3.5]			[1.1] [1.6] [3.4] [3.5]	[3.4] [3.5]				[5.5]	[1.6]	[1.6]

KEY TO MATRIX:

[1.1] SAND CASTING
[1.2] SHELL MOULDING
[1.3] GRAVITY DIE CASTING
[1.4] PRESSURE DIE CASTING
[1.5] CENTRIFUGAL CASTING
[1.6] INVESTMENT CASTING
[1.7] CERAMIC MOULD CASTING
[1.8] PLASTER MOULD CASTING

[2.1] INJECTION MOULDING
[2.2] COMPRESSION MOULDING
[2.3] VACUUM FORMING
[2.4] BLOW MOULDING
[2.5] ROTATIONAL MOULDING
[2.6] CONTACT MOULDING
[2.7] CONTINUOUS EXTRUSION (PLASTICS)

[3.1] CLOSED DIE FORGING/ UPSET FORGING
[3.2] COLD FORMING
[3.3] COLD HEADING
[3.4] SHEET METAL SHEARING
[3.5] SHEET METAL FORMING
[3.6] SPINNING
[3.7] POWDER METALLURGY
[3.8] CONTINUOUS EXTRUSION (METALS)

[4.A] AUTOMATIC MACHINING
[4.M] MANUAL MACHINING

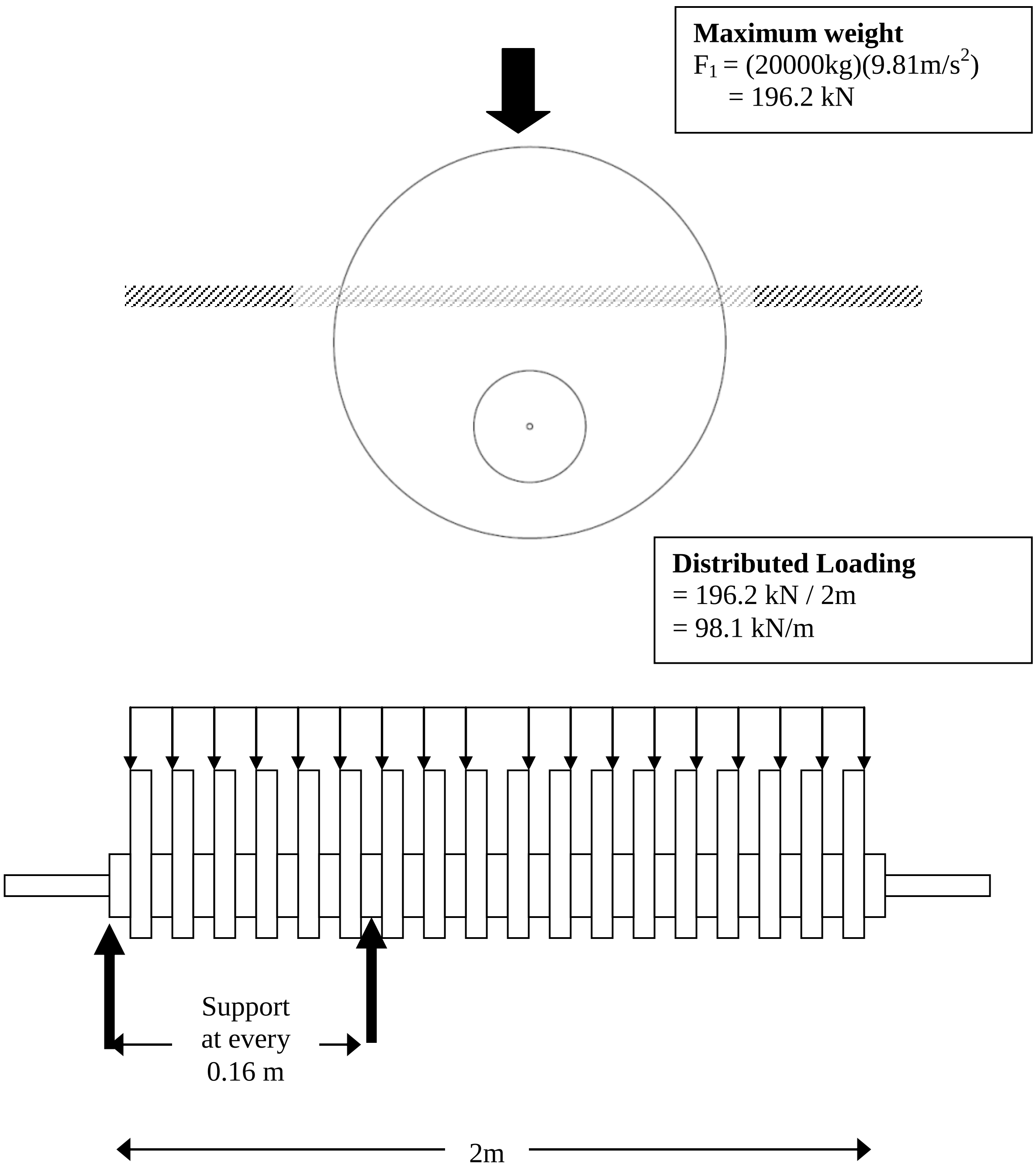
[5.1] ELECTRICAL DISCHARGE MACHINING
[5.2] ELECTROCHEMICAL MACHINING
[5.3] ELECTRON BEAM MACHINING
[5.4] LASER BEAM MACHINING
[5.5] CHEMICAL MACHINING
[5.6] ULTRASONIC MACHINING

Figure 17 PRIMA selection matrix (K.G Swift and J.D Booker, “Process Selection p.18.Arnold, London, 1997)

4.8 BENDING ANALYSIS

The speed breaker will be designed to hold up to 20 Tons of load.

Force which will acting on retractable speed breaker;



4.8.1 Shear and moment diagram

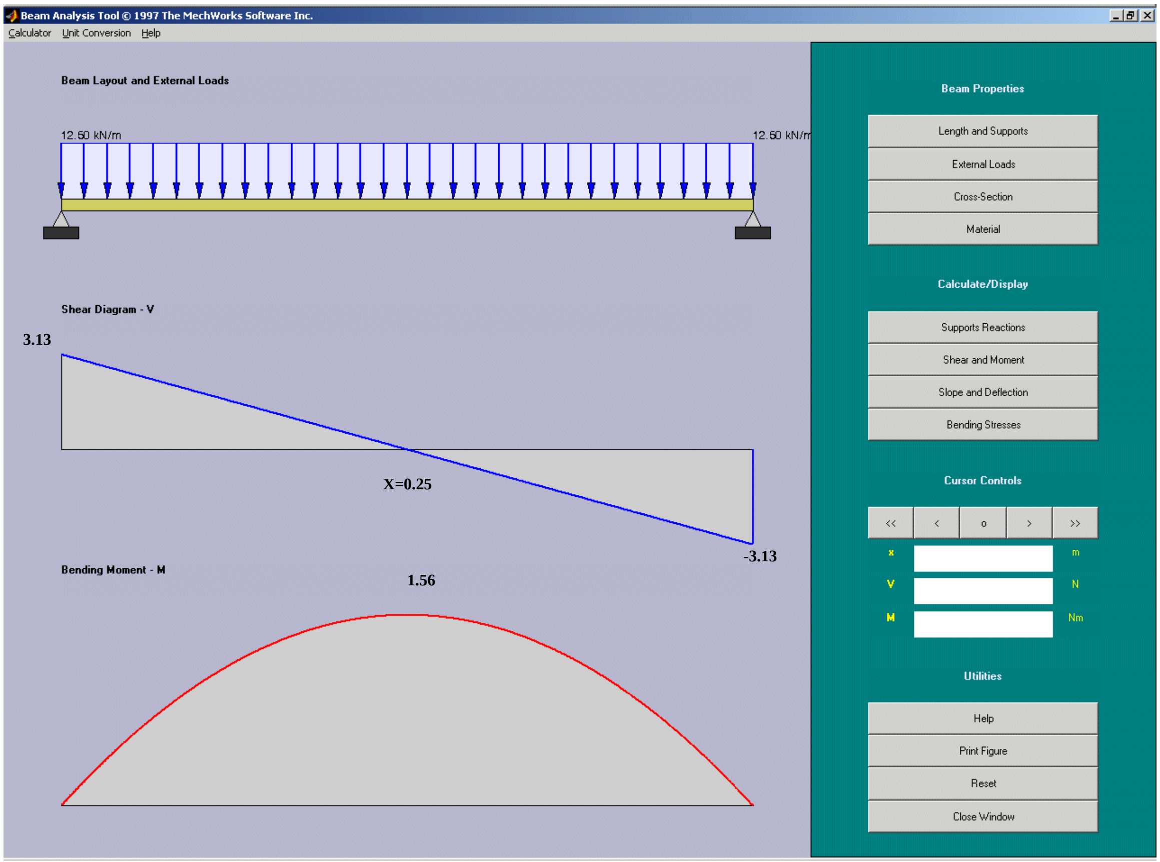


Figure 18: Reaction analysis using Matlab Simulation Tools

4.9 FABRICATION

4.9.1 Metal Forming Process

The process is being done at Hoe Hup Eng Engineering workshop & UTP laboratory.

Step 1 - Preparation and validation (marking up)

Marking out (also known as layout) is the process of transferring a design or pattern to a work piece and is the first step in the handcraft of metalworking. Marking out consists of transferring the engineer's plan to the work piece in preparation for the next step, cutting. There are engineering quote said that "*measure twice, cut once*" .The process involve marking up from the raw material.

Step 2 - Forming

The forming processes involve cutting and bending process. The cutting process is necessary for the top part of the disc of speed breaker and essential for removing unwanted part from the raw material.
The marked raw material then cut into predefined pieces.

After the cutting process finish, there are some parts of the project need to be bending, which is the disc supporter to give surface area for the vehicle.

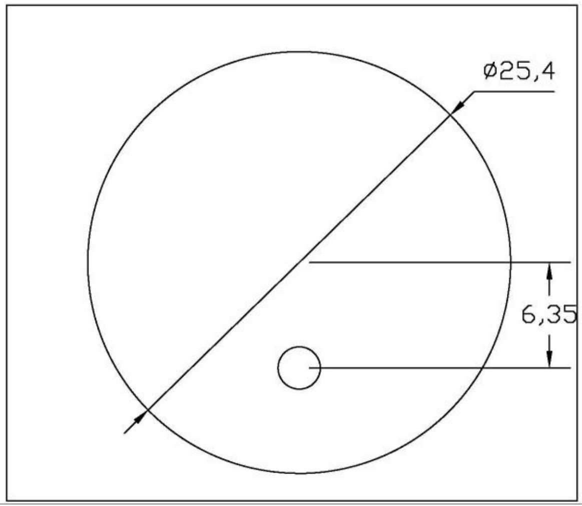


Figure 19 : Marking process for item 1

Item 1: A circle with diameter 254mm is marked out from a 2mm thick plate. Then another circle with 25.4mm is marked out with the centre 63.5mm from the first circle. The number of the circular plate made is depending on the road length. As for this case the authors only made 3 copies for cost saving. Then, using the round cutter, the first circle is cut off from the position. Then proceed to the 2nd circle which is drilled from the centre.

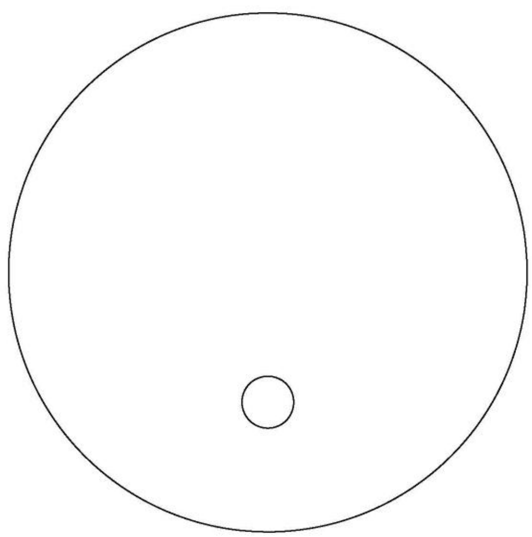


Figure 20 : Item 1 after cutting process

The product of item 1 before any welding is attempted. The jagged edge was smooth using the metal grinder.

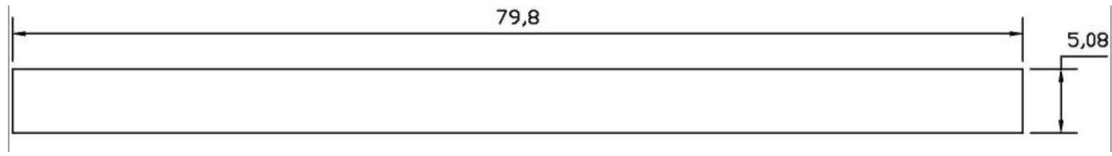


Figure 21 : Item 2 in marking and cutting process

Item 2: Item 2 were marked out 2mm thick inch with 50.8mm wide (2inch wide). Each Item 1 will have one set of this. Item 2 were cut from a long sheet of metal. The quantity of this item was depending on the first item. Then the first item was rolled using metal bender to form it into a circle.

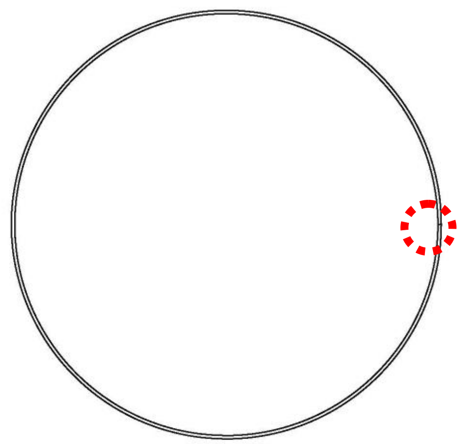


Figure 22 : Point where item 2 rolled and welded together

At the above figure it shows that the point of joint when the sheet is rolled.

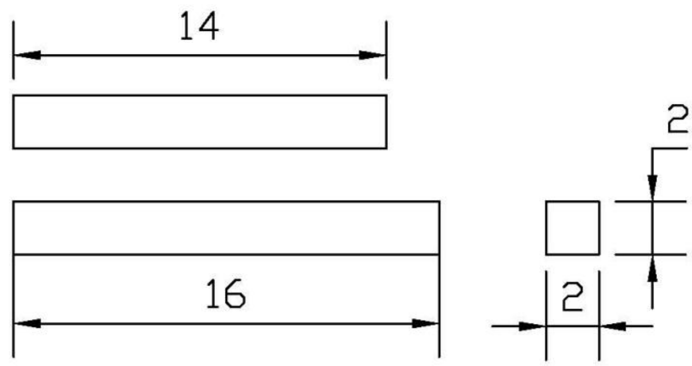


Figure 23 : Marking process for item 3 (frame)

Item 3: Item 3 is the frame of the cylindrical disc. It is made from a square hollow bar which is it cross section is 2mmx2mmm. The bar is cut in 2 lengths which is 14inch (4pieces) and 16inch (8 pieces).

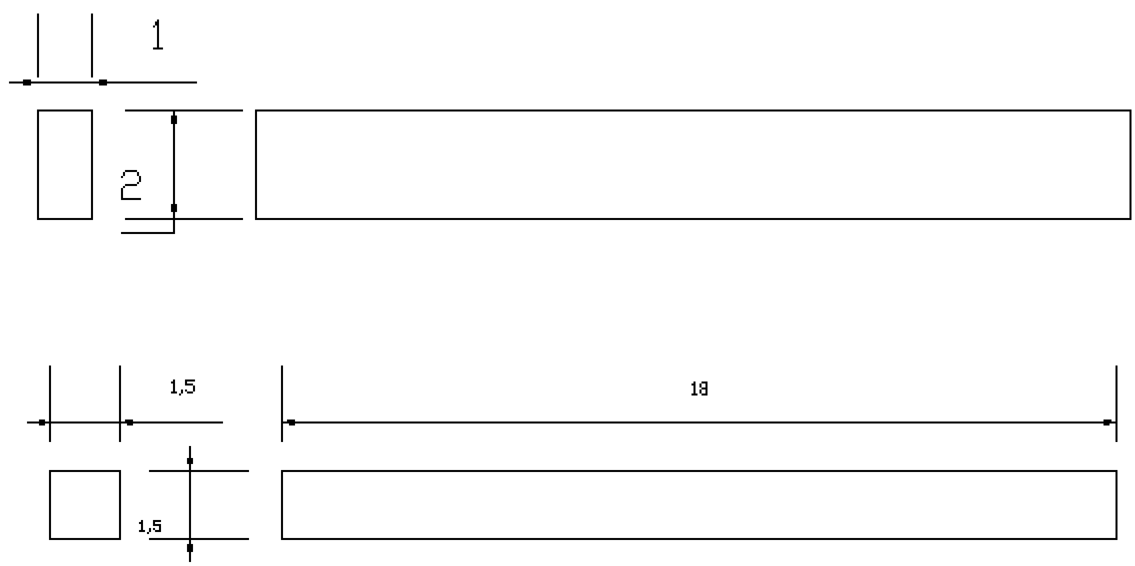


Figure 24 : Marking process for item 4

Item 4: Item 4 is the top part of the speed breaker. It is made from a square hollow bar which is it cross section is 38mmx38mm (1.5inchx1.5inch).The bar is cut to 457mm (18inch) (5pieces). The bar is supported with 2 supports bar which it cross section is 1inchx2inch and cut to 16inch (2pieces)

Step 3 - Fitting

After all parts are ready, the next stage is to fit all the parts and to see the complete structure before joining the parts together.

Step 4 - Tack weld

Before everything is welded together, the initial process of welding take place which is tack weld. This process is to ensure that the parts joined together will not move during the next stage which is welding process. Tack weld is done by only weld a small area just to make sure that the part will not move. If there are mistake during this process, it simply revert back to original condition by removing the single weld.

Step 5 - Welding

The welding process employ the used of arc welding as it is widely available and one of the easiest method of welding compare to the other type of welding. Beside it also provide lower cost compare with other type of welding.

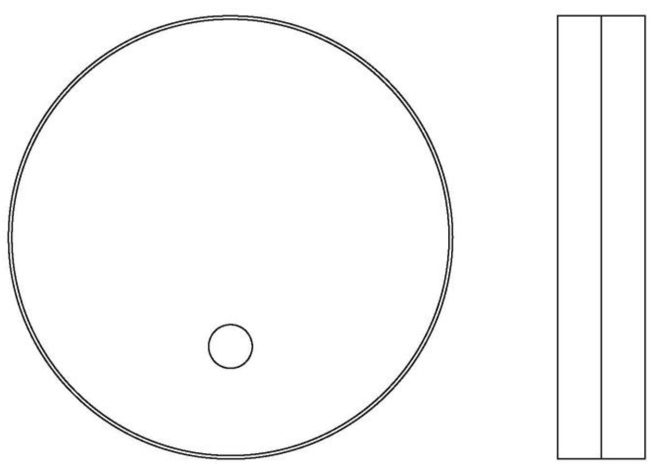


Figure 25: Item 1 and 2 fit together and welded

Item 1 and Item 2: Item 1 is put inside the inside the middle of item 2. The figure above shown the front and side view of the circular disc. Then both pieces were fit to see any space between both items. Then using the arc welding, small tack weld is made at each of circle side.

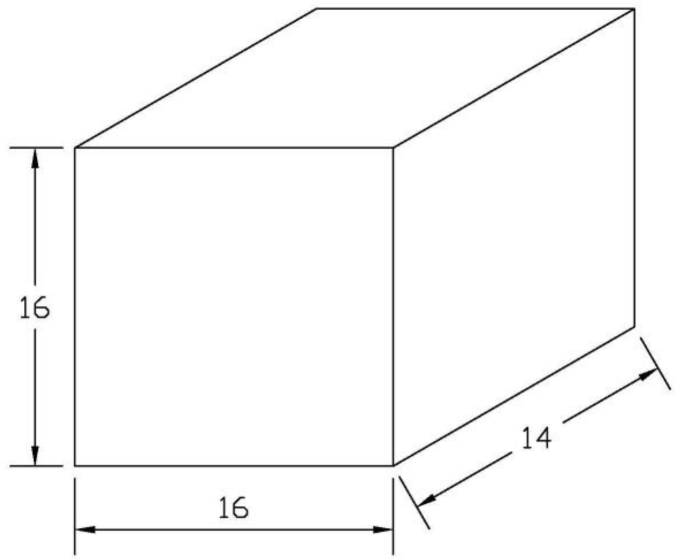


Figure 26: Item 3 where all the bars were connected and welded

For item 3, the bar is connected as figure above where the item then welded together to make the frame for the cylindrical disc.

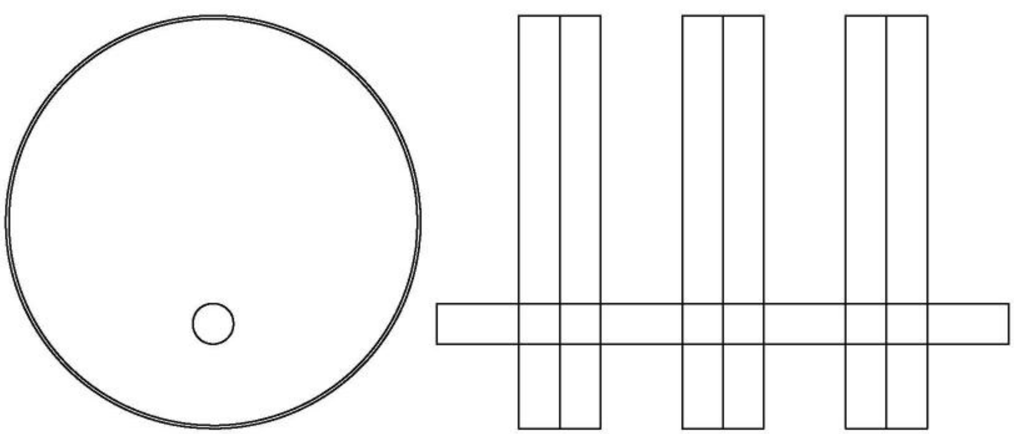


Figure 27: Shaft in position and welded

Then a rod with 25.4mm (1inch) diameter is inserted in the previous drilled hole. The space between each cylindrical disc is 50.8mm (2inch). Then the disc is welded together.

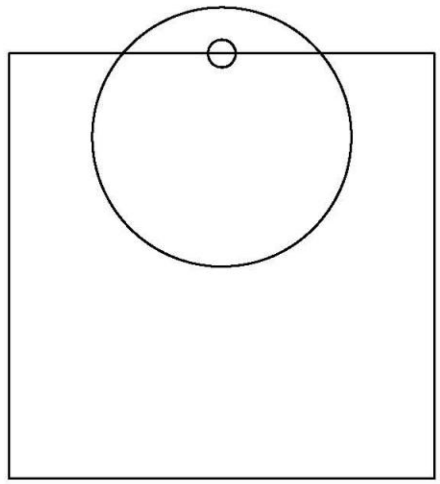


Figure 28: The location where the cylindrical disc and frame attach

Then the cylindrical disc is attached at the centre of the frame, where the cylindrical disc is attached via its 1 inch shaft. The shaft is attached by screw to the frame body.

Item 4: Item 4 is connected together to form the top surface of the speed breaker.

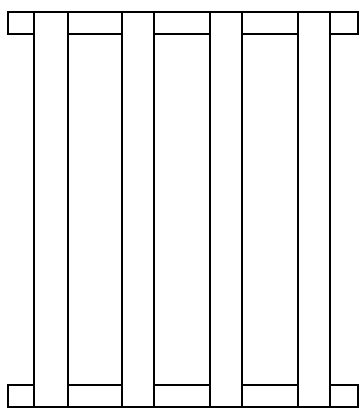


Figure 29: The top surface of speed breaker is connected

Step 6 - Finishing

Finishing process is a process where the excess slag were removed by induce small tap at the welding surface to remove the slag. Then, at certain point, the surfaces of the welding were grind to remove the welding surface to give smooth surface of the joint. The process of finishing is essential to give the model appropriate look.

Step 7 - Inspection

The inspection process is to look whether the joint and welding zone were smooth and near to perfect. Welding methods that involve the melting of metal at the site of the joint necessarily are prone to shrinkage as the heated metal cools. Shrinkage, in turn, can introduce residual stresses and both longitudinal and rotational distortion. Distortion can pose a major problem, since the model is not the desired shape. To alleviate rotational distortion, the work pieces can be offset, so that the welding results in a correctly shaped piece. Other methods of limiting distortion, such as clamping the work pieces in place, cause the build up of residual stress in the heat-affected zone of the base material. These stresses can reduce the strength of the base material, and can lead to catastrophic failure through cold cracking. Cold cracking is limited to steels, and is associated with the formation of martensite as the weld cools. The cracking occurs in the heat-affected zone of the base material. To reduce the amount of distortion and residual stresses, the amount of heat input should be limited, and the welding sequence used should not be from one end directly to the other, but rather in segments. The other type of cracking, hot cracking or solidification cracking, can occur with all metals, and happens in the fusion zone of a weld. To diminish the probability of this type of cracking, excess material restraint should be avoided, and a proper filler material should be utilized.

4.10 CONTROL MECHANISM

The timer will initiate the power of the motor. It is control by predefined time schedule using 24 hours clock control. User can managed the switch to on or off using the timer. The timer later will initiate the relay for both positive and negative source to the motor. The control of both relay were simultaneously to avoid electrical shock.

For open position where the motor will turn and bring the speed breaker to the open position can be determine in figure 30

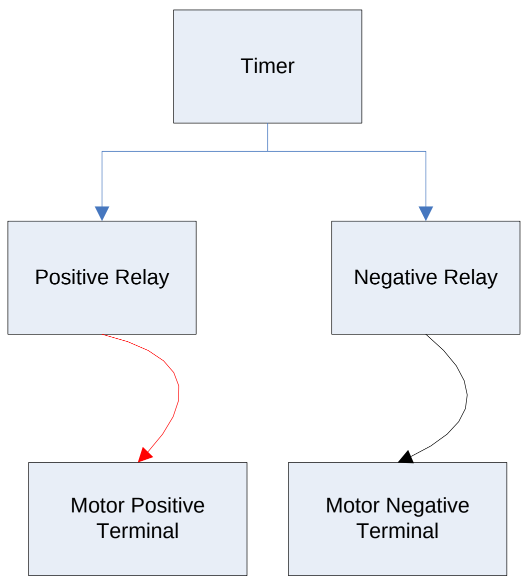


Figure 30: The time control for open position

For closed position where the motor will turn and bring the speed breaker to the down position can be determine in figure 31. In this process, the power will switch the positive and negative terminal to turn the motor backward.

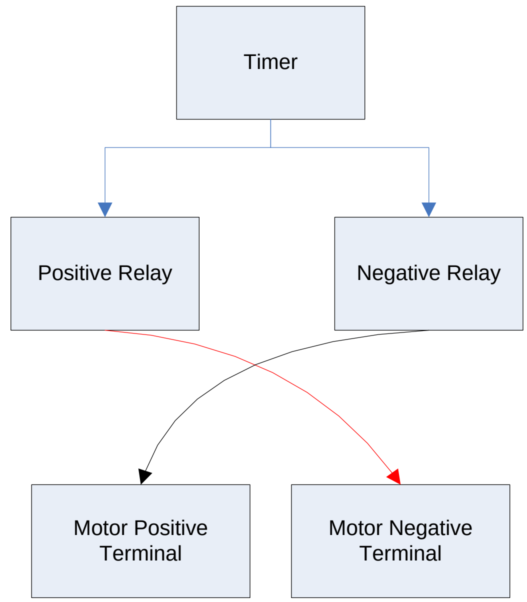


Figure 31: The time control for closed position

In order to stop the motor from keep spinning, the sensors will be added to positive power source to control the motor from keep spinning. The sensors will control the relay which will cut the circuit when the speed breakers in its position.

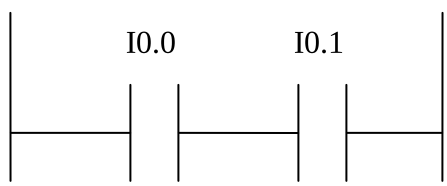


Figure 32: The PLC for the speed breaker

When the sensors sense the position of the speed breaker is right, it will initiate the locking mechanism and at the same time cut the power source. Thus, the speed breaker in its position. I0.0 is a sensor controller relay while I0.1 is a current control relay. Current control relay is important to make sure there is no excessive current flow in the system. This condition can happen when the motor still keep turning when there is vehicle moving while the retraction mechanism is in progress.

4.11 FINAL MODEL

4.11.1 Closed Position

Figure 33: Front View

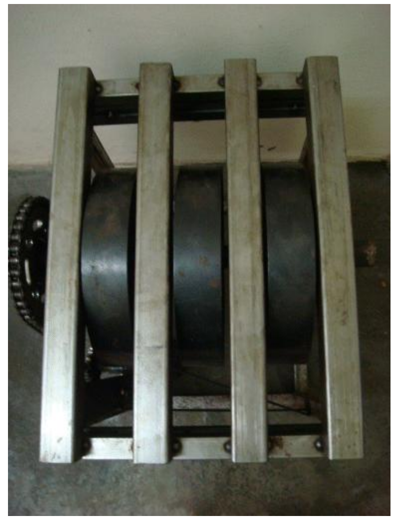


Figure 34: Top View

Figure 35: Chain Drive

4.11.2 Open Position

Figure 36 : Front View

Figure 37 : Side View

CHAPTER 5

CONCLUSION AND RECOMMENDATION

As a conclusion, this project would help local authority in resolving the disadvantage of the current design of the speed breakers. There also a few benefit for drivers and passengers besides reducing the energy losses due to the problem brought by the current design. The retractable speed breaker is of relatively easy to implement. The present invention provides an increasing level of deterrence to a speeding driver based on a particular vehicle's increased speed through a zone.Looking at the prospect of this project, it is hoped that these project will bring a new breakthrough in enhancing the way we reduces speed and traffic calming methods.

For further recommendation, the retractable speed breaker could be become more dynamic. Rather open and closed at predetermined time. It can be control by the multiple remote means from signals generated by traffic conditions. It also can be control through a series of programmable logic controllers, by way of analog or digital signals come from permanently mounted speed detecting device of prior art, such as radar, lasers; infra-red; electrical induction loops; electric eyes, or the like; vehicular mounted radar, laser, sonic; light emitting; radio frequency transmitters; or other existing state of the art signaling means.

CHAPTER 6

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http://en.wikipedia.org/wiki/Speed_breakers

http://en.wikipedia.org/wiki/Types_of_road

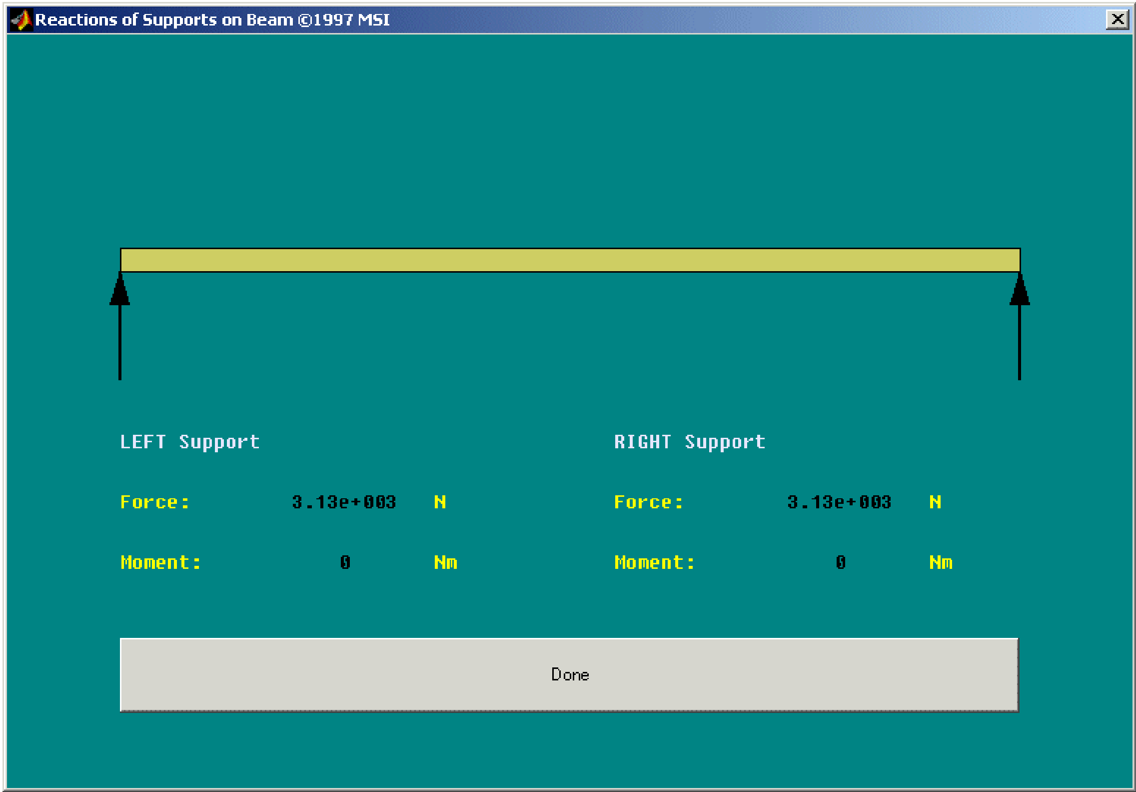
APPENDICES

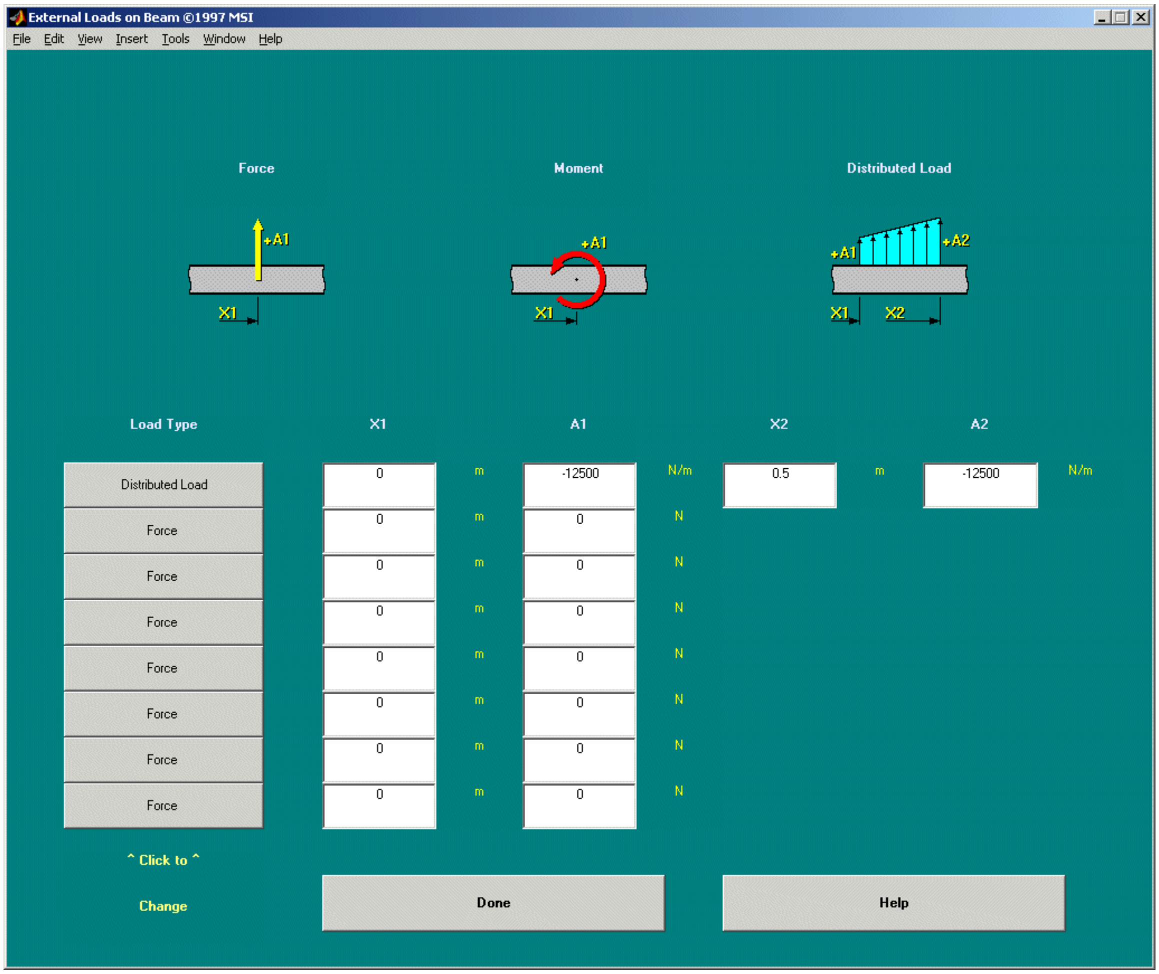
Project : Design of Retractable Speed Breakers

No	Work Details	WEEKS														
		1	2	3	4	5	6	7		8	9	10	11	12	13	14
1	Project Topic Selection								MID SEMESTER BREAK							
2	Preliminary Research Work															
3	Submission of Preliminary Report															
4	Idea Development (Design sketch)															
5	Submission of Progress Report															
6	Design Analysis.															
7	Drawing Production															
8	Submission of Interim Report															
	Oral Presentation															

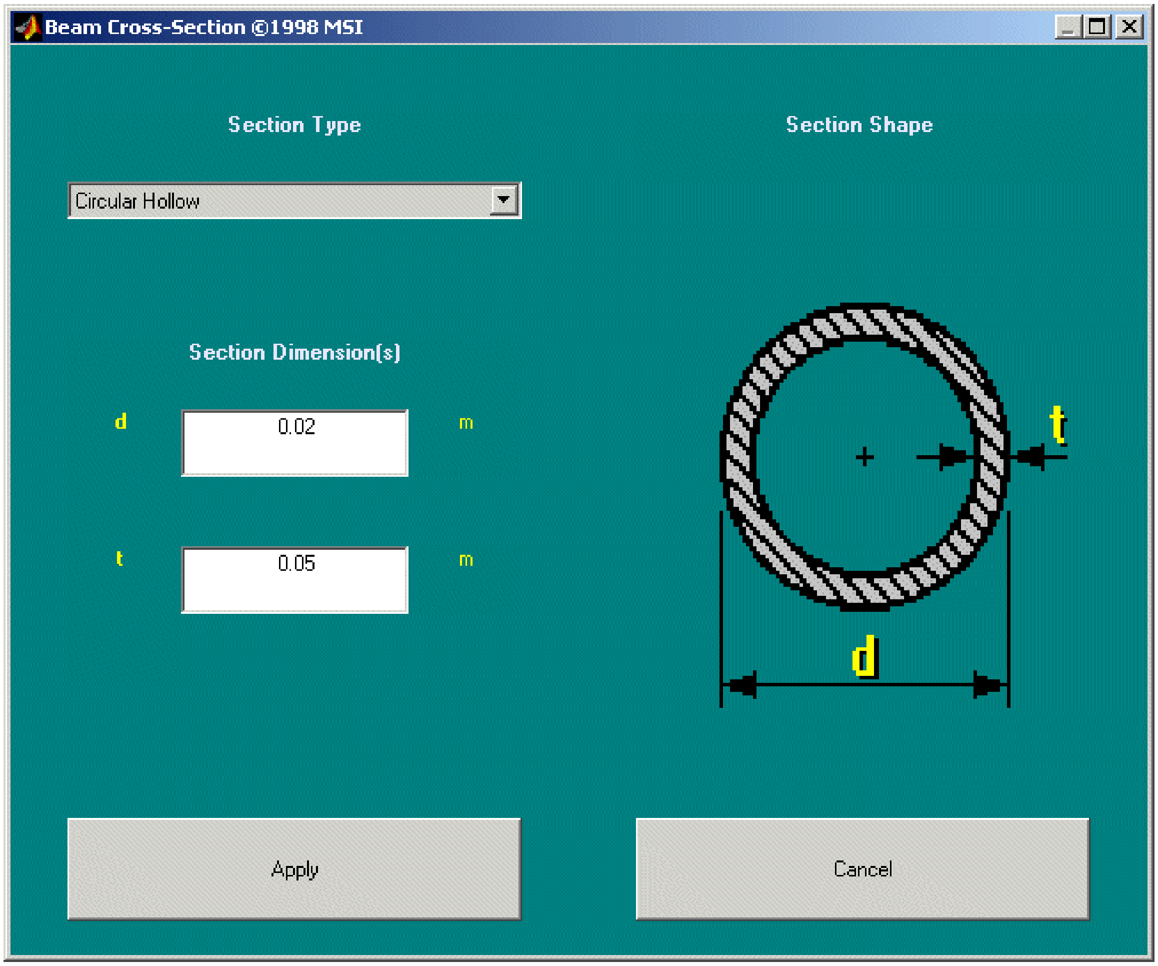
Appendices 1 :Final Year Project I Work Schedule

Appendices 2 : Matlab Simulation Tools




External Loads on Beam ©1997 MSI
File Edit View Insert Tools Window Help
Force
+A1
X1
Moment
+A1
X1
Distributed Load
+A1
+A2
X1
X2
Load Type
X1
A1
X2
A2
Distributed Load
0
m
-12500
N/m
0.5
m
-12500
N/m
Force
0
m
0
N
Force
0
m
0
N
Force
0
m
0
N
Force
0
m
0
N
Force
0
m
0
N
Force
0
m
0
N
Force
0
m
0
N
^ Click to ^
Change
Done
Help


Material Propeties © 1998 MSI
File Edit View Insert Tools Window Help
1. Select Material Group
Cast Iron Alloys
2. Select Material
Gray_ASTM20
Mass Density
7190
kg/m3
Young's Modulus
6.7e+010
Pa
Shear Modulus
2.7e+010
Pa
Yield Strength
0
Pa
Shear Strength
0
Pa
Ult. Tensile Strength
1.79e+008
Pa
Ult. Compressive Strength
6.69e+008
Pa
Ult. Shear Strength
0
Pa
Elongation
0.6
%
Poisson's Ratio
0.28
--
Thermal Expansion Coef.
1.2e-005
1/°C
Done
Cancel


Beam Cross-Section ©1998 MSI
Section Type
Section Shape
Circular Hollow
Section Dimension(s)
d
0.02
m
t
0.05
m
t
d
Apply
Cancel

Appendices 3 : Final Design Drawing