DESIGN AND FABRICATION OF ENVIROMENTAL NOISE REDUCTION DEVICE

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DESIGN AND FABRICATION OF ENVIROMENTAL NOISE REDUCTION DEVICE

QAMARUDDIN BIN MOHD FAUZI

A report submitted in partial fulfillment of the requirements for the award of the diploma of Diploma in Mechanical Engineering

Faculty of Mechanical Engineering
UNIVERSITI MALAYSIA PAHANG

JANUARY 2012

SUPERVISOR'S DECLARATION

We hereby declare that we have checked this project and in our opinion this project is satisfactory in term of scope and quality for the award of the diploma of Diploma of Mechanical Engineering.

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Position :
Date : 10 January 2012

AUTHOR'S DECLARATION

I hereby declare that the work in this thesis is my own except for quotations and summaries which have been duty acknowledged. The thesis had not been accepted for any diploma and it's not concurrently submitted for award of other diploma.

Signature :

Name : Qamaruddin Bin Mohd Fauzi

ID Number : MB09055

Date : 10 January 2012

To my beloved family

ACKNOWLEDGEMENT

First of all, I would like to thank ALLAH S.W.T. for the strength and all His guidance. With His blessing, I finally accomplished my project as schedule.

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ABSTRACT

This project is about designing and fabricating the environmental noise reduction device to help people while doing their work in gas turbine laboratory. This project involves the process of designing the device using the considering reduction rate and ergonomic factor for laboratory used. After the design has complete, it was transformed to its real product where the design is used for guideline. These project also require ensuring the safety for indeed of publishing. Method and process involve in this project for instance joining using bending, welding, drilling and cutting process. This project is mainly about generating a new concept of environmental noise reduction device that could minimize the noise around laboratory that helps to give convenience workplace to others. After all process had been done, this noise reduction device may help us to understand the fabrication and designing process that involve in this project. This product is tested with place it to Gas Turbine Machine at FKM laboratory. As the result, the sound rate is reducing into 73.5 dB which is reducing 35% before the product is placed. Through this testing show that product fulfills the objective to make an ergonomic product to human hearing.

ABSTRAK

Projek ini adalah mengenai merekabentuk dan membuat alat penyerap bunyi bagi memberi keadaan yang selesa semasa kita melakukan kerja-kerja di makmal terutamanya berkaitan mesin-mesin. Projek ini melibatkan proses mereka alat penyerap bunyi berdasarkan daya dan ergonomic bagi memudahkan penggunamenggunakannya di makmal. Selepas proses ini siap, alat penyerap bunyi tersebut dihasilkan berdasarkan reka bentuk yang telah dibuat. Projek ini juga melibatkan cirri-ciri keselamatan bagi memastikan ianya boleh dipasarkan. Kaedah dan proses yang terlibat dalam projek ini bagi penyambungan segera menggunakan proses melibat, menebuk, kimpalan dan memotong. Projek ini sebenarnya melibatkan proses menjana konsep baru dalam menghasilkan alat penyerap bunyi dan ianya mudah untuk dibawa kemana sahaja. Selepas semua projek ini siap, alat penyerap bunyi akan membantu kita tentang pemahaman proses mereka bentuk dan penghasilan yang terlibat dalam projek ini. Produk ini diuji pada Mesin turbin gas yang terletak di makmal FKM. Keputusan daripada ujian tersebut menunjukkan kadar bunyi dikurangkan kepada 73.5 dB iaitu pengurangan sebanyak 35% dari sebelum produk ini diletak pada mesin. Melalui ujian ini menunjukkan bahawa produk ini memenuhi matlamat projek untuk menghasilkan produk yang ergonomik untuk pendengaran manusia.

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CHAPTER 1

INTRODUCTION

The sole purpose of this project is to understand the fundamental knowledge of design and mechanism for noise reduction and a simple device mechanism.

In operating a machine, noise produce can disturb other people that also do their own work. A noise reduction device is basically one of important mechanism in every machine or system. It helps to reduce the noise hazard and give a convenient usage to operate. Thus helps create a better place to work in laboratory or work place. This environmental noise reduction device can actually be the future mode of existing noise reduction. It can be placed at the back of machine to not disturb the operation of machine.

Therefore, as a student of mechanical engineering of university Malaysia Pahang, this project interest and expose me the field of mechanism and design engineering. To design the mechanical part of noise reduction device and to fabricate the mechanical part of the device is step to learn mechanical engineering.

1.1 PROJECT SYNOPSIS

In this project, development of environmental noise reduction device so the noise produce from machine can be reduces by spare and reflects it. The design is environmental friendly and use simple mechanism properties. The design is done so that the knowledge of designing, mechanism and forces.

1.2 PROBLEM STATEMENT

Some operating machine will produce a noise hazard that obviously disturbs other at same laboratory. Some machine has their mechanism or system to reduce noise produced, but some machine can't have their own noise reduction because of some reason.

The noise reduction can come internally or externally to any machine. But before this, externally noise reduction is for a whole hall and not specific to machine itself such as anechoic chamber. This condition sometimes makes uncomfortable condition in laboratory for other people.

So this design is use to reduce noise produce from machine and try to redact and spare at maximum rate without disturb the operation of machine and surrounding.

1.3 OBJECTIVE OF PROJECT

i. To reduce noise produce from machine that can disturb people at surrounding.
ii. To design and fabricate a device that can spare and redact noise at maximum rate.

1.4 PROJECT SCOPE

i. To study the ability of noise reduction device for turbine machine at Mechanical Laboratory.
ii. To make a portable device that easy the user to place, carry and transfer.
iii. To make a device and system that can redact at maximum rate or noise by using selected material to redact noise produced.

1.5 PROJECT PLANNING

To start the project, a meeting with supervisor in the first week is done to manage the schedule of weekly meetings. The purpose is to inform the supervisor on the progress of the project and guided by the supervisor to solve difficulty.

Briefing based on the introduction and next task of the project is given by supervisor. Make research of literature review with the means of internet, books, available published articles and material that is related to the title.

Designing phase start of by sketching few model using manual sketch on A4 papers. Do it comparison for choose the best concept. Software application is downloaded from internet to design the model based on the sketches. Software Solid Work helps to draw the better dimension.

The preparation of mid-presentation of the project is next. Before presenting, the supervisor will see through the slide presentation and comment on corrections to be made. Then, presentation on the knowledge attained and instilled in the design phase is presented to a panel of three judges.

Following up, is the fabrication of make some method for this project. Choose the material, make some list for the material and dimension. Do it planning of fabrication process for this project.

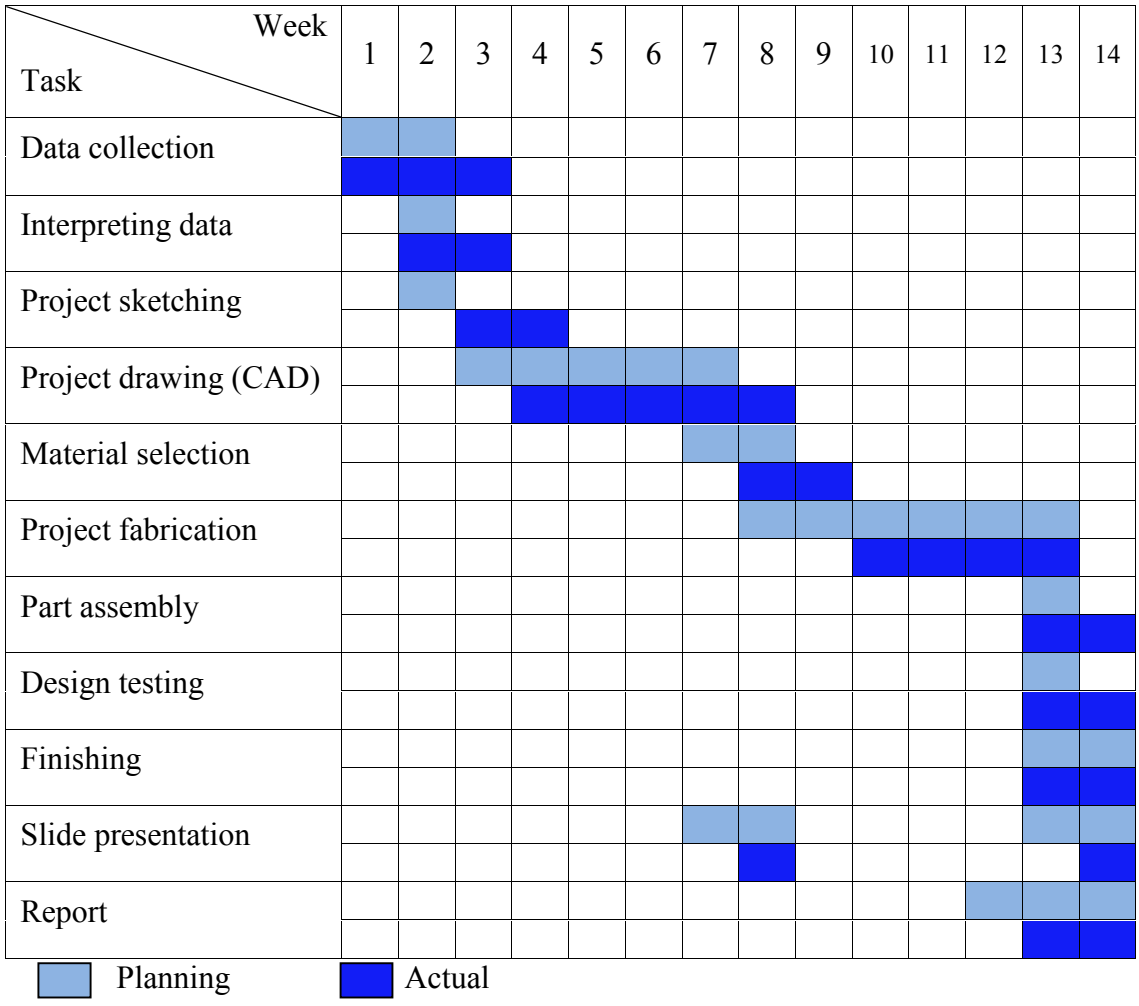
After that, start the fabrication process. It would take several weeks to get this design and fabrication process alternation done. Make some testing for the project. Do it correction for error this project. Finish the fabrication process with finishing process.

After that, the final report writing and final presentation will be the last task to be accomplished. The supervisor will review the final presentation and revise mistake to be amended. The final presentation then again be presented to three panels. A draft report would then be submitted to the supervisor to be point out the flaws. Corrections are done and the real final report is handed over as completion of the final year project.

1.6 GANTT CHART

Table 1.1 shows the Gantt chart of this project from the planned work and the actual work done.

Table 1.1: Gantt chart



CHAPTER 2

LITERATURE REVIEW

The title development of noise reduction device requires an amount of good understanding on the knowledge of the science. Therefore, executing a research is necessary to obtain all information available and related to the topic. The information of literature review obtained is essentially valuable to assist in the construction and specification of this final year project. With this ground established, the project can proceed with guidance and assertiveness in achieving the target mark.

2.1 TERMINOLOGY

Noise reduction is the process of removing noise from a signal. All recording device, both analogue and digital, have traits which make them susceptible to noise. Noise can be random or white noise with no coherence or coherent noise introduced by the device's mechanism or processing algorithms.

2.2 NOISE CONTROL

Noise control is an active or passive means of reducing sound emission, often incentivised by personal comfort, environmental considerations or legal compliance. Practical and efficient noise control is wholly reliant on an accurate diagnosis of what is causing the noise, which first involves finding the source of noise. Once the source of noise has been found, the focus is reducing the noise at source by engineering means.

The most common noise source can be divided into aerodynamic (fans, pneumatics, combustion) and mechanical (impact, friction). Effective noise control focuses on reducing the noise from this source as close to the source as possible. Noise control for aerodynamics sources includes quite air nozzles, pneumatics silencers and quiet fan technology. (Everest 1994)

Types of noise control, there are four basic principle of noise control;

i. Sound insulation is to prevent transmission of noise by the introduction of a mass barrier. Common materials have high-density properties such as brick, thick glass, concrete and metal.
ii. Sound absorption is a porous material which acts as a ‘noise sponge’ by converting the sound energy into heat within the materials includes decoupled lead-based tiles, open cell foams and fibreglass.
iii. Vibration damping is applicable for large vibrating surfaces. The damping mechanism works by extracting the vibration energy from the thin sheet and dissipating it as heat. A common material is sound deadened steel.
iv. Vibration isolation is preventing transmission of vibration energy from a source to a receiver by introducing a flexible element or a physical break. Common vibration isolators are springs, rubber mounts and cork.

2.3 SOUNDPROOFING

Soundproofing is any means of reducing the sound pressure with respect to a specified sound source and receptor. There are several basic approaches to reducing sound;

i. Increasing the distance between source and receiver.
ii. Using barrier to reflect or absorb the energy of sound waves.
iii. Using damping structures such as sound baffles.
iv. Using active anti-noise sound generators.

Two distinct soundproofing problems may need to be considered when designing acoustic treatments;

i. To improve the sound within a room
ii. Reduce sound leakage to/from adjacent rooms or outdoors.

Acoustic quieting, noise, mitigation, and noise control can be used to limit unwanted noise. Soundproofing can suppress unwanted indirect sound waves such as reflections that cause echoes and resonances that cause reverberation. Soundproofing can reduce the transmission of unwanted direct sound waves from the source to an involuntary listener through the use of distance and intervening objects in the sound path. (Bell 1973)

The energy density of sound waves decreases as they spread out, so that increasing the distance between the receiver and source results in a progressively lesser intensity of sound at the receiver. In a normal three dimensional setting, with a point source and point receptor, the intensity of sound waves will be attenuated according to the inverse square of the distance from the source. (Bell 1973)

Damping means to reduce resonance in the room, by absorption or redirection (reflection or diffusion). Absorption will reduce the overall sound level, whereas redirection makes unwanted sound harmless or even beneficial by reducing coherence. Damping can reduce the acoustic in the air, or mechanical resonance in the structure of the room itself or things in the room. (Bell 1973)

Absorbing sound spontaneously converts part of the sound energy to a very small amount of heat in the intervening object (the absorbing material), rather than sound being transmitted or reflected. There are several ways in which a material can absorb sound. The choice of sound absorbing material will be determined by the frequency distribution of noise to be absorbed and the acoustic absorption profile required. (Bell 1973)

Porous absorbers, typically open cell rubber foams or melamine sponges, absorb noise by friction within the cell structure. Porous open cell foams are highly effective noise absorbers across a broad range of medium-high frequencies. Performance is less impressive at low frequencies. (Bell 1973)

The exact absorption profile of porous open cell foam will be determined by a number of factors including the following:

i. Cell size
ii. Torosity
iii. Porosity
iv. Material thickness
v. Material density

Resonant panels, Helmholtz resonators and other resonant absorbers work by damping a sound wave as they reflect it. Unlike porous absorbers, resonant absorbers are most effective at low-medium frequencies and the absorption of resonant absorbers is always matched to a narrow frequency range. In an outdoor environment such as highway engineering, embankments or panelling are often used to reflect sound upwards into the sky. If a specular reflection from a hard flat surface is giving a problematic echo then an acoustic diffuser may be applied to the surface. It will scatter sound in all directions. (Bell 1982)

A room within a room (RWAR) is one method of isolating sound and stopping it from transmitting to the outside world where it may be undesirable. Most vibration / sound transfer from a room to the outside occurs through mechanical means. The vibration passes directly through the brick, woodwork and other solid structural elements. When it meets with an element such as a wall, ceiling, floor or window, which acts as a sounding board, the vibration is amplified and heard in the second space. A mechanical transmission is much faster, more efficient and may be more readily amplified than an airborne transmission of the same initial strength. (Bell 1982)

The use of acoustic foam and other absorbent means is less effective against this transmitted vibration. The user is advised to break the connection between the room that contains the noise source and the outside world. This is called acoustic de-coupling. Ideal de-coupling involves eliminating vibration transfer in both solid materials and in the air, so air-flow into the room is often controlled. This has safety implications, for example proper ventilation must be assured and gas heaters cannot be used inside de-coupled space. (Bell 1982)

Since the early 1970s, it has become common practice in the United States and other industrialized countries to engineer barriers along major highways to protect adjacent residents from intruding roadway. The technology exists to predict accurately the optimum geometry for the noise barrier design. Noise barriers may be constructed of wood, masonry, earth or a combination thereof. One of the earliest noise barrier designs was in Arlington, Virginia adjacent to Interstate, stemming from interests expressed by the Arlington Coalition on Transportation. Possibly the earliest scientifically designed and published noise barrier construction was in Los Altos, California in 1970. (Bell 1982)

Figure 2.1 and Figure 2.2 show the example of Soundproofing board that commonly used.

Figure 2.1: The acoustic damping tiles used for noise absorption

Source: Bell 1982

Figure 2.2: Sound reflection board.

Source: Bell 1982

2.4 ANECHOIC CHAMBER

An anechoic chamber (an-echoic meaning non-echoing or echo-free) is a room designed to stop reflections of either sound or electromagnetic waves. They are also insulated from exterior sources of noise. The combination of both aspects means they simulate a quiet open-space of infinite dimension, which is useful when exterior influences would otherwise give false results. (Jensen etc. 1984)

Anechoic chambers were originally used in the context of acoustics (sound waves) to minimize the reflections of a room. More recently, rooms designed to reduce reflection and external noise in radio frequency has been used to test antennas, radars, or electromagnetic. (Jensen etc. 1984)

Anechoic chambers range from small compartments the size of household microwave ovens to ones as large as aircraft hangars. The size of the chamber depends on the size of the objects to be tested and the frequency range of the signals used, although scale models can sometimes be used by testing at shorter wavelengths. (Jensen etc. 1984)

Anechoic chambers are commonly used in acoustics to conduct experiments in nominally "free field" conditions. All sound energy will be travelling away from the source with almost none reflected back. Common anechoic chamber experiments include measuring the transfer of a loudspeaker or the directivity of noise radiation from industrial machinery. In general, the interior of an anechoic chamber is very quiet, with typical noise levels in the 10–20 dBA range. According to Guinness World Records, 2005, Orfield Laboratory's NIST certified Eckel Industries-designed anechoic chamber is "The quietest place on earth" measured at −9.4 dBA. The human ear can typically detect sounds above 0 dBA, so a human in such a chamber would perceive the surroundings as devoid of sound. The University of Salford has a number of anechoic chambers, of which one is unofficially the quietest in the world with a measurement of −12.4 dBA. (Jensen etc. 1984)

Full anechoic chambers aim to absorb energy in all directions. Semi-anechoic chambers have a solid floor that acts as a work surface for supporting heavy items, such as cars, washing machines, or industrial machinery, rather than the mesh floor grille over absorbent tiles found in full anechoic chambers. This floor is damped and floating on absorbent buffers to isolate it from outside vibration or electromagnetic signals. A recording studio may utilize a semi-anechoic chamber to produce high-quality music free of outside noise and unwanted echoes. (Spon 1991)

The internal appearance of the radio frequency (RF) anechoic chamber is sometimes similar to that of an acoustic anechoic chamber; however, the interior surfaces of the RF anechoic chamber are covered with radiation absorbent material (RAM) instead of acoustically absorbent material. The RF anechoic chamber is typically used to house the equipment for performing measurements of antenna radiation patterns, electromagnetic compatibility (EMC) and section measurements. Testing can be conducted on full-scale objects, including aircraft, or on scale models where the wavelength of the measuring radiation is scaled in direct proportion to the target size. Coincidentally, many RF anechoic chambers which use pyramidal RAM also exhibit some of the properties of an acoustic anechoic chamber, such as attenuation of sound and shielding from outside noise. (Spon 1991)

Figure 2.3 show the example of anechoic chamber as example of Soundproofing system.

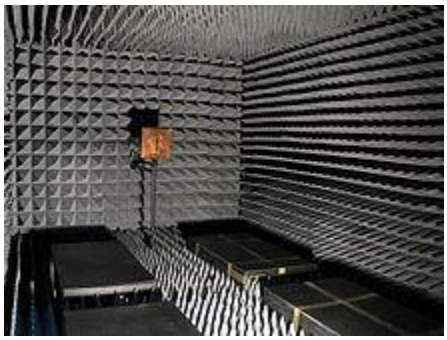


Figure 2.3: An RF anechoic chamber

Source: Spon 1991

2.5 RADIATION ABSORBENT MATERIAL

The RAM is designed and shaped to absorb incident RF radiation (also known as non-ionising radiation), as effectively as possible, from as many incident directions as possible. The more effective the RAM is the less will be the level of reflected RF radiation. Many measurements in electromagnetic compatibility (EMC) and antenna radiation patterns require that spurious signals arising from the test setup, including reflections, are negligible to avoid the risk of causing measurement and ambiguities. (Probst 1995)

One of the most effective types of RAM comprises arrays of pyramid shaped pieces, each of which is constructed from a suitably lossy material. To work effectively, all internal surfaces of the anechoic chamber must be entirely covered with RAM. (Probst 1995)

Sections of RAM may be temporarily removed to install equipment but they must be replaced before performing any tests. To be sufficiently lossy, RAM can neither be a good electrical conductor nor a good electrical insulator as neither type actually absorbs any power. Typically pyramidal RAM will comprise a rubberized foam material impregnated with controlled mixtures of carbon and iron. The length from base to tip of the pyramid structure is chosen based on the lowest expected frequency and the amount of absorption required. For low frequency damping, this distance is often 24 inches, while high frequency panels are as short as 3–4 inches. (Probst 1995)

Panels of RAM are installed with the tips pointing inward to the chamber. Pyramidal RAM attenuates signal by two effects: scattering and absorption. Scattering can occur both coherently, when reflected waves are in-phase but directed away from the receiver, and incoherently where waves are picked up by the receiver but are out of phase and thus have lower signal strength. This incoherent scattering also occurs within the foam structure, with the suspended carbon particles promoting destructive interference. Internal scattering can result in as much as 10 dB of attenuation. Meanwhile, the pyramid shapes are cut at angles that maximize the number of bounces a wave makes within the structure. With each bounce, the wave loses energy to the foam material and thus exits with lower signal strength.

An alternative type of RAM comprises flat plates of ferrite material, in the form of flat tiles fixed to all interior surfaces of the chamber. This type has a smaller effective frequency range than the pyramidal RAM and is designed to be fixed to good conductive surfaces. It is generally easier to fit and more durable than the pyramidal type RAM but is less effective at higher frequencies. Its performance might however be quite adequate if tests are limited to lower frequencies (ferrite plates have a damping curve that makes them most effective between 30–1000 MHz). (Probst 1995)

There is also a hybrid type, a ferrite in pyramidal shape. Containing the advantages of both technologies the frequency range can be maximized while the pyramid remains small (10 cm). (Probst 1995)

Figure 2.4 show the example of RAM that is the soundest redactor.

Figure 2.4: Close-up pyramidal RAM

Source: Probst 1995

2.6 MUFFLER

A muffler (or silencer in British English) is a device for reducing the amount of noise emitted by the exhaust of an internal combustion engine. A US Patent for an *Exhaust muffler for engines* was granted to Milton and Marshall Reeves in 1897.

Mufflers are installed within the exhaust system of most internal combustion engines, although the muffler is not designed to serve any primary exhaust function. The muffler is engineered as an acoustic soundproofing device designed to reduce the loudness of the sound pressure created by the engine by way of Acoustic quieting. The majority of the sound pressure produced by the engine is emanated out of the vehicle using the same piping used by the silent exhaust gases absorbed by a series of passages and chambers lined with roving fibre glass insulation and/or resonating chambers harmonically tuned to cause destructive wherein opposite sound waves cancel each other out. An unavoidable side effect of muffler use is an increase of back which decreases engine efficiency. This is because the engine exhaust must share the same complex exit pathway built inside the muffler as the sound pressure that the muffler is designed to mitigate. (Probst 1995)

Some vehicle owners remove or install an aftermarket muffler when Engine in order to increase power output or reduce fuel consumption because of economic or environmental concerns, recreational pursuits such as motorsport and hyper milling and/or for personal aesthetics preferences. Although the legality of altering a motor vehicles OEM exhaust system varies by jurisdiction, in most developed parts of the world, modification of a vehicles exhaust system is usually highly regulated if not strictly prohibited. (Probst 1995)

With cars, length wise underneath blows backwards at the rear. To the sides before the rear wheel.

With large diesel-powered trucks:-

i. Mounted vertically behind the cab
ii. Crosswise under the front of the cab, blowing sideways.

With motorcycles:

i. Usually, beside the engine and rear wheel blowing backwards.
ii. In more modern motorcycles, under the seat blowing backwards from under the back of the seat. (Under-slung)
iii. Under-engine exhausts first reached popularity with Buell motorcycles, though by 2008 most manufacturers began using the under-engine design as well.

Motorcycle enthusiasts sometimes use the term "raygun," "drag pipes", "pea-shooter" or "hotdog-style" for the old shape of motorcycle exhaust silencer/muffler with a long straight cylindrical barrel that merged roundedly at each end into the pipe, as in this image and this image. (Probst 1995)

Figure 2.5 show the exhaust for automotive usage.

Figure 2.5: Dual tailpipes attached to the muffler on a passenger car

Source: Probst 1995

CHAPTER 3

METHODOLOGY

In designing and fabricating this noise reduction device, a flow of methods had to be used. First of all, a process planning had to be charted out. This acts as a guidance to be followed so that, the final model meets the requirement and time could be managed. This would determine the efficiency of the project to be done. Regulating and analyzing these steps are very important as each of it has its own criteria to be followed.

3.1 FLOW CHART

Figure 3.1 show the flow chart of the project for the guidance of this project work.

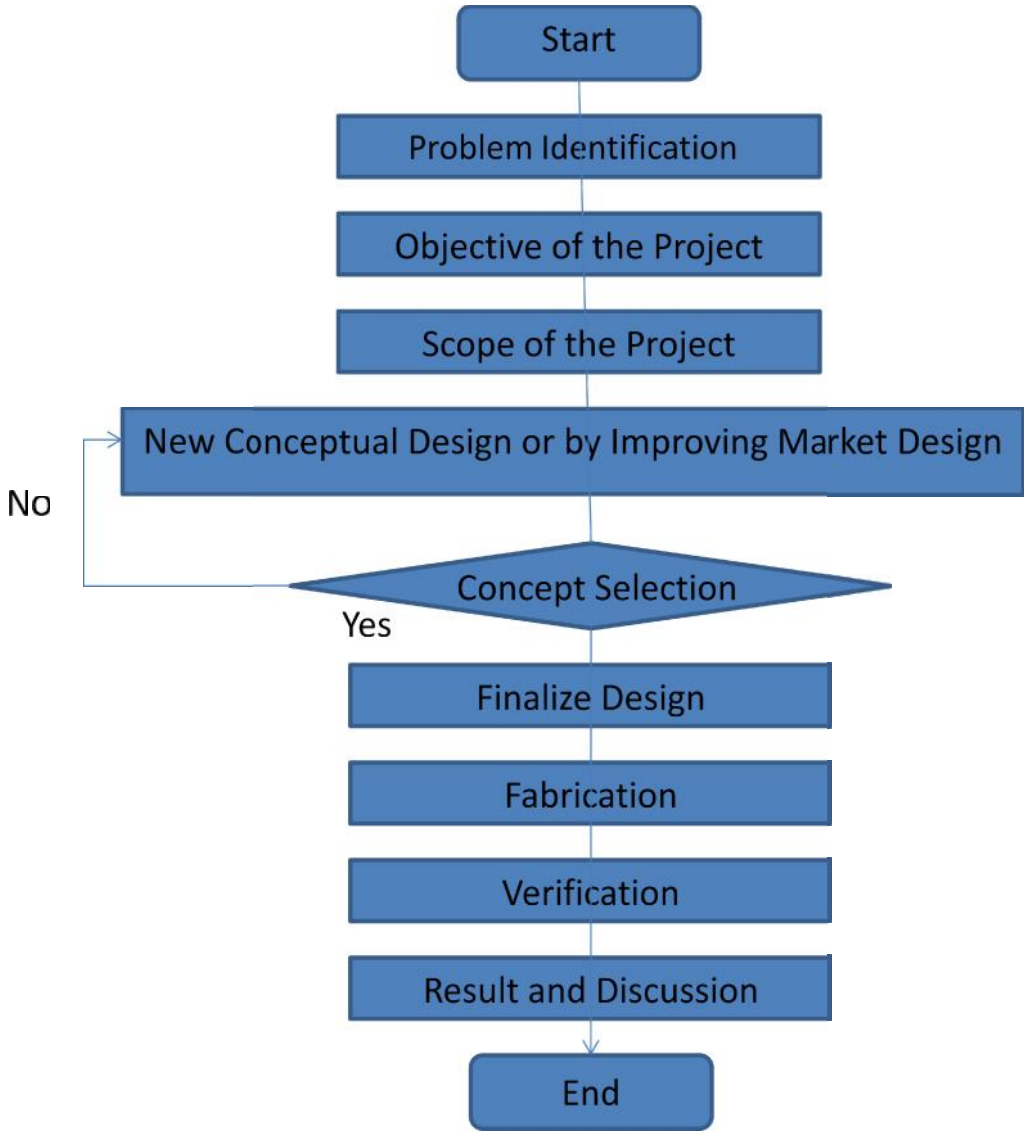


Figure 3.1: Flow chart diagram

The flow chart starts with the introduction. Here, the introduction is first plan to start the project. The supervisor request for understanding of the project and make some research about the project title. The introduction included problem identification, project objective, and scope of work, project synopsis and project planning.

Once the introduction is done, the supervisor request for the understanding of the project. Thus, literature review on the title is done thoroughly covering all the aspect of the project. The medium for this research are via internet and books. Essential information related to the project is gathered for referencing.

In conceptualization, few designs are done using the sketching which is the saved to be reviewed. Sketch three concepts suitable for the project with a 3-dimensional and understanding. The sketching is first step for designer used of the time.

The designs and concepts are then reviewed and recalculated to fit the best dimensions and performance of noise reduction device. After three design sketched, design consideration have been made and one design have been chosen.

The selected design sketched is then transfer to solid modelling and drawing using solid work application. Software is used because it gives a better dimension of noise reduction device compared to manual draw and is much easier to use. However, the drawing using software is just a guideline to be followed to improve the noise reduction device.

After the draw is done, the project proceeds to next step that is fabrication process. The finished drawing and sketching is used as a reference by following the measurement and the type of material needed. The fabrication process that involved is cutting, welding, drilling, bending and other. After every process was finish, the part is check to make sure that the output of the process obeys the product requirement.

If all the parts had been processed, the parts are joined together to produce full-scale noise reduction device. Here comes the testing process. The noise reduction device will be test to see if it fulfils the requirement such as portable device; can be place at the back of turbine machine and the reduction rate. During the testing, if problem occur such as can't move the device, the noise reduction device will step back to previous process to fix back the problem. The noise reduction device is expected to have an error that may cause the part to be redesign again. The noise reduction device is finished by doing some finishing process such as grinding and spraying.

After all parts had been joined together and tested, the last phase of that process that is result and discussion. In result and discussion, the draft report and the entire related article are gathered and hand over to the supervisor for error checking.

For the conclusion, the finish product will be compare with the report to make sure that there is no mistake on both project and report.

After the product and report had been approve by the supervisor, the report is rearrange and print out to submit at supervisor, the project coordinator and faculty of Mechanical Engineering. In this stage, final presentation wal also finished to present the result of project.

3.2 DRAWING

The drawings are diving into two categories, which are;

i. Sketching: all the ideas for noise reduction device fabrication are sketched on the paper to ensure that ideas selection can be made after the selected design choose.
ii. Solid Work Application: the design or concept sketched is transfer to solid modelling and drawing using Solid Work Application.

3.3 SKETCHING AND DRAWING SELECTION

From the existing ideas, only three sketching that had been chosen to be considered as the final ideas, which are:

3.3.1 Concept 1

This concept is using the half ‘V’ shape to hold the sponge. The sponge holder directly connected to stand that is simply built. The design of half V shape is good but the stand can not able to put a wheel. Figure 3.2 show the concept 1 sketch drawing.

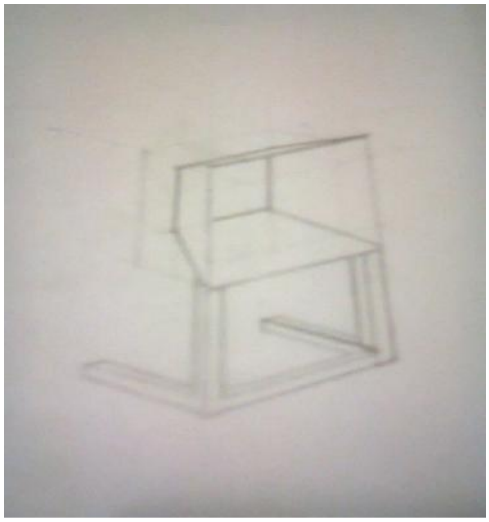


Figure 3.2: Concept 1

3.3.2 Concept 2

This concept is use the straight ‘U’ shape to hold the sponge. It has been connected to stand with four leg and wheels. It just change the holder and leg stand from concept 1. Design of sponge holder is too simple and the stand base is is too big for this product. Figure 3.3 show the sketch drawing for concept 2.

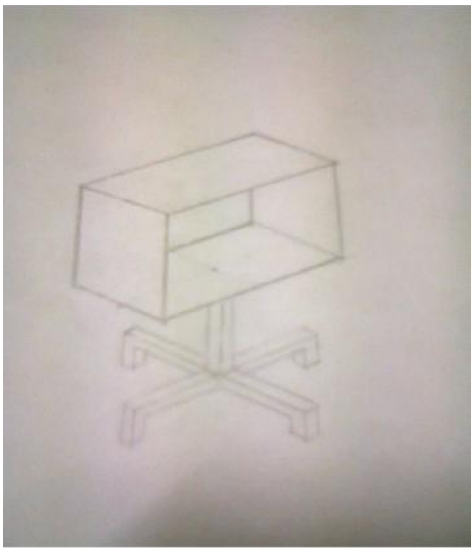


Figure 3.3: Concept 2

3.3.3 Concept 3

This concept is the same leg stand like concept but has only three legs. But for sponge holder, it has two sides at front and back. It has two wings that will hang the sponge. This concept is use the systems of muffler where reflection of sound will reduce the noise distribute out from gas turbine machine. Figure 3.4 illustrate the concept 3 sketching.

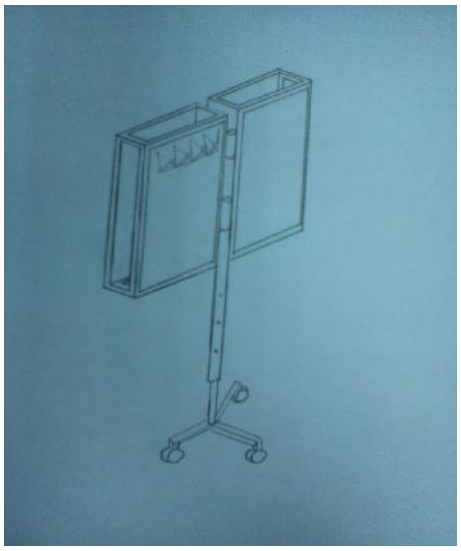


Figure 3.4: Concept 3

3.4 CONCEPT GENERATION AND EVALUATION

Three concepts for noise reduction device were developing. These are evaluated against the datum of standard noise reduction device show in Table 3.1.

Table 3.1: Matrix chart

Criteria	Concept 1	Concept 2	Concept 3	Best concept
Easy to carried	****	***	***	1
Adjustable	**	**	****	3
Rotate	*	****	****	2,3
Can be fold	**	**	****	3
Presence of wheel	*	*****	*****	2,3
Presence of air gap	**	**	*****	3
Has a wing shape	*****	**	***	1
Easy to hang sponge.	***	**	*****	3

* =very bad

** =bad

*** =medium

**** =good

***** =very good

From the concept of selection table, the advantages and disadvantages of the design can be outlined. Criteria or characteristic for the project to be fabrication are important thing to be consider, before the fabrication process. Eight criteria are been chosen to be considered. According to the table, study of concept selection shows that Concept 3 scores the highest value. As we can see on the figure in concept 3, the sponge can hang easily at the plate holder.

3.5 COMPUTER AIDED DESIGN DRAWING

After a design has been selected, the next step in designing process is dimensioning. The design is separated into part by part and the dimensioning process is firstly sketched on the paper. The dimensioning is base on relevant dimensions and also referring the existence noise reduction so that the design is fit into other part.

After dimensioning, the drawing of the design is drawn using Solid Work application; at this stage solid modelling method is used. Part by part solid modelling create according to the dimension done before, after all part create, the 3D model is assemble with each other base on the design.

Figure 3.5 is the 3D model for my product and figure 3.6 is the orthographic drawing for my product.

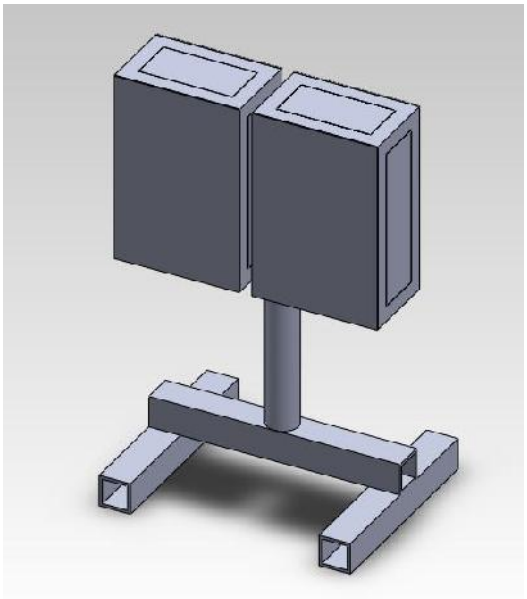


Figure 3.5: Overall view of the design

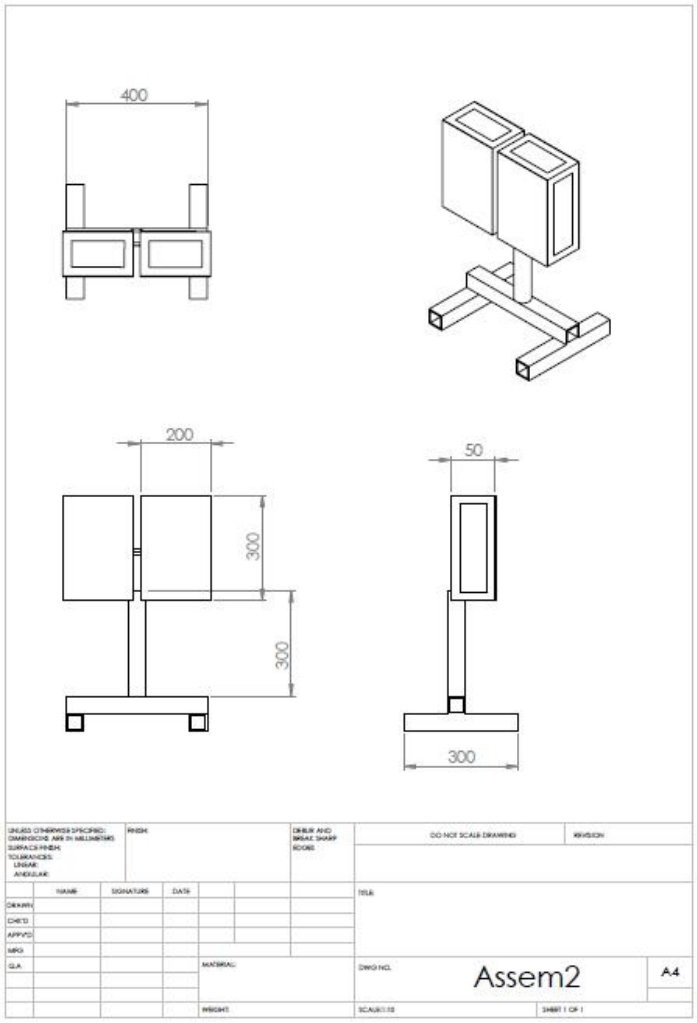


Figure 3.6: Overall Orthographic Drawing for selected concept.

3.6 DESIGN SPECIFICATION

The concept 3 is the best design that can be evaluated. The table 3.2 is the detail product design specification of concept 3.

Table 3.2: Design Specification

PARTS	MATERIAL	TYPE	SIZE (mm)	QUANTITY
1	Mild Steel	L-shape Rod	300×50×50	2
2	Mild Steel	Square Hollow	400×50×50	1
3	Mild Steel	Steel Rod	400×Ø50	1
4	Mild Steel	Steel Rod	700×Ø40	1
5	Mild Steel & Rubber	Wheel	-	4
6	Mild Steel	Bolt & Nut	Ø8	16
7	Mild Steel	Engsel	-	4
8	Aluminium	Sheet Metal	300×200×1	4
9	Aluminium	Sheet Metal	300×75×1	4
10	Aluminium	Sheet Metal	200×75×1	4
11	Sponge		300×200×25	4

3.7 FABRICATION PROCESS

After designing phase, fabrication process takes place. These processes are about using material selection and make the product base on the design and by followed the design dimension. Many methods can be used to fabricate a product, like welding, cutting, bending, grinding, drilling and many more methods. Fabrication process is a process to make only one product rather the manufacturing process was used at the whole system production. This way include part by fabrication until assembly to others component.

3.7.1 Process Involve

In order to make the design come reality, fabrication process needs to be done first. The fabrication process starts from dimensioning the raw material until finish as a desire product. The processes that involves are:

i. Getting material-Material has in UMP mechanical laboratory had more types of steel like L-shape, rectangular hollow steel, rectangular steel and etc.
ii. Measuring and marking-After get the material, the next step is measurement and marking material. The equipment used in this process is measuring tape and marker pen. The scale is from solid work software and this scale is the true.
iii. Cutting material-The process of cutting material is using shearing machine after complete measurement and marking process.
iv. Drilling-Mark the position to drill using scraper before start drilling process. After that, start the drilling process freely and safely.
v. Bending-After drilling process the sheet metal will undergoes process of bending using bending machine to get true shape for the project.
vi. Joining-This process is done by using MIG welding. This process is used to joining the part using steel. The joining parts are base, their frame are also the cover of frame.

vii. Riveting-This process is done using riveter. This process is used to joining the part that cannot be welding.

viii. Grinding-After cutting, drilling, welding process the chip from work piece must remove using hand grinding to remove chip after process cutting and drilling also remove bead after welding process on the work piece. And get smooth surface before joining and after joining process. This step must take to protect from dangerous because chip is very sharp.

3.8 SUMMARY

This chapter has been discussed generally about project methodology, how to manage flow work and process involved. Throughout this project have learned how to design start with sketching, design concept, concept selection and drawing until fabricate and assemble the noise reduction device with step by step. This project can be developing the skill to manage the machine such as drill machine, shear machine, welding and grinding.

CHAPTER 4

RESULT AND DISCUSSION

The result and discussion function as the achieving the target of the final project. However if the target is not met, it mean there were problems faced during the process and will be discussed. If the result proves that the objective is accomplished, the process is discussed testing process. This part of the project is about understanding the outcome of the process. The outcome of the testing resolved in the performance of the noise reduction device. This performance will prove the design was accurate with slight alternation during the fabrication process.

4.1 FINAL PRODUCT

The noise reduction device was finish and get result undergoes step by step start with literature review, design and sketching, technical drawing and solid modelling using Solid Work and Auto CAD application, fabrication process with cutting, bending, drilling, welding, joining and assembly.

4.1.1 Result After Finishing

This are the picture of final project from the full product shown in figure 4.1, side view shown in figure 4.2, upper view shown in figure 4.3 and folded view shown in figure 4.4.

Figure 4.1: Noise Reduction device

Figure 4.2: Side view

Figure 4.3: Upper view

Figure 4.4: Fold view

4.2 PRODUCT SPECIFICATION

For the product specification, there are lot of factor that consider. The product is classify to several categories such as weight, colour, wide, height and other else. The product specification is like below. Below is the result for product specification which refers to table 4.1.

Table 4.1: Product Specification

Type	Category	Result
Noise reduction device	Weight	2.5kg
	Wide	500mm × 50mm
	Height	950mm
	Base wide	400mm × 300mm
	Folded wide	100mm×200mm

4.3 TYPES OF DEFECTED

There are many things that happened in fabrication process such as defect. This defect happened because lack of skills to operate a machine such as when handling MIG welding machine. This defect can see after fabrication process is finished. At the same time, this problem make we have new experiences and how to avoid this problem happen again. There some of defects happen on the product below:

i. Not Parallel-This defect happen cause by less skill when process of cutting the sheet metal.
ii. Gap-It occurs after using rivet for the joining process. The surface between the joining process is not flat each other.
iii. Bead-The bead is not trim from welding process. The voltage when welding process is not suitable for this material and the speed of wire. Insufficient experience to handle also caused of the defected.

4.4 PROBLEM IN PROGRESS

Many problems occur in progress to design and fabrication of this device such as gather raw data and literature review, design and fabrication.

4.4.1 Design Problem

The problems also occur at this step. The problems came during decision to making that suitable with available machine and material in UMP Mechanical Lab. During this period many concept design have been find but when to choose one design that have all criteria needed by specification is can proceed. After a design is selected another problem encountered is details dimensioning, the dimension should suitable with scope of the project and after consider all part and material use the dimensional was suitable with project scope.

4.4.2 Fabrication Problem

Problem during this stage is very critical that make the actual progress not follow project planning schedule. First, the problem is to find material that suitable for the title of the project. The suggestion material to produce holder for noise reduction device is not available. After consider all problems about material available design for the project was change follow material available.

The problem also come during fabrication process, mainly is the available cutting tools is enough but the problem where many cutting tools broken such as drill tool. The solution for this problem is drill force to buying by our self. Another else, punching machine is not available to use. The solution for this problem is using drilling machine and hand grinding. This project have problem when to welding parts of project because gas for MIG welding was finish and forced wait for several days to get new gas for MIG welding.

4.5 TESTING

After fabricate the part into full assemble device. Testing is the last process for this project. This process can make sure this product achieve the objective or not. Figure 4.5 and Figure 4.6 are shown the testing process:

Figure 4.5: Before place the Noise Reduction Device

Figure 4.6: After place the Noise Reduction Device

According the result when take the noise rate produce. The reading was taken using Sound Level Meter at position of 0.5m for gas turbine and the turbine rotate at 500 rpm. After all the data collected, the data is transfer to tables. Table 4.2 shown the result of testing:

Table 4.2: Testing result

Noise reduction device	Sound level (dB)
No	113.3
Yes	73.5

Calculation,

% of Noise Reduction = [(113.3-73.5) ÷113.3] ×100

=35.13%

Table shows that the noise reduction device can reduce sound produce from gas turbine machine. This shows that it can reduce noise produce by use suitable material with the good mechanism and system. When the result gets is less than 85 dB, it is suitable for human hearing to work around the machine.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

In this chapter, a summary is established to conclude the whole final year project. There will be a recommendation for future project of the same kind to improve it. Therefore, a more complete understanding and enhanced application steps can be attained. In addition, the interest on the fundamental knowledge of design and mechanism can be spread to a larger population not only in the engineering field but also for public.

5.1 Introduction

This chapter is about problems the project encounter before, during and after project. This chapter also will discuss about the conclusion of the project. Problems that will be discussed are the entire problem encountered in every task in the project.

5.2 Conclusion

The conclusion, the project to fabricate the noise reduction device was achieves the objectives successfully. This project was done around fourteen week included the report, almost all the step such as literature review, design, fabrication process. To complete this project was follow the planning and Gantt chart.

5.3 Recommendation

The planning schedule and Gantt chart of the project must be done before the project was started. More time given to the project, it include statement the final year student should more focus on final year project, this could make the result of the project finish on time and have better result.

The task for every student must be explaining more detail. This information wills briefly the student about the project and speedy their progress. The involvement of the student must be observed more efficient.

5.4 Future Work

Future work for the noise reduction device is to add the net. This is net can protect sponge and make sponge long lasting. This project can be used by student to gain knowledge and understanding of mechanical response in process to make product and could helpful in the study of process machining such as bending, drilling, shearing, and etc.

To be more efficient, the upgrade should involve, using good material. If the upgrade can be done the noise reduction device can have better performance, more stable, high strength and life longer. In the future the noise reduction device can reduce noise hazard and it is more ergonomic, light, more function or useful and good from before.

The base of product also needs a small metal bar to support sponge holder.

Finally, hope that future product is useful to other machine also. Not only for turbine machine.

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APPENDIX A

3D Drawing Noise Reduction Device