

**IDENTIFICATION OF AUDIO AND ROOM PARAMETERS FOR
OPTIMUM SPEECH INTELLIGIBILITY IN ROOM**

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I declare that this thesis entitled “*Identification of Audio and Room Parameters for Optimum Speech Intelligibility in Room*“ is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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ABSTRACT

The installation of electronic amplification system in the meeting or conference room is intended to having a louder, clear and an even sound propagation. Furthermore the conversation exchanged will be at ease, since speakers do not have to raise their voice to be heard. However, the interaction between amplified sound waves in the room and the characteristics of the room may not produce desirable results, which is clarity of the speech. The aim of this project is to identify room and audio parameters in meeting room, which influence conversation so that optimum speech intelligibility can be achieved in that room. The room and audio parameters such as room shape and size, room furnishes, reverberation time and background noise, these characteristics will be studied so as to evaluate their effects on speech intelligibility. CARA program is used to simulate room samples to determine which acoustic design can achieve the optimum speech intelligibility. From the simulation results it is found that 17 out of 18 of the room design model within the range of acceptable speech intelligibility. The proper selection of acoustical materials for the surfaces of ceiling, wall and floor in these meeting room models provide optimum acoustical properties and meet the design requirements.

ABSTRAK

Pemasangan sistem pembesaran elektronik di dalam bilik mesyuarat atau bilik perjumpaan adalah bertujuan untuk menghasilkan perbualan yang lebih kuat, jelas and sama nyata di semua sudut bilik. Lagipun perbualan itu akan menjadi lebih mudah, kerana orang yang cakap tidak perlu meninggikan suaranya supaya orang lain boleh dengar. Tetapi, interaksi antara gelombang bunyi di dalam bilik dan juga kelakuan bilik itu mungkin tidak dapat menghasilkan keputusan yang diinginkan, iaitu kejelasan ucapan. Tujuan projek ini adalah untuk mengenalpasti ciri-ciri bilik dan bunyi di dalam bilik mesyuarat, di mana mereka menghasilkan kesan kepada ucapan, supaya kepandaian ucapan yang optimum dapat dicapai di dalam bilik tersebut. Ciri-ciri bilik dan bunyi seperti rupabentuk dan saiz bilik, perhiasan bilik, masa gema and kebisingan persekitaran, kesemua kelakuan ini akan dipelajari supaya mengenali kesan-kesan mereka terhadap kepandaian ucapan. Program CARA digunakan untuk simulasi terhadap model bilik tersebut and mengenali rekabentuk akustik yang mana satu dapat mencapai kepandaian ucapan yang optimum. Daripada keputusan simulasi yang telah dilakukan di projek ini, 17 daripada 18 rekabentuk bilik terletak di dalam lingkungan kepandaian ucapan yang boleh diterima. Dengan pemilihan yang menyempurnakan bagi bahan akustik permukaan untuk siling, dinding and lantai di dalam model bilik mesyuarat tersebut, kandungan akustik yang optimum dapat dicapai and memenuhi keperluan rekabentuk itu.

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LIST OF SYMBOLS

RT, T	-	Reverberation time
V	-	Volume
S, A	-	Total room surface
$\bar{\alpha}$	-	Average absorption coefficient
ΔL	-	Noise reduction
D	-	Critical distance
Q	-	Directivity
r	-	Distance
k	-	Constant
l	-	Length
b	-	Width
h	-	Height

CHAPTER 1

INTRODUCTION

This chapter will discuss briefly about problem statement, background study and objectives of the project.

1.1 Problem Statement

Rooms such as meeting or conference room is intended for speech, but most of them are often not designed to meet this intended use. Meeting room can be as small as just consist of a few seats with a table in the center of the room with one whiteboard in the front, and as large as consist of a few ten of seats with more tables, projector, and some of them with sound reinforcement system. Conversation in a small room is much more clear and ease to understand since the talker and listener are seated face to face. They do not need to raise their voice when speaking to each other.

In the case of larger meeting room, the installation of sound reinforcement system is intended to having a louder, clear and bigger coverage of conversation in the room, since speakers do not have to raise their voice to be heard. When the acoustical design issues are ignored, inaccurate communication can result. Both the excessive noise and inappropriate room acoustics can degrade the intelligibility of speech in room, which will affect clarity of the speech.

1.2 Background Study

This project identifies the room and audio parameters that will affect the degree of speech intelligibility. The room parameters that will be discussed in this project are regarding to the shape and size of the room and its room's furnishes. This usage of the room that will be analyzed is a meeting or conference room with rectangular shape. Different sizes of the room will be analyzed since the volume and surface area of the room are important parameters to determine the reverberation time. The pictures on Figure 1.1 show some example of meeting or conference room.





Figure 1.1 Example of meeting or conference room

1.3 Objectives of Project

The objectives of this project are:

- i. To identify parameters that influence speech intelligibility
- ii. To select suitable audio and room parameters for analysis
- iii. To manipulate these parameters so as to achieve optimum speech intelligibility in the room

1.4 Scope of Project

The scope of this project included the design of proper meeting room to achieve optimum speech intelligibility and fulfill the acoustical design requirements.

One of the important criteria when designing room acoustics is the reverberation time. The reverberation time is influenced by room size and sound absorption. Therefore, in this project, three different room size with small, medium and large size are modeling with different absorption coefficient respectively. There are total eighteen room models differ in dimension, surface material and furnishing.

The simulation is done by using CARA program. The reverberation time, average absorption coefficient and noise reduction level are shown on simulation. Based on the simulation results, the %ALCons is use as method to evaluate degree of speech intelligibility, and also which kinds of room acoustical design much fulfill the design requirements.

The limit of this project is room acoustical designs are analyzed by using the components given in the CARA program only. Only simulation by computer but no any experiments has been carried out for actual audio measurements. The recommended requirement by the DIN 18041 standard, where stated in the program, is not necessary to be met. Furthermore, the ventilation issue, lighting, cost of acoustical design and etc. are not included in the project as well.

1.5 Layout of Thesis

The first chapter of this project thesis discusses the introduction and background of the project. Problem statement and scope of the project also has been mentioned.

Second chapter having the detailed researches on the theories of the room and audio parameters that have been chosen. The equations of calculating reverberation time and %ALCons also stated.

The more discussion about the usage of the CARA program to analyzed speech intelligibility is located on the chapter three that is the project methodology. The various room acoustical designs for analysis are also mentioned here.

The results of room acoustical design and analysis are discussed on chapter four and chapter five. The conclusion and the recommendations for further study will be made on the last chapter.