CHAPTER I
INTRODUCTION

1.1 Background

The Federal Aviation Administration (FAA) released a new AC No: 150/5320-6G version, "*Airport Pavement Design and Evaluation*." On 6/7/2021. The most recent version, AC 150/5320-5G (FAA 2021), comes with an upgraded FAARFIELD software package, FAARFIELD 2.1.1. The extensive usage instructions included in the AC are meant to serve as either a user manual or a broad overview of the document's contents. Instead, its purpose is to record, from a technical standpoint, the noteworthy modifications and advancements that could impact the kinds of thickness designs carried out with FAARFIELD.

The acronym FAARFIELD (FAA Rigid and Flexible Iterative Elastic Layered Design) accurately encapsulates the software's purpose. This tool is classified as a mechanistic-empirical pavement design method, combining two key elements: analyzing stress and strain in multi-layered pavement structures using continuum mechanics principles and applying empirically derived failure models to create compelling designs. The particular failure models employed by FAARFIELD are rooted in extensive traffic testing, including the most recent full-scale experimental series carried out by the Federal Aviation Administration. The experiments were performed at the FAA's National Airport Pavement Test Facility near Atlantic City, New Jersey. The FAAREFIELD system incorporates two crucial analytical tools: LEAF (Layered Elastic Analysis - FAA) and NIKE3D-FAA. The latter is an advanced three-dimensional finite element analysis program, initially developed by the US Department of Energy's Lawrence Livermore National Laboratory using Fortran and subsequently adapted by the FAA to suit their specific requirements. Within the FAAREFIELD framework, finite element analysis is utilized explicitly for new rigid pavements and rigid overlays due to the discontinuous nature of these structures. However, FAAREFIELD relies on LEAF's continuous layered elastic models for flexible pavement design. These two analytical modules, LEAF and NIKE3D-FAA, are the core components of FAAREFIELD's structural analysis capabilities. Most of the processing time in practical design is consumed by thickness calculations. FAARFIELD categorizes thickness designs into three main types: newly constructed flexible pavements, rigid pavements, and overlays. The overlay category can be divided into hot-mix asphalt (HMA) applied over existing rigid surfaces and HMA overlays on flexible surfaces. In the latest iteration, FAARFIELD 2.1.1, modifications have been implemented across all design types, resulting in thickness design outputs that differ from those produced by the preceding version, FAARFIELD 2.1.1.

The runway was used to increase friction and reduce the chance of slipping, especially in inclement weather. Modern airport pavement design considers environmental factors, with attempts to minimize the impact on adjacent ecosystems and manage stormwater runoff. Overall, the evolution of airport paving reflects the evolution of aviation technology, the rise of air travel, and ongoing efforts to improve airport safety and efficiency.

Pavement is a complicated physical structure that responds complexly to external traffic loading and environmental factors. This is mainly owing to the diverse composition of the asphalt mixture, aggregate, and subgrade soil and the wide variance in traffic and environmental factors from region to region. Evaluation, such as assessing and measuring surface distresses such as cracking and rutting, or structural properties such as deflection and strain, and forecasting the effect of such conditions on future performances is essential in making design, construction, maintenance, and rehabilitation decisions for pavements. When extending a runway or taxiway is possible, installing an isolation joint at the starting point of the extension is necessary. Furthermore, the edge should be thickened or reinforced in areas where future connections to driveways or parking lot entrances might be required. To prevent water accumulation beneath the pier, ensuring that the subgrade under the pier supporting the base (or subbase) maintains a consistent transverse slope is crucial.

A runway is a square space on the surface of an airport that is prepared for aircraft take-off and landing. The pavement's length, width, direction, configuration, slope, and thickness are rigidly and methodically considered when building a runway. Because runways are critical components of airports, the pavement thickness plan must be estimated following applicable regulations. Airport pavement differs from typical pavement structures in that loads change based on the type of aircraft used, and the standard axle differs from roads in general. As a result, the thickness chart of the airport pavement layer must be examined.

Designing the pavement structure is an iterative process at FAARFIELD. The passage describes the initial presentation of the dock configuration and plane traffic patterns within the designated area. Subsequently, FAARFIELD conducts an assessment to determine the minimal requirements for pavement layers. It then modifies the concrete's thickness to ensure the pavement's projected lifespan matches the intended structural durability, typically two decades. Compaction is increasing the density of soil or material by removing air voids, improving its bearing capacity and stability. This process is essential for flexible pavement design. Compaction specifications typically include factors such as lift thickness and moisture content. Compaction requirements ensure constructed flexible pavements' long-term stability and performance. Otherwise, deflections, reduced bearing capacity, settlement issues, and other problems can result. Therefore, quality control procedures must ensure and verify that pressure requirements are met during the flexible pavement design process. Compaction specifications are derived from the pressure index (PI) concept. In determining the necessary compaction for roadway design, the adhesive earth material must exhibit a plasticity index below 3. Additionally, the density of the foundation layer under the road surface, encompassing the side areas, needs to meet or surpass the specified compaction level. It's crucial to thoroughly analyze the thickness design before computing the subgrade compaction requirements.

1.2 Problem Statement

Based on the background stated above, it is formulated. The problems of this research are as follows:

1. How can flexible pavement thickness be analyzed, and can the cumulative damage factor (CDF) for pavement layers be determined using FAARFIELD software?

2. How can the flexible pavement thickness for all layers be analyzed using the Federal Aviation Administration (FAA)?

1.3 Research Scope

The objective scope of the research includes flexible pavement design for airports using the FAA method, and the software application for flexible pavement thickness planning is FAARFIELD. In contrast, the time range for this research is from 2023-2024. This research will mention the areas not covered by the study at the end of this research project, as one of the objectives is to analyze the flexible pavement using the FAARFIELD program. The sources used in this research are the Federal Aviation (FAA/AC No: 150/5320-6G) method and secondary data.

1.4 Research Objectives

Based on the research objectives mentioned above, it is expected that this research will be helpful for:

1. Civil engineering students and researchers, especially in transportation, can calculate a flexible pavement design plan for all individual layers of flexible pavement using the Federal Aviation Administration (FAA) method.
2. Provide an overview to planners to consider the most appropriate and efficient way to plan the design of flexible pavements using the Federal Aviation Administration (FAA) method.
3. Civil engineering students and researchers, especially in the transportation sector, can learn how to use FAARFIELD software to determine the value of CDF and Compaction Requirements of flexible pavement design.