POLITEKNIK MELAKA

IMPROVED CURB DESIGN
(ICD)

JANANNI A/P KUMARASAN
(11DKA23F1005)

CIVIL ENGINEERING DEPARTMENT

SESI I :2025/2026

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This report submitted to the Civil Engineering Department in fulfillment of the requirement for a Diploma in Civil Engineering

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DECLARATION OF ORIGINALITY AND OWNERSHIP

IMPROVED CURB DESIGN (ICD)

1. I, **JANANNI A/P KUMARASAN (**[redacted] is a final year student of **<u>Diploma in Civil Engineering, Politeknik Melaka</u>** which is located at **<u>No.2, Jalan PPM 10, Plaza Pandan Malim,75250 Melaka</u>**.(Hereinafter referred to as 'the Polytechnic')

2. I acknowledge that 'Improved Curb Design (ICD)' and the intellectual property therein is the result of our creations without taking or impersonating any intellectual property from the other parties.

3. I agree to release the 'Improved Curb Design (ICD)' intellectual property to 'The Polytechnics' to meet the requirements for awarding the **<u>Diploma Kejuruteraan Awam</u>** to me.

Made and in truth that is recognized by;

JANANNI A/P KUMARASAN
(No. Kad Pengenalan :[redacted]

……………….
JANANNI A/P KUMARASAN

In front of me, PUAN FARA HASZILLAH

BINTI HASIM
(No. Kad Pengenalan : [redacted]
As a project supervisor, on the date : 10/11/2025

……………………….
PUAN FARA HASZILLAH BINTI HASIM

ACKNOWLEDGEMENT

I have taken efforts in this project called Improved Curb Design (ICD) throughout the year. I want to continue by thanking my supervisor, the supporter of my project, Puan Faraa Haszillah Binti Hasim. Thank you for your incredible guidance, your sharp and constructive feedback, and for the constant encouragement you gave me throughout this entire process. Your insights and expertise were not just helpful they truly pointed this project in the right direction, and I learned so much from your mentorship.

I am also incredibly thankful for the wider community at the Civil Engineering Department, Polytechnic Malacca. The faculty and staff here provided not only the resources I needed but also an academic environment that challenged and supported me.

To my friends and colleagues, thank you for being in the trenches with me. The late-night discussions, brainstorming sessions, and simple words of support made this journey so much more manageable and even enjoyable.

Finally, to my family, I could not have finished this without you. Thank you for putting up with me, for cheering me on, and for your unconditional support through every late night and stressful deadline. Your belief in me has been an anchor through my entire time at university. I couldn't have done it without you. Thank you for your endless patience, your unwavering support, and for believing in me through every high and low of my academic journey. This accomplishment is as much yours as it is mine.

ABSTRACT

This project focuses on developing an improved curb design (ICD) that enhances drainage efficiency, pedestrian safety, and aesthetic appeal while reducing installation time. As we made a comparison on the traditional curb are flawed. The study was carried out to overcome the weaknesses of traditional curb systems, which often experience lengthy installation processes, and limited crash resistance as well as poor water drainage.

The main problem addressed is slow installation time, an incompatible design, low curb strength, the road damage, and pedestrian hazards. To solve this, a design-based and analytical approach was applied through structural modeling, prototype development, and data analysis.

The improved design integrates interlocking joints for faster installation and uses strong materials like steel to enhance curb strength performance. Ultimately, this new curb is a modern, safe, and efficient alternative for our cities. The next logical step is to see if we can test it on a larger scale, and analyze the costs for real-world projects.

ABSTRAK

Projek ini memberi tumpuan kepada membangunkan reka bentuk kerb (ICD) yang dipertingkatkan yang meningkatkan kecekapan saliran, keselamatan pejalan kaki dan daya tarikan estetik sambil mengurangkan masa pemasangan. Seperti yang kita buat perbandingan pada tepi jalan tradisional adalah cacat. Kajian ini dijalankan untuk mengatasi kelemahan sistem curb tradisional, yang sering mengalami proses pemasangan yang panjang, dan rintangan ranap yang terhad serta saliran air yang lemah.

Masalah utama yang ditangani ialah masa pemasangan yang perlahan, reka bentuk yang tidak serasi, kekuatan jalan yang rendah, kerosakan jalan dan bahaya pejalan kaki. Untuk menyelesaikannya, pendekatan berasaskan reka bentuk dan analisis telah digunakan melalui pemodelan struktur, pembangunan prototaip, dan analisis data.

Reka bentuk yang dipertingkatkan menyepadukan sambungan saling mengunci untuk pemasangan yang lebih pantas dan menggunakan bahan yang kuat seperti keluli untuk meningkatkan prestasi kekuatan mengekang. Akhirnya, sekatan baharu ini adalah alternatif yang moden, selamat dan cekap untuk bandar kita. Langkah logik seterusnya adalah untuk melihat sama ada kita boleh mengujinya pada skala yang lebih besar, dan menganalisis kos untuk projek dunia sebenar.

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Symbol

A	$Cross - Sectional\ Area\ of\ Specimen$
◦	Degree
fc’	Compression Strength
kN	Kilonewton
m	Mass
mm	Millimeter
MPa	Megapascal
N	Newton
%	Percentage
P	Maximum Load
±	Plus Minus

LIST OF ABBREVIATIONS

ASTM	American Society for Testing and Materials
ATJ	Arahan Teknik Jalan
AutoCAD	Automatic Computer-Aided Design
CTM	Compression Testing Machine
DMF	Dual-Mass Flywheel
EN	European Standard
FEA	Finite Element Analysis
HSIP	Highway Safety Improvement Program
MS	Malaysian Standard
NDBA	New Dynamic Barrier for Highways
JKR	Jabatan Kerja Raya
JKR	Public Works Department
R&D	Research and Development Project

CHAPTER 1
INTRODUCTION

1.1 INTRODUCTION

Road curbs had appeared to be simple structures, yet they played an important role in maintaining city, functionality and safety. They defined street edges, guided traffic, and protected pedestrians. Traditionally constructed from concrete, curbs acted as sturdy barriers. However, despite their usage, they often lacked effective drainage and aesthetic appeal (Smith et. al, 2018). Poor drainage had led to stagnant water, which damaged roads, posed safety risks, and increased maintenance costs (Lee, 2020). As urban areas expanded, concerns about sustainability and smarter infrastructure grew. This gave rise to the development of innovative curb designs that not only marked roads but also improved drainage, reduced environmental impact, and enhanced urban aesthetics.

Road safety had remained a pressing global issue, with numerous lives impacted by traffic accidents every year. To mitigate these risks, median barriers had provided essential protection and regulated vehicle movement. Road agencies had employed various types, including concrete, cable, and metal-beam barriers (A Grana, et. al., 2024). Among modern solutions, the NDBA 2.0 had stood out for its effectiveness. Constructed with durable steel and lightweight materials, it had improved safety and simplified installation. Its advanced design had shortened construction time and adapted to diverse roadway conditions. Furthermore, its crash-mitigation system had reduced accident severity and associated costs. The barrier's easy installation, which required minimal foundation work, had also lowered long-term maintenance expenses.

1.2 BACKGROUND RESEARCH

Street curbs do a lot more than just separate the sidewalk from the road; they're vital for keeping us safe, managing rainwater, and making our communities look good. The problem is, most traditional curbs are falling short. They don't offer much protection in a crash, can damage cars, and often cannot handle heavy rain, which leads to dangerous flooding and water pooling. This research explores a new, innovative curb design that uses an interlocking system to be much stronger, safer for pedestrians especially in busy areas, and easier to maintain. By comparing this new idea to old-fashioned curbs, we aim to offer city planners a practical, sustainable, and safer solution for modern urban life.

1.3 PROBLEM STATEMENT

Conventional curb systems have been found to depend more on manual labor and on-site concrete casting, which significantly slows down the installation process. The absence of modular or interlocking components further increases construction time and labor demands. Additionally, inefficient material handling and poor coordination between different phases of work have contributed to frequent project delays (Ibrahim et al., 2021). These prolonged installation periods result in extended project timelines, elevated labor costs, and disruptions to traffic flow. Such delays negatively impact the public, block urban mobility, and affect local economies due to restricted road access during construction activities (Public Works Department Malaysia, 2020). Preliminary research and site observations from ongoing road projects consistently indicate that conventional curb installation methods are the main source of delay, a conclusion supported by existing literature on the inefficiencies of conventional curb systems (Ibrahim et al., 2021; Public Works Department Malaysia, 2020).

Existing curb designs often fail to meet the evolving requirements of modern infrastructure. The lack of strength in curb dimensions and functional adaptability limits their integration with diverse road profiles and contemporary urban planning needs (Hassan et al., 2020). As a result, these incompatible designs contribute to poor surface water management, frequent ponding, and increased maintenance costs. Furthermore, inefficient curb structures can shorten the lifespan of adjacent road surfaces and diminish the visual appeal of urban environments (Tan & Rahman, 2021). Reviews of drainage and road maintenance records have revealed that outdated curb designs are a key factor in ineffective stormwater control. This observation is corroborated by previous studies linking poor curb design to premature pavement deterioration (Hassan et al., 2020; Tan & Rahman, 2021).

Conventional curbs frequently suffer from poor structural strength due to the use of low-grade concrete and insufficient reinforcement. These weaknesses are exacerbated by inconsistent quality control measures and improper curing practices during construction (Razak et al., 2019). As a consequence, curbs are prone to cracking, displacement, and early failure under the stress of traffic loads and environmental conditions. This not only increases long-term maintenance costs but also poses safety risks to both vehicles and pedestrians (Salleh et al., 2022). Field inspections and data from municipal engineering departments have confirmed that curbs lacking proper material strength experience frequent structural failures. Supporting studies further emphasize that the absence of adequate reinforcement significantly compromises curb durability (Razak et al., 2019; Salleh et al., 2022).

1.4 RESEARCH OBJECTIVES

According to the project Improved Curb Design, the objective that had been set are:

1. Design the Improved Curb Design (ICD) products as main objective to develop an improved curb design compared to conventional curbs. The primary objective of this study was to design the Improved Curb Design (ICD) products, focused on the development of a curb system that offers enhanced performance compared to conventional curbs. This objective defined and focused on creating a better design that labeled existing limitations in safety, drainage, and urban aesthetics. The deliverables included AutoCAD 3D model, sketch-up drawings, and material specifications, making the goal measurable and visible. With access to appropriate engineering tools such as AutoCAD and a solid understanding of structural and environmental requirements, the design process was both achievable and realistic. As the base step of the project, this objective was important to proposed a sustainable and practical solution for modern urban infrastructure. The design phase was scheduled to be completed within a time frame of 7 to 28 days, ensuring the objective was time-bound and according with the overall project timeline.

2. The study of the effectiveness of the product in terms of Crash Resistance Evaluation. The second objective of this study was to evaluate the effectiveness of the Improved Curb Design (ICD) in terms of crash resistance. This objective specifically focused on assessing the structural performance of the product under impact conditions, using crash resistance as the key metric. The evaluation was designed to yield measurable results through quantitative analysis, such as Finite Element Analysis (FEA), which would determine the maximum force in kilonewtons (kN) the curb could withstand before failure. These results would then be compared to a control model representing conventional curb designs. The objective was achievable using standard engineering simulation tools and methodologies, and could be further validated through physical testing if resources permitted. Given that insufficient crash resistance is a major limitation of traditional curbs, this objective was both realistic and directly aligned with the study’s aim to improve urban safety infrastructure. The evaluation was scheduled to commence immediately after the completion of the design phase, ensuring a logical and time-bound progression within the overall research timeline.

1.5 SCOPE OF RESEARCH

This project focused on improving traditional curb designs by adding the concept of interlocking, testing the effectiveness of the invented and conventional curb, and functional elements. The study was limited to the following scope to ensure focus and achievability:

1. Material Selection

The Improved Curb Design (ICD) used the materials like cement, sand and chipping stone with the standard grade 20, the ratio mixture was 1:2:4 same as the conventional curb. Those materials needed to be as JKR standard so that the cost of the materials doesn’t exceed too much comparing conventional curb. Besides that, the addition of chipping stone and Y-12mm steel starter bars for ICD. Those addition materials in the curb made the structure of the curb to be stronger and less maintenance needed for it.

2. Location

The study was conducted in Melaka, Plaza Malim. The chosen locations were nearby study area of us and also with approval from 'Jabatan Kerja Raya Negeri Melaka’ (JKR).

3. Targeted User

The project was designed for JKR and infrastructure developers, such as contractors, in the area of Melaka.

4. Timeline

The project was conducted within 1 year, covering research, design development, material selection, testing, analysis, approval from the JKR, as well as reporting the results. The study was completed within the duration of the Final Year Project, adhering to academic deadlines.

5. Crash Resistance Evaluation Through Testing.

The test was conducted by using the Swing Test that evaluated the crash-resistance. The materials and tools were chosen according to the capabilities as part of the project's own design. The test was conducted by the JKR itself with specifications and also gained the performance metrics.

6. Comparison between Conventional Curb and Invented Curb Design (ICD)

The strength test, which was a swing test, showed the ability of both curbs to withstand the crash resistance and also allowed for a comparison from all aspects like design, strength, and the compelling reasons to adapt to this ICD by JKR.

1.6 PROJECT SIGNIFICANCE

The importance of this project lay in its potential contributions to infrastructure safety, the effectiveness of crash-resistance evaluation, and design innovation. The study aimed to develop an Improved Curb Design (ICD) product, which was expected to provide meaningful advancements in road safety and construction practices.

The design was specifically determined for safety and also to increase the functionality of the invented curb by inserting an interlocking concept into the blocks. This could be followed and used to increase the productivity of the road curbs and lower the maintenance process and cost.

Consequently, the study addressed the critical issue of crash resistance by designing and testing ICD products that enhanced the safety of curbs in high-risk environments. This improvement had the potential to reduce the severity of accidents, save lives, and minimize property damage, contributing to public safety and well-being.

1.7 CHAPTER SUMMARY

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