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# **Development of Engineering Material Selection Computer Package for Enhanced Decision Making**

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#### Abstract

An engineering material selection computer package for enhanced decision making has been developed. MATLAB software (2021 edition) which has built-in application design environment was employed for the development. The package integrates three main windows: the Login Window, the Add Material Window, and the Select Material Window. Through a detailed review of existing material selection methodologies, this research work presents a unified software solution tailored for engineering material selection. The software automates material classification, provides systematic ranking mechanisms, and offers detailed property displays during selection. Results demonstrate successful integration of material selection into a user-friendly interface, automated classification based on predefined parameters, and systematic ranking mechanisms. The software enables seamless updates, incorporates interactive documentation, and facilitates efficient material selection. The package is recommended for use by engineering students and practicing engineers, providing them with a valuable tool for material selection processes in their respective fields. Further recommendations include, regular software updates and integration with external databases to optimize impact. Overall, this thesis presents a robust software solution that enhances efficiency and accuracy in engineering material selection, aiding decision-making processes across engineering industries.

## I. Introduction

The selection of suitable engineering materials is a critical aspect of the design and manufacturing process in various industries, including aerospace, automotive, construction, and electronics (Smith et al., 2018; Jones, 2020). The performance, durability, and reliability of engineered systems heavily depend on the choice of materials. However, the material selection process can be complex and time-consuming due to the vast array of available materials and their diverse properties. Quality of Engineering Accounting plays a crucial role in ensuring efficient resource allocation and cost control in engineering projects (Nusa, 2021). A key factor influencing this is material selection, as choosing the right materials impacts durability, safety, and cost-effectiveness. Poor material choices can lead to financial losses and operational inefficiencies. This directly affects organizational performance, as companies relying on suboptimal materials may experience product failures, increased maintenance costs, and reputational damage (Romanus et al, 2023). Effective decision-making is essential to balancing cost, quality, and performance in engineering and accounting processes. Leaders must use business judgment to assess risks, forecast financial implications, and make strategic choices that align with long-term goals

#### Keywords

Development, engineering, material selection, computer package, decision making

Budapest Institut



(Iryadi et al, 2020). A well-integrated approach, where financial insights support technical decisions, enhances competitiveness and sustainability.

In engineering design, materials possess various characteristics, including density, strength, price, corrosion resistance, and others (Ashby, 2005). When designing a product, a specific combination of these characteristics is often required. For example, a design may call for a material with low density, high strength, affordability, and resistance to seawater. The material selection process involves identifying and matching the most suitable material to meet the design's requirements. This process typically begins by considering a wide range of materials available in the "universe" of options. These materials can be categorized into different families, such as polymers, metals, ceramics, glasses, natural materials, and hybrid materials formed by fusing different material types (Ashby & Jones, 2019). Figure 1.1 depicts the classification of materials into these families, providing an overview of the different options available. Polymers encompass a wide range of synthetic and natural organic materials, while metals include various alloys and pure metals. Ceramics consist of inorganic, non-metallic materials with high melting points, and glasses are amorphous solids with unique properties. Natural materials encompass materials derived from biological sources, such as wood or fibers, while hybrid materials are formed by combining different material types to achieve specific properties (Callister & Rethwisch, 2018).

By understanding the classification and characteristics of these material families, engineers can make informed decisions during the material selection process. They can explore the properties, advantages, and limitations of each family to identify the materials that best match the design's requirements. Improving the material selection process is essential for achieving optimal design outcomes. It ensures that the selected material meets the necessary criteria, resulting in a product that performs effectively, meets cost targets, and satisfies durability and sustainability requirements (Ashby & Cebon, 2017). Overall, understanding the characteristics and classifications of different material families provides a foundation for successful material selection, enabling engineers to make informed decisions and choose the most appropriate materials for their designs.

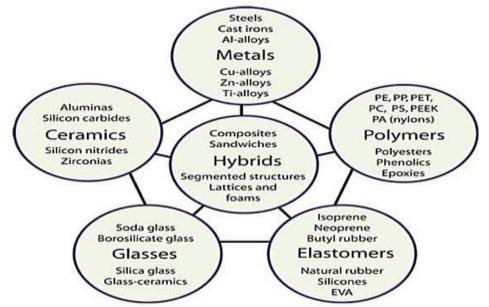


Figure 1. The Menu of Engineering Materials

This arrangement is expanded in Figure 2, which implies that the population is organized hierarchically. Each family includes classes, sub-classes, and members; in this illustration, the family of metals is expanded to illustrate the class of aluminum alloys and the sub-class of 6000-series aluminum alloys, which has a large number of members (e.g. Al6061). It shares features with every other element of the universe, including its mechanical, thermal, electrical, optical, and chemical qualities, its processing traits, its cost and availability, and the effects its use has on the environment. This is the profile of its properties.

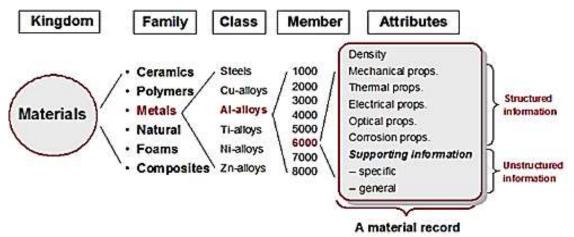


Figure 2. A Hierarchical Structure For Material Classification

Traditionally, engineers have relied on handbooks, material property charts, and expert knowledge to make informed decisions during material selection. While these methods have proven effective, they often suffer from limitations such as subjective judgments, incomplete data, and time constraints (Ashby, 2005; Callister Jr. and Rethwisch, 2018). Additionally, as materials science and engineering continue to advance, the number of available materials and their properties have significantly increased, making it even more challenging to identify the optimal materials for specific applications. To address these challenges, the utilization of computational tools and software solutions has gained significant attention in recent years. These tools can assist engineers in efficiently navigating through vast material databases, analyzing material properties, and making informed decisions based on specific design requirements (Gurrappa et al., 2014; Rahman and Mithu, 2019). Among the various software platforms available, MATLAB stands out as a powerful and versatile tool for scientific and engineering applications.

MATLAB offers a wide range of functionalities, including data manipulation, numerical analysis, visualization, and algorithm development. Its extensive library of builtin functions and toolboxes allows for efficient processing of large datasets and the implementation of complex algorithms (MathWorks, 2022). By leveraging the capabilities of MATLAB, a computer package specifically tailored for engineering material selection can be developed to streamline the decision-making process, improve accuracy, and enhance productivity. The proposed computer package aims to address the following challenges in engineering material selection: Material Database Integration: The computer package will integrate comprehensive material property databases into a unified platform. These databases will include a wide range of materials, their mechanical, thermal, electrical, and chemical properties, as well as their performance under different environmental conditions (ASTM International, 2020; MatWeb, 2022). By providing access to a diverse range of materials in one centralized location, engineers can efficiently explore and compare various options. Multi-Criteria Decision Making: The computer package will incorporate advanced algorithms and decision-making techniques to evaluate and rank materials based on multiple criteria.

This approach considers not only the basic material properties but also the specific requirements of the application, such as strength, weight, cost, corrosion resistance, and environmental impact (Fasoyinu and Vahdati, 2021; Duan et al., 2022). By incorporating customizable criteria, engineers can prioritize their design objectives and identify materials that best meet their specific needs. Material Selection Visualization: The computer package will offer interactive visualization tools to facilitate the exploration and comparison of material properties. Engineers will be able to generate plots, charts, and graphs to visualize the relationships between different material properties and how they align with the desired design requirements (Nogueira et al., 2017; Pujari et al., 2021). These visualizations will aid in identifying trends, outliers, and trade-offs, providing a comprehensive understanding of material behavior. User-Friendly Interface: The computer package will have a user-friendly interface that allows engineers, even those with limited programming experience, to navigate and utilize its functionalities effortlessly (Abbas and Wu, 2020; Ma and Cai, 2021).

The interface will provide intuitive controls, clear instructions, and help documentation to ensure smooth user interaction. By removing barriers to entry, the computer package will enable a wider range of engineers to benefit from its capabilities. In summary, this research proposal aims to leverage the capabilities of MATLAB software to develop a specialized computer package that will revolutionize the way engineers select materials for engineering applications. By providing a user-friendly and efficient platform, this package has the potential to streamline the material selection process, ultimately leading to improved product performance, reduced development time, and enhanced overall productivity in engineering industries. By addressing the challenges of material database integration, multi-criteria decision making, material selection visualization, and user-friendliness, this computer package will empower engineers with a comprehensive tool for effective and efficient material selection. By addressing these challenges and developing an effective computer package for engineering material selection, this research aims to enhance the efficiency, accuracy, and effectiveness of the material selection process. The proposed solution will provide engineers with a powerful tool that streamlines material selection, improves product performance, reduces development time and costs, and promotes sustainability in engineering applications. The aim of the study is to develop a computer package for the selection of engineering materials for enhanced decision making.

#### **II. Review of Literatures**

#### **2.1 Experimental Procedure**

These are materials employed for the design of the computer package. This involves Matlab software, Mysql Database software. MATLAB software; one of the software employed for the development of the package is Matlab software version 2021. The software use to come in many versions according to the year the version was made public. The 2021 version was made public in the year 2021 and it has a built in application design environment (app design), which makes it suitable for building the computer package. Figure 3 displays the outcome of clicking on the Matlab icon on the computer desktop after installation.

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Figure 3. Matlab version 2021 open in the computer after installation

The window is automatically divided into three aspects: the current folder, the workspace and the command prompt which displays the folders and files, displays running programs and command outputs, and used for entering executable commands respectively. To locate the app design environment, one has to go through the processes of clicking on the New + sign on the menu barand navigating to the app design as shown in Figure 4.

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**Figure 4.** Navigating to the application design environment

After opening the app design environment and clicking on Blank App, the window shown in figure 5 is displayed

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Figure 5. The application design development environment

The app design environment as shown is divided into three parts; The components library that houses all the components used for app design. Some of the components are the push button, the label, the edit text field. The design/code view which displayed the assembled components and codes behind the assembled components respectively. The user has to click to toggle between the design view and the code view. It is equally in the code view that codes and functions are written that helps the components interact with each other and display the required output. The component browser which displays the title and functionalities of the components in the design view. The user can click on the title of any components to set it's functionalities and display specifications that the component will adopt during run time.

	Design View Co	ode View
L - h - h		
Label		
Edit Field		
Button		

Figure 6. The Design View of the App Design development environment

		Design View	Code View
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2 4 5	2	% Properties that correspond to app components properties (Access = public) UIFigure matlab.ui.Figure EditField matlab.ui.control.EditField EditFieldLabel matlab.ui.control.Label Label matlab.ui.control.Label Button matlab.ui.control.Button	
0	-	end	
1		% Component initialization	1.00
2 3 E	2	methods (Access = private)	
5		% Create UIFigure and components	
6	1	function createComponents(app)	
7 8 9 0		% Create UIFigure and hide until all components are created app.UIFigure = uifigure('Visible', 'off'); app.UIFigure.Position = [100 100 640 480]; app.UIFigure.Name = 'MATLAS App';	
2			
8		% Create Button	
4		<pre>app.Button = uibutton(app.UIFigure, 'push'); app.Button.Position = [33 337 100 22];</pre>	
6		second se	
-		% Create Label	

Figure 7. The Code View of the App Design development environment

#### **III. Research Methods**

#### **3.1 Material Databases**

This is the software tool employed for data storage of the computer package. The data storage tool used for this research work is Mysql database tool. Opening the window after installing in the computer will display the window shown below.



Figure 8. The MySQL software window

The user is required to click on MySQL Connection to proceed to make further use of the software to build database and create tables as required.

#### **3.2 Methods**

#### a. The Algorithm

This is the step by step approach adopted by the package through development to actualize the goal. The algorithm below outlines the key steps involved in the operation of the engineering material selection computer package, providing a structured approach to material selection and decision-making processes. Initialization: Load necessary libraries and modules, Initialize variables and data structures. Login Window: Display the login window with options for administrator or client login. Prompt the user to select their role (administrator or client). Proceed to the appropriate window based on user selection. Add Material Window: Display the add material window with options for adding, updating, or deleting materials. Provide a selection pane for choosing the material's family, class, and subclass. Display a properties pane for inputting material properties. Offer an action buttons pane for executing add, update, or delete actions. Implement functionality to add, update, or delete materials based on user input. Material Selection Window: Display the material selection window for clients. Provide options for unconditional selection, screening/constraints, ranking, and documentation. Implement functionality for each selection type based on user input. Unconditional Selection: Display all materials in the database without any conditions. Allow users to scroll through and view all available materials. Screening/Constraints Selection: Allow users to set constraints such as density, temperature, cost, etc. Display materials that meet the specified constraints. Ranking Selection: Allow users to select a material function and objective. Rank materials based on predefined functions and objectives. Documentation: Allow users to access detailed information about selected materials. Display material properties, sources, and additional documentation. User Interaction: Implement interactive features for seamless navigation and data entry. Provide feedback mechanisms for user suggestions and inquiries. Error Handling: Implement robust error handling to address any unexpected inputs or system failures. Provide informative error messages to guide users in resolving issues.

#### **b.** Package Assembly

Figures 6 shows the components assembling and coding interface of the Login Window respectively. The assembling interface and codes for the Login, the Select Material, the Add Material and Documentation windows are displayed in the appendixes.

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Figure 9. Component assembling interface of the Login Window

# **IV. Results and Discussion**

# **4.1 The Computer Package**

The computer package offers a clear and efficient interface for both administrators and clients. It consists of three main windows: The Login Window, The Add Material Window, and The Select Material Window. The package comprises of many modules that represent the various windows. It is requires that the user installs Matlab, then copies the modules to the app design environment of the software where it can be run.

#### a. The Login Window



Figure 10. The Login window

In the Login window, users are presented with the choice of logging in as either an administrator or a client. Administrators gain access to the Add Material Window, while clients enter the Select Material Window.

By selecting their role and clicking the "Continue" button, users are directed to the appropriate window, and the Login window closes. By default, the administrator role is automatically selected.

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	selected Pane		Properties Pane Dick to Userpage
		General Properties	Mechanical Properties
Family		Density (KgWe*1)	Young Mindulus (OPa)
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2003		Thermal Conductivity (Winte)	Turtule Chength (MPu)
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		Electrical Properties	Triscal User
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## b. The Add Material Window

Figure 11. The material addition window

This window empowers users with the ability to add, update, and delete materials in the database. It's designed for individuals familiar with material addition processes. The addition, editing, or deletion of materials is a structured process within the window:

- The user selects the material's family.
- They further specify the material's class.
- The user must then pick the subclass of the material.

Importantly, the software is programmed with a predefined set of families, classes, and subclasses which streamlines and organizes the material selection process.

The window is divided into four panes; the selection pane, the selected pane, the properties pane and the action buttons pane as shown in the figures below.

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ADD MATERIAL	USER								
					Sel	ection Pane			
Familiy Se	lect	-	lass Select	•	Subclass	Select Subclass	Member	Select Member	

Figure 12. The selection pane

This selection pane is for the selection of already existing family, class, subclass and member existing in the database. The selected pane displays the user's selection choice from the selection pane. It can equally be used to input new member into the database.

The properties pane displays the properties of selected material that is stored in the database. Materials properties can equally be entered for new input or update.

	Properties Pane G Back to Userpage			
General Properties	Mechanical Properces			
Density (Kg/m**3)	Young Modulus (GPa)			
Cost (-)	Hardness (HV)			
Thermal Properties	Elastic Unit			
Thermal Conductivity (W/miK)	Tensile Strength (MPa)			
Thermal Expansion	Compressive Strength(MPa)			
Specific Heat (J/KgK)	Elongation (%)			
Glass Temperature (K)	Endurance Limit (MPa)			
Metting Point	Fracture Toughness (MPam**1/2)			
Electrical Properties				
Resolvity (uohm.cm)	Typical Uses			
Dielectric Constaint				

Figure 13. The property pane displays the properties of selected material

Action Buttons	
Add/Update Member	
Delete from Database	
Back to Userpage	

Figure 14. The action buttons pane

The action button pane as the name implies houses the action buttons used to add, update and delete materials from the database. It equally contains the button for going back to the login window.

# 4.2 Adding Material

First we consider adding a material member Aluminum 1050-H14 which belongs to subclass of Aluminum 1000 series, the class of Aluminum Alloys and a family of Metals. The property data of the material as presented by Matweb Database of material properties is shown in figure 15.

		Aluminum 1050-H14						
Categories) Metal Nonferra	nn Metal: Ahmimun Allay: 1000 5	Series Aluminum						
Material Data points with Notes:	Data points with the AA note have been provided by the Ahanimum Association, Inc. and are NOT FOR DESIGN.							
Composition N The abaminant c analyzed metalli alloys and unalle greater than 0.0	ontent for unalloyed abanimum not a c elements present in amounts of 0	010 percent of more each, expre ing process, when the specified m d off and shown as " less than 0.0						
Key Words: Ahminium 1050 B491; Al1050-		ance); DIN A199.5; AA1050-111	4, ASTM B491; BS 1B (UK); CSA 9950 (Canada); ASTM					
Vendors: No vendors are	listed for this material. Please click	there if you are a supplier and wo	ould like information on how to add your listing to this material.					
Physical Properties	Motric	English	Comments					
Density	2.705 g/ce	0.09772 lb/m²	AA: Typical					
Mechanical Properties	Metric	English	Comments					
Hardness, Brinell	30	30	500 kg load with 10 mm ball. Calculated value.					
Tensile Strength, Ultimate	110 MPa	16000 pai						
Tensile Strength, Yield	103 MPa	14900 pai						
Elongation at Break	10 %	10 %	In 5 cm					
	@Thickness 1.60 mm	@Thickness 0.0630 in						
Tensile Modulus	62.0 GPa	10000 ksi	Compressive Modulus is about 2% higher					
Poissons Ratio	0.33	0.33						
Shear Modulus	26.0 GPa	3770 kai	Estimated from similar AI alloys.					
Shear Strength	69.0 MPa	10000 pai						
Electrical Properties	Metric	English	Comments					
Electrical Resistivity	0.00000290 ehm-cm	0.00000290 ohm-cm						
Thermal Properties	Metric	English	Comments					
Heat of Fusion	390 J/g	168 BTU/05						
	21.8 µm/m-*C	12_1 pin/in-"F						
CTE, linear		°C @Temperature -58.0 - 68.0 °	F					
	23.6 µm/m-*C	13.1 µin/in-°F						
	@Temperature 20.0 - 100 *C							
	24.5 µm/m-*C	13.6 min/m-°F						
	27 Terror contains 20.0 - 200 #0	20 Temperature 68.0 - 102.*F						

**Figure 15.** Material properties of Aluminum 1050-H14 as presented by Matweb Database

Selecting the required properties from the select pane, and inputting the few data presented in Figure 16 above in the properties pane is shown in figure 17 below.

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		A CONTRACTOR OF CONTRACTOR		Company's Strength MF-a	
Monther	Alammum 1050-H14	Results Heal (AROP)		Congistion (%)	10
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Figure 17. Inputting the data for Aluminum 1050-H14 in the Add Material Window

Clicking the Add/Update Member button in the Action Buttons pane will prompt the window in Figure 18 requesting the user confirm his action.

承 Add Memb	er	1.000		$\times$
Are you	sure you war Yes	nt to add new m	ember?	

Figure 18. Add material dialog box

Going further to click the Yes button brings another dialog box show in Figure 4.10 confirming the addition of the member, while clicking the No button returns without doing anything.

A fresh selection will confirm the presence of the material member as shown in Figure 19 below.

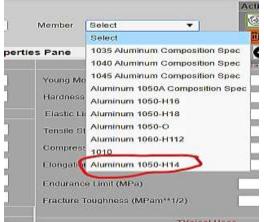


Figure 19. Aluminum 1050-H14 added to the member database

#### a. Updating Material Properties

The price of aluminum can be affected by several factors, including supply and demand, production costs, energy prices, currency fluctuations, and geopolitical events. Supply and demand is a major factor in determining the price of aluminum. Based on the factors stated above or more, the cost of material is subject to change. Let's assume that the cost of Aluminum 1050-H14 at the time of consideration is \$100/kg. Other properties of the material may also be missing from initial input or may need to be changed based on present data at hand. In such scenario, the particular material property data may need to be updated such as done in figure 20 below for Aluminum 1050-H14. It involves following the supposed procedure to bring up the material which is already existing the data base, and inputting the values. The areas marked red in the figure represent the updated values.

Family		Sinn (Alamman Alinys •) S	Selection Pane	Menter (Alamman 1050 • • )	Action Duttors	
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family	Metats	Density (Kg/m**3)	2.705	Young Modulus (GPs)	69.0	
		Cest()	100	Handmens (H-M)	30	
China	Alumenum Alloys	thing	Proventing	Flashe Limit	1	
Subdays 1000 Series	Thermal Conductivity (Winnig:	230	Turnales Strength (MP's)	103		
	North Contraction	themail topanase	24	Consective Strength/MPar		
Venter	Auminum 1050-H14	Specific Inual (J/KgK)	930	Ekenpetern (%)	10	
Clivitreepr	19	Class Tomperature (K)	Ĩ.	Endarance Limit (MPap	1000	
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		Detector Constant		Instantas, food industry containers, cable	e sheathing and architectural	

Figure 20. Updating Aluminum 1050-H14 Properties

Clicking the Add/Update Member button from the action button pane will prompt the user to confirm action as shown in Figure 21, and if the user confirms the dialog, it updates the material properties and display a confirmation box indicating that the material properties of the given material has been updated.



Figure 21. Update Dialog Box

Just like adding and updating materials, a material can equally be deleted from the material database using the "Delete from Database" button in the action button pane. Still considering the Aluminum 1050-H14, let's delete it from the database. First is to follow the supposed steps and bring the material up to display with its properties, then clicking the delete button will bring forth a dialog box enquiring the user to confirm action,

Clicking "Yes" will bring forth the confirmation dialog box which confirms the deletion of the material from the database.

After performing the required action(s) in the Administrative part of the software, which may include; addition, updating or deleting of material members, the user may require to move back to the login page to either logout or login to the client side of the software. Clicking the "Back to Userpage" button in the action button pane will help the user achieve that and will equally display the Login page.

Selecting the "Client" from the Login window and clicking the continue button takes the user to the Select Material Window shown in figure 22.

AAAR AF App					-	×
Solect Material Table						
Function	Construction				Salected Materials	
Evence Punction	Geteral		Vechanical Properties			
Otjective	Denaity	MAX Young Module		***		
Einlect Objective	Gest	Herthole				
		Example Lines				
Summary of selection		Tensãe Streng	*			
- Function		Comprisitive	Shargh			
	Thurmal Properties	Elongation Endurance Li				
	NEN	MAX Practure Toop	Nelson - State			
Objectivo	Thermal Conductivity					
	Thermal Expension		Gerand			
	Gipes Temperature		MIN M	AX		
	Wetting Paint	Restativity     Delectric Con				
Comtrait	-					
	Back In Legen		Jan Select Ma	and a second		

Figure 22. The Select Material Window

The select window is for material selection. Four types of material selection processes can be carried out in this window; unconditional, Screening/Constraints, Ranking and Documentation. This selection is done without any condition and with that,

all materials in the database pass this type of selection. After opening the Select Window, the user proceeds to click the "Select Materials" button in green with pointing finger located at the bottom center of the window as shown in figure 22 This action displays all the materials in the database in no special other in the "Selected Material pane" as shown in figure 23, region marked with red. The user can scroll up or down to view materials.

			Selected Materials
Mechanica	I Properties		Here are the list of selected member
Young Modulus	MIN	MAX	Remember to click on any of the members to about the selected member
Hardness			Austenitic grey cast iron Automotive malleable cast iron
Elastic Limit			CC490K brass
Tensile Strength			CC750S brass CC212E bronze
Compressive Strength			CC330G bronze CC140C copper
Elongation			CR003A copper Zernek 2
Endurance Limit	(		Zamak 3
Fracture Toughness			Zamak 5 EN 1,4869 casting alloy
	<u> </u>	S	EN 1.4889 cast nickel
Ge	neral		AWS BNI-10
	MIN	MAX	AWS ENI-1 EN 2,4608 nickel
Resistivity	[]		EN 2.4632 nickel Grade 15 Babbitt Metal
Delectric Constant			Grade 7 Babbitt Metal
			Grade 8 Babbitt Metal AM100A magnesium
			AM50A magnesium
	I Dro W	T. Materials	AM60A magnesium Grade 360 molybdenum Back to Selectore

Figure 23. Unconditional Selection

It will be discovered that once any selection is made by clicking the Select Materials button, the button blurs out and is reactivated by clicking the "Back to Selector" button located on the Selected Materials pane which clears the pane and reactivates the Select Materials Button.

This type of selection is done based on constraints. Constraints such as density, operation temperature, cost etc can be set at maximum, minimum or both (range) limits. The materials that fall within the set limits are displayed in the Selected Materials pane in no particular other. Figure 24 shows the result of setting the maximum density requirement for the material selection at 6.5.

atranice.		A CONTRACTOR OF A CONTRACTOR O	Selected Meterials
0	emenai	Mechanical Properties Hor	e are the list of selected membe
Density	MIN MAX	Min Makes	enter is one or any of the mantane is get more information I the selected member
Doet	<u> </u>	Hardsen	nan 2
			num 3
			100A magazine
			50A magnesium
			ota magnesium 2 atuminum
Thomas	Properties		15-aduminum
1101110			of adomination
	MIN MAX		A minimum
Thermal Conductivity			12 ahimimim
Thenhal Expension			14 altaminum 16 altaminum
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Olasa Temperature			No advertise vers
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			C atammum
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	11		
Back to Login		Buy Bring the state of the state of the	Back to Selectore

Figure 24. Screening/Constraints Selection with Max density set at 6.5

It can be observed from the Constraints pane that several material properties can be constrained by setting their limits to achieve a particular material selection purpose. The materials displayed on the Selected Materials pane in figure 24 are materials contained in the database with their densities not more than 6.5.

#### **b. Ranking Selection**

This particular type of selection is based on material indices as described in chapter 2. It depends on the function and objective of the material being selected. First the function of the material is selected. The function is limited to Tiles, Beams, Shafts, Columns, Thermal Insulators and springs. Secondly, the objective of the material is selected. The objective is limited to the following; After the function and objective are selected, clicking the Select Materials button displays the materials in the Selected Materials pane along side with their material indices in the decreasing other ash shown in figure 25 where the function is set at "Tiles" and the objective is set at "Minimum weight, stiffness prescribed".

MARLAB App			- 0	
Select Naterial Tabl				
Function	Construints		Selected Materials	
Tersile Lood Tess	Deferal With MAX	Shechanical Properties	Here are the list of selected member	
Summary of selection	Ceel	Yeang Modulor Hardness Earris Lenis Terosia Strangth	Orgele Jall recordsdemail         21           Grads 362 recyclosemail         31           4064 absension         22           AMISSA reagnessiam         22           AMISSA reagnessiam         25           AMISSA magnesiam         26           AMISSA magnesiam         26           AMISSA magnesiam         26	
Tensile Load(TRes)	Thermal Properties Mills MAX Thermal Confluctivity	Compressive Elworgh Elkongene Endacrose Liver Findaces Toughness	THD sharement         25.5556           1425 sharement         25.5556           4000 sharement         25.5556           1000 sharement         25.5556           1000 sharement         25.5556           1000 sharement         25.5556           1000 sharement         25.3156           1000 sharement         25.3156           1000 sharement         25.1352           1000 sharement         25.1352	
Minimum weight, Mithess prescribed	Thermal Expansion Specific Heal Overs Temperature Metting Panel	Oahiral MiN MAX Pasidualy	1060 okonivara         25,1852           AWS END-4         25           Grade-306 motifytelenum         25           Grade-306 motifytelenum         26           100 okonivara         26           ENN ALL         26           101 okonivara         26           ENN ALL         26           ENN ALL         26           ENN ALL         26           ENN ALL         27,059           EN ALL         27,059	
Constant	Tax to Layn		EN 2488 autority     FOC advantage     FOC advantage     EN 2482     EN 248     EN 248     EN 248     EN     EN	

*Figure 25. Ranking Selection with function set at tiles and objective set at minimum weight, stiffness prescribed* 

The user can equally consider setting some constraints alongside the ranking priority in other to filter the materials needed for the selection purpose(s). The result obtained from figure 25 when density is set at minimum 5.5 and maximum 8.5. The material with the highest material index is considered the best material for the selection purpose except it is disqualified by other criterion which is exposed in the documentation. At every stage of selections mentioned above, further enquiry about a particular material displayed in the Selected Materials pane is possible. Clicking on the material displays a separate window that has all the information stored in the database about the material. EN 1.4889 cast nickel is the best material for the particular selection purpose having the highest material index of 25.3165. Clicking on the material displays the material data available in database Software's functionality significantly enhances and simplifies the material selection process.

It addresses the specific needs of both administrators and clients, providing a userfriendly and logical pathway to meet their goals. The structured approach to adding, editing, or deleting materials in the database is noteworthy. The requirement for users to select from predefined families, classes, and subclasses serves to standardize data entry, reducing errors and maintaining consistency. Additionally, the family, class, and subclass hierarchy seems to be based on a well-thought-out classification system, such as Table 2.1, which likely results in a more efficient and accurate selection process. However, to further improve the software and its utility, several aspects can be considered such as; user training and guidance, data validation and error handling, user roles and permissions, feedback mechanism, and scalability. Given the specific nature of this software, it's crucial to provide users with comprehensive training and guidance. Both administrators and clients should understand how to navigate the software effectively. User manuals or tooltips might be beneficial. Implement robust data validation and error-handling mechanisms to prevent incorrect or incomplete data entry. This will enhance data integrity within the material database.

Consider implementing varying levels of user permissions for administrators. Not all administrators should have equal access and authority within the software. Restricting certain actions based on roles is essential for security. Think about how the software will accommodate growth in the future. As more materials are added and more clients join, the software should remain scalable and efficient. The computer package has successfully addressed the need for efficient material selection. With its structured approach and predefined classification system, it streamlines the process, making it accessible for both administrators and clients. Nevertheless, ongoing attention to user training, data integrity, and scalability will be vital for ensuring the long-term success of this solution.

#### V. Conclusion

This research embarked on the ambitious journey of addressing the complex challenges inherent in the material selection process for engineering applications. The overarching problem was the intricate and time-consuming nature of material selection, exacerbated by the expanding landscape of available materials and the evolving requirements of modern engineering. The culmination of our efforts is a robust and versatile MATLAB-based software package that not only streamlines the material selection process but also introduces novel features to enhance user experience and decision-making. By delving into the major findings, we can draw logical conclusions tailored to the core problems the research sought to address. Streamlined material addition process: The development of a user-friendly interface for material addition, updating, and deletion significantly reduces the likelihood of errors and accelerates the process. This directly addresses the problem of the traditionally cumbersome material addition methods.

Automation in material classification and a structured updating process mitigate the risks associated with manual classification errors and inconsistencies in material databases. This aligns with the objective of simplifying the decision-making process and ensuring data accuracy. The incorporation of material indices for ranking and interactive documentation elevates the decision-making process. Engineers can now systematically prioritize materials based on predefined functions and objectives, gaining in-depth insights into material properties. This addresses the need for a more sophisticated ranking mechanism and comprehensive documentation. Diverse material selection options: The provision of structured options in the Select Material Window, including unconditional, screening, ranking, and documentation, caters to the diverse needs of engineers. This flexibility addresses the limitation of previous tools that often lacked comprehensive and structured material selection options. Efficiency in unconditional and constraint-based selection: Efficient unconditional material selection and the ability to screen based on constraints significantly contribute to time savings and focused decision-making.

This tackles the problem of prolonged decision-making processes and limited screening options in existing tools. In light of these major findings, the logical judgment is that the developed MATLAB-based software package successfully addresses the multifaceted challenges posed by material selection in engineering. It not only fills the gaps identified in prior methodologies but also sets a new standard for efficiency, accuracy, and user satisfaction in the realm of engineering material selection. This research, therefore, stands as a testament to the power of computational tools in revolutionizing traditional engineering processes. The computer package has the potential to not only expedite decision-making but also lay the foundation for future advancements in the field of material science and engineering.

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