Budapest International Research and Critics Institute-Journal (BIRCI-Journal)
Humanities and Social Sciences
ISSN 2615-3076 Online)
ISSN 2615-1715 (Print)
www.bircu-journal.com/index.php/birci

Development of Engineering Material Selection Computer Package for Enhanced Decision Making

Daniel Nwankwo[1], Paul Chukwulozie Okolie[2], Augustine Uzodinma Madumere[3]*, Ugochukwu Chuka Okonkwo[4], Chibuzo Ndubuisi Okoye[5]
[1,2,3,4,5] *Mechanical Engineering Department, Nnamdi Azikiwe University, Awka, Nigeria*
au.madumere@unizik.edu.ng

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.

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

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

(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.

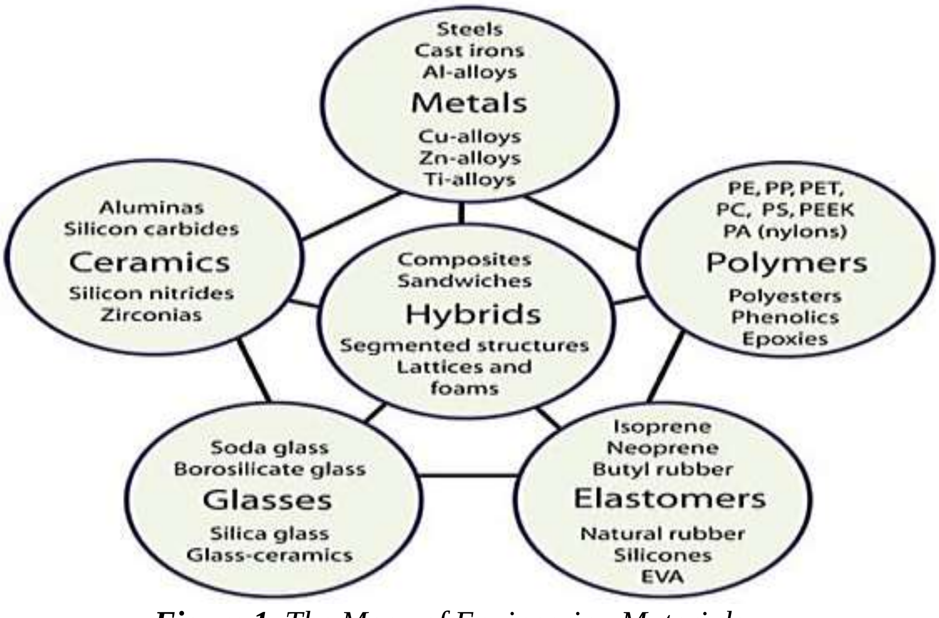


Figure 1. *The Menu of Engineering Materials*

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.

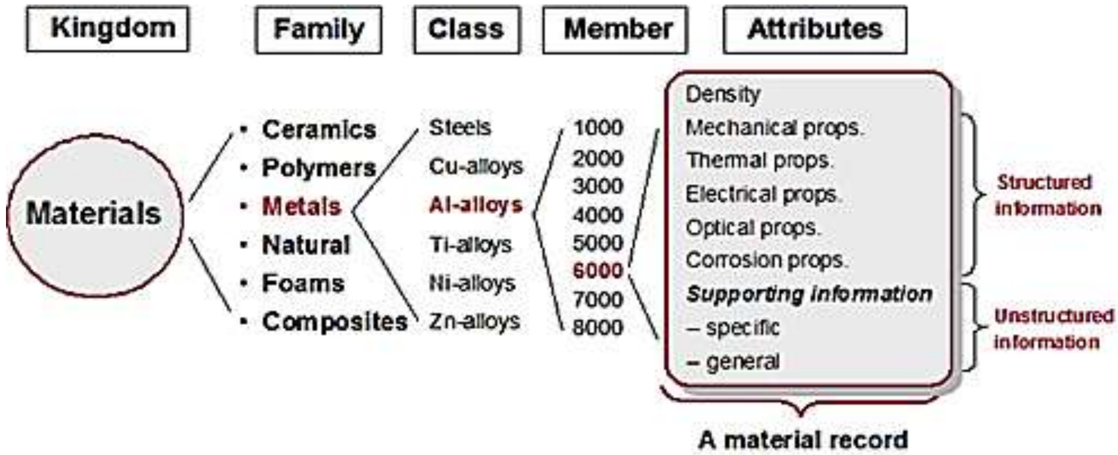


Figure 2. *A Hierarchical Structure For Material Classification*

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 built-in 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.

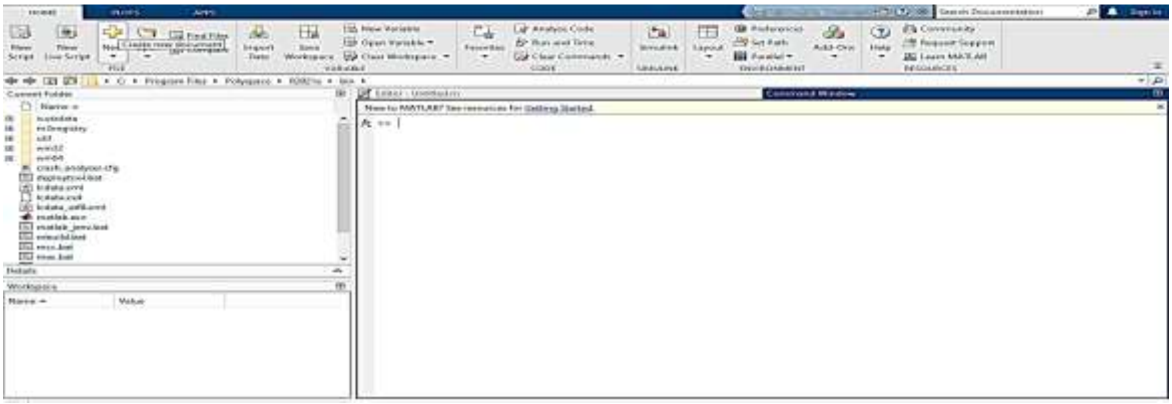


Figure 3. *Matlab version 2021 open in the computer after installation*

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.

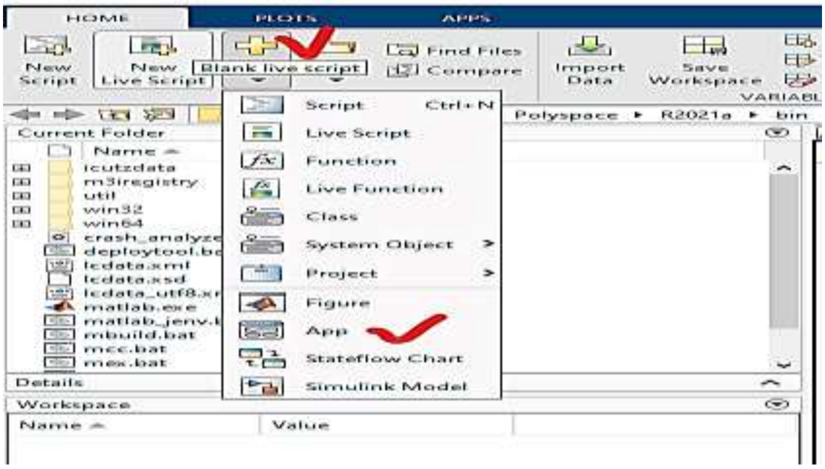


Figure 4. *Navigating to the application design environment*

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

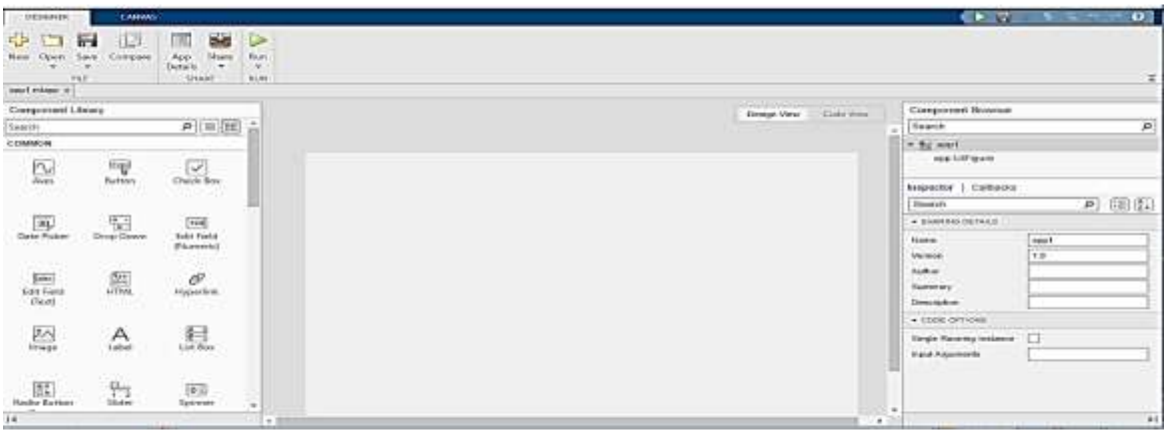


Figure 5. *The application design development environment*

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.

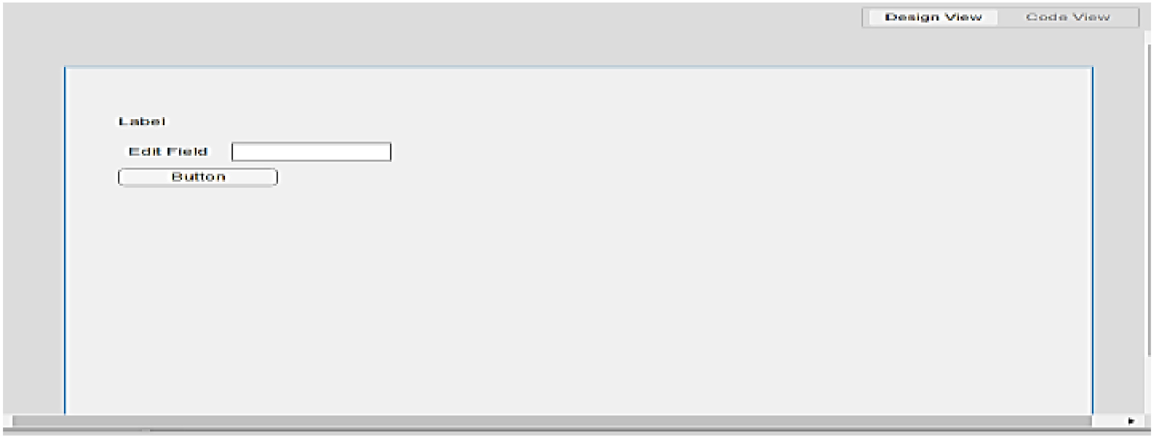


Figure 6. *The Design View of the App Design development environment*

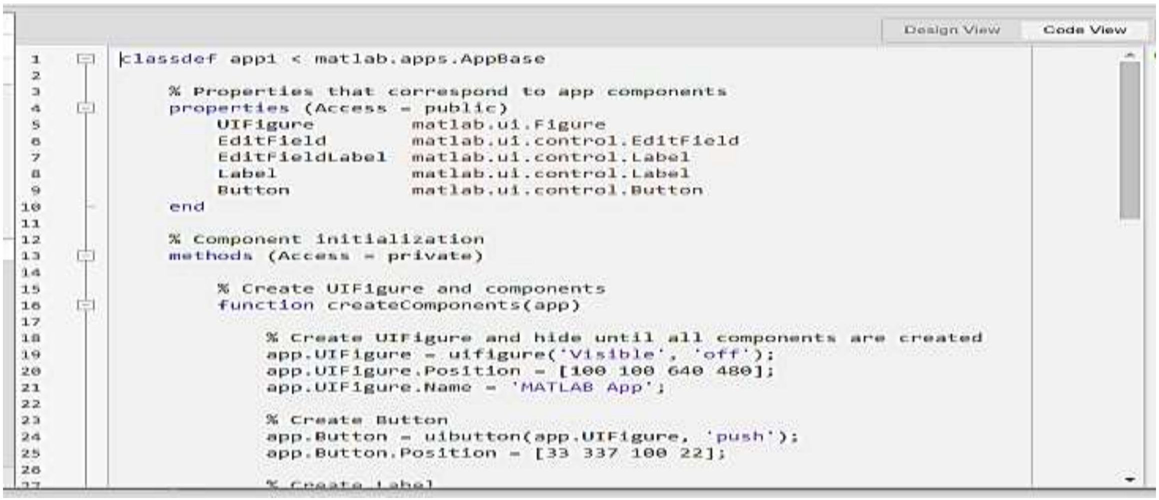


Figure 7. *The Code View of the App Design development environment*

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.

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.

b. The Add Material Window

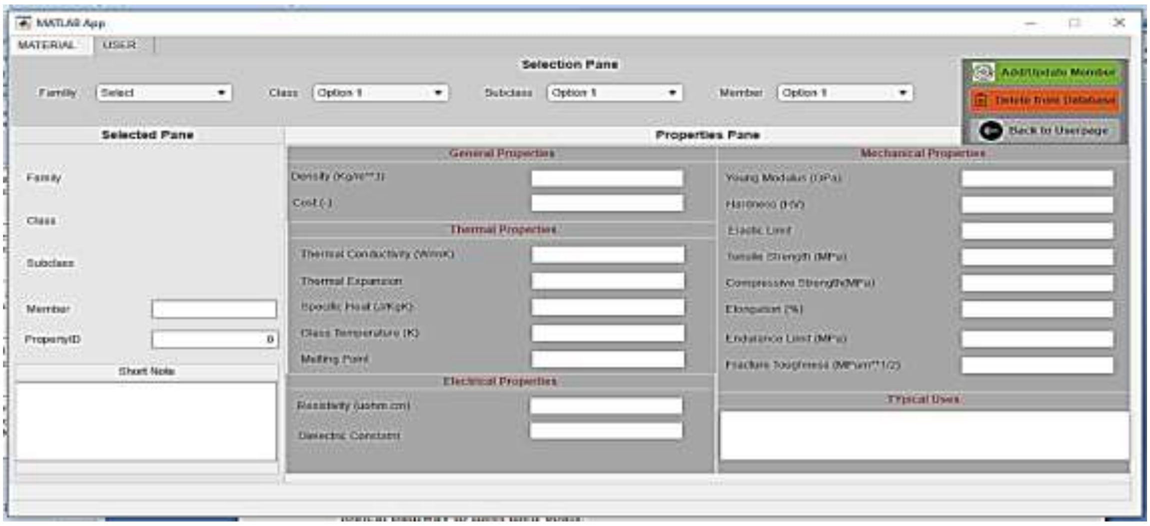


Figure 11. *The material addition window*

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.

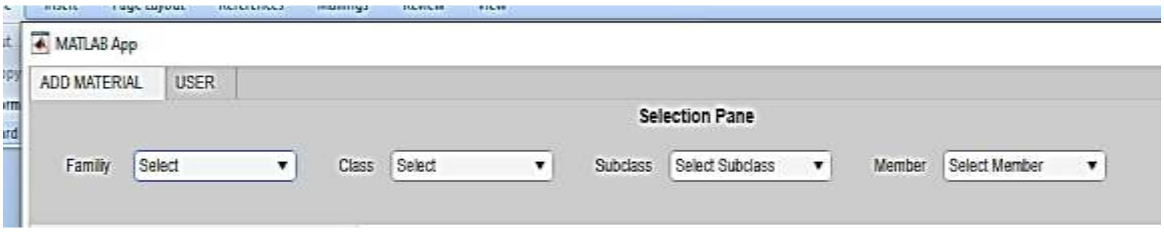


Figure 12. *The selection pane*

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.

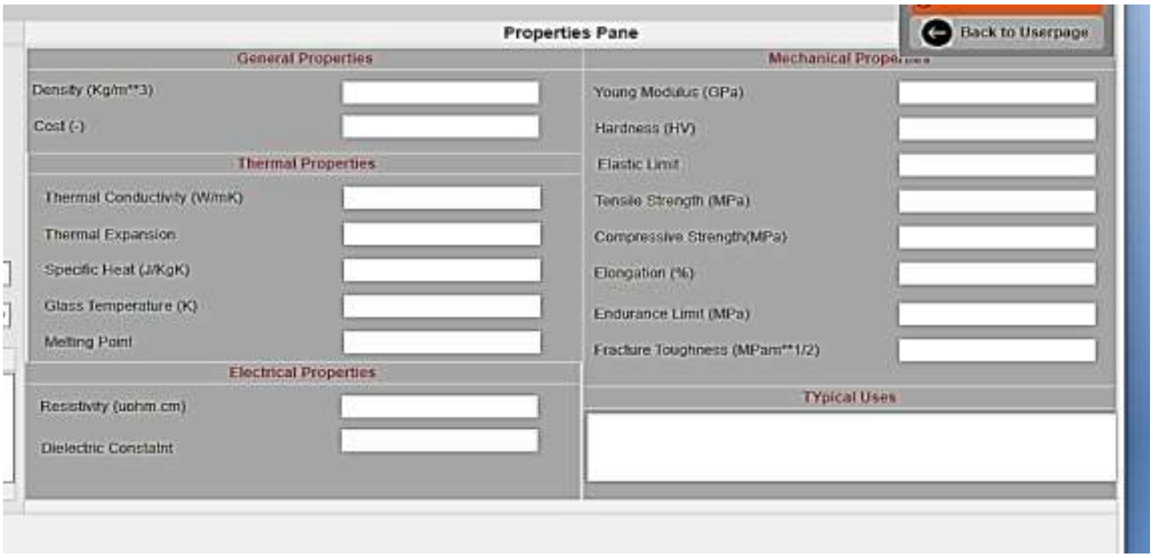


Figure 13. *The property pane displays the properties of selected material*

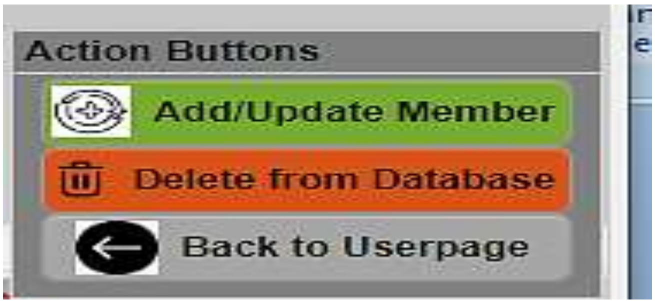
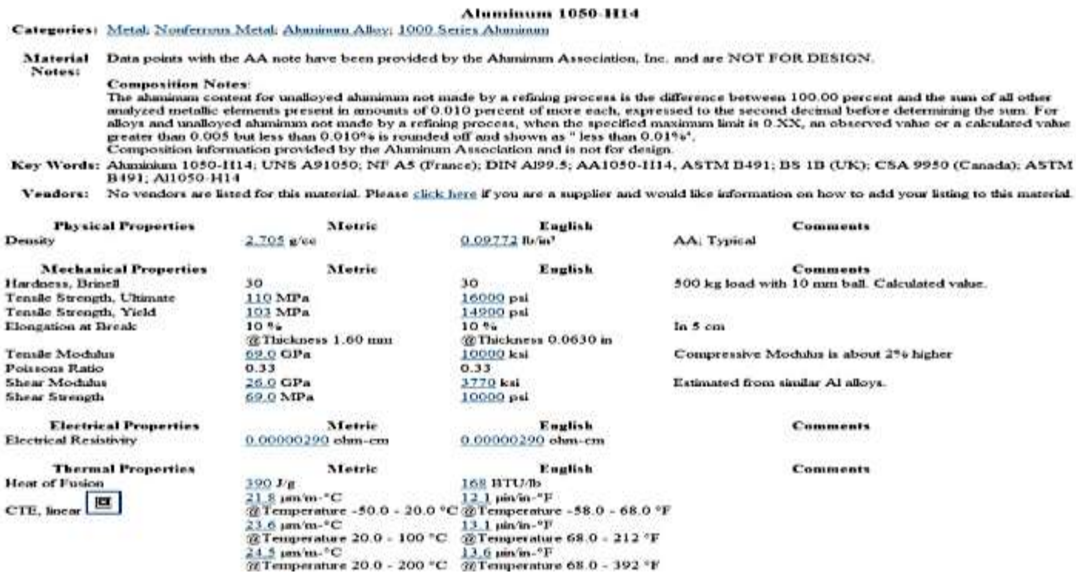


Figure 14. *The action buttons pane*

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; Nonferrous Metal; Aluminum Alloy; 1000 Series Aluminum

Material Notes: Data points with the AA note have been provided by the Aluminum Association, Inc. and are NOT FOR DESIGN.

Composition Notes:
The aluminum content for unalloyed aluminum not made by a refining process is the difference between 100.00 percent and the sum of all other analyzed metallic elements present in amounts of 0.010 percent of more each, expressed to the second decimal before determining the sum. For alloys and unalloyed aluminum not made by a refining process, when the specified maximum limit is 0.XX, an observed value or a calculated value greater than 0.005 but less than 0.010% is rounded off and shown as " less than 0.01%".
Composition information provided by the Aluminum Association and is not for design.

Key Words: Aluminium 1050-H14; UNS A91050; NF A5 (France); DIN Al99.5; AA1050-H14, ASTM B491; BS 1B (UK); CSA 9950 (Canada); ASTM B491; Al1050-H14

Vendors: No vendors are listed for this material. Please click here if you are a supplier and would like information on how to add your listing to this material.

Physical Properties	Metric	English	Comments
Density	2.705 g/cc	0.09772 lb/in³	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 psi	
Tensile Strength, Yield	103 MPa	14900 psi	
Elongation at Break	10 % @Thickness 1.60 mm	10 % @Thickness 0.0630 in	In 5 cm
Tensile Modulus	69.0 GPa	10000 ksi	Compressive Modulus is about 2% higher
Poissons Ratio	0.33	0.33	
Shear Modulus	26.0 GPa	3770 ksi	Estimated from similar Al alloys.
Shear Strength	69.0 MPa	10000 psi	
Electrical Properties	**Metric**	**English**	**Comments**
Electrical Resistivity	0.00000290 ohm-cm	0.00000290 ohm-cm	
Thermal Properties	**Metric**	**English**	**Comments**
Heat of Fusion	390 J/g	168 BTU/lb	
CTE, linear	21.8 µm/m-°C @Temperature -50.0 - 20.0 °C	12.1 µin/in-°F @Temperature -58.0 - 68.0 °F	
	23.6 µm/m-°C @Temperature 20.0 - 100 °C	13.1 µin/in-°F @Temperature 68.0 - 212 °F	
	24.5 µm/m-°C @Temperature 20.0 - 200 °C	13.6 µin/in-°F @Temperature 68.0 - 392 °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.

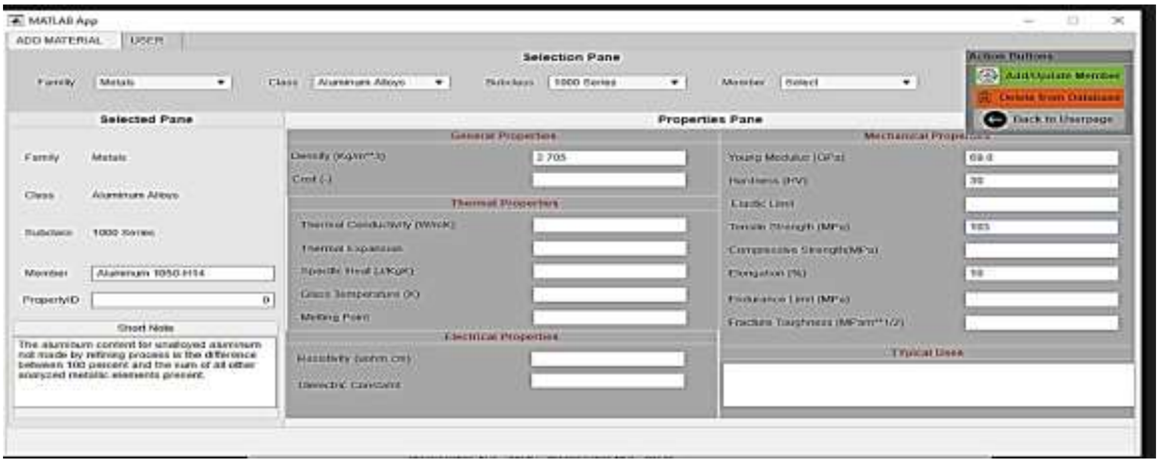


Figure 17. *Inputting the data for Aluminum 1050-H14 in the Add Material Window*

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

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.

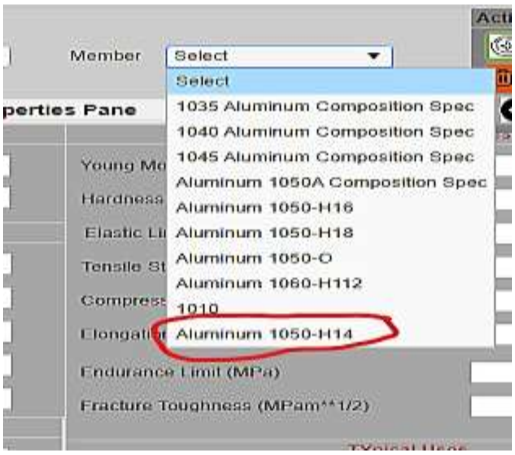


Figure 19. *Aluminum 1050-H14 added to the member database*

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.

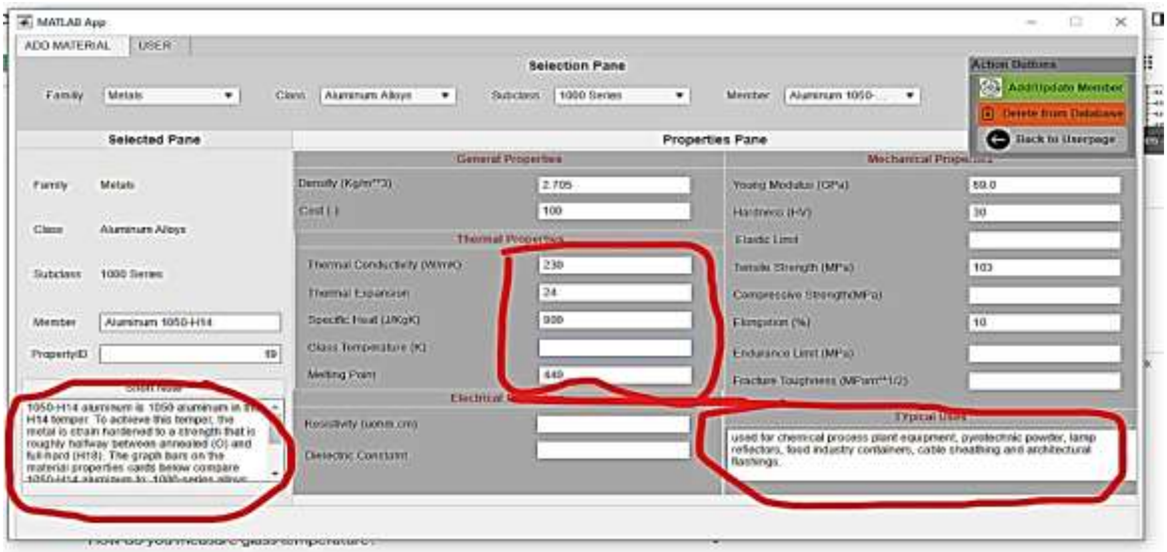


Figure 20. *Updating Aluminum 1050-H14 Properties*

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.

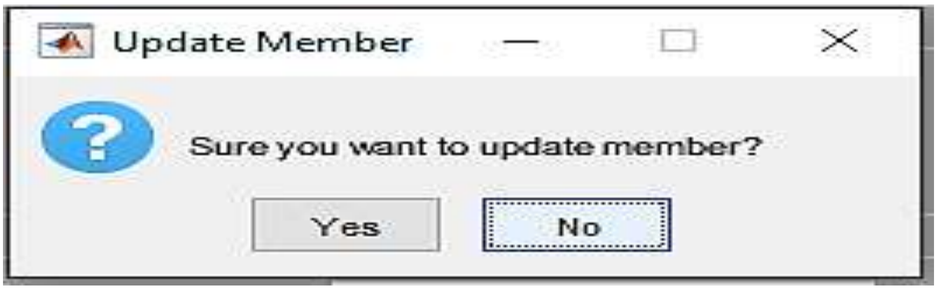


Figure 21. *Update Dialog Box*

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.

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.

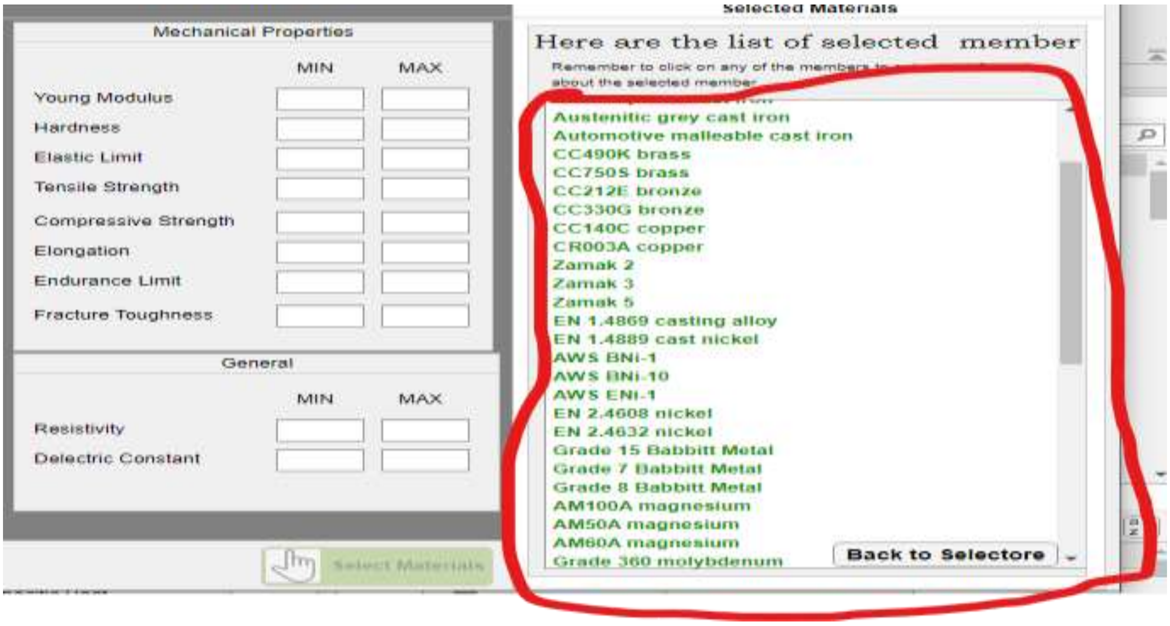


Figure 23. *Unconditional Selection*

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.

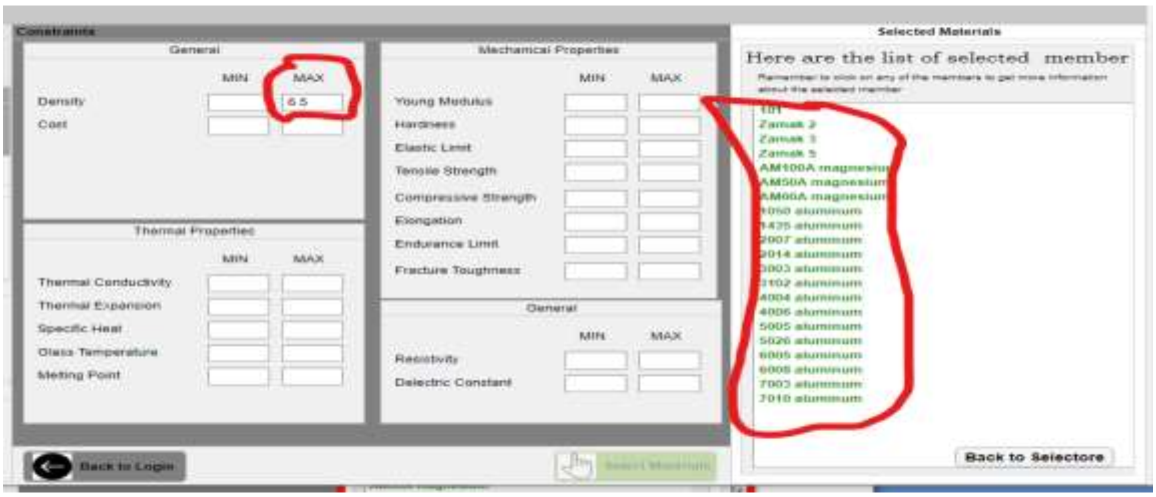


Figure 24. *Screening/Constraints Selection with Max density set at 6.5*

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”.

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 user-friendly 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.

References

Abbas, A., and Wu, Y. (2020). *Interactive Visualization for Materials Science*. Materials Today, 23(5), 34-40.

Ahmed, S., and Ali, M. (2021). *Integration of life cycle assessment (LCA) into engineering material selection*: A review. *Journal of Environmental Engineering and Sustainable Technology, 12(2), 45-58.*

Albahari, J., and Albahari, B. (2012). *C# 5.0 in a Nutshell*. O'Reilly Media.

Ashby, M. F. (2005). *Materials Selection in Mechanical Design*. Elsevier.

Ashby, M. F. (2019). *Materials Selection in Mechanical Design*. Elsevier.

Ashby, M. F., & Johnson, K. (2013). *Materials and Design: The Art and Science of Material Selection in Product Design*. Butterworth-Heinemann.

Ashby, M. F., and Cebon, D. (2017). *Case studies in materials selection for lightweight springs in aerospace applications.* Aerospace Science and Technology, 63, 174-181

Ashby, M. F., and Cebon, D. (2017). *Material classification: Integrating composites and woods into the existing categorization.* Journal of Materials Design and Applications, 231(1), 18-26.

Ashby, M. F., and Cebon, D. (2017). *Materials and Sustainable Development*. Butterworth-Heinemann.

Ashby, M. F., and Jones, D. R. H. (2019). *Engineering Materials 1: An Introduction to Properties, Applications and Design*. Elsevier.

Ashby, M. F., and Shercliff, H. (2019). *Materials: Engineering, Science, Processing and Design*. Butterworth-Heinemann.

Ashby, M., and Cebon, D. (2017). *The challenges in material database development for engineering applications. Journal of Computational Material Design, 13(3), 205-215.*

ASTM International. (2020). *Annual Book of ASTM Standards*. ASTM.

Barati, E., Zakerian, A., &Azarakhsh, A. (2023). *A hybrid Fuzzy AHP and DEA based multi-criteria decision-making methodology for material selection considering uncertainty and performance data envelopment*. Journal of Manufacturing Systems, 52, 87-101.

Booch, G., Rumbaugh, J., and Jacobson, I. (2005). *The Unified Modeling Language user guide*. Addison-Wesley.

Budinski, K. G., and Budinski, M. K. (2019). *Engineering Materials: Properties and Selection*. Pearson.

Callister, W. D. Jr, and Rethwisch, D. G. (2018). *Materials Science and Engineering: An Introduction*. John Wiley & Sons

Campbell, F. C. (2018). *Structural Composite Materials*. ASM International.
Campbell, J. (2008). Complete casting handbook: *Metal casting processes, metallurgy, techniques and* design (2nd ed.). Elsevier.
Dawson, A. (2014). *Effective software documentation practices. Software Quality Journal, 22(3), 141-153*
Duan, Y., Li, H., and Wang, Z. (2022). *Material Selection in Engineering: A Comprehensive Guide*. CRC Press.
Ertugrul, I., and Karakasoglu, N. (2017). *Comparison of fuzzy AHP and fuzzy TODIM methods for facility location selection.* The International Journal of Advanced Manufacturing Technology, 89(9-12), 3245-3258.
Ertugrul, I., and Karakasoglu, N. (2017). *Decision-making methodologies in material selection.* CRC Press.
Fasoyinu, E. O., and Vahdati, N. (2021). *Multicriteria decision making in material selection*. Materials Today: Proceedings, 37(2), 1230-1236.
Flanagan, D. (2006). *JavaScript: The Definitive Guide.* O'Reilly Media.
Fowler, M. (2018). *Refactoring: Improving the Design of Existing Code.* Addison-Wesley Professional.
Gosling, J., Joy, B., Steele, G., and Bracha, G. (2014). *The Java Language Specification.* Addison-Wesley.
Gurrappa, I., Bhat, R., and Rao, A. (2014). *Addressing interoperability in engineering software platforms:* A case study. *Journal of Engineering Software and Systems, 7(4), 290-301*.
Iryadi, I., Ansari, T. S., Zulkarnain, I., & Aisyah, T. (2020). Business Judgment Rule and Fairness Standards in the West: A Theoretical Review. *Britain International of Humanities and Social Sciences (BIoHS) Journal*, *2*(2), 556-565.
Nusa, I. B. S. (2021). Quality of Accounting System and Internal Control: How is the Implementation at PT. Nusantara Jaya Sentosa. *Britain International of Humanities and Social Sciences (BIoHS) Journal*, *3*(1), 86-92.
Romanus, N., Orji, M. G., Oyedele, O. M., & Chris, O. (2023). Assessing E-business and Organizational Performance in Nigeria Today: Evidence from Jumia Ltd, Lagos. *Britain International of Humanities and Social Sciences (BIoHS) Journal*, *5*(2), 81-92.