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# Achieving Excellence: A Guide to Identifying Suitable Materials for Building Structures

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***Abstract:*** ***The materials that make up a building's construction are crucial. Strength of the building, cost, durability, construction time, and other aspects are all impacted. That is why it is imperative that everybody working in this industry understands this. Every time you work on a project, you have the option to select the kind of materials you use. The price of the materials will vary, partly due to the product's quality. Cheaper ones could be of less quality, while more expensive ones are probably going to endure longer. Those who want to save money sometimes use the less expensive materials. Using subpar materials could lead to several issues, even if it might seem like a smart idea now. Here are some problems that may arise from using subpar materials. This essay discusses a variety of topics, including the history of materials, their impact on construction, and building materials.***

***Keywords: Building Materials, Sustainability, Cost, History of Materials, Selection Methods***

## I. INTRODUCTION

### *A. History of Structural Material*

#### *1) Stone Age*

The Paleolithic age saw humans as hunter-gatherers. Due to their peripatetic way of life, they constructed sporadic and transient structures, which resulted in a dearth of surviving architectural remnants. The 1.8-million-year-old stone circle in Olduvai Gorge, which is thought to be the remains of a windbreak, is thought to be the world's oldest example of construction.

Mesolithic times saw the beginning of human agricultural development. To provide temporary cover for their ambushes, hunters and gatherers constructed temporary shelters. The first known examples of artificial shelter are thought to have been built in Terra Amata, France, about 400,000 B.C. as a hunting lodge.

#### *2) Neolithic Era*

Humans began to grow plants and domesticate animals during the Neolithic era, sometimes referred to as the New Stone Age, and established agriculture. Due to this departure from a nomadic lifestyle, people began to construct towns and walls. Apart from dwelling in caverns and utilizing rock shelters, the earliest structures were basic tents, like the Inuit's tupiq, and houses. Like pit-houses, huts were constructed as safe havens with defenses like crannogs. Instead of hiring professional builders, the residents of these shelters self-sufficiently constructed them from locally sourced materials, using customary designs and construction techniques. As a result, the little that is known about very early building is mostly speculative and based on vernacular architecture or what is known about how modern herders and nomadic hunters and gatherers create shelter in isolated regions. For instance, it is likely that the earliest bridges constructed by humans were just straightforward wooden planks positioned over streams, which subsequently developed into wooden trackways. Tools were fashioned by prehistoric man from bone, ivory, antler, skin, stone, wood, grass, and animal fibers in addition to metals like gold, copper, and silver. A variety of tools were manufactured and utilized, including those for scraping or chopping (flake tool), cutting (hand axe, chopper, adze, and celt), and pounding, piercing, rolling, pulling, and levering. They utilized animal dung, bark, bamboo, metal, stone, and bones like mammoth ribs to construct their structures. Bricks and lime plaster were also utilized by prehistoric men for construction. For instance, at Jericho, clay mortar and mud bricks from 9000 BC were discovered. The brickmaker's thumbs created the herringbone pattern on these mudbricks, which were created with their hands as opposed to wooden molds.

## II. MATERIAL SELECTION PROCESS

To achieve the intended performance, quality, durability, and sustainability for your project, it is essential to choose the appropriate building materials. However, how can you choose the ideal materials for your project given its design specifications? This article will teach you how to choose materials in construction management and what criteria and considerations to consider in Fig 1.

 

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*A. Process*

*1) Design Specification*

Knowing your project's design parameters is the first step in choosing building materials. The precise guidelines and standards known as design specifications establish the goals, functions, features, and extent of your project. They cover the project's environmental, mechanical, electrical, plumbing, and architectural elements. The foundation for choosing the right materials to fulfill the functional, aesthetic, and technological requirements of your project is found in the design specifications.

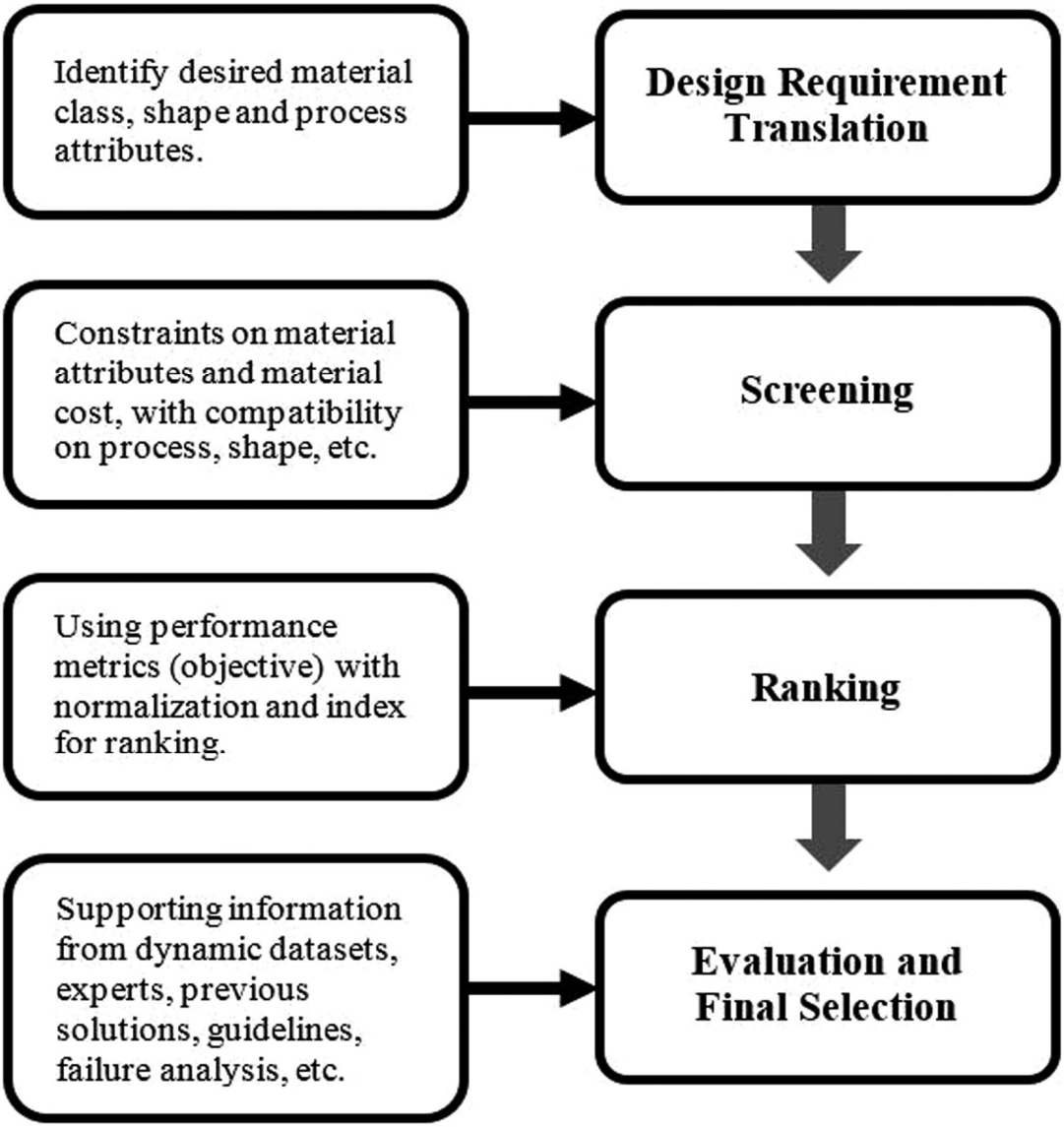


Fig 1. Material Selection Workflow

*2) Material Properties*

Assessing the attributes of the materials that are pertinent to your project is the second phase in the selection of construction materials. A material's behavior and performance under various conditions are determined by its physical, chemical, mechanical, and thermal qualities. Strength, stiffness, ductility, durability, and sustainability are all important factors to consider when evaluating material qualities.

A material is said to be strong if it can withstand failure or deformation when loads are applied; stiff if it can withstand deflection or deformation when loads are applied; ductile if it can undergo plastic deformation without breaking or cracking; and durable if it can withstand deterioration or degradation brought on by external factors and sustainability is the ability of a material to minimize its environmental impact.

 

*3) Material Selection Method*

Using one or more material selection techniques to compare and rank various materials according to your design parameters and material qualities is the third phase in the construction material selection process. Material indices, which are mathematical formulas that combine material attributes and design demands into a single number, are examples of systematic and logical material selection procedures.

There are also graphical depictions that plot two or more material qualities on a coordinate system called material selection charts. Finally, there is material selection software. These computer-based programs search, filter, sort, and analyze various materials according to your design parameters and material qualities using databases, algorithms, and interactive interfaces. When choosing building materials, these techniques might help with the decision-making process.

*4) Material Testing and Verification*

To make sure the materials you have chosen match the project's design requirements and quality standards, you should test and verify them as the fourth stage in the selection process. Depending on the nature and scope of your project, this procedure may involve measuring, examining, and assessing the material's performance under real-world or simulated settings, either in a lab or on-site.

The material is tested using non-destructive testing (NDT), which include methods including visual examination, ultrasonic testing, magnetic testing, or radiography testing without causing any harm or modification to the material. The material is damaged or destroyed using destructive testing (DT) techniques like tensile, compression, bending, and fatigue testing. Sampling, statistical analysis, and auditing are examples of quality control (QC) techniques that are used to verify that the material complies with design specifications and quality standards.

*5) Material Optimization and Innovation*

Optimizing and innovating material performance and utilization is the fifth phase in choosing construction materials, and it will help you get the greatest results for your project. Material innovation and optimization refer to the process of developing, enhancing, or producing novel materials that can raise the project's value, efficiency, and efficacy.

This could involve using less material overall without sacrificing functionality or quality, recycling waste or existing materials for your project or other projects, and replacing traditional or current materials with new or alternative materials that can provide better quality, performance, durability, or sustainability.

Using lighter or thinner materials, removing superfluous materials, repurposing, or refurbishing materials, using composite or smart materials, and implementing new technologies or procedures are a few examples of this.

## III. SELECTION OF CONSTRUCTION MATERIALS: INFLUENTIAL FACTORS

*A. Strength*

The most crucial factor to consider when choosing building materials is strength. It shows how well the materials can tolerate stresses including shear, tension, and compression in Fig 2.

For example, there are multiple steel grades available to contractors, each with a different yield strength. Low steel grade can be utilized in this situation to cut costs if the construction is not intended to support heavy weights. Still, a lot will depend on how readily available steel is on the market.

*B. Durability*

Building a structure with a long lifespan and low maintenance costs requires components that are durable. Therefore, while some materials may cost more than others, these higher costs will be mitigated by future low maintenance expenses.

*C. Cost*

The ultimate choice of materials will typically be determined by the cost of the building materials.

Building material expenses are essential since they account for a significant amount of the overall expenditure. In the end, it manages the project's total cost.

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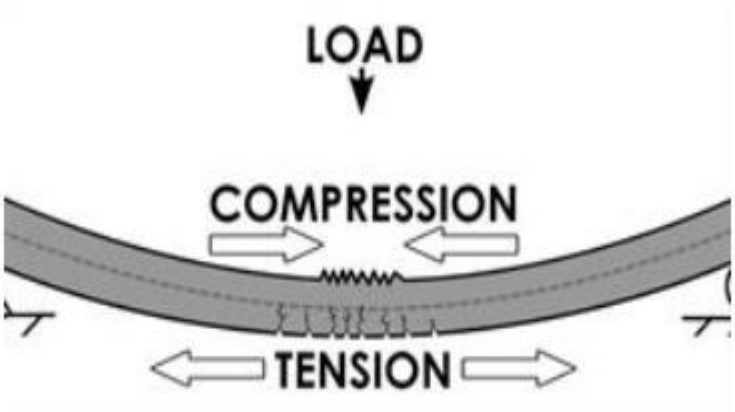


Fig .2 Compression and Tension in Material

*D. Locally Available Materials*

Local material availability has an impact on building costs and schedules. The cost of transportation will be considerable and the work may be delayed if the materials are located far from the construction site and are not ordered in advance.

On the other hand, less transportation expenses and a smooth construction process will result from locally sourced supplies.

*E. Handling and Storage*

Another important consideration is how materials are handled and stored, as this has an impact on construction time, personnel and equipment requirements, and cost in Fig 3.

Fig 3. Storage of Construction Materials

*F. Climate*

Another crucial element that needs to be taken into account while selecting materials is the climate. The factors to be concerned about are things like the typical annual temperature range, wind, rain, snow, and weather, as well as the quantity of sunlight and ventilation that are needed.

There is a relationship between the characteristics of building materials and climate. Therefore, the materials chosen should take the local environment into consideration when building a construction.

*G. Required Skills and Avaibility*

The decision-maker should be aware of the level of competence necessary to use each material while choosing construction materials. The price of building goes up if expert labor is required. Furthermore, construction projects are delayed if skilled personnel is not accessible, which is typically the case in remote places.

*H. Sustainability*

The desire for lowering carbon emissions is driving up the need for sustainable development.

Stricter guidelines about carbon release are constantly being established by applicable codes and standards. Because of this, decision-makers tend to favor environmentally friendly materials that can be used to cut down on carbon dioxide emissions and cement consumption, such as fly ash, ground granulated blast furnace slag, and silica fume.

*I. Recycling*

When choosing materials, their capacity to be recycled at the end of their useful lives is crucial. For example, rather than using weld connection steels, designers and developers should choose bolted steel connection kinds.

The former is fully recyclable, but it may take more time and accuracy to finish. The latter, on the other hand, is scarcely recyclable without adding more carbon to the climate.

*J. The Function of The Building*

The selection of building materials can be influenced by the purpose of the structure, as it directly impacts the inhabitants. The material that has been chosen specifies the area that is being built.

As the principal load-bearing component of a load-bearing construction, you should choose premium masonry bricks.

*K. Aesthetic Appearance*

The kind of material determines how the building looks. Some people may find a particular appearance charming, whereas others may not find it attractive.

Because the owner may have chosen the kind of appearance the building should have, their requirement is therefore quite important in this situation. For instance, the kind of material affects how the floor looks, so the material should be chosen to provide the desired appearance.

Flooring can be made from a variety of materials, including wood, granite, marble, vitrified tile, ceramic tiles, and Kota stone. The most expensive floor material might also be the most aesthetically pleasing, so that narrows down the alternatives.

*L. Maintenance*

The choice of materials can occasionally be influenced by maintenance, as high-quality materials preserve the building's visual appeal while also being inexpensive to maintain.

*M. Specifications*

Another crucial factor in the choosing of materials is specifications. For a particular project, the necessary strength, durability, and aesthetic appeal are taken into consideration while determining the material specifications and quality.

For example, if a building is built in a tidal zone, the specifications might specify a cement type that can withstand attacks from carbonation and chloride. Additives and additional cementitious materials might be required in this situation.

*N. Guarantee*

To guarantee the correct material selection, carefully review and comprehend the product description, technical specifications, and guarantee terms and conditions. There are situations where a salesperson's presentation or the material selector's understanding can be deceiving.

*O. Support and Service After Sell*

While selecting materials, it is crucial to take services and post-purchase support into account. Thus, find out if the seller offers services and support like regular or yearly repairs, spare parts, etc.

## IV. CONCLUSION

You always have the option to select the kind of materials you use when working on a project. The cost of the materials will differ depending, partially, on the type of product. More expensive ones are probably going to endure longer, while less expensive ones might be of lesser quality. Some choose the less expensive materials to save money. Although at first glance this would seem like a smart idea, employing subpar materials could lead to several issues. Thus, no one should be given a tipping point when choosing materials because all of these have been covered in this document.

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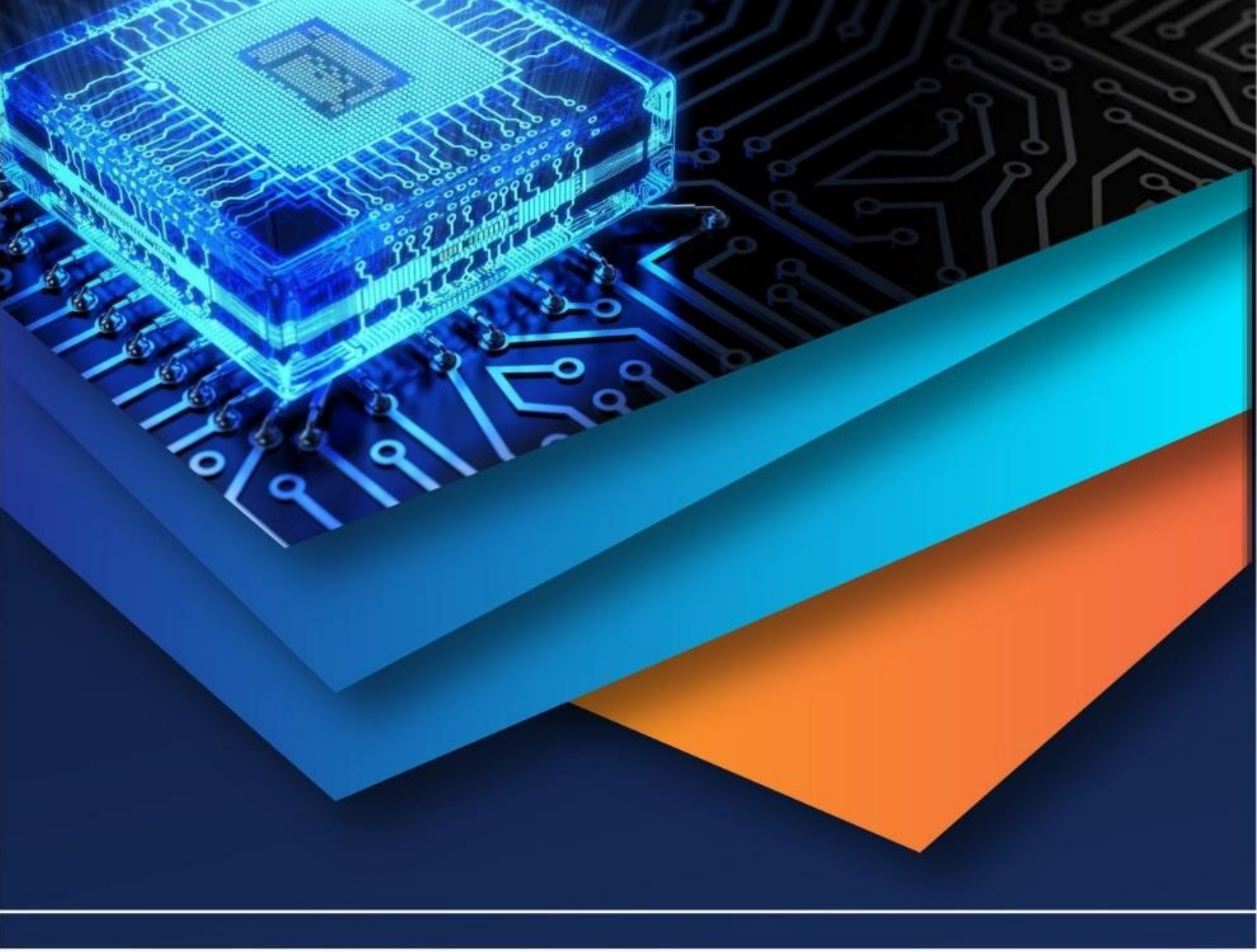

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