



# REVIEW OF LITERATURE

## **CHAPTER – II**

### **REVIEW OF LITERATURE**

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A review of literature is the art of looking again over something to correlate or improve a general survey or reconsideration of some subject or thing (Fowler, 2014). The review of the literature is an essential part of any research. It is a condensed version of an exhaustive literature survey. It helps to understand the problem and to place it in its proper perspective and go through the related theoretical write-ups and carefully review the research done on the related themes to provide insight for identifying the need for the research that can further be conducted (Kerlinger, 2007). The relevant highlights of the connected literature studied are conferred during this chapter, in two broad categories: 1) Theoretical Orientation and 2) Empirical Studies.

The theoretical orientation includes related literature reviewed by the researcher throughout the research, whereas empirical studies include studies conducted by different authors in India and Abroad related to any relevant area of the research problem.

#### **2.1 Theoretical Orientation**

- 2.1.1 Problems faced due to Scarcity of Space
- 2.1.2 Space Planning
- 2.1.3 Multipurpose Furniture
- 2.1.4 Furniture Materials
- 2.1.5 Need to Plan Multipurpose Furniture for Small Space Houses

#### **2.2 Empirical Studies**

- 2.2.1 Studies on small spaces
- 2.2.2 Studies related to multipurpose furniture
- 2.2.3 Studies related to multipurpose furniture designing

#### **2.3 Conclusion**

## **2.1 Theoretical orientation**

Theoretical orientation is the section that describes the theoretical content related to the topic of the study. These are discussed independently in the succeeding description.

### **2.1.1 Problems faced due to Scarcity of Space**

According to United Nations, World population prospectus 2019, there are nine countries, that will make up more than half of the projected population growth by 2050. The largest increase in population between 2019 and 2050 is predicted in nine countries; one of them is India. Around 2027, India is projected to overtake China as the world's most populous country. <sup>3</sup>

Everyone wants their home to be big, pleasant, comfortable, and beautiful (Gandotra & Patel, 2006). But lack of space in cities, rising prices of buildings, and low salaries act as a hindrance in fulfilling the dream of possessing such a house. People are migrating from rural areas to urban areas for the betterment of their future. They come to urban cities some for their studies, some for jobs, some for the settlements for the future, some due to their transfers, etc. So, owning a large space or bungalow becomes quite impossible due to overpopulation. Furthermore, owning a large house is very difficult due to inflation and low salaries. Due to the problem of space people are forced to live in small-spaced apartments.

India is the 7<sup>th</sup> largest country in the world, it has 28 states and 8 Union territories, with around 400 cities.<sup>4</sup> Cities consist of very large numbers of people living in a relatively small amount of space. Some of these people are economically stable, while few people have very little earnings. This imbalance gives rise to the problem of housing. Urban housing is often not affordable for many city residents, as housing prices in cities can be very high. Usually, the price of houses in the city is higher than in rural areas, and the residents' incomes are typically very low. Cities have a great need for adequate, affordable housing. Thus, designing a space with a specific purpose considering the scarcity of space and other resources is necessary. Along with that, it is necessary to make optimum utilization of available space, one needs to design proper furniture.

As per recent research in 2022, it is projected that the country's increasing urbanization will benefit the furniture sector in India. The demand for residential and commercial infrastructure development is being driven by the area's rapidly growing middle class. The demand for creative and distinctive home décor solutions is also being driven by increased disposable income and improved living standards. In addition, the popularity of working from home is driving increasing demand for furniture with multiple uses to support home offices. There are more creative furniture solutions available now to help with space-saving approaches and provide an elite appearance in this regard. Additionally, it is anticipated that the increasing accessibility of a wide variety of furniture on internet marketplaces is boosting their sales <sup>5</sup>.

The recent market collapsed due to the COVID-19 pandemic. A lot of people are suffering from financial problems. Thousands of people became unemployed and lost their homes, pensions, and almost every financial aid they earlier possessed. This economic catastrophe left many people questioning the solution they could afford. Eventually, many people were forced to live in small houses without many facilities or an unplanned and unorganized structure. Since they had limited access; they had minimum options left.

When it comes to small spaces, there is a common misconception that it is not worth the time or money that it takes to create a beautiful home. On the contrary, small spaces are always worth working on, more than larger ones in any setting. The main reason for it is that each inch of space to be valued and used most efficiently. Thus, it is evident that space is one of the most valuable assets for anybody, with prices per square foot increasing all the time.

The Indian furniture industry is anticipated to witness healthy progress soon. This progress can be attributed to the intensified demand for home furniture, fuelled by the expanding population and speedy urbanization in the region. This is leading to rising investments in structure renovation activities, with consumers increasingly adopting aesthetic furniture solutions. In addition, the growing disposable incomes and improved living standards are also driving consumers to invest in household décor enhancement solutions. These factors are projected to aid market growth in the future. <sup>5</sup>

## **2.1.2 Space Planning**

Space planning is a broad concept that includes utilizing available space considering the requirements fulfilling the need and adding an element of art that beautifies the overall space.

### **2.1.2.1 Meaning of space planning.**

Creating spatial concepts and interrelationships that will be responsive to the users' need is a part of designing| a method called house planning. It involves various ideas on paper followed by real execution to accomplish the needs/desires of the resident.

Planning a house is more important than designing a house because it is important to meet the consumer's practical, physical, and psychological needs. Planning also includes aesthetic and visual concerns of the space, creating a functional relationship between the space and its inhabitants (Stamp & Ulloa, 2020).

Nowadays due to the lack of space, it becomes important for interior designers to be aware of the wise use of space. The core objective of Interior designing is to create interior spaces that are both functional and aesthetically appealing. The interior designer's job is to convert a house into a home.

### **2.1.2.2 Importance of small space planning**

Space planning is a broad concept that includes the allocation and division of the interior of a house according to the people residing in the unit. And if the space is small, it becomes even more significant to plan the space wisely.

The philosophy of beauty is known as aesthetics. Aestheticians have studied objects made by man, and by determining what qualities are common to all beautiful things, have established certain laws and principles that help us to recognize and appreciate beauty. These principles form a basis for judging the art quality of any object. An

understanding of the components, principles, and aims of art helps to clarify vague ideas about beauty, partly by providing a standard terminology relating to it. The use of art components namely line, form, Texture, pattern, light, and color; according to art principles namely, proportion, balance, emphasis, rhythm, repetition, variation, opposition, and transition helps to achieve the objective of art. Art includes expressiveness (personality), unity, order, honesty, functionalism, fine space relations, and colour harmony which facilitates accomplishing the goal of designing beautiful space (Rutt, 1948).

Thus, we can say that prioritizing family desires and necessities, over style and aesthetics, accomplishes the goal of effective space planning. One needs to consider a variety of factors and consider most possibilities, in terms of space planning for a residential unit like considering the available space and thinking about utilizing it in the most optimal manner seeing the economic limits of the people residing in the residential unit.

According to Guardian (2014), effective space planning can be achieved by selecting the proper size of the furniture, adequate placement of existing furniture with well-planned privacy, as well as avoiding too much cluttering of the space. Ideally, one is compelled to rent the expertise and skilled professional to achieve the desired interior of the space. Sometimes it can also be achieved by smart use of various techniques and principles resulting in optimum usage and delightful outcomes.

In planning a new residence or refashioning an existing one, one can take into consideration the following design concerns. (Kilmer & Kilmer, 2014)

1. The user's needs, characteristics, aspirations, and activities.
2. The context of the residence: location, orientation, and relationship to the physical and societal patterns.
3. The economics or budgeted money for the project.

4. The aesthetic influences concerning beauty and character that the designer and the client exert.
5. Sustainability, energy conservation, and environmental concerns.
6. Possible long-term use or flexibility of the residence for changes such as children growing up, moving out, or aging-in-place users.

Thus, the above points are to be considered in designing walls, floors, furniture, and other accessories for the new residence especially when the house is small.

### **2.1.3 Multipurpose Furniture**

Multipurpose furniture is a kind of furniture, in which more than one purpose can be achieved, with a single piece of unit.

#### **2.1.3.1 Meaning of Multipurpose Furniture**

According to Yerdle, 2013

“Multipurpose furniture can: expand or shrink depending on needs, serve two purposes at once, or transform seamlessly from one function to another.”

(Yerdle, 2013)

Over the years, the population has grown significantly, demanding more space to create residential spaces. Houses are manmade creations, which are the outcome of transforming the environment into a household. The rapid increase in houses sometimes creates cluttered slum-like regions, especially in small cities. With little to no money, families end up settling in very small dwellings. With their inability to afford new houses or expand the existing ones, the next-generation family often share the same living space; thus, intensifying what was originally a complex problem (Wilhide, 2008). Overcrowded homes could result not only from more family members but also from mismanaged space. The solution, to this problem, was identified by proposing multifunctional furniture. Furniture could be designed in a way to serves multiple purposes. This space-saving concept is there for many years; however, it was not as popular as it is in current times. With the passing of time, the importance and

convenience of multifunctional furniture were recognized, particularly due to the increase in urban lifestyle which is associated with limited living surface area. Transformable space-saving furniture which uses less space and provides dual functions is called dual-function furniture (Gauer, 2004). There are many kinds of transformable space-saving furniture, which are readily available in the market. A few examples are coffee tables that convert into dining tables, bookshelves that transform into beds, sofa cum beds, folding chairs, and tables. Most commonly, the main drawback of readymade furniture is that, if they are made of good quality, they are expensive and if they are made from cheap materials; then they are generally less durable.

Multipurpose furniture saves space, especially floor space making the space more efficient. It also saves money as the cost is reduced to only one piece of furniture rather than two/three separate pieces of furniture. The cost is also saved for the number of raw materials used and the labour cost involved in its construction.

### **2.1.3.2 History of Multipurpose Furniture**

In modern times some people might believe that space-saving furniture, multifunctional design, and tiny transforming spaces are new concepts. Though in reality, it is a misconception. These concepts of multipurpose furniture or designing space-saving furniture is there since olden times. As with the passage of time, people are expanding their habitat across the globe and they need to find methods to make their homes more space-efficient and their products more adaptable.<sup>5</sup>

A lot of folding furniture was invented until about the 1900s. The most common example of space-saving furniture is folding chairs which initially showed up with the Romans or the Egyptians. It had multiple characteristics like being foldable, portable, and effectively storable, which made them popular.

The folding beds would disappear during the daytime and come out only at night-time when one needs to sleep. These beds were designed with the purpose of folding up neatly and saving space occupied by the bed during the daytime and were kept away in the storeroom when not in use.

Since ancient times, people are searching for approaches to make their homes more space-efficient and items more flexible. (Goel, 2021).

The researcher came across some inventive and uncertain space-saving designs like range-refrigerator<sup>6</sup>, collapsible shoe-shining stands<sup>7</sup>, folding canvas sheets<sup>8</sup>, portable globe houses in 1961<sup>9</sup>, bedroom living rooms<sup>10</sup>, folding bathtubs<sup>11</sup>, dream desk from 1947<sup>12</sup>, two beds built in the space of one, April 1939<sup>13</sup>, bunk room, convertible couch, folding armchair, dresser table, folding table. Wonda chair<sup>14</sup> and folding iron board, Danish furniture which knocks down for moving from 1947<sup>15</sup> and many such pieces of furniture.

Thus, it can be said that in the past there were furniture pieces with multiple uses. Some were created with the purpose of ease of handling, while some with portable purposes. Although space scarcity is a problem faced in recent years, multi-purpose furniture is found since olden times in the history of furniture. With the passing of time, more space-saving furniture is found. If the present market is considered multifunctional furniture is used not only in small houses or in spaces with space scarcity but also used in sophisticated interior designs. Many constructions have automated convertible furniture, which saves space, though involves a lot more investment as compared to manually operated multipurpose furniture.

### **2.1.3.3 Importance of Multipurpose Furniture**

It is rightly said that furniture is one of the most important elements in decorating a house. It is always challenging to transform an empty room into a specific room with some utility. For example, if one wants to create a bedroom, out of an empty room, one needs to design the floor, wall, ceiling, and most importantly the furniture necessary to live in that room. Without designing the specific furniture necessary for the room, the room is just an empty box.<sup>16</sup>

Following are the reasons which highlight the importance of selecting appropriate material for the Furniture.

1. Furniture materials help in adding comfort to the furniture. (Rangwala, 2015)
2. Durability of the furniture is very important which can be assured with the selection of an appropriate material. Along with strength, it is important to identify that the furniture should reduce the overall weight of the product/component.
3. Portable furniture is designed by choosing a material that has a pleasant texture, is strong, and is not too heavy to carry.
4. Aesthetics is also one of the most important factors when constructing an interior space, thus it is important to choose a furniture material that can be given an appealing finish (Trivedi, 2019).
5. The material should be flexible enough to fit into various settings for which the furniture design is intended. It must be able to maintain constant dimensions, form, and strength under extreme pressure and heat.
6. Furniture material having sustainable for the environment should be preferred.
7. If the appropriate material is not selected, it impacts the design of the product/component making it highly susceptible to failure.
8. When referring to upholstered furniture, the choice of suitable fabric is also a component of the furniture design.

#### **2.1.3.4 Advantages of Multipurpose Furniture**

Some of the space-saving furniture that is available includes folding tables which means a dining area that converts back into the living area after its use. Folding tables make it easy for one to have convertible rooms within a home. People are converting their space for the activities that they are taking part in, rather than simply having set furniture or decor that offers no excess storage or conversion. Every piece of furniture should be designed to offer either extra storage or provide some

type of conversion so that one can save space and have space readily available for activities. Folding tables make it easy to entertain or have a sit-down dinner even in a small space, many folding and convertible dining tables can be instantly converted into other items such as desks, smaller coffee tables, and more. Multipurpose furniture takes different positions giving a user, extra floor space available and allowing oneself to have a much larger and more comfortable living space. (Hotz, 2015)

Few Multipurpose furniture available in the market includes convertible box furniture, transformable chairs, office on wheels, and transformable office (Dunn, 2020). Murphy beds are also quite popular and are used in many residential interiors, both in small houses and sophisticated residences. (Perry, 2020) The other most common multipurpose furniture is a sofa converted into a bed. The sofa set could be used in the daytime to serve the purpose of the living room. And the same room could be used as a bedroom during night-time by converting a sofa into a bed (Gohri, 2023).

The advantage of space-saving furniture is that it allows one to stretch. Every piece of furniture has a scope to either provide extra storage or provide some type of conversion so that one can save space and have readily available space for the activities that one needs to complete.

#### **2.1.4 Furniture Materials**

There are a variety of furniture materials which are available in today's market. As a consumer one always has confusion, regarding the selection of material that is appropriate for their furniture. One needs to think about the advantages, disadvantages, and properties, which are associated with each material. Along with that the cost also plays a major role in the selection of the material for furniture.

### 2.1.4.1 Furniture Materials proposed by the researcher in designing Multipurpose Furniture:

Though there are many furniture materials available in the present market; selecting the appropriate material to design multipurpose furniture considering its cost is very crucial. The material should be selected considering its durability, resistance, and strength along with price, and affordability for the end users.

There are varieties of materials available in today's global market where transportation plays a major role. Below listed are the Furniture materials which can be used in designing Furniture. <sup>17</sup> (Estonia, 2017)

1. **Wood:** The wood can physically maintain its structural integrity in long run. Furniture and other wooden objects discovered at various excavation sites serve as examples of how wood may persist for hundreds or even thousands of years in exceptional condition. It can resist elemental and natural forces of decay although degradation can occur from fungus (caused by cycles of rain/moisture), termites, or other tedious/destructive insects.<sup>18</sup> Wood exhibits a low thermal conductivity (high heat-insulating capacity) compared with materials such as metals, marble, glass, and concrete (Tsoumis, 2020).
2. **Plywood:** Plywood is an assembly of sheets of wood bonded together to produce a flat sheet. the normal product consists of at least three plies, with the grain in the alternate plies running at right angles. (Tailor, 2020). With high strength and stiffness-to-weight ratios, plywood is very cost-effective. Plywood does not corrode and is durable material so can be used in the construction of furniture used in most of the interior space. <sup>19</sup>
3. **Fiber Board:** Fiberboard is an engineered wood product composed of wood fibers.<sup>20</sup> Following are different kinds of fiberboards used in the construction of furniture.
  - **High-Density Fiber Board (HDF):** High-Density-fiberboard (HDF) is an engineered board produced from resin-bonded fibers under high pressure and heat. HDF is a non-load-bearing product for interior use in dry conditions. HDF, due to its very fine surface, is suitable for different coatings – veneering, laminating,

painting, and varnishing. HDF is available in a variety of thicknesses and different finishes like plain and sanded surfaces on one or both sides.

- **Medium Density Fiber Board (MDF)** Medium-density fiberboard (MDF) is a type of engineered wood that is created by breaking down hardwood or softwood residuals into wood fibers, mixing them with wax and a resin binder, breaking them down into a pulp-like texture, and creating panels under high temperature and pressure. MDF is denser than plywood (Bloch, 2012). It is composed of separated fibers, yet it may be utilized as a construction material in the same way as plywood is. It is denser and stronger than particle board (Sebring, 2019). When exposed to moisture, unfinished MDF can swell and lose strength. MDF is an excellent building material, as it accepts glue bonds very well and joins securely with nails and screws with minimal chances of fracturing, making the furniture sturdy (Beneke, 2020).
  - **Particle Board:** Particle board is created by pressing wood fragments together with adhesive. The chips in flat-pressed particle boards are mostly parallel to the surface. Because the chips in the surface layer are smaller than those in the center layer, the particle board's surface is denser and more compact than the middle. Urea formaldehyde is mostly utilized as a glue in ordinary particle boards.<sup>21</sup> They are categorized in order of increasing density, with High-Density Fibreboard or Hardboards having a higher density than the other two categories, particleboard, and medium-density fibreboard. It is denser, considerably stronger, and tougher due to its density.
4. **Plastic:** There are two types of plastics used in the furniture industry: thermoplastics and thermosetting polymers. The molecular structures of thermoplastics and thermosetting polymers vary. Thermoplastics are made up of two-dimensional molecular chains that soften when heated. Thermosetting polymers sometimes

referred to as thermosets, are a form of plastic with three-dimensional molecular chains. Thermoset molecular chains form stronger bonds to provide a stronger framework for furniture components, making this type of plastic more durable than thermoplastics. Plastics are manufactured out of non-renewable hydrocarbons. According to Value Created Resources, thermoplastics used in furniture are more ecologically friendly than other forms of plastic since they can be melted down and recycled (Hamilton, 2017).

5. **Aluminum:** Aluminum is an excellent material, which could be used in all weather conditions in outdoor furniture. It does not easily rust, it is light in weight and convenient to use, and possesses good strength. Aluminum is long-lasting if correctly handled throughout the initial production process, it does not degrade, or decay.
6. **Stainless steel:** It is both corrosive and stain resistant due to its waterproofing in the manufacturing process. It also does not need a further coating for protection as it is inherently already protected and has anti-rust properties. This makes the material ideal to be matched with a whole variety of finishes, from wood to furnishings without overpowering the interior. Stainless steel is usually used in hardware, furniture legs, and other parts which are usually not dominantly visible. (Forder, 2018)

Thus, the researcher has proposed a few designs of multipurpose furniture in the following chapters, which could be designed using real wood, plywood, and MDF as the base materials. Though not limited to these materials as users can use any material they wish to, construct multipurpose furniture.

According to Flexner, 2011, to finish furniture, various finishes are to be used, which include stains, dye, and paint. Apart from these finishes, one can also apply veneer and laminate to finish the furniture according to the colour and combination preferred by the user.

- **Stains:** A stain is a colorant (pigment or dye) and a binder (some sort of finish) with a lot of thinner added, so the excess stain is

easy to wipe off. This leaves some color in or on the wood. A stain can also be just dye and thinner with no binder added. Common categories of wood stain include oil stain, water-based stain, a gel stain, a Dye stain, and a Combination stain and finish. Generally, all stains provide good grain definition if the excess is wiped off because more colorant is left in the grain.

- **Dye and paint:** It is a colorant dissolved in a liquid, so dye penetrates well and doesn't need a binder. Dye stains produce slightly less definition than pigment stains.

Apart from the above-mentioned finishes, other finishes used to finish a piece of furniture are laminate and veneer could be used on plywood, or MDF, to finish a furniture piece, according to the finish, colour, and texture desired by the end user.

It is believed that laminate is a replacement for real wood, when, with affordable price by most the users (Blitchok, 2022). According to Tyagi, 2019, Laminates are one of the most popular decorative materials that are used for surfacing cabinets, furniture, walls, ceilings, external facades, and so on. They are available in the form of sheets with a standard size of 8x4 feet (Tyagi, 2019). A wood veneer is typically made up of a thin layer of natural hardwood, that is then bonded to a stable composite base material. Natural, solid wood is very susceptible to moisture, while veneer could be treated and made long-lasting over real wood. It is also less expensive as compared to using real wood with a stain, and is usually more expensive than laminate.<sup>22</sup>

#### **2.1.4.2. Furniture Construction and joinery**

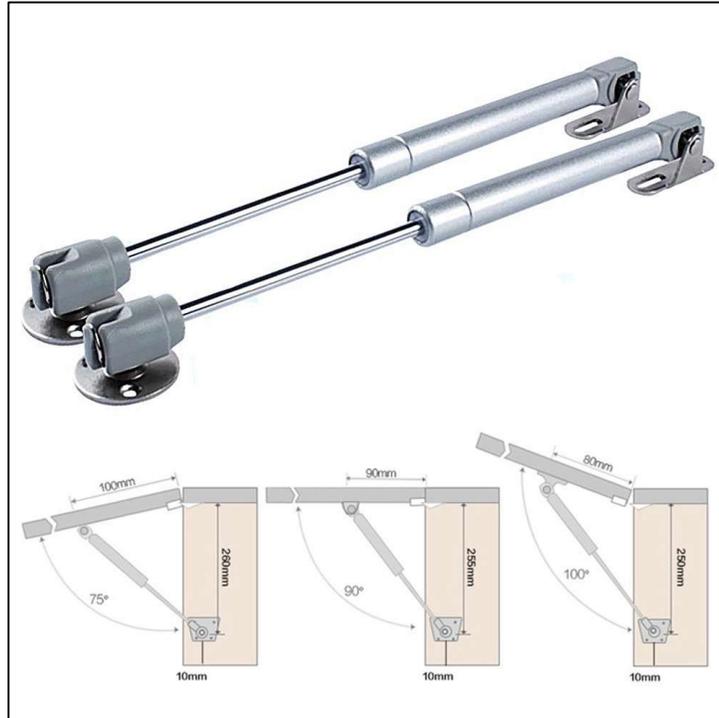
To carry out any project related to the construction of furniture; the basic concept of furniture joinery comes into existence. This concept is derived from wood joinery, but can be considered even in plywood, MDF (Medium-density fibreboard), and other major construction materials used in furniture designing.

**Wooden Joinery:** Joinery is the process of combining pieces of wood, engineered timber, or synthetic replacements (such as laminate) to create more complicated things. Some woodworking joints involve mechanical fasteners, bindings, or adhesives, while others rely only on wood (such as dowels or plain mortise and Tenon fittings). The attributes of the materials used and the function of the junction determine the features of wooden joints, such as strength, flexibility, toughness, and appearance. As a result, different joinery techniques are utilized to satisfy varying needs. (Pourny, 2014). Wooden joineries come in a variety of configurations such as Peg or Nail, Mortise and Tenon, Dovetail, Basic Butt Joint, Mitered Joint, Half-Lap Joint, Tongue and groove Joint, Biscuit Joint, Pocket Joint: Rabbet Joint, Dado Joint, Dowel Joint, Dovetail Joint, Half-Blind Dovetail, Sliding Dovetail, and Box Joint. To create above mentioned joinery in the furniture one needs to use screws and bolts wherever necessary. Various screws are categorized into different categories. Wood screws are also categorized according to the shape of their heads. There are several types of wood screw heads, but the three styles most common screws available are Flat-head screws, Round-head screws, and Oval-head screws (also called pan-head). Other types of screws used in furniture are Cheese-head screws (also known as fillister heads), Truss-head screws (sometimes called “mushroom head” screws), and Washer-head screws (Baylor, 2020).

**2.1.4.3 Hardware used for the construction of multipurpose furniture:** Many hardware options could be used in the construction of multipurpose furniture. A few major hardware used in constructing multipurpose furniture are listed below.

1. **Vertical Lift-Up Door Mechanism Channel:** A lift-assist mechanism for smoothly opening cabinet door panels. The door stays in any desired position. The regulator is equipped for soft and silent closing at the end. The door stays in any desired position and remains parallel while moving in most of these kinds of channels but might vary according to the brand installed. Usually,

it comes with a soft closing option to prevent slamming noise and door damage. Most of the brands provide full kit which consists of screws for fixing and with all the necessary fittings and there is no other hinge required if it is to be used to open a vertical door.<sup>23</sup>



**Plate 1: Vertical Lift-Up Hinge Mechanism<sup>23</sup>**

- Hydraulic Bed lifting channels:** Hydraulic bed channels comes with manual opening, remote-operated and switch-operated option. They usually open at around 30 degrees, for easy access. The angle of the opening might vary according to the brand of the hydraulic channel selected. This lifts mechanism helps to create storage space underneath the bed, in the sofa, sofa cum bed, and other such furniture pieces.<sup>24</sup>



**Plate 2: Vertical Lift-Up Hinge Mechanism<sup>23</sup>**

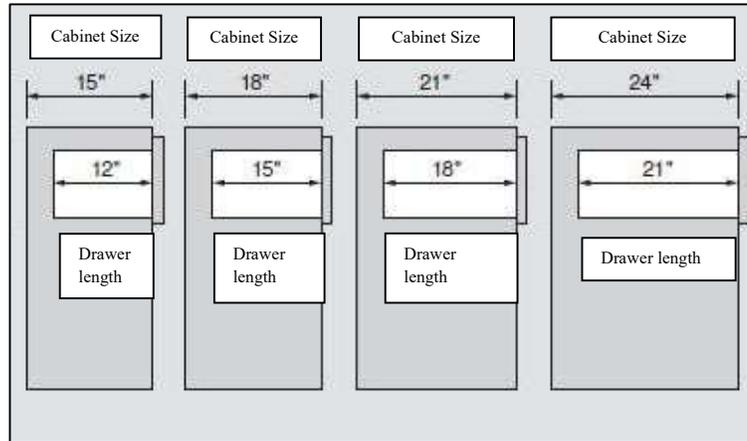
3. **Drawer Channels:** Drawer channels come in three major kinds; namely, **Push to open, soft close, and not soft close.** Push to open is used in the drawers which can be opened with a push and there is no need of installing handles to those drawers. Soft close could be used when a user does not want a loud sound while closing. Soft closes get automatically closed while generally are open nearly an inch but can vary according to the brand selected.<sup>25</sup>



**Plate 3: Different channels used in drawers<sup>25</sup>**

Drawer channels come in various sizes and materials standard sizes. There is a thumb rule to add 3” to the length of the drawer to create a cabinet with enough room. Though the size could be altered as per the availability of the space. Drawer channels come in the standard size of 6”, 9”, 12”, 15”, 18”, 21”; for which the possible cabinet depths could be 9”, 12”, 15”, 18”, 21”, 24”.

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**Plate 4: Size of the drawer and size of the cabinet <sup>26</sup>**

4. **Wall Bed Fitting Mechanism:** This mechanism comes in different sizes for single beds, and double beds, and with different load-bearing capacities according to the brand selected and as desired by the user. <sup>27</sup>



**Plate 5: Wall Bed fitting mechanism <sup>27</sup>**

5. **Hydraulic-based dining table fitting:** Hydraulic dining table fitting can be used for any vertical or horizontal surface to pull out at 90 degrees. These fittings are available in the form of packing including all the fittings in different brands. The capacity varies according to the brand selected.<sup>28</sup>



**Plate 6: Hydraulic-based dining table fitting<sup>28</sup>**

The place where the furniture is going to be used, the period for which the furniture is designed, the number of hours for which the furniture is to be used daily, and how many people are going to use the furniture; are various aspects that are necessary while choosing material. Through the market survey, the researcher came across many such vendors but none of the brands provided multifunctional furniture, especially for small spaces at low cost. The furniture options which were available at low cost did not possess multifunctional use, and the multipurpose furniture which was readily available was mostly made out of imported materials or sold by international brands; which made them expensive and difficult to buy by the owners of small houses; who generally don't have a huge budget to spend on furniture. Moreover, if the manufacturing of the

furniture is done overseas the material might not settle in the Indian climatic conditions resulting in low lifespan and high maintenance.

### **2.1.5 Need to Plan Multipurpose Furniture for Small Space Indian Houses**

Multipurpose furniture or convertible furniture is one solution, which includes a variety of furniture items having multiple uses. Furniture items including desks and sofas convert into beds, drawers pulled from under stairs, and storage space pushed up to vertical until ceilings. There is also a concept of elevated bedrooms which provides an extra layer and leaves no space left unutilized. These are a few examples of convertible or multipurpose furniture. (Thøgersen, 2017) Flexible partitions, multipurpose furniture, flexible furniture arrangements, and the provision for ample storage help in making space available for several uses. Guardian, 2014 states that any space needs to be flexible and reusable. It must be multifunctional and must possess enough strength to withhold daily activities. He further adds that flexible and multiple uses of space are a part of designing small spaces. Multifunctional furniture can reduce the use of floor space by up to fifty percent. He believes a small space is, in general, more useful if it is not divided into too many small rooms. (Guardian, 2014)

Small homes or apartments come with the challenge of not having enough space to balance the functional and aesthetic requirements. To choose space-saving furniture, one could consider multipurpose furniture as the best option. Three benefits of multipurpose furniture are as follows:

- **Maximizing available space:** Maximizing available space, could be done by knocking down the walls, using space efficiently, and using furniture with multiple purposes.
- **Minimizing clutter:** Reducing clutter is the next important benefit. Using multipurpose furniture reduces the number of furniture pieces, which automatically reduces the chance of increasing clutter in the room.

- **Lowering the cost:** If multipurpose furniture is used, one piece of furniture serves the purpose of multiple pieces of furniture, which not only saves space but also saves the cost of buying multiple pieces of furniture (Kinneer, 2022).

The processes used in the manufacture of furniture include cutting, bending, moulding, laminating, and assembly of materials such as wood, metal, and glass. However, the production process for furniture is not solely bending metal, cutting, and or shaping wood. Design and fashion trends play an important part in the production of furniture. The integrated design of the article for both aesthetic and functional qualities is also a major part of the process of manufacturing furniture.

The biggest problem in modern society is the high cost of living and limited availability of space. Along with that, the shortage of natural resources and high prices are the other issues. The limited availability of commonly used materials like wood, steel, and iron used for furniture construction, causes the need for new materials and new technologies, but are usually expensive. In a society with diverse people, users of furniture and product have a lot of different requirements, based on their background, personal preferences, and some other factors like habits and needs of the member. These issues could be addressed by considering multi-functional and space-saving furniture. Multipurpose furniture fits into the limited space better and would carry various functions (Xie, 2016).

With the increase in the cost of living, there is more demand for space-saving furniture designs. Small space house has increased in every part of the world. (Susanka, 2000). Utilizing furniture, which occupies less amount of floor space, improves the scope of having more space to work with. The space-saving furniture serves many functions and is designed to fit into the space without taking up too much of the floor area. Multi-functional furniture is a solution that offers a combination of functions, and styles, so every square foot in a home can be beautifully used and performed twice or thrice its size. As apartments get smaller and

smaller, furniture with multiple usage becomes almost a necessity. There is a mental conversion associated with the transformable multifunctional furniture that creates the feeling of more space. (Guardian, 2014).

According to one press release, the multifunctional furniture market is to be sustained by technological advancements. In 2022, multifunctional furniture is a piece of furniture with multiple uses that can adapt to smaller spaces along with fulfilling multiple needs of users. The rise in population and urbanization has driven the demand for accommodation, resulting in boosting the real estate market. Urban houses have enforced the habitants to choose smaller spaces, which has increased the demand for furniture suitable for small spaces or furniture with multiple uses. Multifunctional furniture has been offering greater suitability to users, specifically to those, who have limited living space. The concept of multifunctional furniture has evolved significantly, leading to the development of a wide range of space-saving solutions that incorporate advanced technology, and yet are aesthetically appealing.<sup>29</sup>

Extensive market research was done to study the various material options available to construct the furniture designed by the researcher. This helped to provide material options for each part of the furniture.

**Note:**

\*<sup>1</sup> Price varies according to the company, brand, size, and finish of the material purchased.

\*<sup>2</sup> Price varies according to the company, brand, size, specifications, finish, and capacity of the hardware selected.

**List of furniture materials available to design multipurpose furniture.**

<b>Sr. No.</b>	<b>List of Furniture Material</b>	<b>Price</b>
1)	<b>Wood</b>	Starting at ₹ 2000 /Sheet 8'0" X 4'0" * <sup>1</sup>
2)	<b>HDF</b>	Starting at ₹ 1500 /Sheet 8'0" X 4'0" * <sup>1</sup>
3)	<b>MDF</b>	Starting at ₹ 1000 /Sheet 8'0" X 4'0" * <sup>1</sup>
4)	<b>Particle Board</b>	Starting at ₹850 /Sheet 8'0" X 4'0" * <sup>1</sup>
5)	<b>Plywood</b>	Starting at ₹900 /Sheet 8'0" X 4'0" * <sup>1</sup>
6)	<b>Laminate</b>	Starting at ₹ 500 /Sheet 8'0" X 4'0" * <sup>1</sup>
7)	<b>Veneer</b>	Starting at ₹ 800 /Sheet 8'0" X 4'0" * <sup>1</sup>
8)	<b>Vertical Lift-Up Door Mechanism Channel</b>	Starting at ₹ 1300/ set * <sup>2</sup>
9)	<b>Hydraulic Bed lifting channels</b>	Starting at ₹ 1500/ set * <sup>2</sup>
10)	<b>Drawer Channels</b>	<b>9"</b> Starting at ₹ 100/ set * <sup>2</sup>
		<b>12"</b> Starting at ₹ 150/ set * <sup>2</sup>
		<b>15"</b> Starting at ₹ 200/ set * <sup>2</sup>
		<b>18"</b> Starting at ₹ 250/ set * <sup>2</sup>
		<b>21"</b> Starting at ₹ 300/ set * <sup>2</sup>
11)	<b>Wall Bed Fitting Mechanism</b>	Starting at ₹ 1800/ set * <sup>2</sup>
12)	<b>Hydraulic-based dining table fitting</b>	Starting at ₹ 1200/ set * <sup>2</sup>

## 2.2 Empirical Studies

### 2.2.1 Studies on small spaces

**Thogersen (2017)** in his research on “Small spaces, need smart solutions Designing furniture for small spaces, in connection with human wellbeing”, carried out the study to investigate the relationship between small apartments, furniture, and human wellbeing. The findings of the study were based on literature that was collected through a combination of articles regarding small apartments and urban housing development with papers about furniture and psychological articles about human needs and well-being. The researcher concludes that there is a significant connection between furniture, small apartments, and human well-being, as well as the physical surrounding in an apartment having a large impact on its residents. Thus, it was summarized that, if the above factors are considered, designing furniture for an apartment, human well-being can be affected positively.

A study on space-saving and multiple using furniture in Egypt were conducted. The researcher aimed to raise awareness of the importance of using space-saving and multipurpose furniture, especially in residential units with small spaces, along with setting up theories and scientific foundations to consider while designing this type of furniture. The researcher also highlighted several ideas, designs, and technological methods used in space saving and multiple using furniture to achieve the functional and aesthetic dimensions of the space. The researcher also recommends increasing the production of multipurpose furniture and establishing factories for manufacturing machinery for this type of furniture to be self-sufficient and not be imported from abroad (**Ashraf, 2019**).

In a study on functional furniture as a smart solution for small spaces, the researcher surveyed 258 units of Zaniary tower apartments in Erbil city, Iraq. The samples were selected through random sampling, and a total of 103 respondents were considered for the study. A questionnaire consisting of furniture needs, preferences, and recommendations was prepared. Data were collected and investigated through SPSS (statistical package for social sciences)

software. The findings of the study highlighted that most of the respondents faced the problem of scarcity of space to accommodate enough furniture to satisfy their requirements. So, the researcher came up with a solution of Multifunctional furniture as a solution to address this issue smartly, as multipurpose furniture can balance space utility and beauty, by efficiently using the available space. **(Husein, 2021)**

**Nagasudha, et al. (2022)** conducted a study on; “space-saving furniture as a smart solution for 2BHK apartments”. The study contributes to the factors that influence the purchase of space-saving furniture on the space efficiency of apartments, through a survey method, which was conducted randomly among 500 respondents who were residing in apartments in Tirupur and Coimbatore. The data collection was done through a purposive sampling technique. This study finds that most participants have difficulties with their small spaces and supported the idea that space-saving furniture can be a smart solution to their problems. Findings were highlighted, using 37 items, seven factors, and a five-point scale. Data revealed several factors related to the purchase of space-saving furniture. The major factors were compact and space-saving factors, quality-based factors, price-based components, style-based factors, psychological-based factors, stress-based factors, and environment-based factors.

**Kandalkar (2020)** conducted a study on, Approach towards design small spaces using multifunctional furniture: A review. The main goal of this study was to study the low cost of living in limited space and to create a design for feasible and sustainable multi-functional furniture which could transform a living space based on the need and time of the day. The research concluded that Transformable space-saving furniture is an innovative product with plenty of room for future development and an enormous potential metropolitan market. It is important to have furniture with more than one feature to save as much valuable space as possible.

### **2.2.2 Studies related to Multipurpose furniture.**

**Sapuan, et al. (2007)**, conducted a study on the design and fabrication of a multipurpose table using a composite of epoxy and banana pseudo-stem

filaments. The research methodology followed evaluating criteria to design a multipurpose table which included Stability of Product, Cost of Product, Ease of production, Reliability of service, Ergonomic aspect, Low setup, Ease of transport and compared the 8 Concepts and evaluated them with a 5-point scale. After a brainstorming session in the engineering design laboratory, the option's highest score was chosen to prepare a design. A dining table was designed with the use of four layers of epoxy and fiber along with mechanical fasteners used for joining them with banana woven fabric. The product was lightweight, compact, stable, and easy to transport with an aesthetically pleasing golden brown colour.

**Wang (2013)** in his study “An Analysis of Transformable Space Saving Furniture”, studied space-saving furniture both mechanically as well as financially. His study also included the comparison of transformable space-saving furniture as compared to normal furniture, concerning cost and price. The report focused on beds, tables, and chairs, as they are the most frequently used furniture according to the author. The study also covered effective and efficient transformable space-saving furniture designed by the architects and engineers in its manufacturers. Its designs could then be combined with the structures and layouts of buildings so that the functions of both the furniture and buildings could be maximized. These kinds of innovative buildings could also save energy and lower the cost of living for people living in large cities. He researched that manufacturing costs and product price were the limitations for a piece of transformable space-saving furniture. The author also suggested that to improve the future of transformable space furniture, more innovative ideas should be incorporated into its design. Lowering overhead costs and furniture prices are some other elements that need to be given due consideration.

**Nasser (2013)** conducted research on the need and potential for multifunctional furniture design features to maximize space usage and improve the living conditions of people living in underprivileged communities. The study was titled Multifunctional furniture for underprivileged communities. A milestone in sustainable development. Depending on the situation and time of day, the author created a piece of furniture that may be used as a table, storage, seating,

or bed. Easy-to-implement and aesthetically beautiful modular furniture was produced following the design parameters. The local manufacturing process was taken into consideration when conducting the research, and furniture was designed with their specs, prototype schematics, and easily understood visuals. Based on the availability of raw materials on the market and the location of the importer of wood, options were given.

**Astonkar and Kherde (2015)** conducted a study to highlight the importance of Ergonomics with anthropometric principles of multipurpose space-saving seating arrangements in different places. The market study and user survey method were followed by the researcher to conduct the research, in which 8-10 seating arrangements or chairs were studied to identify the problems; 3 new concepts were suggested for seating and 1 with waste material was suggested, whose ergonomic reliability was also tested. The researcher concluded that to improve the future of space-saving products, designers need to create more innovative ideas to understand the importance of ergonomics and the use of waste material in our daily life. These kinds of innovative designs could prove ergonomically efficient and solve problems of the physical stress of people along with lowering the cost of production due to the utilization of waste material in its production.

**Astonkar and Kherde (2015)** conducted a study on multipurpose space-saving seating arrangements with CAD and CAC software. The research was conducted by following a step-by-step procedure which included conceptualizing a CAD model, analysis of finite elements with different materials and loads in ANSYS, comparison analysis, and later seating arrangements with space-saving approach were developed along with ergonomic details with the use of waste materials of our daily life. Thus, reducing the cost.

A similar study was conducted on multipurpose space-saving seating arrangements using finite elements along with its analysis. The researcher recommended a new dining table design that would occupy less space than the deployed area; thus, addressing the issue of constrained space in urban segments in India.

**Danyang (2016)** conducted a research study on Fika Living - A sharing multifunctional furniture for single-person households. He started a study with the vision of an expected increase in single-person households by 40 per cent in the upcoming 40 years. The project aimed at designing a sharing furniture that could be used for the living room of a young single-person household. The theories applied by him, included sustainability, life cycle, human needs, and design methodologies. In the study, the researcher designed a piece of furniture that contained three cushions and a table that are removable and could be stacked together. The researcher gave a variety of combinations of using this furniture as seating for three people, a study by one person along with the seat, and backrest. It could also be used as a footstool while seating on the sofa.

**Harun and Halip (2018)** conducted a study on stylish coffee table furniture, influenced by modular furniture for students in Batu Pahat Malaysia. The research design consisted of data collection of current issues, and problems faced by the users through visual research through the geometric and engineered form. After that, the ideation sketches were created, with different perspectives, tones, locations, sizes, and features, followed by design development and mock-up development of scale models. Principles of design were applied to mock-up design and the selected design was examined through the two-dimensional and three-dimensional models using computer applications and design software. The last step was to create a final product by finalizing the finishing and jointing system (engineering). This stage is concerned with assembly for efficiency in the manufacturing process. In the conclusion stage, the design was tested for its suitability and harmless, overcoming the problems identified as a part of the research. (Muhammad Fikri Bin Harun & Halip, 2018)

**Astonkar and Kherdi (2019)**, in their study on the design and fabrication of multifunctional furniture, evaluated the existing dining furniture by studying their construction, assembly, and sub-assemblies along with the demand and needs of the customers. The survey method was used as a part of the design methodology to design, investigate, fabricate and test the product. Detailed engineering drawings and CAD drawings were constructed along with the prototype and the designed furniture was tested for its structural deformation

and stress analysis with the help of ANSYS software. The results obtained were in favour of the production of the proposed dining table.

**Cheng, Hou, et al. (2021)**, conducted on designing multipurpose modular, flexible, and space-saving Dining tables. For data collection and analysis of the product, the study was conducted on different types of dining tables. The materials were identified, and the types of hinges and shapes of dining tables were studied as a part of the market study. Through user observation and ergonomic considerations, concept generation was done. A lifestyle board and visual theme board were prepared, using a bubble diagram. The researcher came up with six design concepts. One concept was selected and its final detailing with product features, assembly and the mechanism was done. The final prototype was created and validated. It showed that the final proposed concept occupied just less than 25 percent of its deployed area, and was proposed to suit the constrained space conditions of the urban segment in India.

### **2.2.3 Studies related to multipurpose furniture designing**

A researcher conducted a study on “Designing furniture as learning facilities for early young child education”, in Desa Gunung Sari, Tangerang. The study’s main objective was to design well-planned furniture at an early stage of education for children. Furniture was designed considering the anthropometry to provide better ergonomic seating position, to facilitate the learning process. The in-depth observation was conducted as one of the methods of data collection along with the interview technique. The teachers of the school were interviewed, the building conditions were observed and a few lecturers from architecture were also interviewed to gain insight into conducting the design process. The researcher designed twenty multifunctional modular furniture named SALA (Sarana Alas Duduk Anak). They were designed fulfilling the function of table and chair for students, and table and stool for teachers and could be arranged in form of a stage for conducting school functions and student performances. The furniture was designed thoughtfully, as they could be stacked up to three modules for saving floor space. The design was brought into reality with the help of one of the home-based, furniture makers near the village. The research was conducted with a broad vision of contributing to the

community by assisting in early childhood education to support the nation **Gumulya, et al. (2020).**

**Huang, et al. (2015)** did research on designing an adjustable table with multiple uses for persons who must spend more time in bed owing to a disability. The research team concentrated on improving the features of a table that may enable people to read books or use tablet computers on beds in a comfortable manner after reviewing the literature and determining that there are already many similar items on the market. Additionally, it can help folks walk and stand up. The product was fixed to the bed with a C-clamp. Moreover, the table was automatically raised to the correct height with the hydraulic and micro-computer systems. To ensure the safety of the entire construction, simulation, test, and analysis tests were carried out in Abaqus 6.1.2 and Autodesk Inventor 2015. Their design may catalyse the development of auxiliary equipment, stressing the significance of the creation of healthcare mechanisms.

### **2.3 Conclusion of Review of literature:**

The literature collected by the researcher highlighted various studies focusing on furniture design, furniture analysis, commercial furniture design, material survey, residential space planning, commercial space designing, space optimization, and small space designing. While reviewing the literature the researcher found that problems are faced by people having small-space residential houses. There is a need to design furniture for small houses, according to their requirements and considering their affordability. A dearth of researches were found regarding multipurpose furniture with low-cost materials for small spaces. This motivated the researcher to design multipurpose furniture for small spaces, with the use of a variety of interior materials. The researcher was interested in identifying the problems faced by homeowners of small houses, related to furniture concerning the Foyer, Living room, Kitchen, Dining, bedroom, bathroom, and other areas of the residence. Thus, the present study was undertaken.