EFFECT OF SPACE SIZE OF VEHICLES TO HELP MULTIFUNCTIONAL ACTIONS IN HOUSING DESIGN

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Submitted to Graduate School of Natural and Applied Sciences
in Partial Fulfillment of the Requirements
for the Degree of Master of Science in
Architecture

Yeditepe University
2021

EFFECT OF SPACE SIZE OF VEHICLES TO HELP MULTIFUNCTIONAL ACTIONS IN HOUSING DESIGN

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ACKNOWLEDGEMENTS

During my thesis study, my very valuable thesis advisor, who shared all kinds of knowledge and experience with me, guided me, was by my side with his trust and support during the development of my study and always motivated me. I would like to extend my gratitude and respect to Assoc. Sema Karagüler.

My mother Semiha Gülsever, who has been with me all my life in all matters material and spiritual, my mother who is everything, my brother Electrical and Electronics Engineer Emrah Gülsever, my sister Environmental Engineer Sema Gülsever, thank you forever.

Finally, I would like to thank my cousin Lawyer Assoc. Prof. Dr. Devrim Elvan, who never denied her support, and my dear friend interior architect Ceyda Misli Elbir, who always motivated and smothered me in smiles during this process.

ABSTRACT

EFFECT OF SPACE SIZE OF VEHICLES TO HELP MULTIFUNCTIONAL ACTIONS IN HOUSING DESIGN

Houses are structures that are located as single or multiple floors, where people spend a significant part of their lives in which they continue their vital activities. Places suitable for different needs can be provided more effectively with auxiliary tools for actions that can be transformed into many functions, instead of using fixed furniture and tools. Here, all fixed or mobile objects and furniture used in spaces are defined with the concept of "action aids". The auxiliary tools in the design that can be transformed into more than one function will make the user's action-space-tool relationship practical, make the unused idle spaces usable and gain from the space. Spatial size of dwellings; The different lives of the user in our age vary depending on many factors such as sociological factors, nuclear family, single-person lives, busy work life, difficulty in moving, economic reasons and cultural status. In this context, the use of space of today's and future residences differs from previous housing designs, thanks to the tools that assist the actions with alternating functionality.

In the thesis, on the basis of literature researches, the usability criteria of tools for transformative actions were determined, and the multi-functional distribution of these tools in the space was explained with tables and figures. Various application examples were investigated, and the spatial differences brought by the use of multi-functional and single-functional vehicles were emphasized, and space savings were highlighted by the use of multi-functional tools for multi-functional actions in four different housing types in an existing residential area. It was revealed that the reduction in the area sizes calculated based on the sample housing types and numbers examined through the conversion tables and function diagrams of the plans into multi-functional spaces, and it was revealed that multi-functional vehicles provide more rational and economical use in space sizes by making residential living spaces flexible.

ÖZET

ÇOK FONKSİYONA DÖNÜŞEBİLEN EYLEMLERE YARDIMCI ARAÇLARIN KONUT TASARIMINDA MEKAN BÜYÜKLÜĞÜNE ETKİSİ

Konutlar, insanların içinde yaşamsal faliyetlerini sürdürdükleri yaşamlarının önemli bir kısmını geçirdikleri tek ya da birden fazla katlı olarak konumlanan yapılardır. Farklı ihtiyaçlara uygun mekanlar, sabit mobilya ve araçların kullanımı yerine, birçok fonksiyona dönüşebilen eylemlere yardımcı araçlar ile daha da etkin olarak sağlanabilir. Burada "eylemlere yardımcı araçlar" kavramıyla mekanlarda kullanılan sabit ya da hareketli tüm eşyalar, ve mobilyalar tanımlanmaktadır. Birden fazla fonksiyona dönüşebilen tasarımdaki yardımcı araçlar, kullanıcının eylem-mekan-araç ilişkisini pratikleştirerek, kullanılmayan atıl mekanları kullanabilir hale getirip, mekandan kazanç sağlayacaktır. Konutların mekansal büyüklüğü; kullanıcının çağımızdaki farklı yaşamları, sosyolojik faktörler, çekirdek aile, tek kişilik yaşamlar, yoğun iş hayatı, taşınma zorluğu, ekonomik nedenler ve kültürel statü gibi bir çok faktöre bağlı olarak değişmektedir. Bu bağlamda, günümüz ve geleceğin konutlarının mekan kullanımları, dönüşümlü işlevsellikteki eylemlere yardımcı araçlar sayesinde, önceki konut tasarımlarına göre, farklılaşmaktadır.

Tezde, literatür araştırmalarına da dayanarak, dönüşebilen eylemlere yardımcı araçların kullanabilirlik kriterleri belirlenmiş, bu araçların mekandaki çok fonksiyonlu dağılımı da Tablelar ve şekillerle açıklanmıştır. Çeşitli uygulama örnekleri araştırılarak mevcut bir konut yerleşim alanındaki dört farklı konut tipinde çok fonksiyonlu eylemlere yardımcı araçların, amaca uygun kullanılması ile çok ve tek fonksiyonlu araç kullanımlarının getirdiği mekansal farklılıklar vurgulanmış, alan tasarrufu ön plana çıkarılmıştır. Planların, çok fonksiyonlu mekanlara dönüşüm Tableları ve fonksiyon şemaları yoluyla, incelenen örnek konut tipleri ve sayıları üzerinden hesaplanan alan büyüklüklerindeki azalma belirlenip, çok fonksiyonlu araçların, konut yaşam alanlarını esnek mekan haline getirerek, mekan büyüklüklerinde daha rasyonel ve tasarruflu kullanım sağladığı ortaya konmuştur.

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1. INTRODUCTION

Spaces describe a life style and are the places that interact with the user the most and reflect cultural values related to life due to this interaction. While designing the spaces, they are designed according to these cultural and life styles. New developments in various auxiliary tools-equipment suitable for the actions in spaces gradually affect the architectural space design. In this context, when dwelling structures are considered, convertible vehicles / goods come to the fore. However, nowadays, many designs have been made that restrict our living space, which prevents our actions in the residential space and narrows the space. Due to these designed vehicles, the spaces become even smaller and useless. The handling of the thesis subject is also based on this subject. It is thought that it will be possible to make the place more useful and spacious by using multifunctional designed tools instead of standard tools in order to facilitate our actions in the spaces. For this reason, the effect of multi-functional designed tools / items on the size of the space has been chosen as the subject of study in the thesis. In this context, the thesis reveals how the spaces can be affected and changed both dimensionally and qualitatively and gain different functionality while using the said multi-functional tools in residential spaces.

The results of this study; The combination of multiple functions in a large number of residences brings an intense programming and solution to the interior space layout, and at this point, the features and functionality of the preferred fittings in the space gain importance. Thanks to the basic functional features of these reinforcements, which are specified as stability / mobility, functional diversity, modularity, collectability, size interchangeability and storability, spaces can be reduced to dimensions that provide optimum utility in both dimensional and spatial partitioning by gaining transformation and interchangeability. At the same time, these fittings can also allow flexible housing design according to the user, as they can work on the space-action-vehicle relationship and reduce and optimize the number of space types. In this way, many living spaces that cannot be used in residences can be made more usable and active due to this flexible use of housing.

1.1. PURPOSE

In the face of constantly changing technology and fast life, one wants to feel modern and practical at home. Designers who shape the world we live in; In style, comfort and ergonomics center, they try to express the space larger and more useful in order to make the user feel more comfortable. In addition to the flexible space design plans developed to ensure continuity and optimization in the use of space, nowadays multi-functional space usage tools have also come into play. The main purpose of this study is to help provide opportunities for housing solutions of sufficient width with multifunctional housing use vehicles in houses and thus contribute to the sustainability of houses.

1.2. SCOPE

Within the scope of the study in accordance with the purpose; Apart from furniture design, there are arrangements in space of tools that assist actions that can be transformed into multiple functions. The qualities and various examples of multi-functional vehicles used in residences are given for spatial arrangements. The research focuses on residential design as a structural function. In this context, the study includes the development of sample housing design solutions using multifunctional tools within the framework of existing housing designs, comparisons and suggestions between these solutions in terms of space sizes. For the purpose; The research focuses on the use of the existing multifunctional conversion vehicles in the space and its effect on the size of the space, and its contribution to the flexible space design is revealed; However, flexible space design is not included in the content.

1.3. METHOD

In the study, an analytical method was chosen in general, and a working method was followed within the framework of the following steps.

First, a general literature search has been conducted in order to follow the publications dealing with the tools to assist multi-functional actions on this subject. Following the literature review, the reasons for discussing the subject within the scope of the purpose of

the study were explained in detail. Then, the usability criteria of the tools that assist the multi-functional actions, the applicability of these tools in housing projects and the functional difference of the tools that assist the actions were revealed by researching and determining them based on the visuals of the current application examples. Later, the distribution and comparisons of single and multi-functional vehicles of housing projects were made, and as a result of the results of this comparison, the use of multi-functional vehicles in different housing types was started. This examination includes the steps of creating sample plans for each house type, first single, then furnished according to multi-functional actions, action-space-tool table and function diagrams according to this table. As a result of the examination made according to these steps, the plan sample of each house type was evaluated comparatively by calculating the area sizes separately. This evaluation results in the examination of the optimized values obtained in the house sizes by reducing the space sizes without reducing the use of space. At the end of the research, the results obtained are announced.

2. LITERATURE STUDY

When the literature on this subject is examined, there are various articles and theses on the objects, and examples of these studies are presented below. Under this section, the thesis that I have researched and found, the current thesis and article examples that are compatible with the position and that help my thesis are briefly mentioned.

Mimar Sinan University Graduate Student Yüksel Gezer conducted studies on Furniture Used in Narrow Space Residential Spaces and Showing Functional Flexibility. In this study, he investigated the size-space-housing relationship of furniture and addressed narrow-space residential spaces and their problems. He explained how to make narrow-space residences more livable so that furniture with functional flexibility will be used solution-oriented for living spaces. He talked about the effect of functional flexible furniture on residential-space designs and the place of these furniture in narrow-space residential spaces [1].

Istanbul Technical University Ph.D. Student Esra Nasır investigated the transformation of Living Room Furniture in her thesis. The Living Room Idea, Furniture Acquisition Dynamics and Usage Practices in Daily Life. It is known that this practicality of use continues to be maintained in many homes, especially in middle class homes in the thesis, the transformation of this dominant practice is taken as a ground, and the functional transformations that the living room furniture undergo as part of the daily routines in the living room are examined [2].

Trakya University Post Graduate Student Özer Özçelik and Namık Kemal University Master Student Timur Kaprol discussed the topics they dealt with in their thesis, in narrow spaces, and the flexibility and use of furniture with functional change / transformability in spaces [3].

3. REASONS OF THE SUBJECT

The most important reason for addressing this issue is to be able to show its effect on the size of the space in houses by using more and more multi-purpose housing items. With technology, users may need flexible furniture designs according to their wishes and multi-purpose use can be a reason for preference for residential spaces depending on the size of the space. Nowadays, as a result of the production of small square meters of housing and the widespread needs of student dormitories, the need for products that provide solutions to narrow spaces is increasing. Numerous solutions are produced for prefabricated housing, container, home office, 1 + 0 and 1 + 1 studio apartments, guesthouses and all living spaces of limited square meters. Architectural drawings are designed in the most optimal way and the narrow spaces inhabited are designed as ideal spaces for daily use at maximum level. When opened the bed, when closed, wardrobe, television unit, table or library, etc. It is seen that the furniture with the characteristics of the furniture is presented to the consumer in accordance with the demands of the consumers in different cultures, besides the designs made specifically for the person, situation and group, in the products made by the manufacturers in series.

3.1. THE CHANGING LIFE IN OUR TIME

Different lives in our age have the characteristic of being someone who changes the way we perceive space. These different lives require different functional needs in the context of social requirements. The data belonging to the place, which is important in the differences in these lifestyles, may be meaningless in another life. Thus, it is necessary to construct different space designs for each different culture. The images that make up the space do not have an abstract perception on their own. It contains different semantic codes of its own in every different life. Designed spaces meet many functions. Even though the spaces are the same in form, the meanings attributed to them differ in line with different lives. Every culture gives different meanings to different living spaces. In the last age when individualism came to the fore, there are many lifestyles that we adopt by reading and researching or with the influence of our environment. The minimalist movement is one of the most important approaches in this matter. For minimalism, as a lexical meaning, we

can say that the life style that provides more focus, comfort and quality by limiting and minimizing the material and spiritual elements in human life according to needs [4]. But if we need to examine it from a wider window, it is necessary to avoid being captive of objects in order to live a minimalist life. The minimalist life philosophy is to push ourselves to simplicity. With the motto of simplicity is many, if we simplify our head first, then our life, our environment, the place we live in and the means of use, we can do ourselves a favor and fold the flavor we call from life. As in mass housing productions; The uncertainty of the users of most of today's houses has revealed the need for flexible housing design and flexible use of furniture. Apart from these, the ever-developing technical possibilities allow more complex and versatile product designs [4]. For this reason, multi-functional designs of articles as a means of action have started to develop rapidly.

The gradual decrease in the practicality of using large residences is also a changing life factor in our age. The practicality of the use of large dwellings gradually disappears with the separation of social relations and therefore the use of large dwellings decreases over time. The most determinant of these are the separation of residence and work, the separation of public and private spheres, the separation of human groups, the separation of producers and consumers in the housing market, causing a decrease in residential use. Generally, we spend less time in our residences, which are our living spaces, due to the workload, so we use less space we live in. Thus, the need for large housing use is gradually decreasing.

3.2. SOCIOLOGICAL REASONS

Due to the changes in the sociological society, when the transition to the nuclear family becomes more frequent, single-person lives increase, business life becomes more intense, difficulty in moving increases, accommodation in large residences decreases due to economic reasons.

- **Transition to nuclear family**

Nowadays, the size of the household is shrinking and the nuclear family is increasing as their extended family lives are eliminated. Single life is increasing, divorces are increasing

rapidly and business life is intensifying. Dependence on work, increasing time at work and all this shortening the time spent at home. Residential use only serves the accommodation function. Therefore, the transformation to the nuclear family is accelerating as the importance of individual life increases.

- **Increasing single person lives**

The new developments brought about by life increase the importance of education and marriages are delayed as well as sociological divorces. Thus, one-person lives come to the fore.

- **The intensity of business life**

Working life and length of working time constitute a large part of our life. For this reason, we spend less time in our living spaces at home. In large residences, the usage area decreases and studio apartments are transferred to, and for this reason, multifunctional transformable furniture is preferred.

- **Difficulty moving**

Cities get bigger and traffic gets harder. With a lot of traffic and the growth of the city, it is getting harder to move from one place to another. Therefore, it is becoming increasingly important to use these multifunctional items to facilitate transportation or reduce the number of moves. In daily life, as the use of multifunctional items increases, the difficulty of transportation will disappear.

3.3. ECONOMIC REASONS

When we use multi-functional transformable furniture instead of standard furniture that we will use in daily life, we gain both cost and space. The standard furniture we currently use in our homes is usually a separate furniture for each function. Because each has a different function and a different function. For this reason, both the number of furniture will increase and the space will reduce our living space in residences because of the high functionality. Therefore, when we use many furniture with different functions, the cost will increase and cause economic damage. However, if multi-functional furniture that can be transformed into more than one element is used in order to prevent this, we will reduce the

function of many furniture to a single piece of furniture and save money and narrow spaces can be used more comfortably.

In addition, with this approach, housing costs can be reduced, as houses can become simpler and more practical.

3.4. GROWTH OF GLOBAL TOURISM

Nowadays, people prefer to spend time in more practical and useful places in order to spend their living spaces more comfortable. They usually want to achieve this in working environments and vacation venues. The vast majority of people do not want to stay in hotels on holiday. One of the most effective reasons for this is that they want to feel at home. These preferences of people cause the increase of global tourism. With the proliferation of global tourism, this system brings people to practical home use. It leads to designs with less spatial division. At the same time, Global Tourism as a mass movement leads to the change of the natural and cultural landscape through cultural expansion, so that touristic globalization can show itself in the "spatial" dimension [5]. "Apart hotels", which are generally preferred by large families because they have a large structure, and "timeshare properties", which are summer houses purchased or rented during a certain period, arise from this need.

Owning a detached house on certain dates constitutes the content of the concept of timeshare. We can buy some immovable property for a certain period of time. The right to own a property between certain dates is called a timeshare. Among the aims of this ownership are vacation, health, spa, etc. phenomena.

People prefer home-type apart hotels or timeshare properties where they will feel like home. Apart hotels and Timeshare properties come from here. Due to these preferences, an increase in global tourism is also provided. In order to increase the number of spaces due to the increase in global tourism, these systems include designs defined as "saloon-salomanje", which provide a flexible space design with a movable partition, in order to be able to use a more practical home.

4. FUNCTIONAL CHANGE OF TOOLS TO HELP ACTIONS

As mentioned before, especially in narrow houses, there may be differences in line with the needs of the user in accordance with the lifestyle. Accordingly, in many houses, especially in narrow residences, in order to use unused spaces or less used spaces more actively, different interior design and choice of different reinforcement elements are required in line with the needs of the user. It is expected that the needs of the person will be met in a single space, and thus the number of multiple spaces will be reduced by the use of these functionally changing equipment in the residences. We are expected to use spaces that are difficult to use, especially in narrow-planned residences and cannot meet the needs of the user, in a way that allows the desired size. For example; Spaces in residences can be used as sleeping, resting and dining areas. Naturally, this is provided by functional interior reinforcement elements that provide functional change in spaces. The furniture, which is preferred in these houses, shows functional changes, that is, provides transition from one function to another and can be differentiated to serve a complete purpose, can be defined as "auxiliary tools for transformational and multi-functional actions". Thanks to these interior fittings, which can also be defined as "Smart compact furniture" in the literature, we can have both more comfortable use environments and comfortable and spacious houses in our living spaces. For example, both storage and creation of a larger area can be provided. The opening and closing wall beds eliminate the problem of being small in young and children's rooms. Especially for those who own a home, permanent, wall-mounted function, teen and children's rooms can be recommended. Thus, living spaces can be made more useful spaces by gaining space. Depending on this functional change, the criteria that are suitable for the usability of the tools to assist the transformational and multifunctional actions are listed below to serve the purpose.

4.1. USABILITY CRITERIA OF TOOLS TO HELP MULTIFUNCTIONAL ACTIONS

These criteria are listed as follows.

- **Portability**

All items and furniture in residences have different usage characteristics, protection conditions and transportation requirements. Portability is very important in such compact furniture in order not to damage the items and to prevent any furniture from becoming unusable. It is important for these interior fittings to be easily transportable and not to lose their functionality and functional change in order to prevent any damage to the furniture.

- **Lightness**

The most important factor affecting the portability of these designs and furniture in houses is its lightness. It must be fairly light to be easily transported. This is about the good design of the material used and the mechanism that affects its functionality.

- **Easy of mechanism**

The function of the mechanism, in other words its ease, is very important for the furniture to change its form by changing its function. The mechanism should be able to switch from one function to another very easily. Thus, while providing a function transition in the mechanism, this feature increases the ease of use.

- **Convertible functions suitability**

These transformable functions are also important in order to perform the actions we want at the same time, the suitability of the functions to the space and the building structure.

- **Practical for people of all ages who do not want too much force**

It is one of the most effective choices of transformable functions, that is, they do not require much force during function change, and they can easily change. Because these users can be of any age, the usage feature should appeal to all ages. For example; These designs used in children and play rooms should be practical for people of all ages. In the

options that affect this, of course, the lightness of the design, the ease of the mechanism, the portability and the adaptability of the transforming function to that place are very effective.

4.2. IMAGES OF CURRENT APPLICATION EXAMPLES

Multi-functional vehicles are the ones that are used for actions in residences that have been transformed from a single function to more than one function. Some examples used in practice on this subject have been investigated. These used examples support flexible scanning and flexible use in architecture.
When considered etymologically, flexibility and flexible usage are elongation, shortening, bending etc. under the influence of an external force. It must be elastic, elastic and suitable for different interpretations, which can take its old form after the change of shape, with the removal of the effect [6].

According to the architect Collins (1965), he defines it as "flexibility is a kind of functionalism". In other words, by taking the desired form that can show functional changes, it has been transformed into more than one function and the functionality has been increased, thus giving a new breath to the architecture.

Every flexible use also contributes to sustainability. As mentioned below in the Brundtland Report.

- **Brundtland report (1987)-Sustaınability**

Development that meets the needs of today without compromising the ability of the future to meet its own needs. The best examples of this sustainability were also studied extensively in the Plant Building course I took during my undergraduate semester [7].

In sustainable furniture designs, economical, renewable, ecological materials that are less harmful to nature, easy to recycle and obtained with less energy are used. Thus, by using natural resources efficiently, consumption and damage to nature can be reduced by making use of wastes. With the selection of ecological materials, a different approach to design can be brought in addition to elements such as form, function, aesthetics and ergonomics. Designs designed with the selection of ecological materials have a very positive

contribution to the ecological life. In this way, sustainable self-esteem is achieved [8]. Therefore, literature study and current application examples on this subject gain importance.

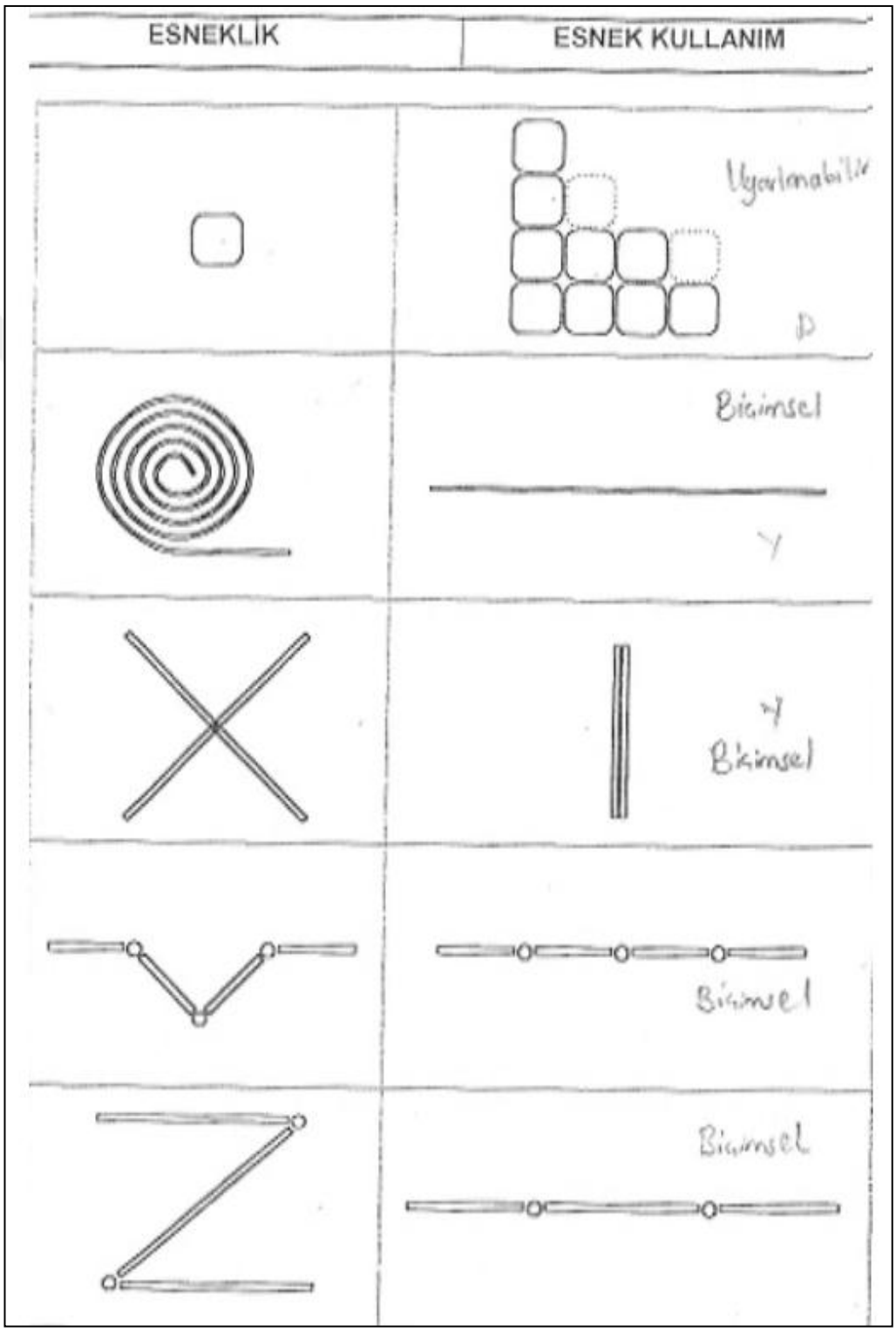

Figure 4.1. Diagram drawings for flexible use [9].

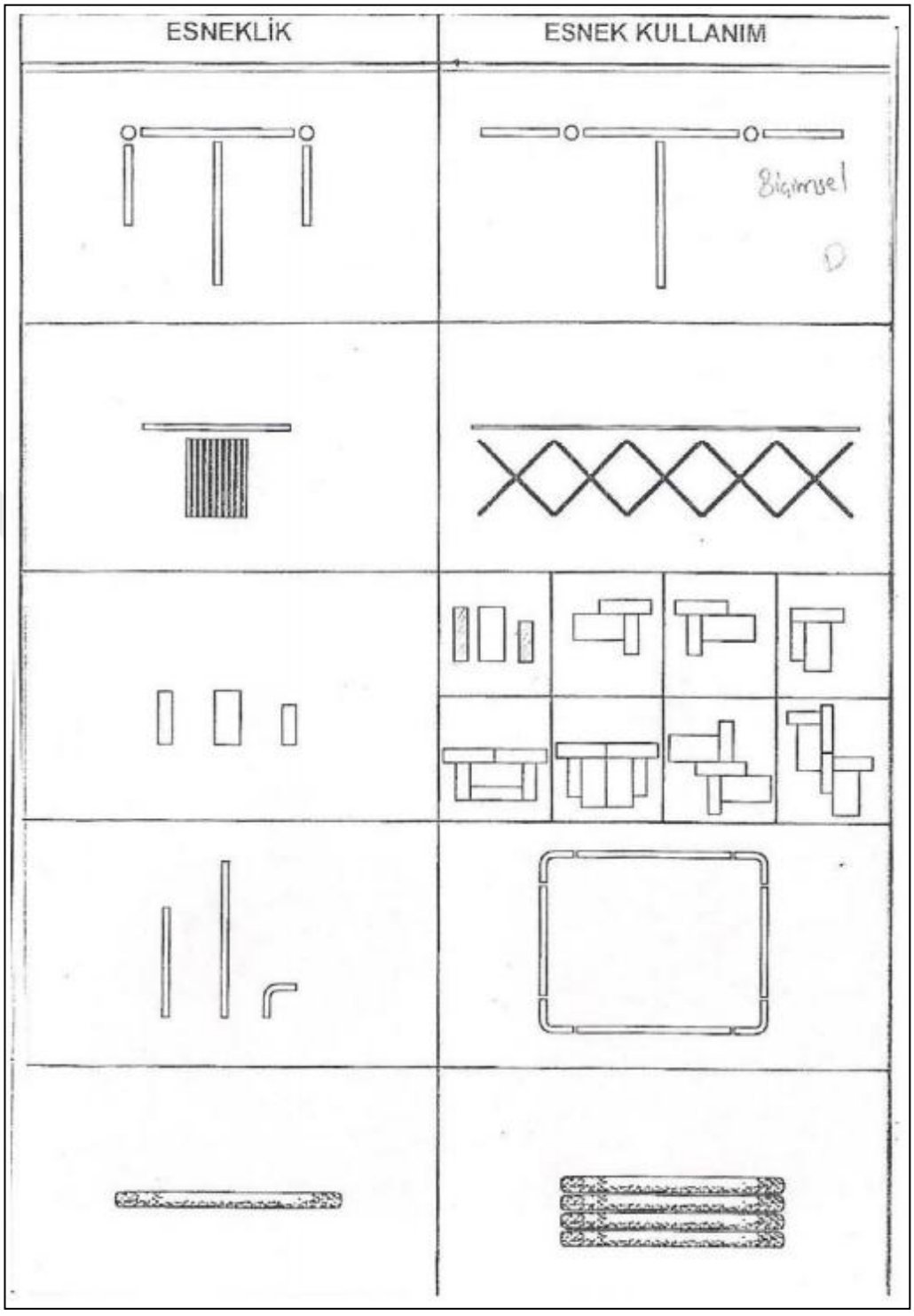

Figure 4.2. Diagram drawings for flexible use [9].

Figure 4.1. and Figure 4.2. We can see its flexibility and flexibility in its practical form and its flexibility, which can be transformed by changing stylistically, with diagram drawings in different forms.

- **A lot of multi-purpose drawers**

Figure 4.3. Multiple drawer cabinet [10].

Figure 4.3. Designed as a multi-purpose drawer, this design, which takes up less space and contains more than one drawer, is also possible to use the upper drawers. It may cause space gain in many places such as the bedroom and dressing room at the entrance. The last four covers can be pulled out like drawers and turned into a ladder step, thus facilitating access to upper covers and their use.

- **Extendable table**

(a)

(b)

Figure 4.4. David Fletcher design expandable round table (expandable round table designed by David Fletcher). (a) Closed position. (b) Opened position [11].

Figure 4.4 shows a David Fletcher design round table showing functional change. The table, which expands by rotating around its own axis, reaches a diameter of 220 cm from 167 cm diameter with the emergence of a hidden table under the upper table, increasing the usage rate by 73 percent. While it is 6 equal parts in closed state, the table reaches 13 parts in total when opened and can be produced in different sizes depending on the needs of the space. It can also be controlled and opened or closed manually or electronically in order to allow easy use [12].

With its expandable feature, this table is among the designs that can be transformed into more than one function. It has an expandable feature with its opening wings. Thus, more than one person can sit on the table when opened. When the wings are closed and shrunk, the area covered is smaller. Therefore, it takes up little space. Dining table, meeting table, etc. like

Figure 4.5. Growing Table [13].

Figure 4.5. On the other hand, an example of a growing table is seen as in the example in figure 4.4. It is a multi-functional design that grows when a 4-person table is opened while closed and can turn into a table for 10 people at once and gains space. It can function as a work desk or meeting table in study rooms, libraries, meeting rooms and offices, and as a dining table in living areas. It is a design that appeals to every space, is used by optimizing many spaces and is suitable for frequent use. It emerges as a design that can be used for

any space that is not difficult to move and is very important in gaining space. The usage area can be increased in places needed by the users.

Due to the reinforcement elements that are not used in many places in residences, blind spots, i.e. unwanted dead areas, can occur in the space. These designs should be given more space in order to evaluate these areas and transform them into more actively usable areas.

- **Both ironing board and mirror**

Figure 4.6. Mirror that can be turned into an ironing board [14].

An interesting design in Figure 4.6. This multi-purpose tool, which is used as both an iron and a mirror, is designed to perform more than one action and is also a useful design for us to gain space. All you have to do is lay it down and lock it in place. Allows you to iron your clothes and then admire the mirror. It is a very interesting cool piece that combines two functions that are usually used in a row. It is a design that does not take up much space in your bedroom and dressing room that you can use comfortably.

- **Ironing Board with Basket**

(a)

(b)

Figure 4.7. Ironing Board, mirror and basket. (a) Closed position. (b) Opened position [15].

Figure 4.7. There is another example of a design that can be concealed exponentially and does not occupy space and allows us to gain from space. It can contribute to space gain by using it in laundry rooms and dressing rooms.

- **Double Wall Beds**

Figure 4.8. Royal Set / Wall Beds [16].

As seen in Figure 4.8, it is possible to create a wonderful living room and a functional bedroom in wall beds, so that the comfort of a standard bed and living room can fulfill the functionality. By placing it in front of a single wall, a space that can be used as both a living room and a bedroom or a guest room is created with items such as armchairs, bookshelves, wardrobes, beds.

In this design, which has a modular seat structure, each piece can be placed in the desired place and triple, double, single or L-shaped seat alternatives can be created. Thanks to the special mechanism of the wardrobe doors, thanks to the folding and opening feature called "accordion", the front of the pass-through module does not close, and when the closet is open, there is no need for enough space to be covered by two cupboard doors. In addition, the opening direction of the cabinet door is optional [16].

- **Single Vertical Opening Wall Beds**

Figure 4.9. Diva Happy Twin Set / Wall Beds [17].

Figure 4.9. Along with the desk bookshelf that can change the direction of the bed, the single vertical bed that can be opened upright is a design that can be used frequently in young rooms and relaxes narrow spaces.

- **Folding Wall Beds**

Figure 4.10. Folding Wall Beds [18].

Figure 4.10. With its foldable feature, product diversity can lead to square meter gain in small spaces by emphasizing color and style integrity and at the same time gaining importance in compatibility and functionality. Thus, it takes its place as designs that affect the size of the space in residences.

- **Save candle**

Figure 4.11. Designer Benjamin Shine by Rekindle Candle (Re-Burning Candle) [19].

Figure 4.11. By combining Shine's product design candlestick from 2014 and a mechanism that produces a re-lighted candle from the used candle, it has gained both ecological and sustainability [19].

Another design among multi-purpose items is a product that draws attention as functionality. In this wax, known as energy saving wax, the melted material inside is filled after melting into the tube underneath, and after waiting for it to freeze again after a while, it can be made suitable for reuse. It includes recycled use in terms of ecological life.

The use of sustainable materials has a positive contribution to ecological life in every sense. Sustainability; In general, the necessary natural resource needs can be defined as enabling future generations to reach natural resources without harming their living conditions, and it becomes important today with the decrease of natural resources. Saving wax is also used as a functional tool containing these qualities [20].

- **Both Table and Pool Table**

Figure 4.12. Fusion pool table and dining table, designed by Aramith [21].

Figure 4.12. This design, which serves as a billiard table and dining table, was designed by Aramith. It's a multipurpose piece that allows you to have a tidy looking dining area or living room with just a few changes, but also have fun playing pool after dinner. With its folding cover system, it turns into a dining table when closed, and with the opening of the upper tables, it turns into a billiard table where billiard balls are placed at the bottom. The reason why many multi-functional designs turn into tables is always the material that occupies the most space on the floor among furniture, and for this reason, most of the multi-purpose designs are converted into tables to save space.

- **A different door design**

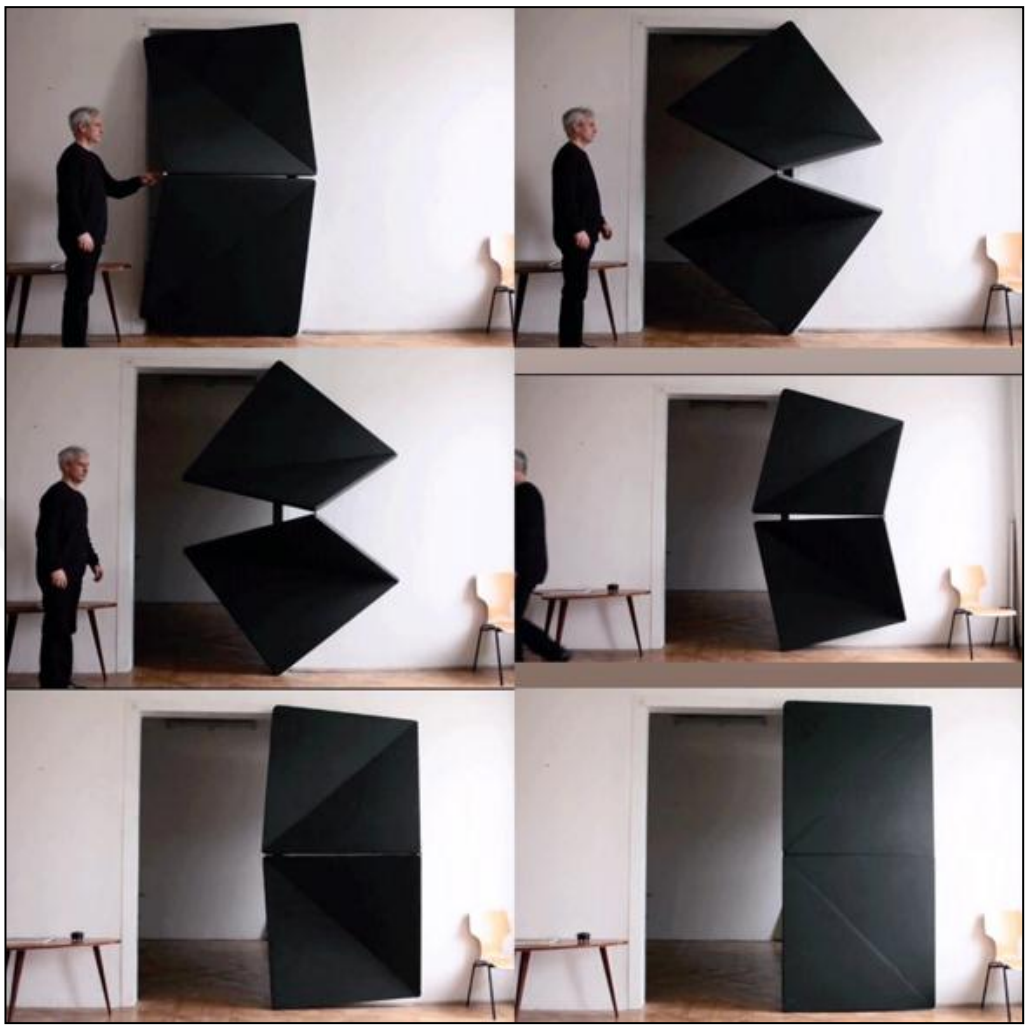

Figure 4.13. Terminal Torggler design [Change Gate]. Evolution door designed by terminal Torggler [22].

Figure 4.13. This door has been radically redesigned by the Australian artist Klemens Torggler with a folding mechanism and uses a folding rotation system. Instead of a single panel attached to a frame by two hinges, the Torggler's Evolution Gate rotates and folds into four triangular sections before turning into a rectangle on itself. The two halves of the door are attached with pivots above and below the frame and a hinge in the middle. By gently pulling from the connection point connecting the two middle panels, the door folds and slides along the entrance [22]. Thus, without creating a sweeping area like other doors in the space, it can relieve the passages and entrances and exits, resulting in m² gain in the space.

- **Both bunk beds and seats**

Figure 4.14. Doc sofa bunk bed / Convertible sofa, (Convertible couch) [23].

Figure 4.14. Designed by the design team at Clei, this convertible piece of furniture looks nothing more than a three-seater sofa at first glance. However, Doc is allowed to turn into a full-fledged bunk bed in literally 30 seconds with the help of a built-in mechanism. It is also equipped with a foldable ladder to reach the upper bunk [23]. It can be used in living rooms, Guest rooms, bedrooms and children's rooms. In this way, we both save space and serve many purposes.

- **Seats that take up little space**

Figure 4.15. Salon de jardin Obelisk, Frank lightart pour dedon [24].

Figure 4.16. Salon de jardin Obelisk, Frank Lightart pour Dedon [24].

In figures 4.15 and 4.16, the garden and terrace furniture of the Obelisk collection created by Dutch designer Frank Lightart and edited by Dedon was covered with prestigious awards. Designed in 2005, this furniture set offers a smart and aesthetic solution to the space requirement of garden furniture. It was stacked on a statue of 2.44 meters in height and 80 cm in diameter, weighing 66 kg [24]. It is before us as a need to store more than one seat in a single module and to save space in open terraces and gardens in adverse weather conditions.

- **Foldable Table**

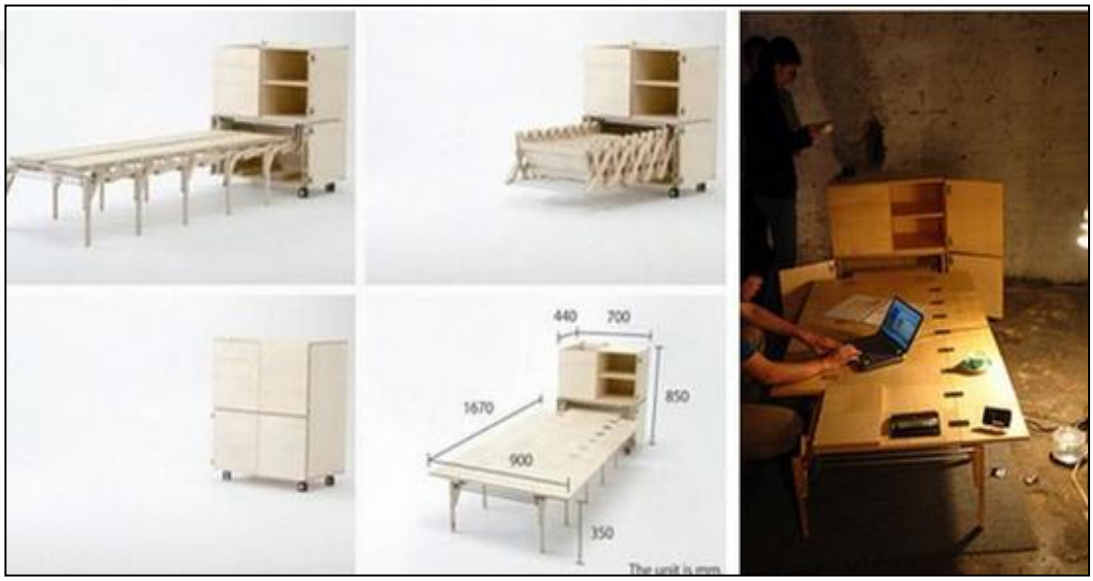

Figure 4.17. Foldable dining table, designed by Nobuhiro Teshima [25].

Figure 4.17. Japanese designer Nobuhiro Teshima from Tohoku University has created a different design by fitting a table into a standard nightstand. Thanks to its foldable structure, you can completely destroy the table and hide it in the coffee table when you are done.

In addition, it allows you to benefit from all the advantages of mobility, and you can easily use it wherever you want. It is a design that can optimize the size of the space in small houses with limited space [25].

This design, which Teshima calls the Dining Table, is a very suitable product for use in Study Rooms and Libraries.

- **Foldable Kitchen**

It is mobile and provides space gain when closed. It creates a new alternative to the kitchen system combined with the living room (American Kitchen) by gaining space.

Figure 4.18. Gorenje modular kitchen design by Goci [26].

Figure 4.18. Materials with a foldable structure are generally products between 1 and 100 nm. These products may exist naturally or can be obtained by making them later. "Foldable materials", which can be included in innovative materials, are preferred in foldable kitchens. Multifunctional products designed with foldable materials always save space and remain popular for future projects.

Gorenje redefines the meaning of flexibility and modularity in this modern kitchen design. It is a foldable design consisting of four different products. It is mounted on mobile screens and pannel. You can easily change the appearance and functionality of the kitchen by mounting and dismounting when needed. [26].

- **Both stove and seat**

Figure 4.19. Cooker convertible chair [27].

Figure 4.19. It is used as a common functional vehicle in 1 + 0 type houses, especially in idle rooms, dormitory rooms and apart hotels when needed. When it is a sofa, it can turn into a stove in an instant, thanks to its unique mechanism, the seat part can be folded and turned over.

- **Both door and table tennis**

Figure 4.20. Foldable ping-pon gate, designed by Tobias Fränzel [28].

Figure 4.20. The Folding Ping Pong Gate is a practical solution for those who like table tennis but do not have a place to fit the order. This small sized game table is the design of Tobias Fränzel, who specializes in functional home furniture. Uses it to create a functional foldable piece of furniture. Setup is quick and easy; Turn the table down, attach the included net so that you combine the two different rooms [28].

Thus, a single function can be considered as a multi-functional tool that both separates and combines two different spaces, taking the form of a table in the vertical door and horizontal.

By dividing the two spaces, the space it occupies as a table can be minimized as soon as the door turns into a tennis table.

To minimize, reduce; It means to belittle. In architecture, it means minimizing, simplifying and minimizing. At the same time, the correspondence of Minimalism in architecture and design can be defined as "reaching the simplest, most economical and most functional result with the least material" [29]. Here, too, we can see this with the product used for functional design purposes. We can provide more than one functionality with a single plain decorative product. This product used has been a very useful design for separating the sports hall from the multi-purpose hall, as we can apply it in my project and in many places.

- **An ideal seat for athletes**

Figure 4.21. Foldable sofa [30].

Figure 4.21. We see a multi-purpose folding seat that is used in sports halls and can show functional changes. It can provide the opportunity to exercise both as a sandbag and on it while doing sports.

- **Athletes foldable treadmill**

Figure 4.22. Foldable treadmill, walking pad [31].

Figure 4.22. The problem with most exercise equipment is that they are very large and take up a lot of space, especially treadmills. Still, this new treadmill, called the WalkingPad, takes up hardly any space as it is foldable and doesn't have a large foot with it. When folded, the tiny treadmill is only 2.7 feet long, 1.8 feet wide and only 5 inches thick. To use it, turn it to your preferred location, turn it on once and then start walking or jogging. It is controlled by a built-in remote control or an app on your phone [31].

- **Bookshelf Coffee Table**

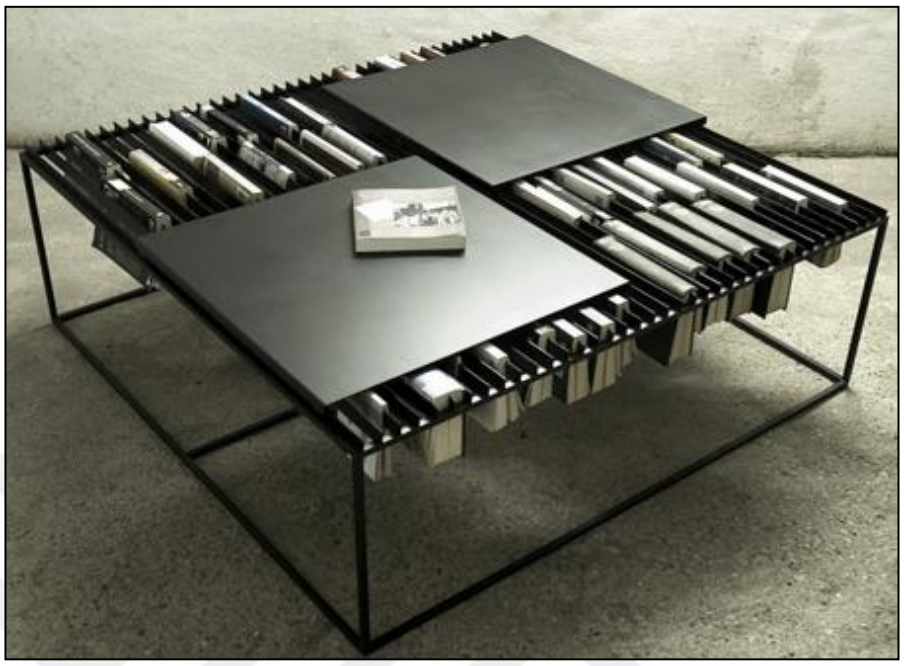

Figure 4.23. Bookcase coffee table [32].

Figure 4.23. Designed as a Bookshelf Coffee Table, this coffee table is a very modern and stylish looking furniture element that saves space, has a lot of functionality and is easy to use.

- When the examples of the vehicles used in the house, which are described with the visuals above, and which assist in alternating or multi-functional actions, are examined in general according to their features, it can be seen that they can be grouped under three main headings.
- Aids for alternating actions with the same function, movement that shrinks and grows.
- Actions aids that can be adapted to multiple functions.
- Auxiliary tools for actions that are easy to store.

As can be seen, not all conversion tools are multi-functional, but; Multifunctional tools such as lightness, portability, ease of mechanisms are convertible tools in terms of their suitability to all features except for multi-function responsiveness and the importance of

their effects on space sizes, and are evaluated in the same sense for their purposes in housing design.

5. FUNCTIONAL EVALUATION OF HOUSING PROJECTS

In practice, institutional housing projects such as TOKI, MESA etc., which are designed for flexible use, are seen. However, there are no housing designs for the use of multi-functional convertible vehicles. Since multifunctional tools are used in the thesis based on how projects can be changed and differentiated, it is necessary to first examine the spaces in housing projects functionally with transformable tools.

5.1. DISTRIBUTION OF SINGLE-FUNCTIONAL VEHICLES IN SPACES

In the Single Storey Detached House Types Plan Showing the Distribution of Single Function Vehicles in Spaces, the existing standard furnished plan is processed and shown together with tables and functional schemes.

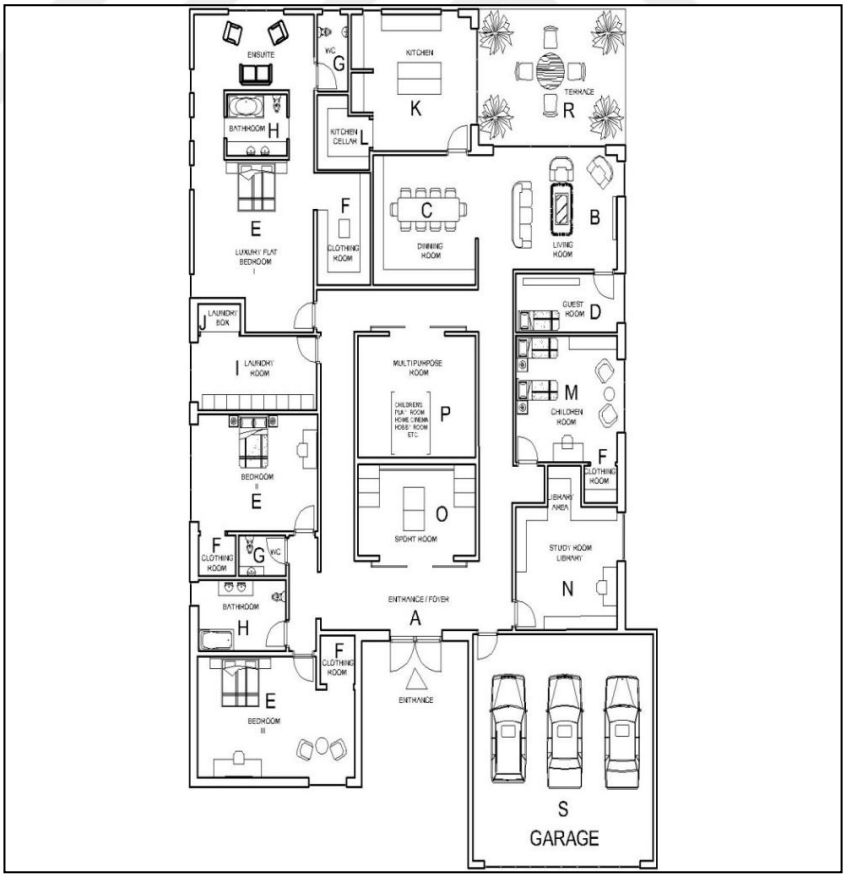

Figure 5.1. Current plan of single storey detached house type. Standard furnishing, designed by author.

Figure 5.1. The main actions, places and vehicles that take place in a house with single-storey detached house types of Single-function vehicles are shown in the Table 5.1.

Table 5.1. The relationship between action-space-vehicle in the residence, prepared by author.

Actions In The Housing	**Places**	**Vehicles**
Login	Entree **A**	Portfolio,Mirror
Sitting, Listening To Music, Watching Tv	Living Room **B**	Seat, Tv Unit
Eating	Dining Room **C**	Dining Table (For 10 People)
Living, Guest	Guest Room **D**	Sofa, Armchair, Ortasehpa, Coffee Table
Laying, Resting, Makeup-Care [X3]	Bedroom [X3] **E**	Bed, Mirror, Cabinet, Etejer, Lamp, Makeup Table [X3]
Clothing Storage	Clothes Room **F**	Clothing Cabinets, Shelves And Puf
Using Wc	Wc- Sink **G**	Toilet, Mirror, Washbasin
Cleaning-Washing	Bath-Shower **H**	Shower Cabinet, Bathtub, Mirror, Cabinet, Towel Holder
Storage, Washing And Ironing Of Laundry	Laundry Room **I**	Washing Machine, Drying Machine
Laundry Storage, Laundry Washing	Laundry Box **J**	Dirty-Clean Washing Cabinets

Preparing Meals, Cooking, Dishwashing	Kitchen	**K**	Cabinet, Shelf, Cooker, Dining Table, Counter, Kitchen Knife, Cutting Board, Spatula, Cooking Spoon, Ladles, Strainers, Dishwasher
Food Storage	Kitchen	**L**	Cold Storages, Cabinets
Living	Children's Bedroom	**M**	Bed And Cabinet
Reading, Storing And Working	Study Room, Library	**N**	Study Desk, Bookcase, Shelf
Doing Sports	Doing Sports	**O**	Running Band, Dambil
Hobby And Game Activities	Multipurpose Room Hobby Room	**P**	Table Tennis, Backgammon, Langirt, Billardo, Play Doughs, Puzzle Vs.
Rest In A Natural Environment	Terrace-Veranda-Winter Garden	**R**	Table, Hammak, Modern Barbecue, Swinging Chair, Prtic Laptop Table, Lighting (For Night), Umbrella, Pump Cushions, Garden Sculptures, Colorful Stools, Ferfoje Table Set, Garden Bar, Garden
Vehicle Parking	Car Park	**S**	Vehicle, Car, Motorcycle

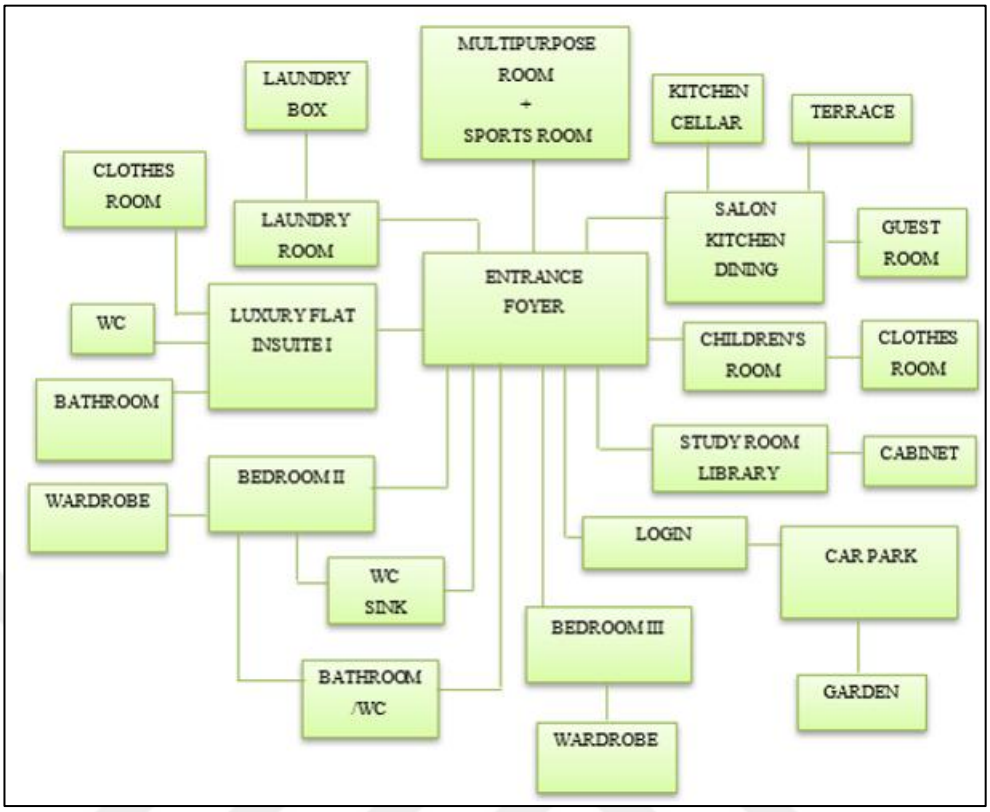

Figure 5.2. Function diagram indicating the action-mode-vehicle relations in the residence, prepared by author.

Figure 5.2. The available spaces in a house with single-storey detached house types of single-functional vehicles are shown in the functional diagram.

5.2. DISTRIBUTION OF MULTIFUNCTIONAL VEHICLES IN SPACES

With the increase in the use of multifunctional vehicles, the change in residential spaces has been examined gradually. Spatial shrinkage and numerical decrease were observed.

5.2.1. Primary Distribution of Multifunctional Vehicles in Spaces

The primary distribution of multi-functional vehicles in single-storey detached house types in spaces is shown in the plan in Figure 5.3.

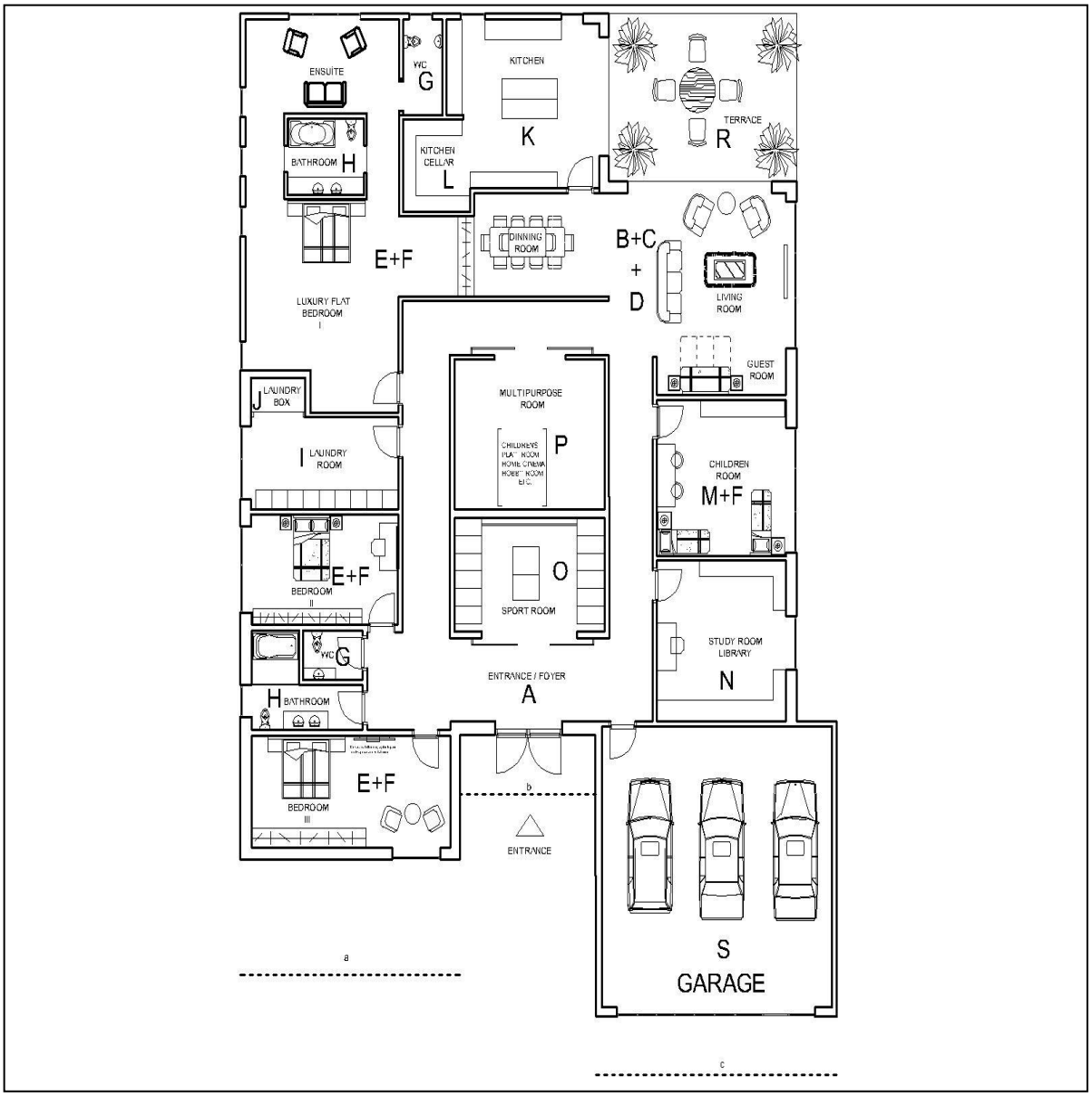

Figure 5.3. Primary plan change, designed by author.

Figure 5.3. The primary distribution of the main actions, spaces and vehicles in a residence, as seen in the plan, is shown in the Table 5.2.

Figure 5.3. As we can see in the plan, due to the primary change made, withdrawals were made on the outer walls by a, b and c, with the gain from the space.

Table 5.2. Action-space-vehicle relationship according to the primary distribution of multi-functional vehicles used in the single-storey detached house type, prepared by author.

Actions In The Housing	**Places**	**Vehicles**
Login	Entree **A**	Portfolio, Mirror
Sitting, Listening To Music, Watching Tv, Eating Living, Guest	Living Room **B** + Dining Room **C** + Guest Room **D**	Seat, Tv Unit, Dining Table (For 10 People) Sofa, Armchair, Ortasehpa, Coffee Table
Laying, Resting, Makeup-Care Clothing Storage	Bedroom **E** + Clothes Room **F**	Bed, Mirror, Cabinet, Etejer, Lamp, Makeup Table Clothing Cabinets, Shelves And Puf
Using Wc	Wc-Sink **G**	Toilet, Mirror, Washbasin
Cleaning-Washing	Bath-Shower **H**	Shower Cabinet, Bathtub, Mirror, Cabinet, Towel Holder
Storage, Washing And Ironing Of Laundry	Laundry Room **I**	Washing Machine, Drying Machine
Laundry Storage, Laundry Washing	Laundry Box **J**	Dirty-Clean Washing Cabinets
Preparing Meals, Cooking, Dishwashing	Kitchen **K**	Cabinet, Shelf, Cooker, Dining Table, Counter, Kitchen Knife, Cutting Board, Spatula, Cooking Spoon, Ladles, Strainers, Dishwasher
Food Storage	Kitchen Cellar **L**	Cold Storages, Cabinets
Living	Children's Bedroom **M** + **F**	Bed And Cabinet
Reading, Storing And Working	Study Room, Library **N**	Study Desk, Bookcase, Shelf

Doing Sports	Doing Sports	**O**	Running Band, Dambil
Hobby And Game Activities	Multipurpose Room Hobby Room	**P**	Table Tennis, Backgammon, Langirt, Billardo, Play Doughs, Puzzle Vs.
Rest In A Natural Environment	Terrace-Veranda- Winter Garden	**R**	Table, Hammak, Modern Barbecue, Swinging Chair, Prtic Laptop Table, Lighting (For Night), Umbrella, Pump Cushions, Garden Sculptures, Colorful Stools, Ferfoje Table Set, Garden Bar, Garden
Vehicle Parking	Carpark	**S**	Vehicle, Car, Motorcycle

***** *By Primary Change, it is meant the first distribution of transformable vehicles according to spaces.*

In table 5.2, which was made according to the primary change plan, the relationship of spaces with tools and actions was established. Thus, by lettering how we combine the spaces, the gain we have achieved in the spaces is shown step by step.

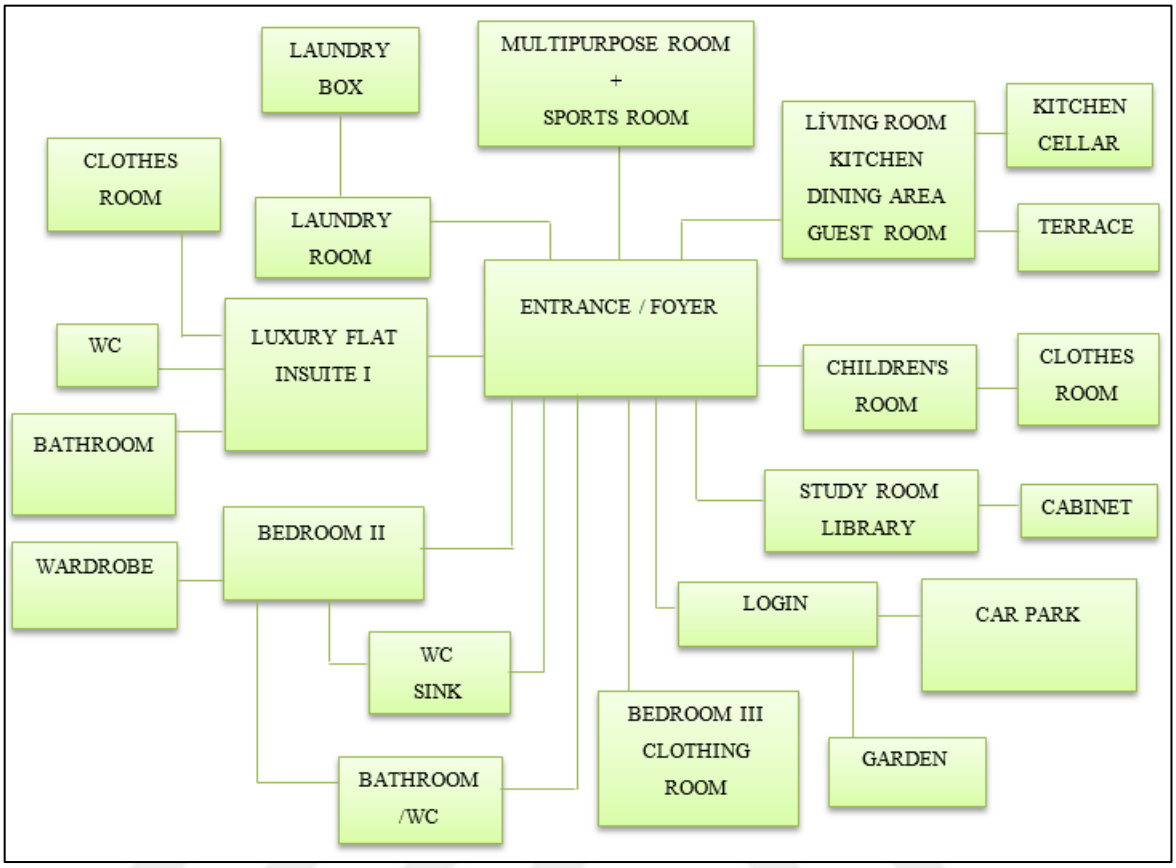

Figure 5.4. Primary function chart indicating the action, space, and tool relationships of the primary change plan, prepared by author.

Figure 5.4. Shows the functional scheme of the changes made according to the primary change plan. This is how we see it.

- **Changes Applied to The Primary Plan**

o **Living Room**

The sofa bed in the living room leaves the guest room with the sofa. Thus, the living area of the hall is expanded. In addition, the dining area can be reduced with the collapsible 8-person (standard) dining table, thus creating a corridor. The multi-purpose hall, sports room and entrance hall are deferred to create a corridor.

- **Bedrooms**

In the bedrooms, the dressing rooms are removed and the wardrobe system with a pull-up and down mechanism is introduced, and the rooms are reduced to more reasonable sizes. In particular, the wardrobe next to the shared WC is removed and the shower and bathtub of the shared bathroom is replaced, and the outer wall of the 2nd Bedroom is shifted in accordance with the newly arranged bathroom.

- **Children's Room**

Since the Guest Room has been removed, the Children's Room next to it has grown and moved to the wall between the Sports Room and the Multi-Purpose Hall to restore this growth.

Thus, the Shield Wardrobe and wardrobes, the Library and Study Room grew. Thanks to the Shifted Entrance, the entrance facade to the building and the wall between the Library and the Study Room and the Garage were brought to the same alignment.

In this way, the area covered by the plan has been reduced by excluding the A, B and C areas shown on the plan. In this way, no function space was reduced and especially the Library and Children's Room were enlarged in contrast.

5.2.2. Second Distribution of Multifunctional Vehicles in Spaces

The secondary distribution of multi-functional vehicles in single-storey detached house types in spaces is shown in the plan shown in Figure 5.5.

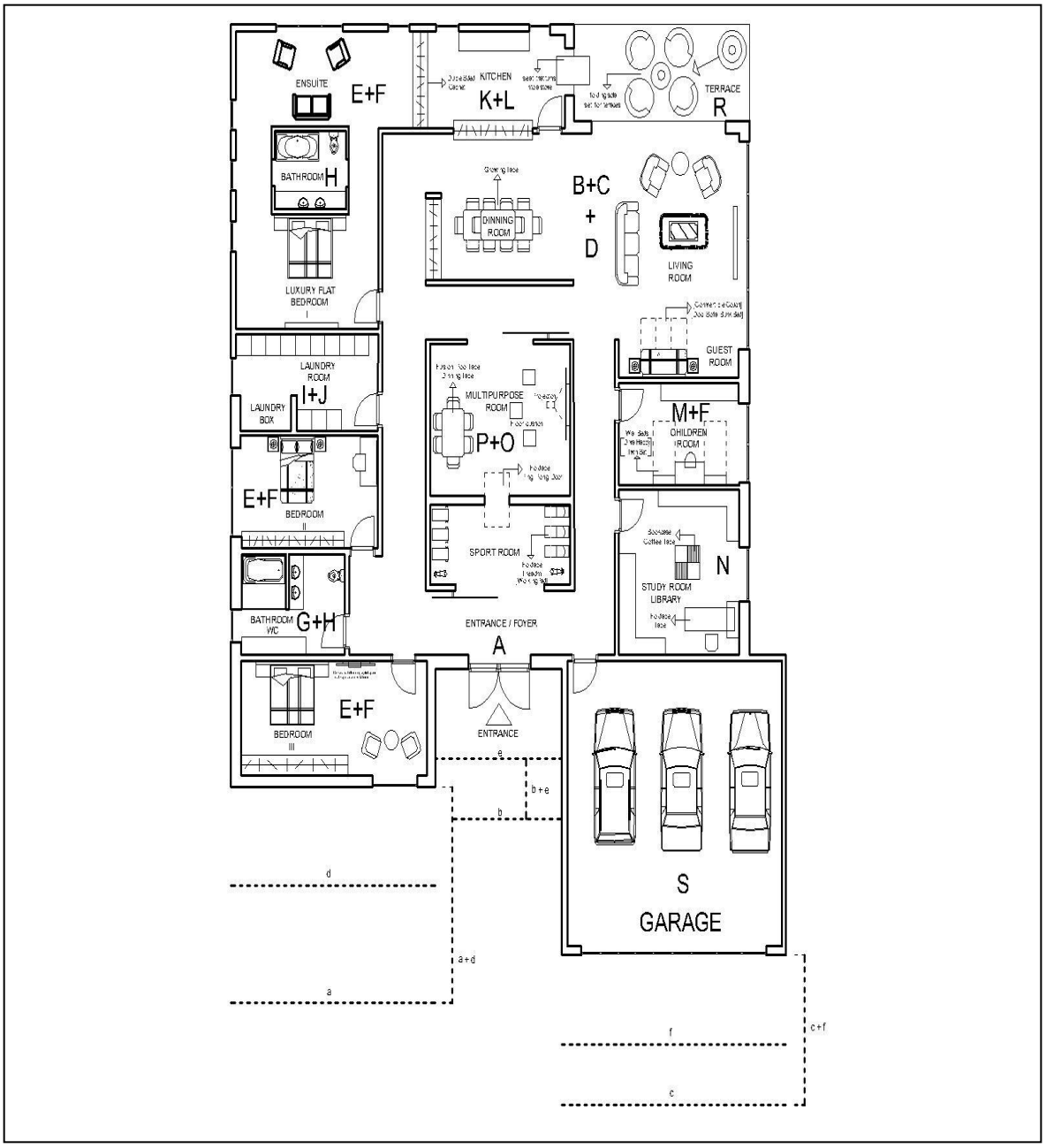

Figure 5.5. Secondary plan change, designed by author.

Figure 5.5. As can be seen, due to the functional designs used in the secondary plan change, a, b, c, d, e and f withdrawals were made on the outer walls due to the gain from the space.

Table 5.3. Action-space-vehicle relationship according to the secondary distribution of multi-functional vehicles used in single-storey detached house type, prepared by author.

Actions To Be Taken In The Housing	**Places**	**Vehicles**
Logın	Entree **A**	Portfolio, Mirror
Sitting Listening To Music, Watching Tv Eating Living, Guest	Living Room Dining Room Guest Room **B + C + D**	Seat, Tv Unit, Dining Table (For 10 People) Sofa, Armchair, Ortasehpa, Coffee Table
Laying, Resting, Makeup-Care Clothing Storage	Bedroom Clothes Room **E + F**	Bed, Mirror, Cabinet, Etejer, Lamp, Makeup Table Clothing Cabinets, Shelves And Puf
Using Wc Cleaning-Washing	Wc-Sink Bath-Shower **G + H**	Toilet, Mirror, Washbasin Shower Cabinet, Bathtub, Mirror, Cabinet, Towel Holder
Storage, Washing And Ironing Of Laundry	Laundry Room Laundry Box **I + J**	Washing Machine, Drying Machine Dirty-Clean Washing Cabinets
Preparing Meals, Cooking, Dishwashing Food Storage	Kitchen Kitchencellar **K + L**	Cabinet, Shelf, Cooker, Dining Table, Counter, Kitchen Knife, Cutting Board, Spatula, Cooking Spoon, Ladles, Strainers, Dishwasher Cold Storages, Cabinets
Living	Children's Bedroom **M + F**	Bed And Cabinet
Reading, Storing And Working	Study Room, Library **N**	Study Desk, Bookcase, Shelf
Doing Sports Hobby And Game Activities	Sport Room Multipurpose Room Hobby Room **O + P**	Running Band, Dambil Table Tennis, Backgammon, Langirt, Billiardo, Play Doughs, Puzzle Vs.

Rest In A Natural Environment	Terrace-Veranda-Winter Garden	**R**	Table, Hammo, Modern Barbecue, Swinging Chair, Prtic Laptop Table, Lighting (For Night), Umbrella, Puff Cushions, Garden Sculptures, Colorful Stools, Ferfoje Table Set, Garden Bar, Flower Beds
Vehicle Parking	Car Park	**S**	Vehicle, Car, Motorcycle

** By the term Secondary Distribution, it is meant the distribution of transformable vehicles to spaces after the primary.*

Table 5.3. We see a table describing the relationship between space, tool and action, created according to the secondary plan change. In this table, spaces are coded with letters, increasing the number of multifunctional designs used before and enabling them to be used in more spaces, causing us to gain from the area. Thus, the number of venues was reduced and the above table was further simplified by combining certain spaces.

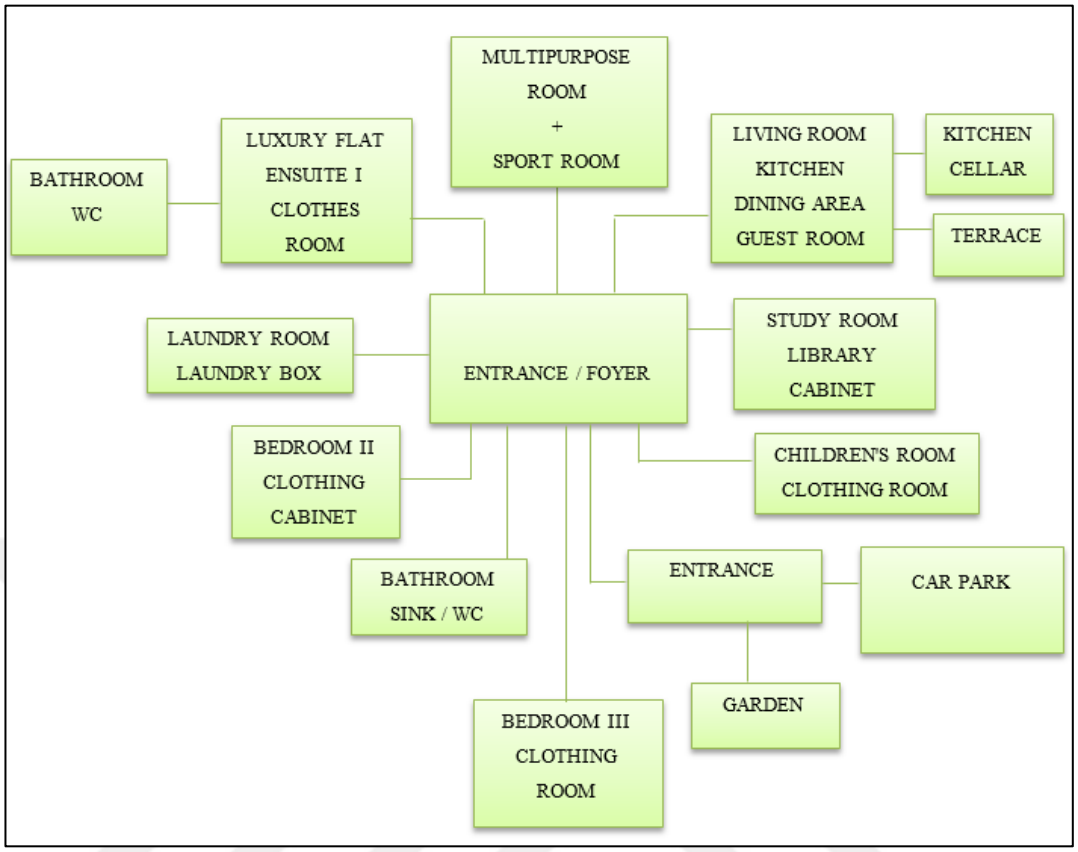

Figure 5.6. Secondary function chart indicating the action, space and tool relationships of the secondary change plan, prepared by author.

Figure 5.6. As can be seen, due to the differences made in the secondary plan changes, there was a numerical reduction in the spaces, and due to these reductions, the circulation in the space became more differentiated and the transitions from space to space were facilitated. Thus, a new functional diagram was created showing the change in the secondary plan.

- **Changes Applied to The Secondary Plan**

o **Parents Bedroom**

o **First Bedroom**

WC is raised in the Master Bedroom, instead of moving a wardrobe with hanging mechanism. The old wardrobe is turned into a corridor and a double-sided built-in cupboard is brought between the dining area and this corridor. Thus, the 1st Bedroom (Parent) gets smaller.

- **Kitchen**

Instead of the wall between the Kitchen and the Dining Room, a double-sided under-counter cabinet with drawers is being introduced. Thanks to these cabinets, the Kitchen Pantry is raised and the Kitchen is reduced, the connection between the Dining Area and the Living Room is integrated, and the transition from the Kitchen to the corridor is providedA rotating stove-seat auxiliary vehicle is placed between the kitchen and the terrace, and the wall between the Terrace and the Living Room is brought to the level of the shifted Kitchen wall and used. Terrace dimensions are changing in favor of the living room.

- **Laundry Room**

The wall between the 1st Bedroom and the Laundry Room is brought to the level of the wall between the Dining Area and the Corridor, and the Laundry Room is displaced. Thus, the unnecessary size of the 1st Bedroom is arranged.

- **Second Bedroom**

The WC between the Second Bedroom and the Bathroom is removed and added to the shared bathroom. Thus, thanks to the growing Bathroom, the wall between the third Bedroom is displaced. The WC door is transformed into a wall and a wardrobe with hangers is carried to this wall.

- **Third Bedroom**

The outer wall of the Third Bedroom is offset again due to the offset bathroom wall, thus preserving the room's existing dimensions.

- **Children's Room**

The wall between this room and the Children's Room is also shifted to a more reasonable size in favor of the Children's Room Library.

- **Multi-Purpose Hall / Sports Room**

The door, which can be turned into a ping-pong table, into the wall between these two rooms, is brought to the wall between the Children's Room and the Library in order to

reduce it in the Multi-Purpose Hall. Likewise, it is offset on the wall between the Entrance and the Sports Room. In this way, the entrance facade wall is also offset.

- **Entrée**

The use of the entrance is facilitated by placing a mechanism door without a wing, placed on the wall between the entrance and the Sports Room.

- **Garage**

The wall between the library and the Garage is brought to the level of the offset entrance wall. Thus, by shifting the outer wall of the garage at the same rate, the size of the garage preserves its current state, and D, E, F areas are added to the unused A, B, C areas.

5.3. COMPARISON OF SINGLE AND MULTI-FUNCTIONAL VEHICLES IN SPACES

The reason for comparing the distribution of single and multi-functional vehicles in spaces; to see the reduction of space in the spaces before and after. For this reason, the effect of the space size of the spaces has been observed with the transformation of the tools used in the actions to multi-functional designs.

When the function diagrams specified in 4.1 and 4.2 are examined, it is observed that there is a decrease in the area and number of the spatial distribution with the use of multi-functional tools. That is to say, since different spaces used for many actions can be integrated with a single space, a decrease in the number of spaces may occur. Because, since the functions of single-function vehicles can be achieved by using less multi-functional tools, there will be a decrease in both the number of auxiliary tools and the use of space. For this reason, although the total area size in the residences will decrease in m2, more easy-useful (practical) spaces will be created.

When Table 1,2,3 and Figure 1,2,3 are examined, the following evaluations can be made.

- Number of places in the 1st action-space table is 18.
- Number of venues in the 2nd action-space table is 13.
- The number of places in the 3rd action-space table is seen as 9-10.

Therefore, as the spaces decrease without changing the actions, the size of the residential areas decreases and the functions remain constant. In the comparison made, the decrease in the number of places and sizes will be examined with m2 values above the house types selected in section 6.

6. INSPECTION OF SELECTED DIFFERENT HOUSING TYPES ACCORDING TO THE USE OF MULTIFUNCTIONAL VEHICLES

In the study, until now, in the functional evaluation of the residence types, "Single Storey Detached House Type" has been selected, on a sample plan; By preparing action-space-auxiliary tool relationship tables and function charts, the savings to be obtained from the total construction area by using tools for multi-functional actions were tried to be revealed.

In this section, the total construction area savings to be achieved are evaluated by working with the same method steps on different types of houses in an existing residential area project. The current residential area project examined is the Uprise Elite Site Housing Project, which is the Project of the Technical Structure, and the use of multi-functional vehicles has been evaluated on the examples of "Two-Storey Detached House Types", "Residance Residence Types" and "Apartment House Types".

Figure 6.1. Uprise elite project view front view [33].

Figure 6.1. and Figure 6.2. In the image, the functional changes of a project that has been implemented, as seen in the facade view and site plans, have been studied on this project.

Figure 6.2. Layout plan of uprise elite project, which is an existing housing project [33].

- **Uprise Elite Project**

The Uprise Elite Project consists of 3 apartment blocks, 1 residence block and 5 double blocks and 1 single block terrace houses. Two-storey detached house, residence residence and apartment house types of these houses were examined in terms of the use of multi-functional vehicles.

6.1. TWO-STOREY DETACHED HOUSING TYPES

In these houses, the use of multi-functional tools is shown on the flat type of 4 + 1. As in the single-storey Detached house type, the functional distribution of the primary and secondary here will be shown with Plans, Tables and Functional Diagrams.

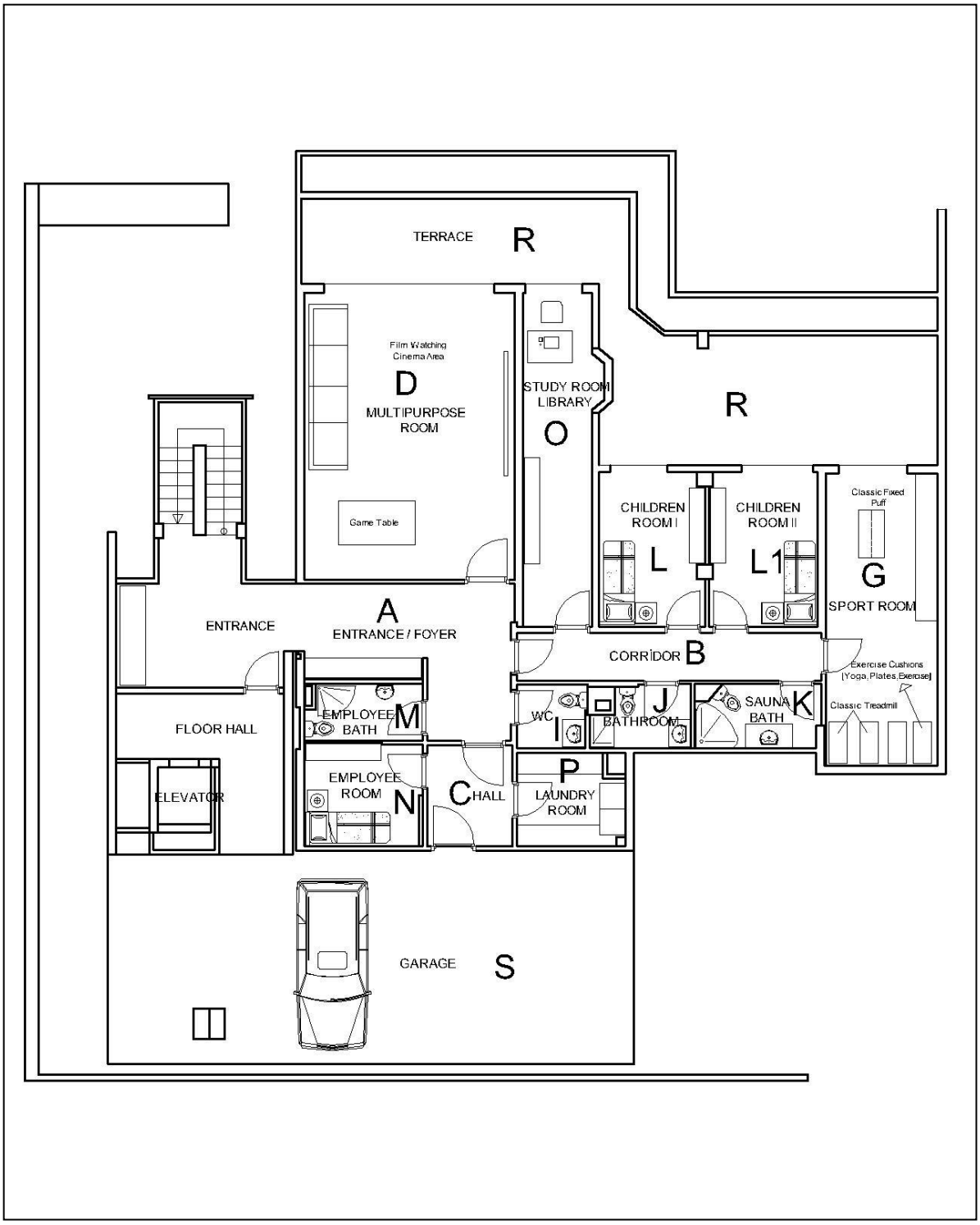

Figure 6.3. Existing ground floor plan of two storey detached house types. Standard furnishing, designed by author.

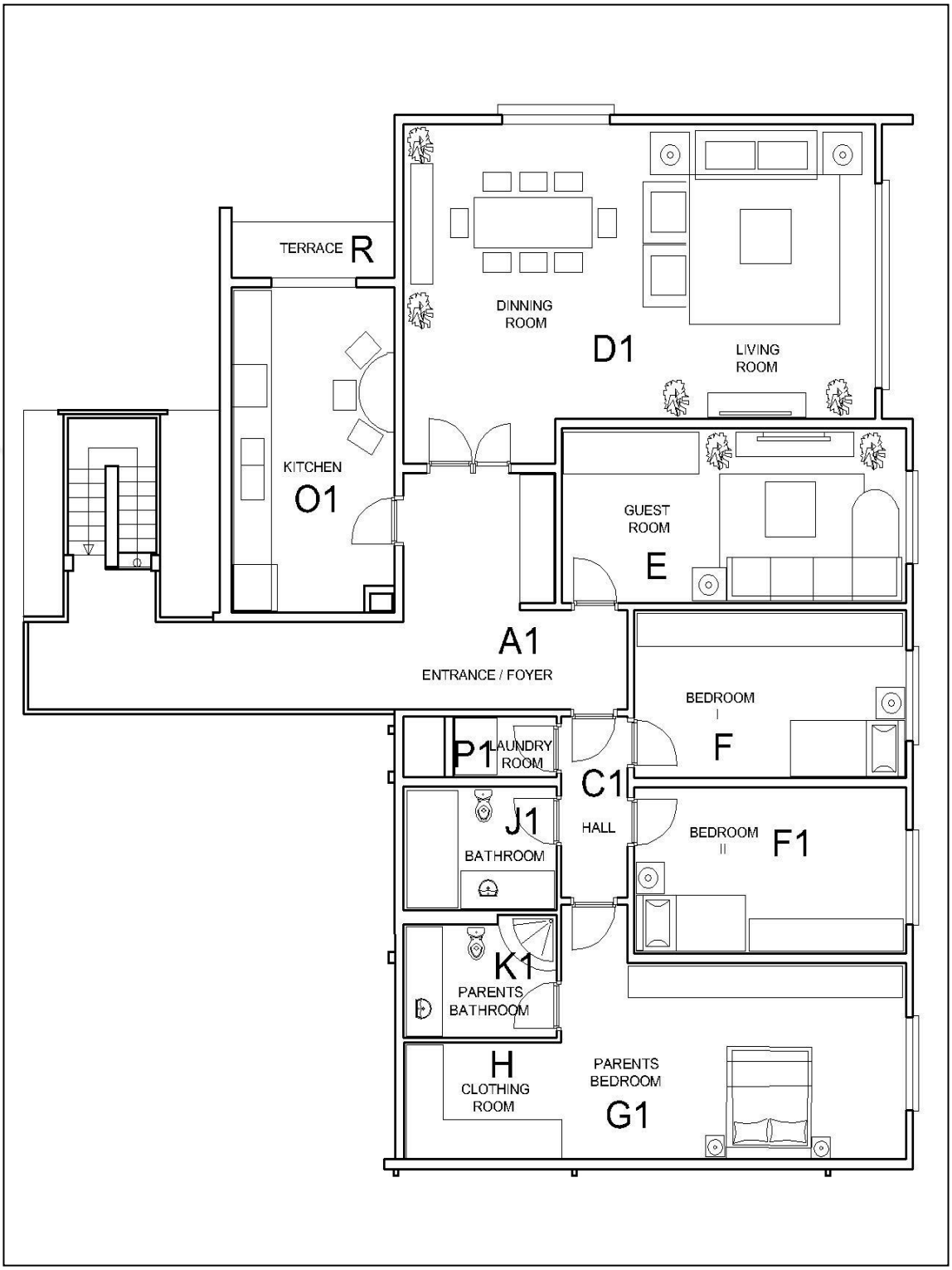

Figure 6.4. Existing upper floor plan. Standard furnishing, designed by author.

Figure 6.3. and Figure 6.4. The main movements, locations and distribution of the two-storey detached house type vehicles in the current plan are shown in Table 6.1.

Table 6.1. Action, space, vehicle relationship of existing ground floor and upper floor plan. Standard furnishing, prepared by author.

Actions In The Housing	**Places**		**Vehicles**
Entrance	Entree	**A**	Portfolio, Mirror
Entrance	Entree	**A1**	Portfolio, Mirror
Transition To Spaces	Corridor	**B**	Mirror
Transition To Spaces	Hall	**C**	Mirror
Transition To Spaces	Hall	**C1**	Mirror
Fun, Playing, Watching Film, Listening To Music	Multipurpose Hall	**D**	Game Tables Cinema Areas
Seating, Dining	Hall, Dining Area	**D1**	Chair, Tv Unit, Dining Table (For 10 People)
Living, Guest	Guest Room	**E**	Sofa, Armchair, Middle Table, Coffee Table, Tv Unit, Bed
Laying, Rest, Makeup-Care	Bedroom	**F**	Bed, Mirror, Cabinet, Etejer, Ladder, Makeup Table
Laying, Rest, Makeup-Care	Bedroom	**F1**	Bed, Mirror, Cabinet, Etejer, Ladder, Makeup Table
Doing Sports	Sport Room	**G**	Dambill, Bicycle, Running Band, Weight Equipment
Laying, Rest, Makeup-Care	Parents Bedroom	**G1**	Bed, Mirror, Cabinet, Etejer, Ladder, Makeup Table
Garment Storage, Dressing	Clothes Room	**H**	Clothing Cabinets, Shelves And Puf

Using Wc	Wc –Sink	**I**	Toilet, Mirror, Washbasin
Cleaning	General Bathroom Shower	**J**	Shower Cabinet, Bathtub, Mirror, Cabinet, Towel Holder
Cleaning	General Bath-Shower	**J1**	Shower Cabinet, Bathtub, Mirror, Cabinet, Towel Holder
Cleaning	Parents Bathroom-Shower	**K**	Shower Cabinet, Bathtub, Mirror, Cabinet, Towel Holder
Cleaning	Parents Bathroom Shower	**K1**	Shower Cabinet, Bathtub, Mirror, Cabinet, Towel Holder
Living	Children's Bedroom	**L**	Bed And Cabinet
Living	Children's Bedroom	**L1**	Bed And Cabinet
Cleaning	Servant Bath	**M**	Shower Cabinet, Bathtub, Mirror, Cabinet, Towel Holder
Living	Servant Bedroom	**N**	Bed And Cabinet
Work, Read Books	Library Study Room	**O**	Bookcase, Study Desk
Preparing Meals, Cooking, Dishwashing	Kitchen	**O1**	Cabinet, Shelf, Cooker, Dining Table, Counter, Kitchen Knife, Cutting Board, Spatula, Cooking Spoon, Ladles, Strainers, Dishwasher
Cleaning	Laundry Room	**P**	Washing Machine, Drying Machine

Cleaning	Laundry Room	**P1**	Washing Machine, Drying Machine
Rest	Terrace-Veranda-Winter Garden Balcony	**R**	Table, Hammo, Modern Barbecue, Swinging Chair, Practical Laptop Table, Lighting (For Night), Umbrella
Vehicle Parking Area	Car Park	**S**	Vehicle, Car, Motorcycle

In Table 6.1, the use of the existing plans with standard-sized furniture, the relationship between space, vehicle and action, are shown by lettering the spaces.

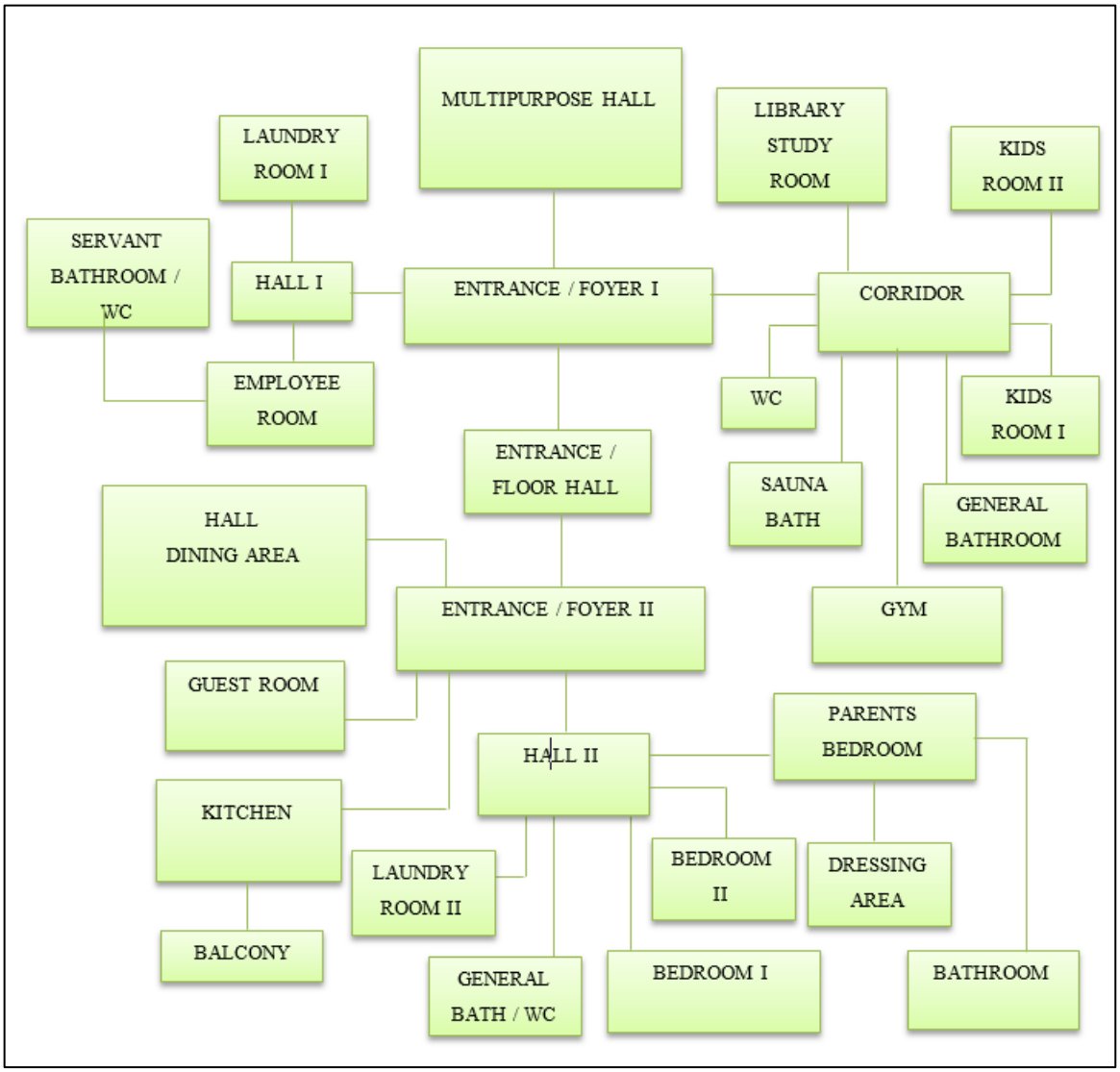

Figure 6.5. Existing function diagram with the action, space and vehicle relations of the existing ground floor and upper floor plan, prepared by author.

Figure 6.5. The functional scheme, which is seen as the first, is a drawing that shows the use of the existing plan with standard-sized furniture, the circulation of the spaces and clearly reveals the number of spaces.

The distribution of the main action, space and vehicles in the ground floor and upper floor primary plans of the two-storey detached house type is shown in Figure 6.6 and Figure 6.7.

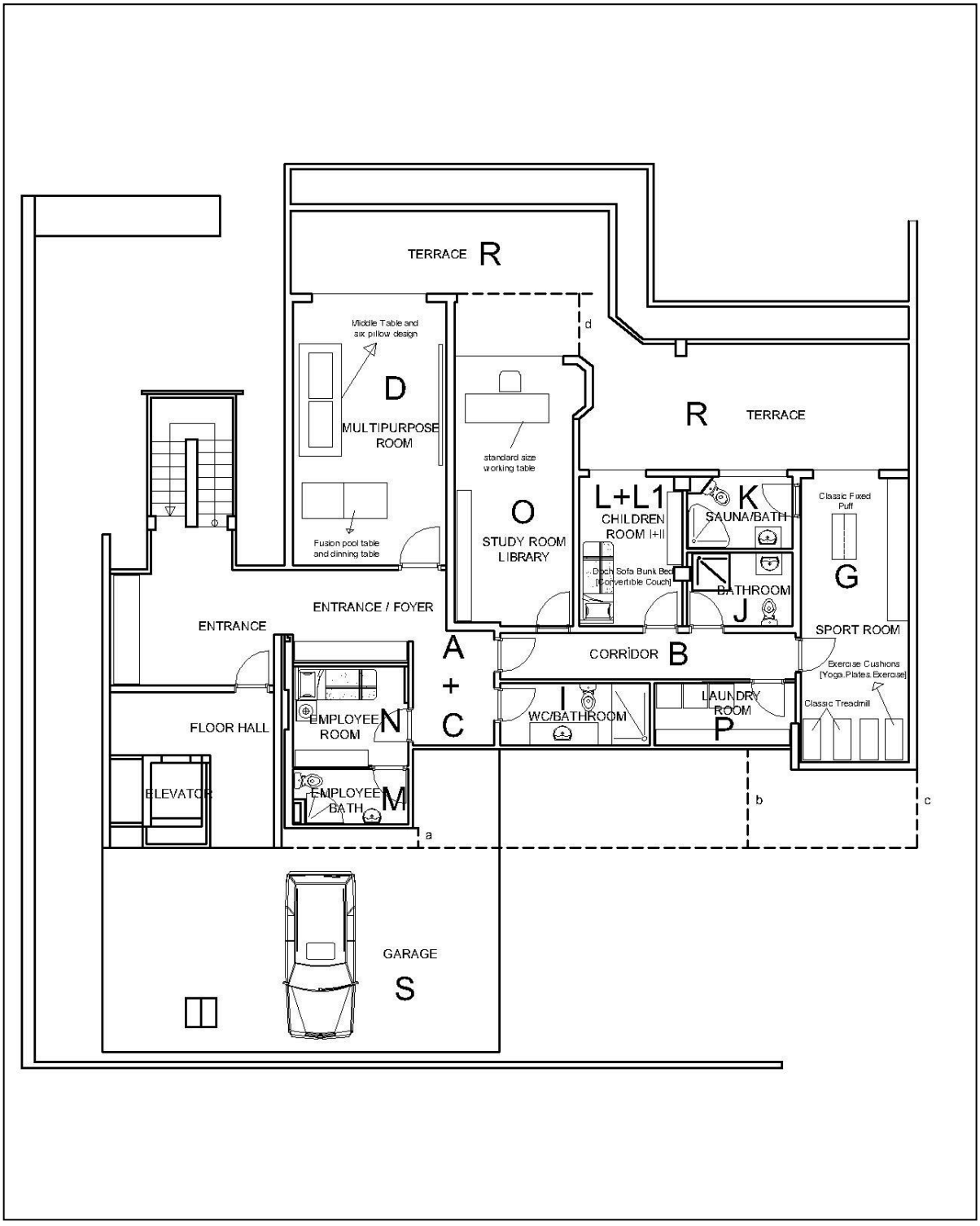

Figure 6.6. Primary change of ground floor plan, designed by author.

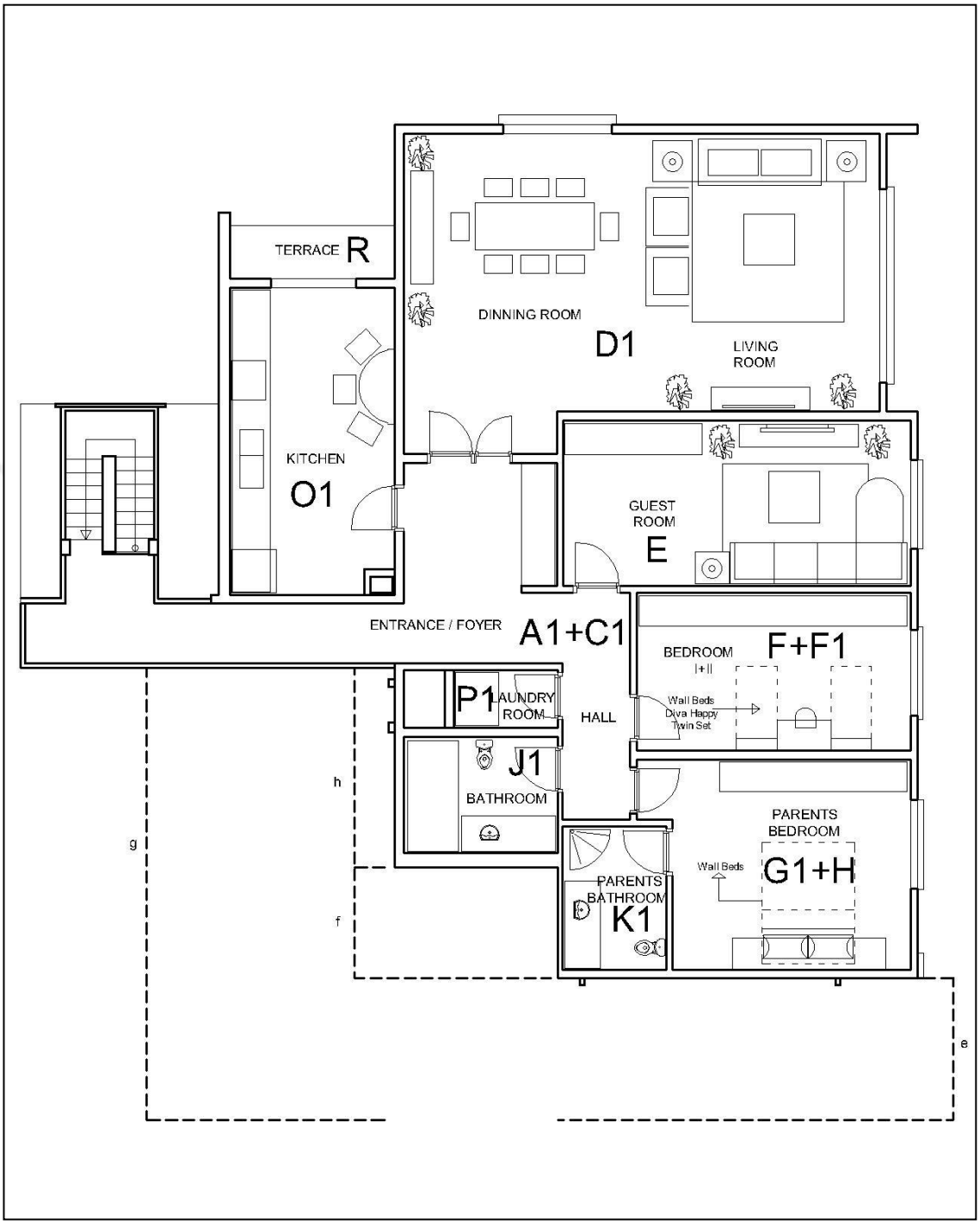

Figure 6.7. Primary change of upper floor plan, designed by author.

Due to the multifunctional designs used in the plan we have seen in Figure 6.6, the outer walls have been pulled in lengths a, b, c and d. In Figure 6.7, due to the multi-functional designs used in the plan, the outer walls have drawn as much as the lengths g, h, f and e.

The distribution of the main actions, spaces and vehicles in the two storey detached house type in the ground floor and upper floor primary plans are shown in the Table 6.2. and Figure 6.8.

Table 6.2. Primary change ground floor and upper floor plan's action, space, vehicle relationship, prepared by author.

Actions In The Housing	**Places**	**Vehicles**
Login Transition To Spaces	Entree Hall **A+A1+C+C1**	Portmanto, Mirror
Transition To Spaces	Corridor **B**	Mirror
Fun, Playing Watching Film, Listening To Music	Multipurpose Hall **D**	Game Tables Cinema Areas
Seating, Dining	Hall, Dining Area **D1**	Chair, Tv Unit, Dining Table (For 10 People)
Living, Guest	Guest Room **E**	Sofa, Armchair, Middle Table, Coffee Table, Tv Unit, Bed
Laying, Rest, Makeup-Care	Bedroom **F+F1**	Bed, Mirror, Cabinet, Etejer, Ladder, Makeup Table
Doing Sports	Sport Room **G**	Dambill, Bicycle, Running Band, Weight Equipment
Laying, Rest, Makeup-Care	Parents Bedroom **G1**	Bed, Mirror, Cabinet, Etejer, Ladder, Makeup Table
Garment Storage, Dressing	Clothes Room **H**	Clothing Cabinets, Shelves And Puf
Using Wc	Wc-Sink **I**	Toilet, Mirror, Washbasin
Cleaning	General Bathroom Shower **J**	Shower Cabinet, Bathtub, Mirror, Cabinet, Towel Holder
Cleaning	General Bathroom Shower **J1**	Shower Cabinet, Bathtub, Mirror, Cabinet, Towel Holder

Cleaning	Parents Bathroom Shower	**K**	Shower Cabinet, Bathtub, Mirror, Cabinet, Towel Holder
Cleaning	Parents Bathroom Shower	**K1**	Shower Cabinet, Bathtub, Mirror, Cabinet, Towel Holder
Living	Children's Bedroom	**L+L1**	Bed And Cabinet
Cleaning	Servant Bath	**M**	Shower Cabinet, Bathtub, Mirror, Cabinet, Towel Holder
Living	Servant Bedroom	**N**	Bed And Cabinet
Work, Read Books	Library Study Room	**O**	Bookcase, Study Desk
Preparing Meals, Cooking, Dishwashing	Kitchen	**O1**	Cabinet, Shelf, Cooker, Dining Table, Counter, Kitchen Knife, Cutting Board, Spatula, Cooking Spoon, Ladles, Strainers, Dishwasher
Cleaning	Laundry Room	**P**	Washing Machine, Drying Machine
Cleaning	Laundry Room	**P1**	Washing Machine, Drying Machine
Rest	Terrace-Veranda Winter Garden Balcony	**R**	Table, Hammo, Modern Barbecue, Swinging Chair, Practical Laptop Table, Lighting (For Night), Umbrella
Vehicle Parking Area	Car Park	**S**	Vehicle, Car, Motorcycle

In Table 6.2, the spaces that combine by coding the spaces with letters and the areas that provide profit are shown by tabulating the relationship between space, tool and action according to the primary change plan.

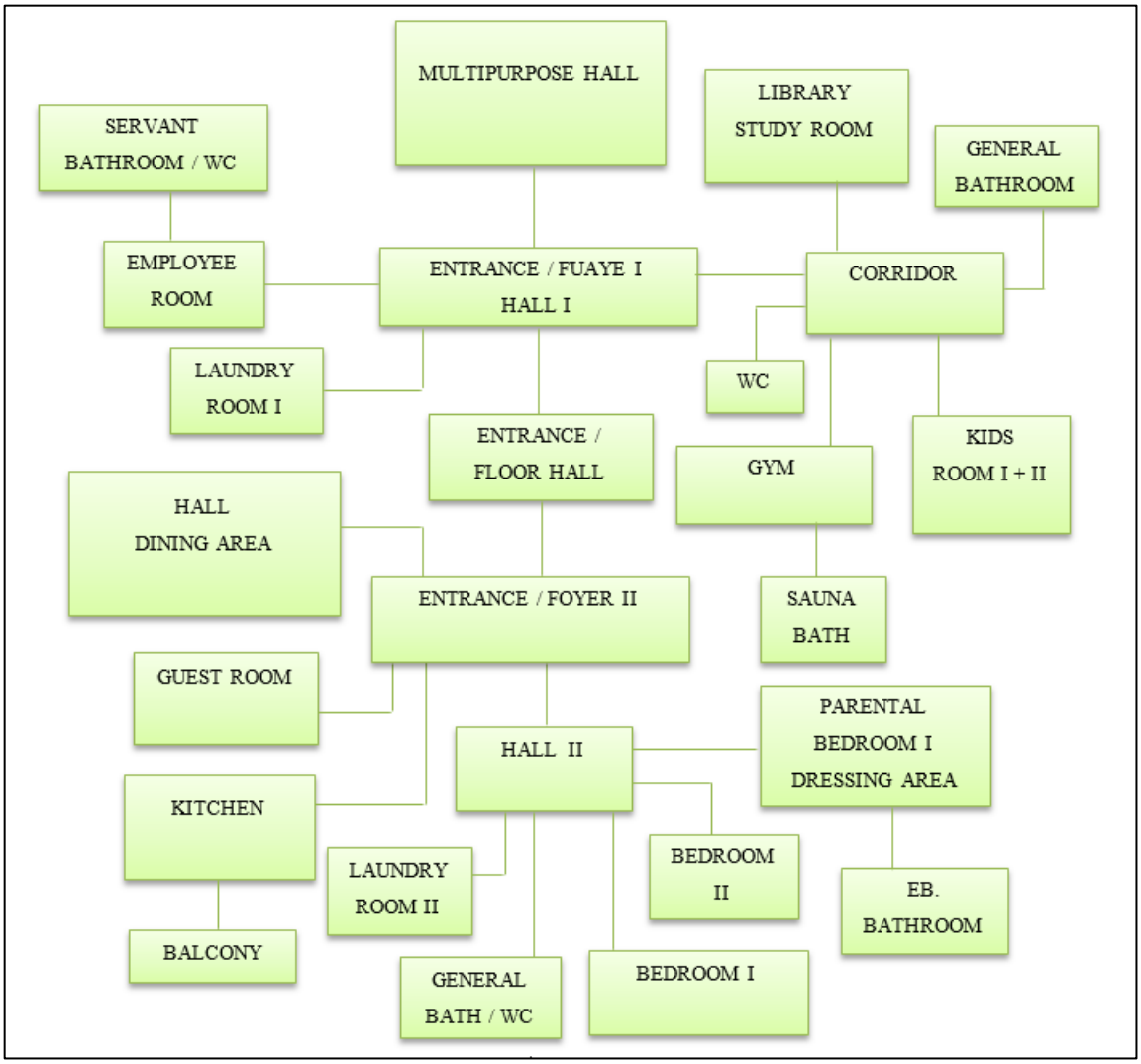

Figure 6.8. Function diagram of the primary change plan of the ground floor and upper floor plan, prepared by author.

Figure 6.8. We see the differences on the functional scheme of the primary change, in which the two folds are evaluated.

- **Changes in the Ground Floor Primary Change Plan**

○ **In the Multi-Purpose Hall**

By using recycled multifunctional elements, a reduction in m2 is achieved without compressing the space. Using these Alternating Functions, the library was further expanded by pulling the common wall of the Multi-Purpose Hall and the Study Room. Thus, a part of the Library was added to the Terrace.

- **Children's Room**

Two different children's rooms were combined into a single children's room with the help of a multi-functional sofa. By transforming the convertible sofa into a double bunk bed, the volume occupied by normal standard beds on the floor was achieved with the help of this sofa that can turn into a bunk bed. With this space gain, the sauna and public bath were moved next to the children's rooms, and a transition from the gym to the sauna / bath was provided. Thus, the Laundry Room was expanded a little and moved to the part where the sauna and bath were located, and the WC was enlarged and turned into a WC / shower.

- **Changes in The Upper Floor Primary Exchange Plan**

- **In The Bedrooms**

With the use of Single Wall Beds, two different single bedrooms were combined and more than one function was realized in a single space. Thanks to the gained m², the entrance and hall were combined by pulling on the inner walls.

- **In Parent Bedroom**

By using Double Wall Beds, the dressing room area was added to the bedroom. When the wall on the left is pulled to the right, it is shifted to the right in the parent bathroom, saving in square meters once again. Thus, by using the Wall Beds (Openable and Closing Bed) in only two spaces, both a practical solution was provided in the space, and the functionality of each point of the rooms was increased, making it more comfortable to use, and thus, m² gain was achieved.

The distribution of the main actions, spaces and vehicles in the two-storey detached house type in the ground floor and upper floor secondary plans are shown in Figures 6.9 and 6.10.

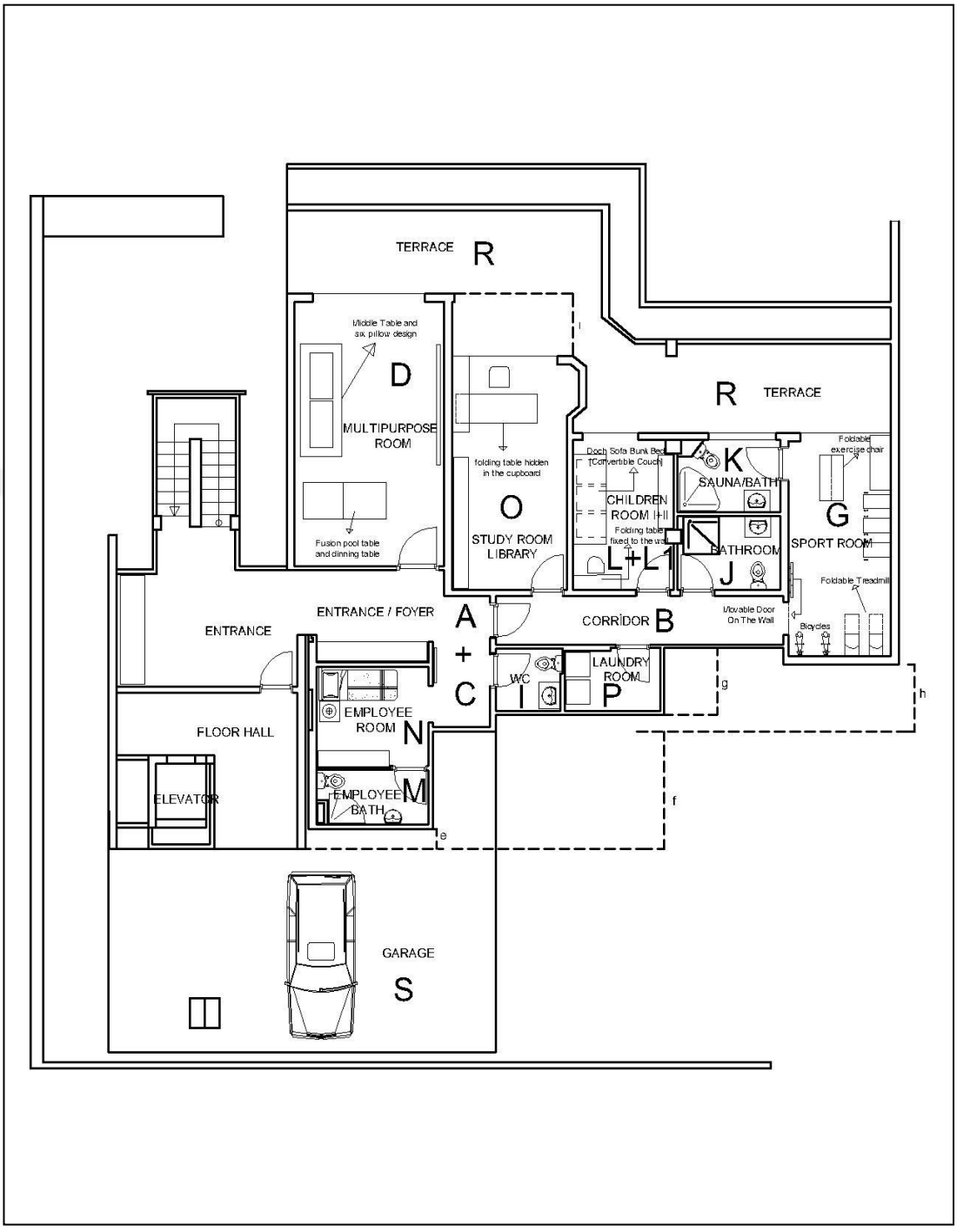

Figure 6.9. Secondary change of ground floor plan, designed by author.

Figure 6.9. We see the secondary change of the ground floor plan that we see in Fig. As we can see in the plan, the number of multifunctional designs has been increased and used in almost every space. Thus, thanks to this use, space is gained and the spaces are reduced. For this reason, tensile lengths e, f, g, h and I were made on the outer walls.

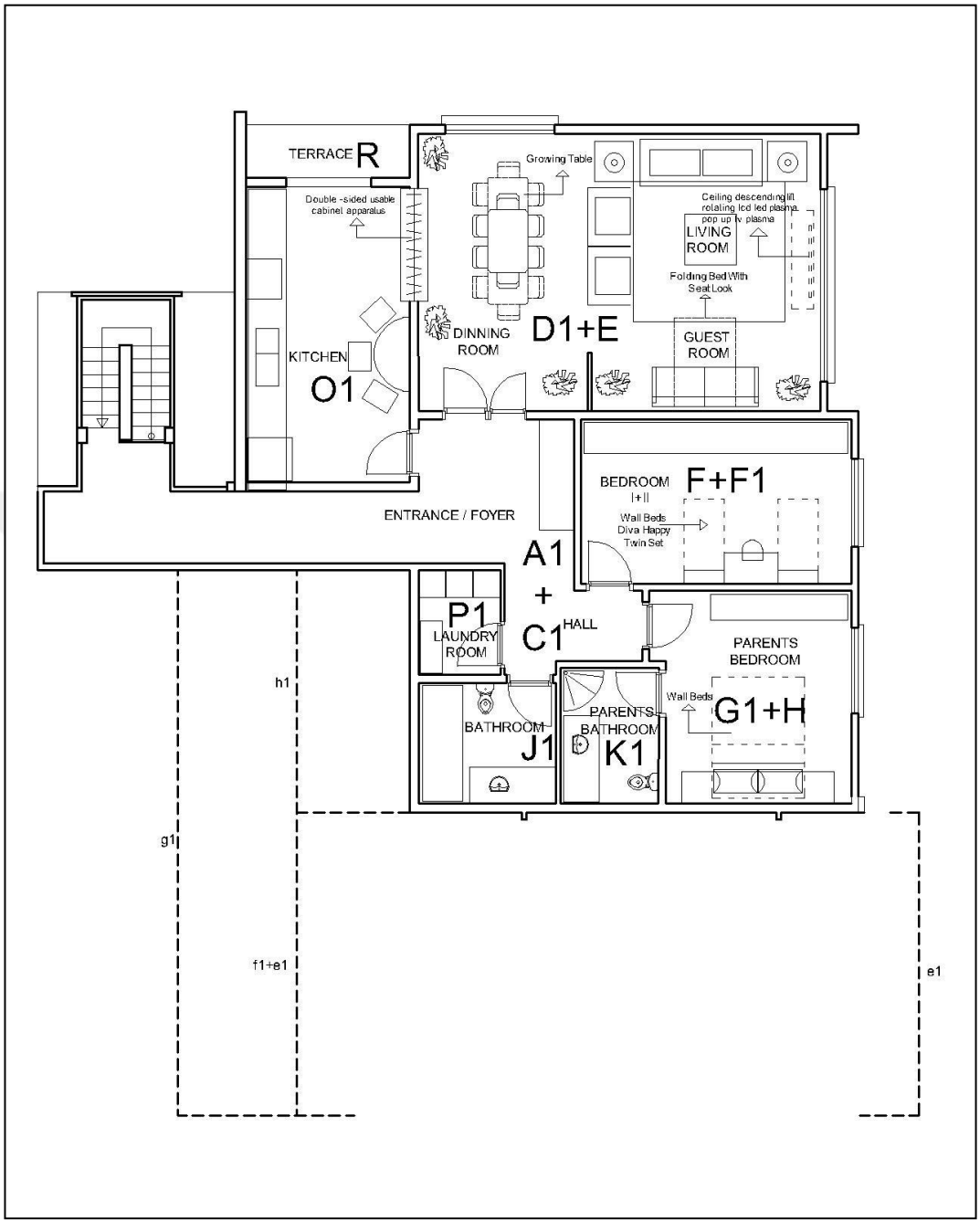

Figure 6.10. Secondary change of the upper floor plan, designed by author.

Figure 6.10. We also see the secondary change of the upper floor plan. As we can see in both the ground floor plan and the upper floor plan, the number of multifunctional designs has been increased in almost every space. Thus, thanks to this use, space is gained and the spaces are reduced. For this reason, tensile lengths of e1, f1, g1 and h1 were made on the outer walls.

The distribution of the main actions, spaces and vehicles in the two-storey detached house type in the ground floor and upper floor secondary plans are shown in the Table 6.3. and Figure 6.11.

Table 6.3. Secondary change ground floor and top floor plan, action, space, vehicle relationship, prepared by author.

Actions In The Housing	**Places**	**Vehicles**
Login Transition To Spaces	Entree Hall **A+A1+C+C1**	Portmanto, Mirror Mirror
Transition To Spaces	Corridor **B**	Mirror
Fun, Playing Watching Film, Listening To Music	Multipurpose Hall **D**	Game Tables Cinema Areas
Seating, Dining Living, Guest	Hall, Dining Area Guest Room **D1+E**	Chair, Tv Unit, Dining Table (For 10 People) Sofa, Armchair, Middle Table, Coffee Table, Tv Unit, Bed
Laying, Resting, Makeup-Care	Bedroom **F+F1**	Bed, Mirror, Cabinet, Etejer, Lamp, Makeup Table
Doing Sports	Sport Room **G**	Dambill, Bicycle, Running Band, Weight Equipment
Laying, Resting, Makeup-Care Garment Storage, Dressing	Parents Bedroom Clothes Room **G1+H**	Bed, Mirror, Cabinet, Etejer, Lamp, Makeup Table Clothing Cabinets, Shelves And Puf
Using Wc	Wc- Sink **I**	Toilet, Mirror, Washbasin
Cleaning	General Bathroom Shower **J**	Shower Cabinet, Bathtub, Mirror, Cabinet, Towel Holder
Cleaning	General Bathroom Shower **J1**	Shower Cabinet, Bathtub, Mirror, Cabinet, Towel Holder

Cleaning	Parents Bathroom Shower	**K**	Shower Cabinet, Bathtub, Mirror, Cabinet, Towel Holder
Cleaning	Parents Bathroom Shower	**K1**	Shower Cabinet, Bathtub, Mirror, Cabinet, Towel Holder
Living	Children's Bedroom	**L+L1**	Bed And Cabinet
Cleaning Living	Servant Bath Servant Bedroom	**M+N**	Shower Cabinet, Bathtub, Mirror, Cabinet, Towel Holder, Bed And Cabinet
Work, Read Books	Library Study Room	**O**	Bookcase, Study Desk
Preparing Meals, Cooking, Dishwashing	Kitchen	**O1**	Cabinet, Shelf, Cooker, Dining Table, Counter, Kitchen Knife, Cutting Board, Spatula, Cooking Spoon, Ladles, Strainers, Dishwasher
Cleaning	Laundry Room	**P**	Washing Machine, Drying Machine
Cleaning	Laundry Room	**P1**	Washing Machine, Drying Machine
Rest	Terrace-Veranda Winter Garden Balcony	**R**	Table, Hammo, Modern Barbecue, Swinging Chair, Practical Laptop Table, Lighting (For Night), Umbrella
Vehicle Parking Area	Car Park	**S**	Vehicle, Car, Motorcycle

Table 6.3. We see the changes in the spaces coded with letters in the secondary change plans. Here, as in the other tables, the spaces have been reduced and it has been seen that space gain is achieved by combining many spaces.

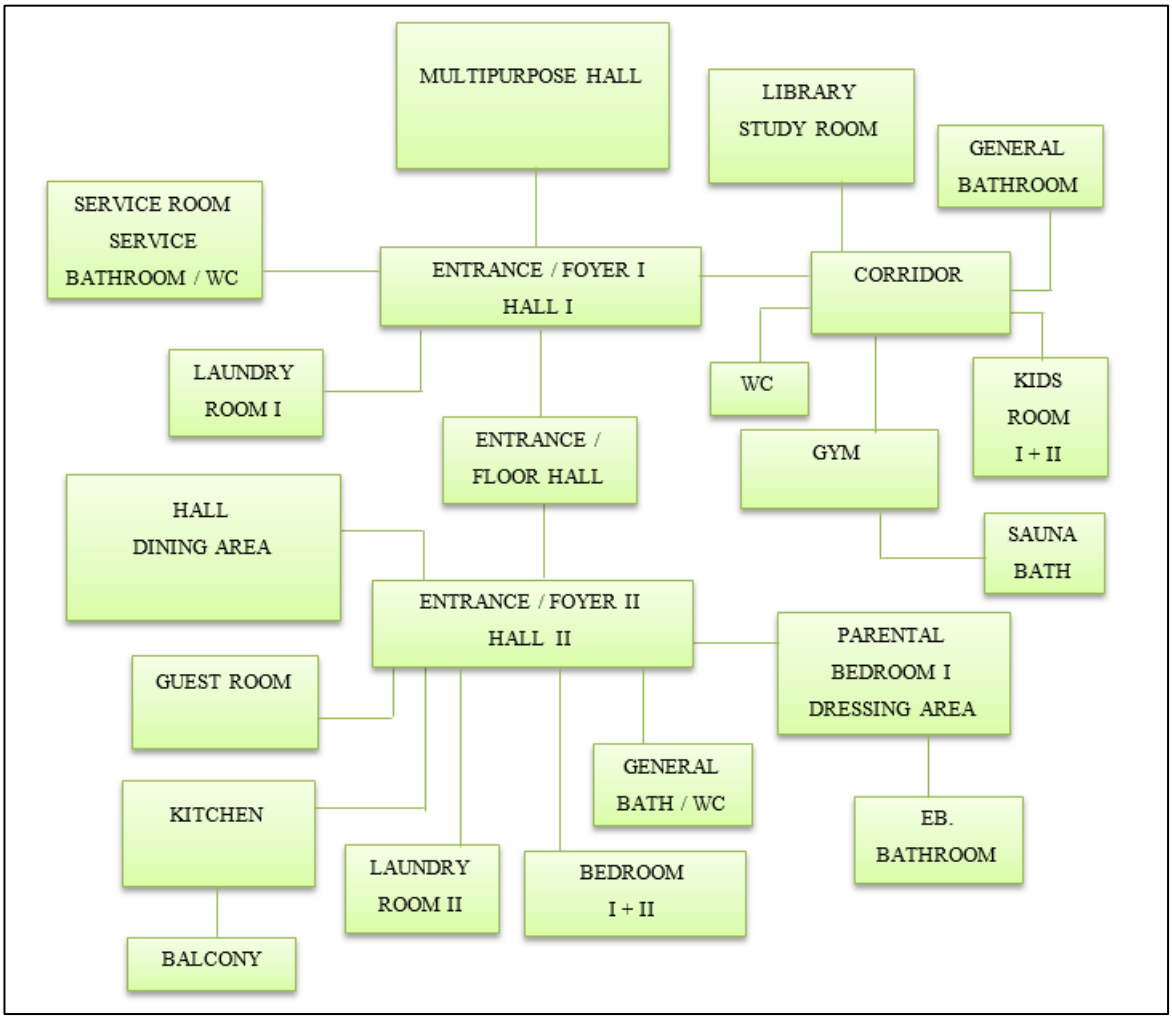

Figure 6.11. the function scheme for the secondary change of the ground floor and upper floor plan, where the action-space relations are specified, prepared by author.

Figure 6.11. It is a functional diagram that shows the circulation of spaces and clearly reveals the number of spaces in secondary exchange plans, as in other diagrams.

6.2. RESIDANCE HOUSING TYPES

In these houses, the use of multi-functional tools is shown on the 3 + 1 flat type. With the existing Plans, Primary and Secondary Functional distribution will be shown with Plans, Tables and Functional Diagrams.

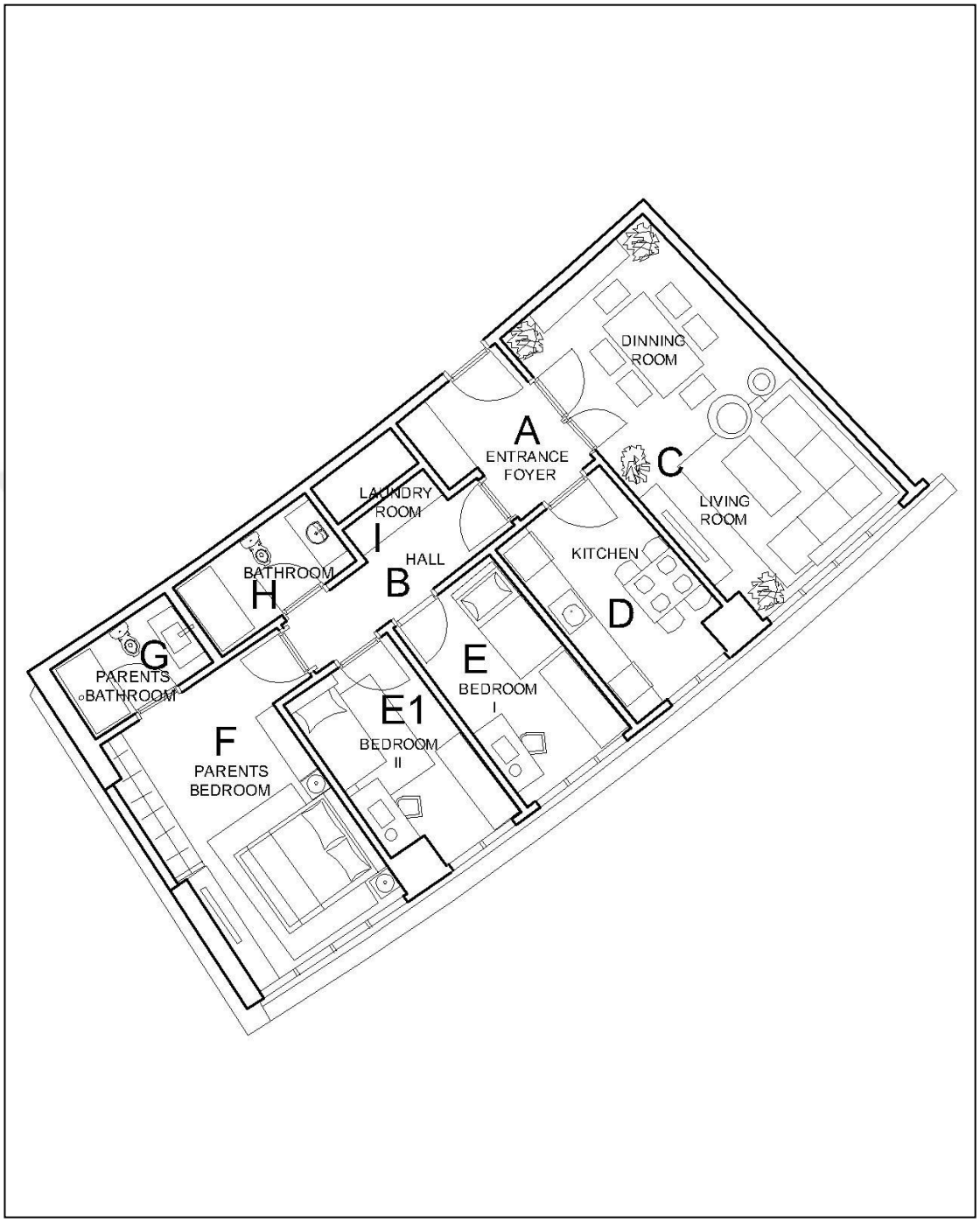

Figure 6.12. Current floor plan of residence. Standard furnishing, designed by author.

In the plan drawn with the use of the existing designs seen in Figure 6.12, the spaces are coded with letters. In this way, we will be able to see the smaller, combined and space-saving spaces more easily.

Table 6.4. Action place vehicle relationship of the current plan. Standard furnishing, prepared by author.

Actions in the housing	**Places**	**Vehicles**
Login	Entree **A**	Portfolio, mirror
Transition to spaces	Hall **B**	Mirror
Seating, dining	Living room **C** Dining area	Seat, tv unit Dinner table
Preparing meals, cooking, dishwashing	Kitchen **D**	Cabinet, shelf, cooker, dining table, counter, kitchen knife, cutting board, spatula, cooking spoon, ladles, strainers, dishwaher
Laying, resting, makeup-care	Bedroom **E**	Bed, mirror, cabinet, etejer, lamp, makeup table
Laying, resting, makeup-care	Bedroom **E1**	Bed, mirror, cabinet, etejer, lamp, makeup table
Laying, resting, makeup-care	Parents bedroom **F**	Bed, mirror, cabinet, etejer, lamp, makeup table
Cleaning	Parents bathroom-shower **G**	Shower cabinet, bathtub, mirror, cabinet, towel holder
Cleaning Using wc	General bath-shower **H** Wc- sink	Shower cabinet, bathtub, mirror, cabinet, towel holder Toilet, mirror, washbasin
Cleaning	Laundry **I**	Washing machine, drying machine

Coding the spaces of the existing plan with letters in the Table 6.4 will allow us to easily see the changes in the space.

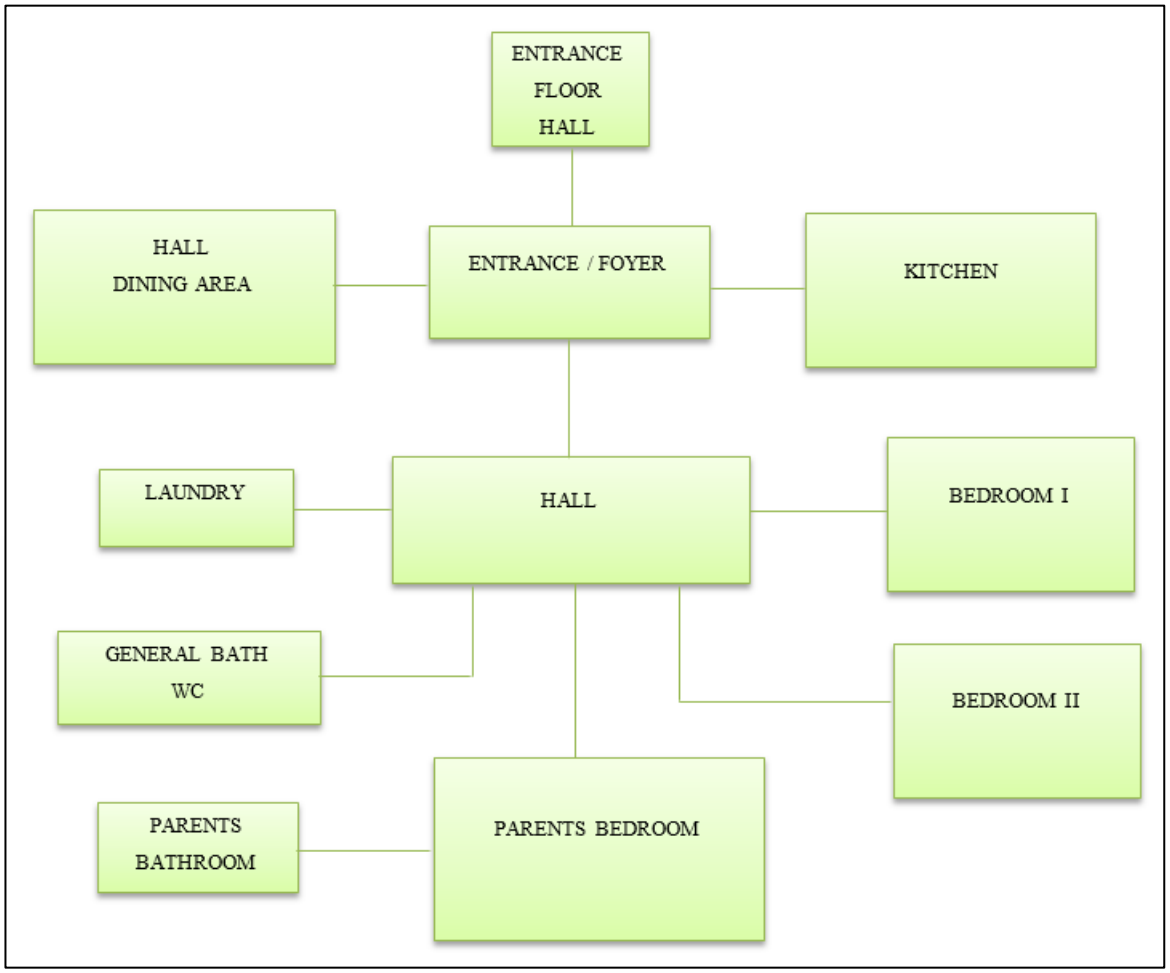

Figure 6.13. Function scheme of the current plan, prepared by author.

In Figure 6.13. we see the functional scheme of the plan of the existing 3+1 residence flat, designed with standard furniture. It will be seen how it differs in primary and secondary, with multifunctional designs used in the next plans.

The primary distribution of the residential type 3+1 flat on the floor plan is shown in Figure 6.14., Table 6.5. and Figure 6.15.

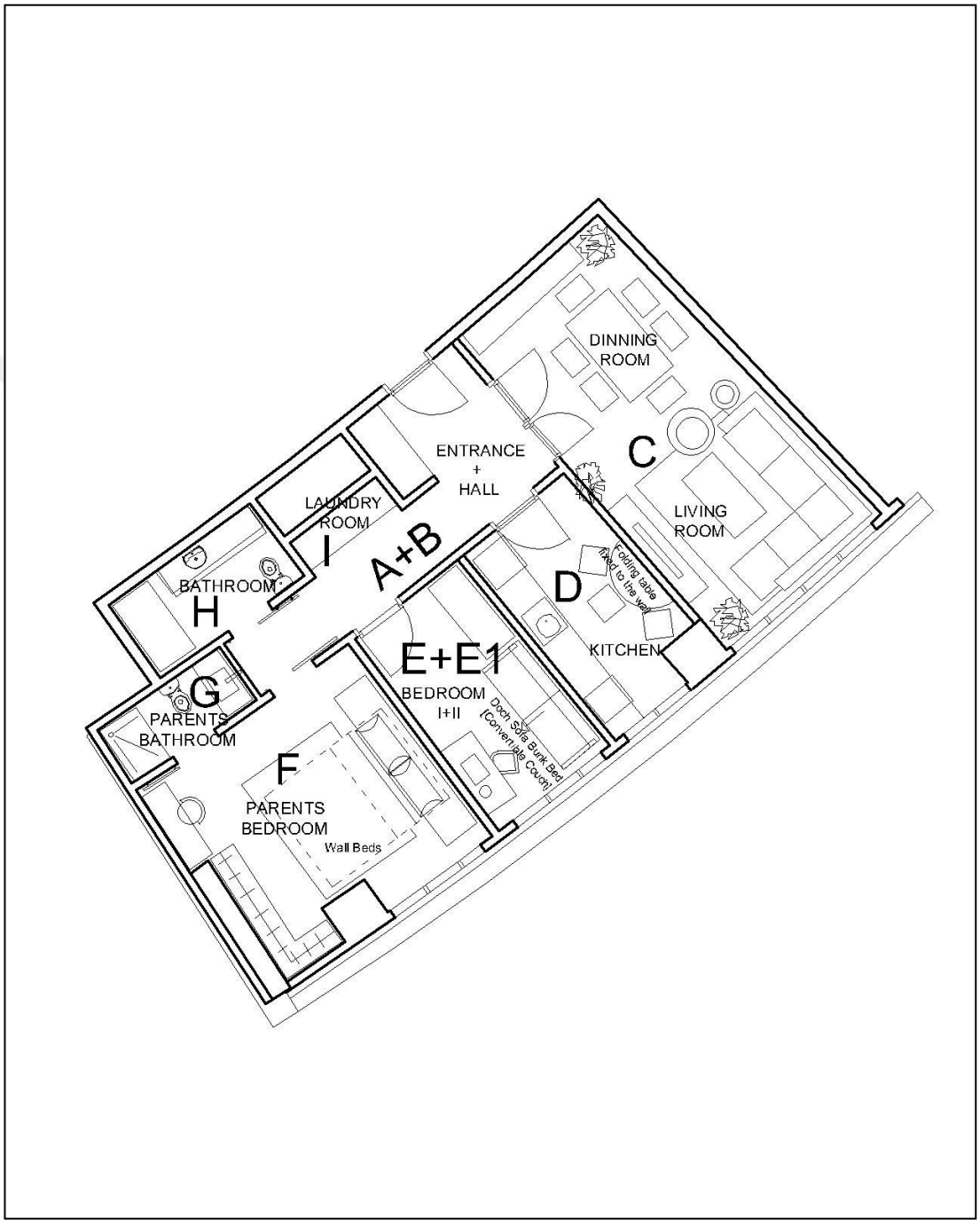

Figure 6.14. Primary conversion plan of residence floor plan, designed by author.

As seen in the primary change plan in Figure 6.14, the combination of different spaces has been achieved thanks to the designs used.

Table 6.5. Action place vehicle relationship belonging to primary transformation plan, prepared by author.

Actions In The Housing	**Places**	**Vehicles**
Login Transition To Spaces	Entree Hall **A+B**	Portfolio, Mirror Mirror
Seating, Dining	Living Room **C** Dining Area	Seat, Tv Unit Dinner Table
Preparing Meals, Cooking, Dishwashing	Kitchen **D**	Cabinet, Shelf, Cooker, Dining Table, Counter, Kitchen Knife, Cutting Board, Spatula, Cooking Spoon, Ladles, Strainers, Dishwasher
Laying, Resting, Makeup-Care	Bedroom **E+E1**	Bed, Mirror, Cabinet, Etejer, Lamp, Makeup Table
Laying, Resting, Makeup-Care	Parents Bedroom **F**	Bed, Mirror, Cabinet, Etejer, Lamp, Makeup Table
Cleaning	Parents Bathroom Shower **G**	Shower Cabinet, Bathtub, Mirror, Cabinet, Towel Holder
Cleaning Using Wc	General Bath-Shower **H** Wc- Sink	Shower Cabinet, Bathtub, Mirror, Cabinet, Towel Holder Toilet, Mirror, Washbasin
Cleaning	Laundry **I**	Washing Machine, Drying Machine

As seen in Table 6.5, the primary plan is the table of change. As we can see in this table, the space is gained and the spaces are combined.

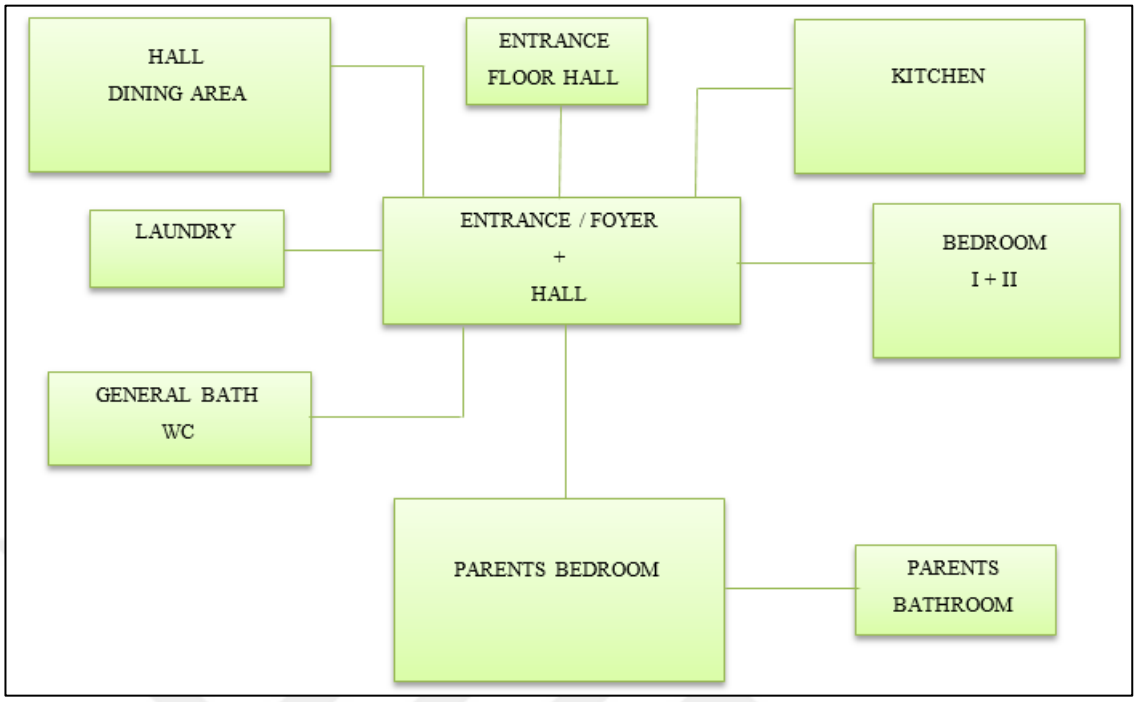

Figure 6.15. Function chart of primary transformation plan, prepared by author.

As seen in the functional chart in Figure 6.15, we see the changes in the primary change plan here as well.

- **Amendments to the Primary Exchange Plan**

In the primary transformation plans of the residence floor plan, two separate spaces are gathered in a single space with the sofa that can be converted into a bunk bed in the bedroom. When it was opened while the seat was closed, it became a bunk bed for two people and saved space.

Wall beds used in the master bedroom, on the other hand, enlarged the space with its opening and closing feature, causing shrinkage on the interior walls. Likewise, with the effect of the folding table, which is another functional feature used in the kitchen, more than one pull is provided on the interior walls and the space has not lost its functionality in square meters and has been reduced with more practical uses.

The secondary distribution of the residence type 3+1 flat on the floor plan is shown in Figure 6.16., Table 6.6. and shown in Figure 6.17.

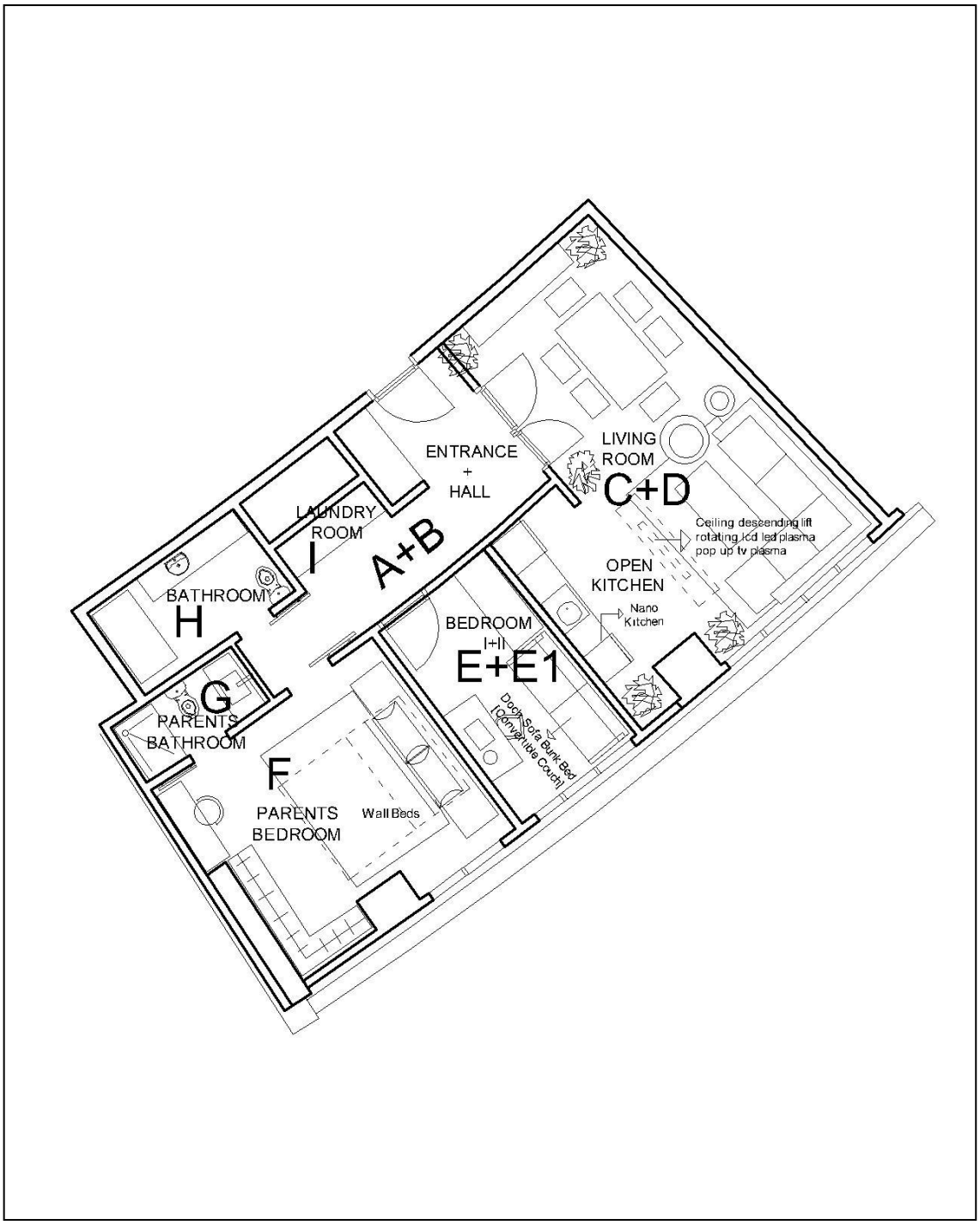

Figure 6.16. Secondary transformation plan of residence floor plan, designed by author.

As seen in the secondary change plan in Figure 6.16, we see the combination of most spaces with the use of multiple transformable designs in many spaces.

Table 6.6. Action place vehicle relationship belonging to secondary transformation plan, prepared by author.

Actions In The Housing	**Places**	**Vehicles**
Login Transition To Spaces	Entree Hall **A+B**	Portfolio, Mirror Mirror
Seating, Dining Preparing Meals, Cooking, Dishwashing	Living Room **C** Dining Area + Kitchen **D**	Seat, Tv Unit Dinner Table Cabinet, Shelf, Cooker, Dining Table, Counter, Kitchen Knife, Cutting Board, Spatula, Cooking Spoon, Ladles, Strainers, Dishwasher
Laying, Resting, Makeup-Care	Bedroom **E+E1**	Bed, Mirror, Cabinet, Etejer, Lamp, Makeup Table
Laying, Resting, Makeup-Care	Parents Bedroom **F**	Bed, Mirror, Cabinet, Etejer, Lamp, Makeup Table
Cleaning	Parents Bathroom-Shower **G**	Shower Cabinet, Bathtub, Mirror, Cabinet, Towel Holder
Cleaning Using Wc	General Bath-Shower **H** Wc- Sink	Shower Cabinet, Bathtub, Mirror, Cabinet, Towel Holder Toilet, Mirror, Washbasin
Cleaning	Laundry **I**	Washing Machine, Drying Machine

Table 6.6 is a chart that explains how the differences in the secondary change plan have changed. The letters coded in the spaces in this table show that converging spaces, shrinking spaces can occur.

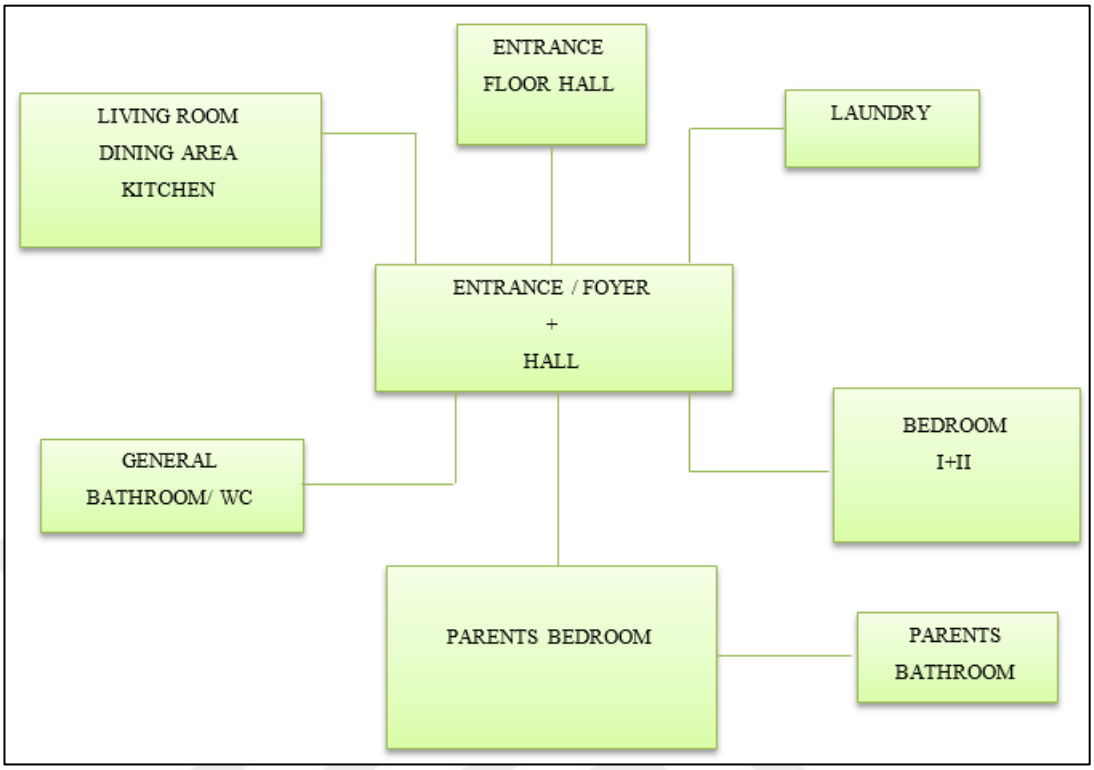

Figure 6.17. Function diagram of the secondary conversion plan, prepared by author.

Figure 6.17. In the functional diagram of the secondary exchange plan, as in the other diagrams, space gains, good and useful circulation and a combination of spaces are seen.

- **Changes in the Second Change Plan**

In the Secondary Change Plan, with the changes in the primary change plan, the living room and kitchen were combined thanks to the Nano kitchen used in the Kitchen.

Thus, these designs, which can turn into multiple functions that cause shrinkage on the interior walls, have led to practical solutions by preserving the functionality in the space.

6.3. APARTMENT FLAT HOUSING TYPES

In these houses, the use of multi-functional tools is shown on the 3 + 1 flat type. As in other house types, this type of house will be shown with the Current Plans, Primary and Secondary Functional Distribution Plans, Tables and Functional Diagrams.

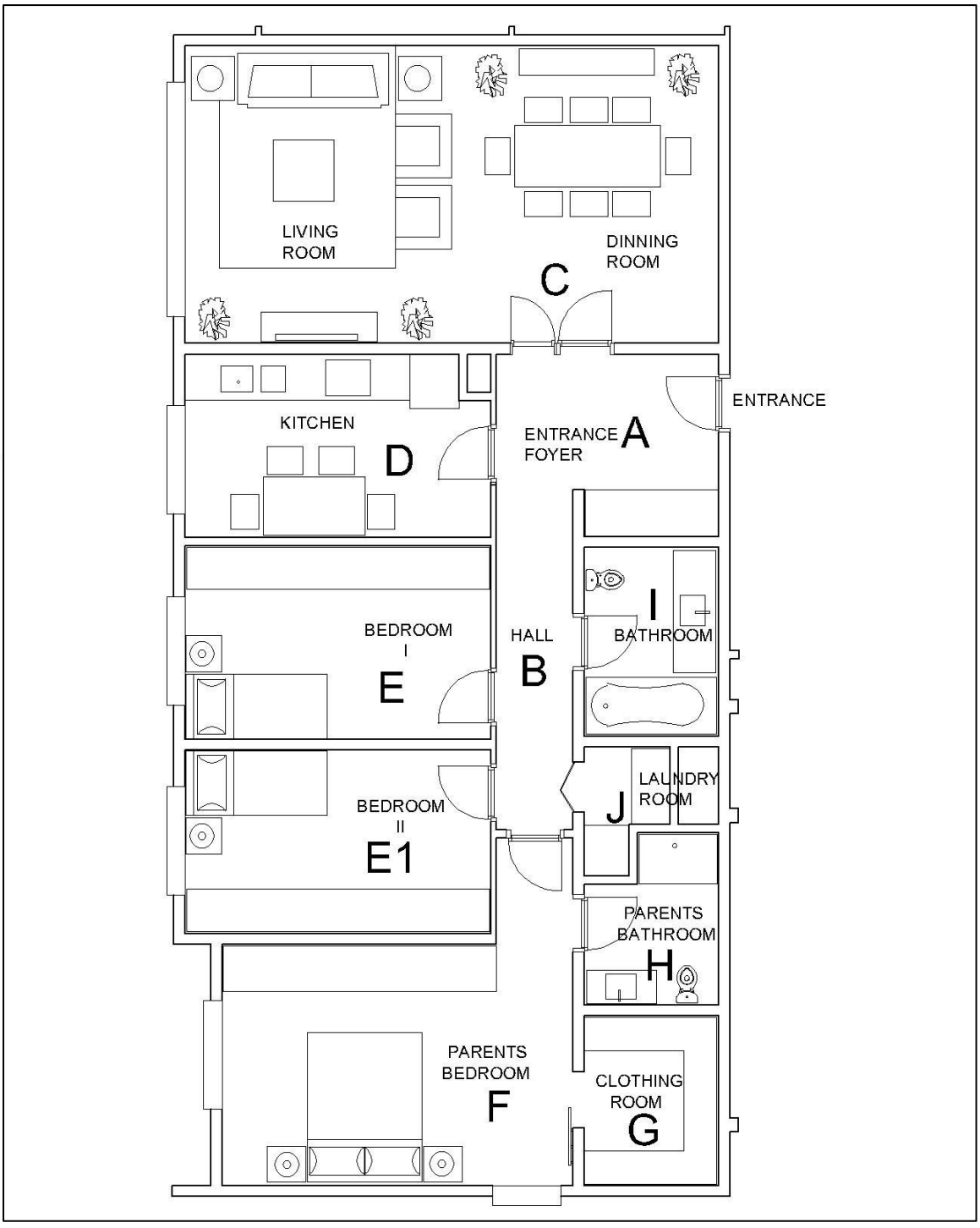

Figure 6.18. Existing apartment floor plan. Standard furnishing, designed by author.

Existing designs with standard scales are used in the Figure 6.18 plan. It's like the first version of the other plans, unaltered.

Table 6.7. Action place vehicle relationship of the current apartment plan. Standard furnishing, prepared by author.

Actions In The Housing	**Places**	**Vehicles**
Entrance	Entree **A**	Portfolio, Mirror
Transition To Spaces	Hall **B**	Mirror
Seating, Dining	Living Room **C** Dining Area	Seat, Tv Unit Dinner Table
Preparing Meals, Cooking, Dishwashing	Kitchen **D**	Cabinet, Shelf, Cooker, Dining Table, Counter, Kitchen Knife, Cutting Board, Spatula, Cooking Spoon, Ladles, Strainers, Dishwasher
Laying, Resting, Makeup-Care	Bedroom **E**	Bed, Mirror, Cabinet, Etejer, Lamp, Makeup Table
Laying, Resting, Makeup-Care	Bedroom **E1**	Bed, Mirror, Cabinet, Etejer, Lamp, Makeup Table
Laying, Resting, Makeup-Care	Parents Bedroom **F**	Bed, Mirror, Cabinet, Etejer, Lamp, Makeup Table
Suit Up	Clothes Room **G**	Wardrobe
Cleaning	Parents Bathroom-Shower **H**	Shower Cabinet, Bathtub, Mirror, Cabinet, Towel Holder
Cleaning Using Wc	General Bath-Shower **I** Wc-Sink	Shower Cabinet, Bathtub, Mirror, Cabinet, Towel Holder Toilet, Mirror, Washbasin
Cleaning	Laundry **J**	Washing Machine, Drying Machine

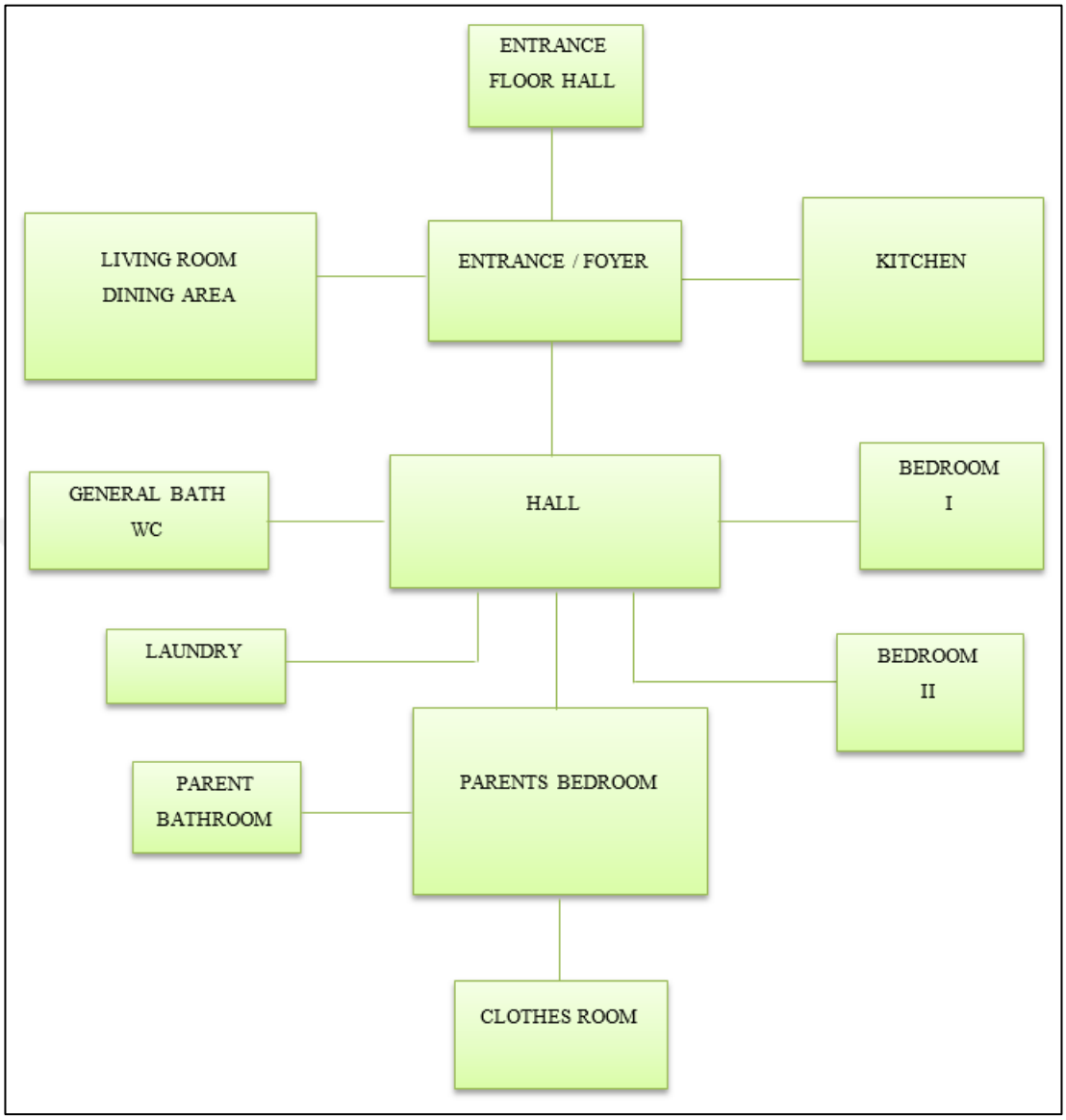

Figure 6.19. Function scheme of the current plan of the apartment floor plan, prepared by author.

The functional diagram designed in Figure 6.19 shows the space distribution of the above existing plan. Here, it is the unaltered version of the standard sized furniture.

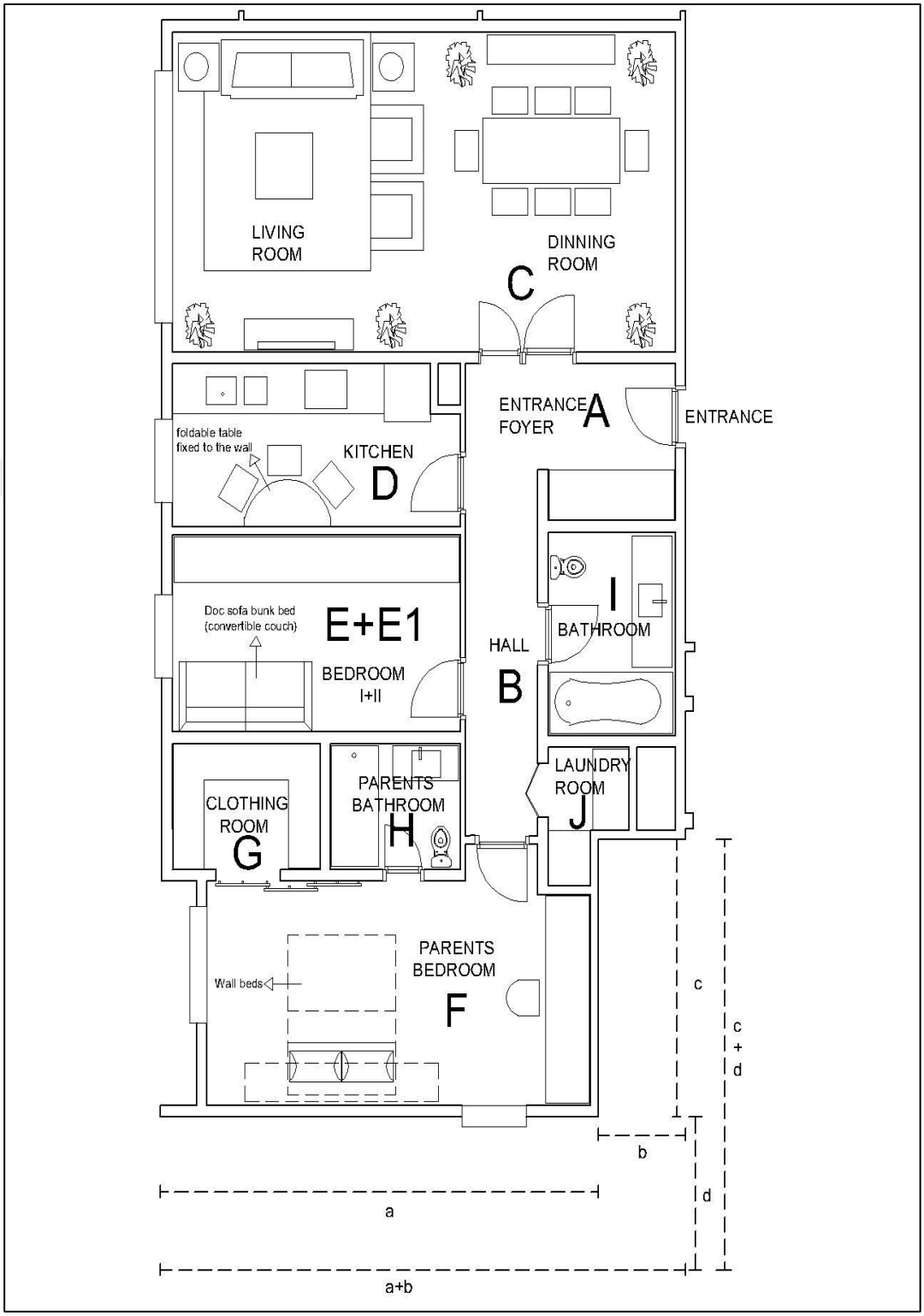

Figure 6.20. Primary conversion plan of apartment floor plan, designed by author.

Due to the multi-functional designs used in the primary change plan in Figure 6.20, there have been shrinkages on the outer walls up to a, b, c and d lengths.

Table 6.8. Action place tool relationship of the primary change plan, prepared by author.

Actions In The Housing	Places		Vehicles
Entrance	Entree	**A**	Portfolio, Mirror
Transition To Spaces	Hall	**B**	Mirror
Seating, Dining	Living Room Dining Area	**C**	Seat, Tv Unit Dinner Table
Preparing Meals, Cooking, Dishwashing	Kitchen	**D**	Cabinet, Shelf, Cooker, Dining Table, Counter, Kitchen Knife, Cutting Board, Spatula, Cooking Spoon, Ladles, Strainers, Dishwasher
Laying, Resting, Makeup-Care	Bedroom	**E+E1**	Bed, Mirror, Cabinet, Etejer, Lamp, Makeup Table
Laying, Resting, Makeup-Care	Parents Bedroom	**F**	Bed, Mirror, Cabinet, Etejer, Lamp, Makeup Table
Suit Up	Clothes Room	**G**	Wardrobe
Cleaning	Parents Bathroom-Shower	**H**	Shower Cabinet, Bathtub, Mirror, Cabinet, Towel Holder
Cleaning Using Wc	General Bath-Shower Wc- Sink	**I**	Shower Cabinet, Bathtub, Mirror, Cabinet, Towel Holder Toilet, Mirror, Washbasin
Cleaning	Laundry	**J**	Washing Machine, Drying Machine

Table 6.8 is a table designed according to the primary change plan of a 3+1 flat. All the changes on the primary plan are explained in tabular form as the relationship between space, vehicle and action.

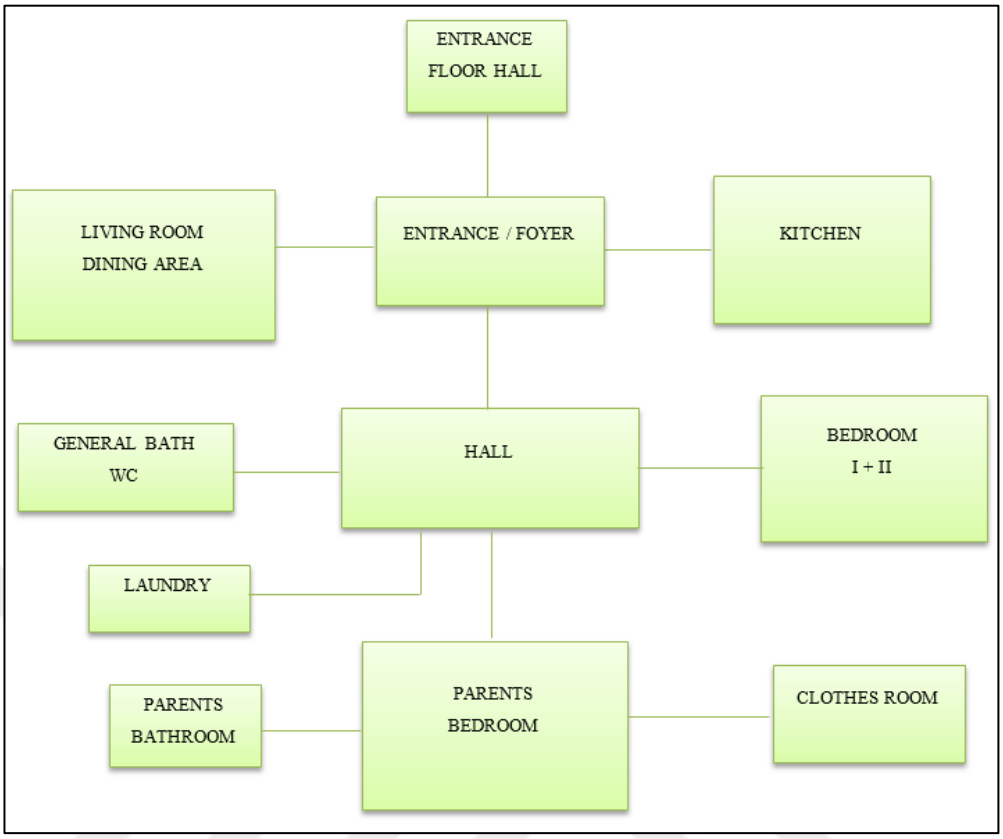

Figure 6.21. Function diagram of the primary change plan, prepared by author.

Figure 6.21 is a functional diagram of the primary change plan, using transformative designs. We can also see the combination of spaces and their spatial changes on functional schemes.

- **Amendments to the Primary Exchange Plan**

In this type of residence, by using the same type of designs, the size of the space was reduced even more, and the space was gained.

With the folding table fixed to the wall used in the kitchen, pulling on the inner walls has enabled us to use the space size even more efficiently. This design, which allows to combine two bedrooms and can turn into a bunk bed with a single material, that is, from a sofa, has also caused shrinkage on the exterior facades.

Using these multi-functional designs, it has shown its effect in the size of the space by pulling a, b and c on the exterior facades by using foldable wall beds in the Master Bedroom.

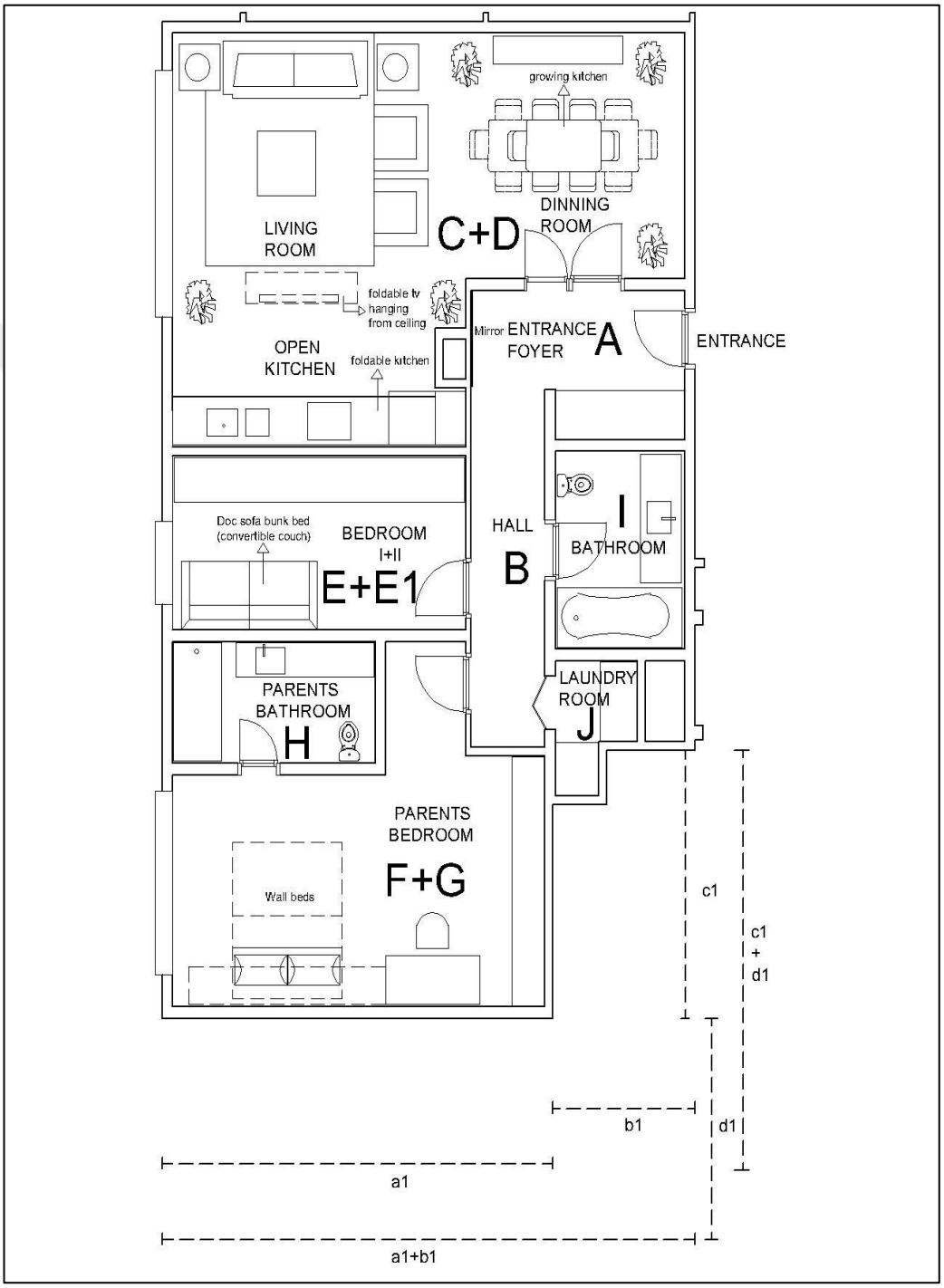

Figure 6.22. Secondary transformation plan of the apartment floor plan, designed by author.

Figure 6.22. As can be seen, in the secondary plan change, the use of multifunctional designs in many areas has provided the combination of more than one space. Thus, due to the areas where gains were made, a1,b1,c1 and d1 lengths were drawn on the exterior facades.

Table 6.9. Action place tool relationship of secondary change plan, prepared by author.

Actions In The Housing	**Places**	**Vehicles**
Login	Entree **A**	Portfolio, Mirror
Transition To Spaces	Hall **B**	Mirror
Seating, Dining Preparing Meals, Cooking, Dishwashing	Living Room **C** Dining Area **+** Kitchen **D**	Seat, Tv Unit Dinner Table Cabinet, Shelf, Cooker, Dining Table, Counter, Kitchen Knife, Cutting Board, Spatula, Cooking Spoon, Ladles, Strainers, Dishwasher
Laying, Resting, Makeup-Care	Bedroom **E+E1**	Bed, Mirror, Cabinet, Etejer, Lamp, Makeup Table
Laying, Resting, Makeup-Care Suit Up	Parents Bedroom **F+G** Clothes Room	Bed, Mirror, Cabinet, Etejer, Ladder, Makeup Table, Clothing Cabinet
Cleaning	Parents Bathroom-Shower **H**	Shower Cabinet, Bathtub, Mirror, Cabinet, Towel Holder
Cleaning Using Wc	General Bath-Shower **I** Wc-Lavabo	Shower Cabinet, Bathtub, Mirror, Cabinet, Towel Holder Toilet, Mirror, Washbasin
Cleaning	Laundry **J**	Washing Machine, Drying Machine

In the Table 6.9, the relationship between the secondary plan change, the space, the tool and the action is discussed. Thus, since the spaces are coded with letters, we can easily see the combination of the spaces.

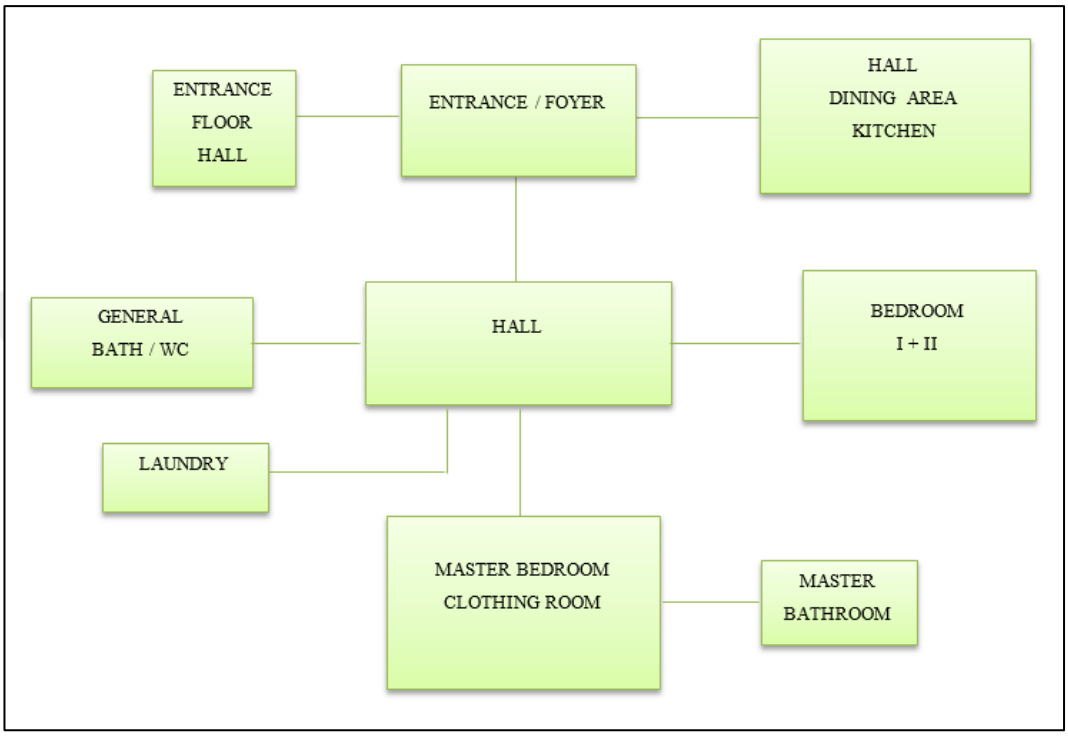

Figure 6.23. Function diagram of the secondary change plan, prepared by author.

As we can see in Figure 6.23, it is a functional scheme used in secondary plan change, showing the decrease in the number of spaces due to functional designs.

- **Changes in the Second Change Plan**

In the secondary plan change, it does not occupy a certain volume in the living room with its mechanism hidden in the ceiling when it is hung from the ceiling and when it is opened and closed. For this reason, a serious gain has been obtained from the area where the TV unit will be placed in the living room.

The kitchen has been combined with the living room due to the space gained from the living room. In the kitchen, the use of foldable kitchen has increased more functionality in the space as desired.

The designs used in the bedrooms and the Master Bedroom caused draws on the interior walls as well as shrinkage a1, b1 and c1 on the exterior facades.

6.4. GENERAL COMMENT ON THE RESULT OF THE REVIEW

When the different house types inspection steps in Section 6.3 are evaluated together; As can be seen from the function diagrams of the plans; action-space-tool relations are simplified from the current plan to the secondary plan. The reason is that, due to the solution of multiple functions together and in the same space, the decrease in space divider elements and so on. There is a decrease in the number of spaces for reasons. It is seen that the decrease in the number of places is based on the decrease in the number of places, although it is more complicated, since the tools that assist actions are transformable and multi-functional.

The spaces in the primary plan are less in number but larger than the spaces in the secondary plan compared to the spaces in the existing plans. However; total residential areas are of lower values. This means space savings.

The decrease in the variety of spaces in the residences also reduces the circulation areas that provide the transition between the spaces. This means that useless and lost areas are evaluated as more useful.

7. EVALUATION OF THE CHANGE OF SPACE SIZES IN RESIDENTIAL SPACES

The functional changes used in the residential spaces and the decreases in the area sizes are shown and explained in the following subsections.

7.1. EVALUATION OF AREA CHANGES FOR SINGLE-STOREY DETACHED HOUSING TYPES

Table 7.1 shows the area change for single-storey detached house types according to existing primary and secondary plan dimensions.

Table 7.1. Area change in a single storey detached house, prepared by author.

Field Change On The Plans [m²]		
Current Plan Size	**Primary Plan Size**	**Secondary Plan Size**
480 m²	439 m²	380 m²

While the current plan size is 480 m², the size obtained in the Primary Plan Change by using some of the multifunctional furniture in certain areas is 439 m². Therefore, an area of 41 m² has been gained in the place due to the areas used only in a certain part. In the Secondary Plan Change, which we use more actively, the area obtained is 380 m². So as a result, our total area gain is 100 m².

7.2. EVALUATION OF AREA CHANGES FOR TWO-STOREY DETACHED HOUSING TYPES

Table 7.2 shows the area change for two-storey detached house types according to the existing primary and secondary plan dimensions.

Table 7.2. Area change in two storey detached house, prepared by author.

Field Change On The Plans [m²]			
	Current Plan Size	**Primary Plan Size**	**Secondary Plan Size**
Ground Floor	185 m²	165 m²	143 m²
Upstairs	267 m²	223 m²	167 m²

Two-storey Detached House Types In the Ground Floor Plan, the current floor plan was 185 m², while its size in the Primary Change Plan was 165 m², in the Secondary Change Plan it was 143 m². Thus, in the Ground Floor Plan, 20 m² in primary change and 22 m² in secondary change was achieved. In the Upper Floor Plan, if the current plan size is 267 m2, it is 223 m2 in the Primary Change Plan and 167 m2 in the Secondary Change Plan. Thus, 44 m² in primary replacement and 56 m² in secondary change were achieved. Therefore, a total of 42 m² in the ground floor plan and a total gain of 100 m² in the upper floor plan, and the total space earnings from the floor plans are 142 m².

7.3. EVALUATION OF AREA CHANGES FOR RESIDENCE HOUSING TYPES

Table 7.3 shows the area change for the residence types according to the existing, primary and secondary plan measurements.

Table 7.3. Area change in residence, prepared by author.

Field Change on the Plans [m²]		
Current Plan Size	**Primary Plan Size**	**Secondary Plan Size**
122 m²	100 m²	94 m²

While the current Plan Size is 122 m², the size obtained in the Primary Plan Change by using some of the multi-functional furniture in certain areas is 100 m². Therefore, an area of 22 m² has been gained in the place due to the areas used only in a certain part. In the

Secondary Plan Change, the area obtained by pulling in certain places without combining the spaces decreased to 94 m². So as a result, our total area gain is 28 m². In this used house type, that is, among the Residence house types, 3 + 1 flat style has been studied. Other room types can be processed by providing the same technical uses. Thus, space gain is provided in other places.

7.4. EVALUATION OF AREA CHANGES FOR APARTMENT FLAT HOUSING TYPES

Table 7.4 shows the area change for apartment house types according to existing, primary and secondary plan dimensions.

Table 7.4. Area change in apartment housing types, prepared by author.

Field Change on the Plans [m²]		
Current Plan Size	**Primary Plan Size**	**Secondary Plan Size**
190 m²	146 m²	131 m²

While the current Plan Size is 190 m², the size obtained in the Primary Plan Change by using some of the multifunctional furniture in certain areas is 146 m². Therefore, an area of 44 m² has been saved in the place due to the areas used only in a certain part. In the Secondary Plan Change, the area obtained by pulling in certain places without combining the spaces decreased to 15 m². So as a result, our total area gain is 59 m². In this used house type, that is, among Apartment house types, 3 + 1 flat style has been studied. Other room types can be processed by providing the same technical uses. Thus, space gain is provided in other places.

7.5. OVERALL EVALUATION ON FIELD CHANGES

The tables in the sections above have been handled over all types and numbers of dwellings examined and the following general assessment table has been created.

Table 7.5. Overall evaluation chart, prepared by author.

Housing Types	Number Of Houses	Dimension Per Housing [m²]	Total Dimension [m²]	Reduction Rate [%]
Single Storey Detached House	1 piece	100 m²	100	20,8
Two Storey Detached House	6 pieces	142 m²	852	31,4
Residence House	74 pieces	28 m²	2072	22,9
Apartment House	120 pieces	59 m²	7080	31
Total	201 pieces	50.26 m²	10104	28

Table 7.5 reveals that the size of the area in the residential areas described in Chapter 7 and Table 7.5 reveals that the design of the housing designs according to the transformable and multi-functional actions, provides an average of 20 percent to 30 percent space savings compared to the design of the single-function actions compared to the aids. It does not make a significant difference according to the types.

Table 7.5 shows that a ranking in terms of space savings in the examined house types; It can be built as a single-storey detached house, an apartment-type residence, and finally a residency residence, especially a two-storey detached house.

By using multifunctional tools in residential spaces, the reduction in the size of the residential area, ie savings or benefit; While it is 20.8 percent in single-storey detached houses, it can be 1/3 higher at the rate of 31.4 percent in two-storey detached houses. This is because; It can be explained as the repetition of circulation losses between spaces for each floor. Based on this, we can conclude that as the number of floors increases in detached houses, the shrinkage will also increase. However, there is a possibility that the rate difference may become clearer with much more sampling.

In addition, it is clear that the change in this space saving will also change depending on the extent of use of the tools that assist in rotational and multifunctional actions. The existing housing projects evaluated in the study were designed according to the use of single-function vehicles, and were partially analyzed to reveal the area gain to be achieved by using multi-functional vehicles. It can be said that a more positive area gain can be achieved if the first design of the project is made according to the furnishing of the auxiliary tools for the transformational and multi-functional actions. In addition, considering the social, cultural, economic and personal differences of the users, it should be thought that different results may occur.

Regarding the change of the area size in the housing spaces, it should be aimed not to minimize the housing area, but to make an optimization that will not compromise the needs of the actions in the housing. For this reason, single-storey detached houses, which have a much larger usage area compared to the other types of houses, do not shrink much more than the areas of other housing types.

8. CONCLUSION

- The usefulness and savings in the Total Floor Area brought by convertible household items that can be transformed into multi-functions naturally make an economical contribution in terms of sustainable.

- Nowadays, as a result of the widespread need for living spaces in all limited square meters such as prefabricated houses, containers, home offices, studio flats, guesthouses, student dormitories, the use of multi-functional household items that provide solutions to narrow spaces has become increasingly important. On the other hand, it is also necessary, to use multi-functional household items in order to reduce unnecessary and lost areas and to design more accurately for large-area houses with increased circulation areas by intensifying the inter-space relations.

- The use of multifunctional household items provides wide possibilities to flexible housing design in terms of both changing the size of the spaces and transforming them into different functions. For example, in pandemic periods that may occur throughout life, the role of multi-functional household items gains importance in the flexible arrangement of spaces such as the variable design of indoor and outdoor spaces and the use of private space when necessary.

- The convenience brought by the use of multi-functional household items in the spaces is important in realizing the design of the houses in line with the numerical and sociological changes in the life cycle of the household.

- The benefit of the use of multi-functional household items in residential buildings depends on the reduction of the number of spaces as well as the reduction of circulation areas. The spaces designed for different functions can be transformed into smaller number of common spaces thanks to the use of multi-functional household items, reducing both the size of the space and the number of spaces.

- As new recyclable and multi-functional household items to be used develop, it is seen that residential spaces can be designed to allow more practical uses.

- It is clear that as the multifunctional household items used increase, the space savings in the residence will increase. However, in the reduction of the area, it should be aimed to make an optimization that will not make concessions the needs of the functions of the actions in the house. The aim in this regard is to save space without changing the number and needs of the users.

- When examining the function diagrams of the action-space relations in the house in the use of multi-functional household items; When looking from the current plan to the primary plan and from the primary plan to the secondary plan, it is seen that the action-space relations are more organized and practical rather than complexity. In other words, the use of multifunctional household items brings simplification in the action-space relations of the residences.

- Although it is seen that as the number of floors increases in detached houses, the shrinkage will increase, it should be taken into account that with much more sampling, there may be a possibility of decreasing the rate of shrinkage after a certain number of floors.

- In terms of the use of auxiliary tools for multi-functional actions, mostly in terms of solutions to less space; It is clear that it will be more in housing types with narrow areas and lower family size. However, examining the housing types in the sample housing area in the thesis, which generally consists of houses with a large family size and therefore large usage areas, showed that the area size of multi-functional auxiliary vehicles can be saved in large-area housing. In this type of dwellings, rather than reducing the number of spaces in general, by incorporating the less used areas into more frequent use and reducing the circulation areas, a partial reduction in the housing area is created and a significant saving can be achieved.

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APPENDIX A

PHASE OF CHANGE OF SINGLE-STOREY DETACHED HOUSING TYPES

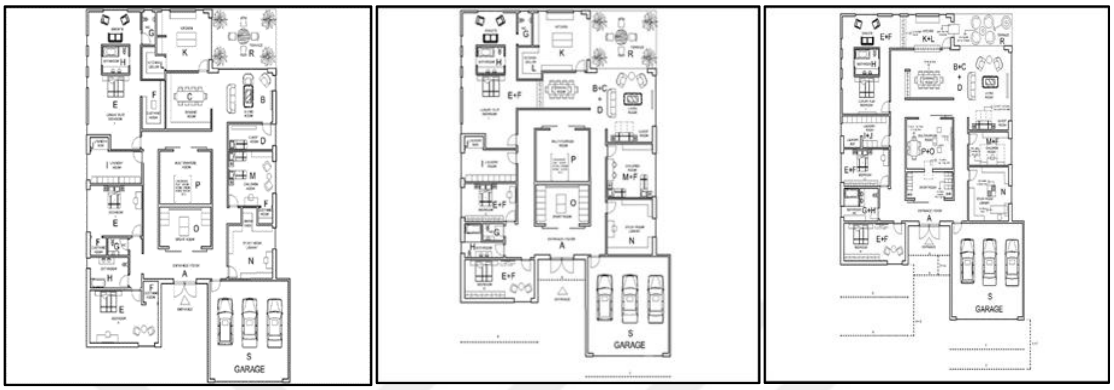

Figure A1. Current plan /Primary plan change /Secondary plan change

CHANGES OF TWO-STOREY DETACHED HOUSING TYPES

Figure A2. Existing ground floor plan change / Primary ground floor plan change / Secondary floor plan change

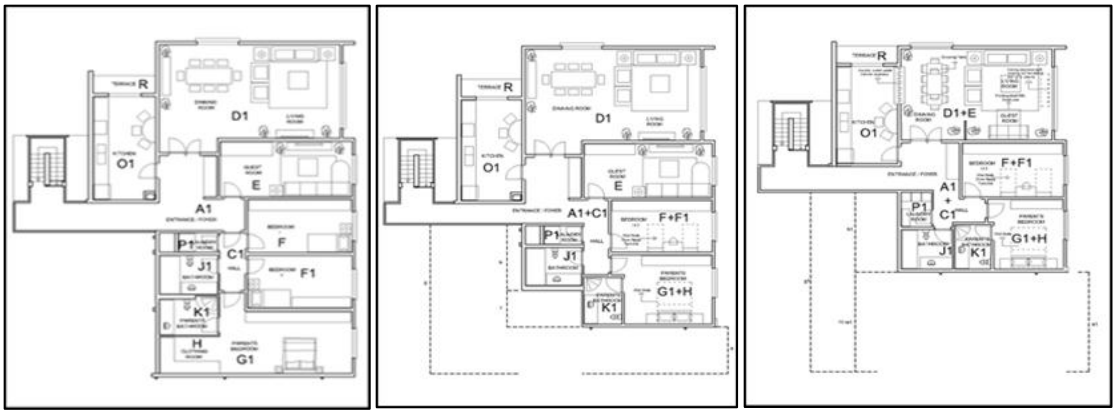

Figure A3. Existing upper floor plan/ Primary upper floor plan change/ Secondary upper floor plan change

PHASE OF CHANGE OF RESIDENCE HOUSING TYPES

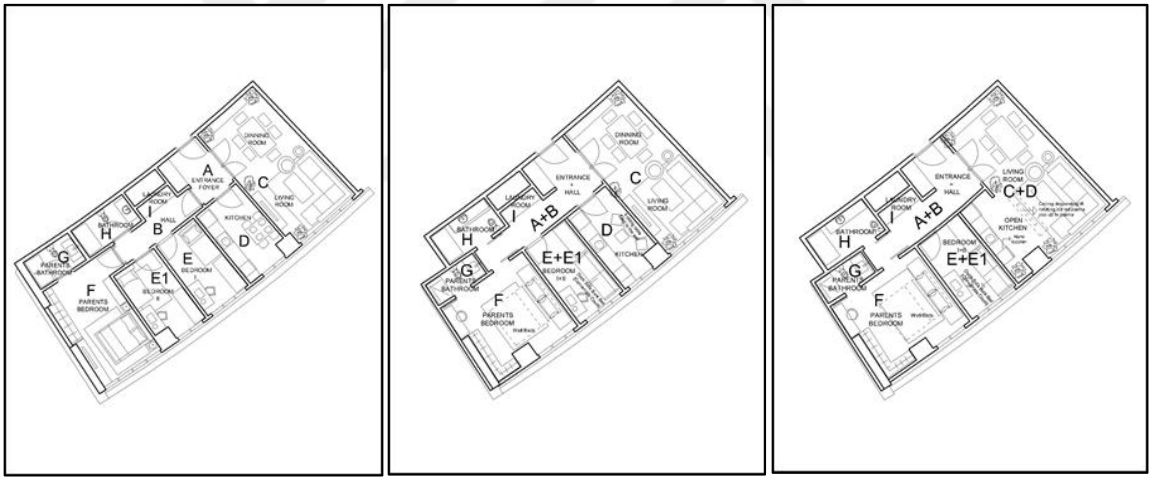

Figure A4. Current plan/ Primary plan change/Secondary plan change

PHASE OF CHANGE OF APARTMENT FLAT HOUSING TYPES

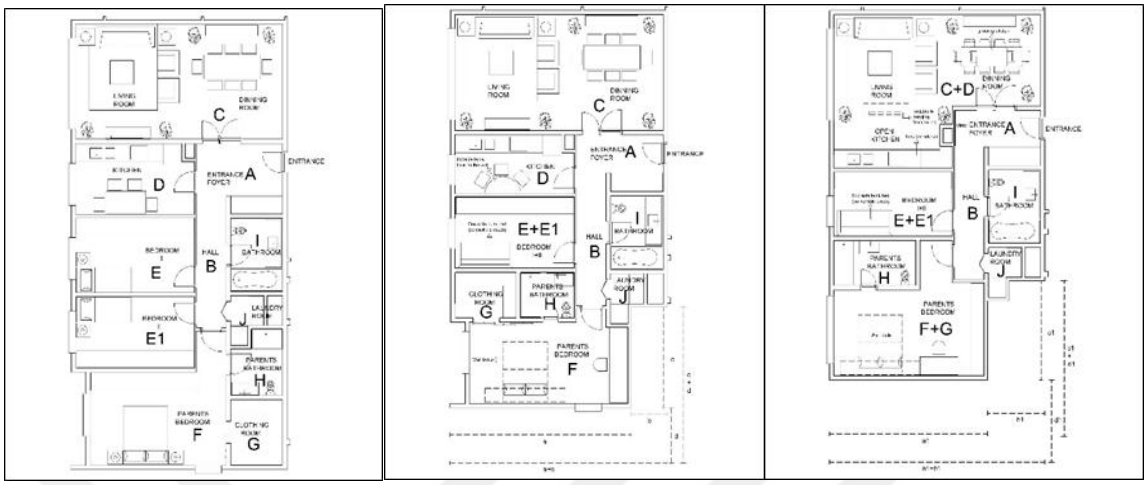

Figure A5. Current plan/Primary plan change/Secondary plan change