

# “Applying Golden Ratio Grids to Interior Design Layouts for Enhancing Movement Flow in Public Spaces (Case Study: Restaurants)”

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## KEYWORDS:

Golden Ratio Grids, Movement flow, Public Spaces, Circulation plan, Restaurant’s Layout.

## ABSTRACT:

Many large public spaces suffer from poor plan division and random placement of furniture, leading to visual clutter and compromised mobility for users. Designers need to find solutions to divide space layouts according to the golden ratio grid, achieves balance among various elements and optimizing furniture distribution. Implementing the golden ratio in public space layouts can improve user movement flow. Restaurants are selected as a primary example due to their high user volume. This research examines the outcomes of applying golden ratio grids to various restaurant layouts and their impact on enhancing user movement flow, particularly during peak hours.

### Research Problem:

Lack of interest in applying golden ratio grids to the initial stages of designing interior spaces, especially public spaces layouts, which has an impact on dividing spaces and distributing furniture pieces in a better way. On the other hand, enhance the movement flow.

### Research Objective:

- Enhancing the importance of applying golden ratio grids to interior design layouts of public spaces.
- Discussing the role of using golden ratio grids in designing restaurants layout to enhance the movement flow of users.

### Research Methodology:

This study adopts an analytical approach complemented by case studies and practical applications to examine the implementation of golden ratio grids in public space design. This multi-faceted methodology allows for a comprehensive understanding of how these grids enhance spatial harmony and user flow.

### Research Limits:

- Formulation of research aims and objectives.
- Implementation of data collection method.

### Research Outline:

#### - Study of Golden Ratio Grids and Their Applications in Interior Design Layouts

- Define the golden ratio and explore how golden ratio grids are constructed and applied in interior design.

#### - Designing Public Spaces Layouts

- Discuss the considerations in designing layouts for public spaces (e.g., lobbies, airports, shopping malls).

#### -Main Problems in Interior Design of Public Spaces Layouts

- Identify common issues faced in designing public spaces (e.g., lack of privacy, noise control, spatial flow).

#### - Study of Restaurant Layout as a Public Space

- Analyze the specific challenges and opportunities in designing restaurant layouts.

#### - Movement Flow in Restaurant Layouts

- Factors influencing effective movement flow in restaurant layouts (e.g., entrance placement, seating arrangement, service areas).

#### - Practical Application: Case Study for Students applications.

### Research Approach

- **Literature Review:** Gather academic articles, books, and research papers on each topic.
- **Case Studies:** Examine real-world examples of interior designs and public spaces layouts.

### Introduction

The golden ratio is a foundational principle in design, profoundly impacting the architecture of buildings, their environmental integration, and the internal spatial arrangements. This principle ensures proportionality and aesthetic harmony, making it indispensable in both interior and exterior design. It emphasizes dividing spaces into proportional geometric shapes to maintain visual harmony and balance. So, the golden ratio

grids maybe useful in designing layouts to achieve the golden division for interior spaces therefore using it as a guide for distributing furniture pieces in an organized and proportional manner to the space, which in turn enhances the flow of movement for users. Public spaces like restaurants are overcrowded of users almost the day so achieve the best movement flow is a must so applying golden ratio grid to the restaurant layout is my best choice.

### 1-First: Golden Ratio in Interior design

Golden Ratio is implemented in architecture, for example, it contributes to a pleasing balance between height, width, and depth. Thus, it contributes to an overall sense of visual balance. Spaces designed using this ratio appear more comfortable and inviting.<sup>1</sup>

Therefore, the golden ratio influences internal spaces by contributing to a balance between height, width, and depth in architectural design. The Golden ratio in interior design can maintain a sense of aesthetic proportion. how to make the most of the golden ratio grids in interior design, whether on the horizontal level, such as floor and ceiling plans, or the vertical level, such as walls and partitions sections. However, applying the grid to the main layout is the subject of the study in this research.

The power of the Golden Ratio is that you can apply it as much as you want to create new visual effects. The golden mean is also referred to as the golden ratio. When two things are in a ratio of 1:1.618, then that is the golden mean.<sup>2</sup>

### 1-1 Golden ratio types

According to the Fibonacci sequence each number is simply the sum of the two numbers before it. It begins with 1, 1 (i.e., 1 + the unseen 0 = 1), and the first 10 members of the sequence are 1, 1, 2, 3, 5, 8, 13, 21, 34, 55. The golden ratio is calculated using two consecutive Fibonacci numbers, with the sequence progressing towards infinity.

To understand how the ratio is used in design? Figure (1) shows a rectangle, with a short side of

<sup>1</sup> Pramod, G.,2023. Golden Ratio in architecture: Crafting beauty in proportions. The Architects Diary.16 December. <https://thearchitectsdiary.com/golden-ratio-in-architecture-crafting-beauty-in-proportions/>

<sup>2</sup> Jae Johns,2024. How to use the golden ratio in interior design.8 April. <https://jaejohns.com/how-to-use-the-golden-ratio-in-interior-design/>

length 1. To calculate the most aesthetically pleasing rectangle, you simply multiply the length of the short side by the golden ratio approximation of 1.618. So, the long side, in this instance, would have a length of 1.618.<sup>3</sup>

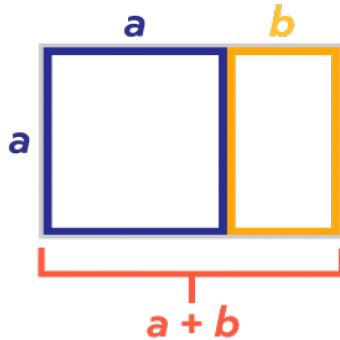
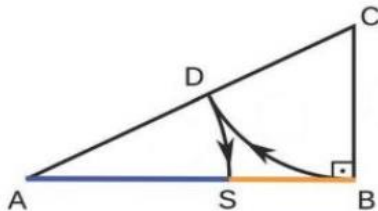


Figure 1 -The golden ratio rectangle.<sup>4</sup>

<https://www.piday.org/calculators/golden-rectangle-calculator/>

As we will discover, the appeal of this golden proportion extends from designer to mathematicians. The golden proportion is present in the natural world and is even intrinsically related to our perception of facial beauty.

Figure (2) shows one of the most common golden constructions that can be made with a ruler and compass:<sup>5</sup>



1. Draw a line  $AB$ .
2. Draw a perpendicular vertical line  $BC$  that is half the height of  $AB$ .
3. Draw a line  $AC$  to complete the triangle.
4. Draw an arc at point  $C$  from point  $B$  to point  $D$  on the hypotenuse.
5. Draw an arc at point  $A$  from point  $D$  to point  $S$  on line  $AB$ .

In this construction,  $AB/AS = \Phi$

Figure 2- Golden Ratio Construction Steps.

<https://www.amazon.in/Golden-Ratio-Divine-Beauty-Mathematics/dp/163106486X>

<sup>3</sup> Soegaard, M.,2024. The golden ratio - principles of form and layout. The Interaction Design Foundation. 27 May. <https://www.interaction-design.org/literature/article/the-golden-ratio-principles-of-form-and-layout>

<sup>4</sup> Golden Rectangle Calculator. Pi Day. (n.d.). <https://www.piday.org/calculators/golden-rectangle-calculator/> 15/5/2024

For example, The Phi grid and Fibonacci sequence grids which are Widely used in design.

#### 1-1-1 Phi grid

The Phi Grid is a grid-based way to apply the Golden Ratio to composing images. It is like the Rule of Thirds but with a tiny difference. Both divide the frame horizontally and vertically into thirds, but when the Rule of Thirds divides the frame into equal sections, as figure (3) shows the Phi Grid follows the 1:1.618 ratio. This pushes the grid lines closer to the center.

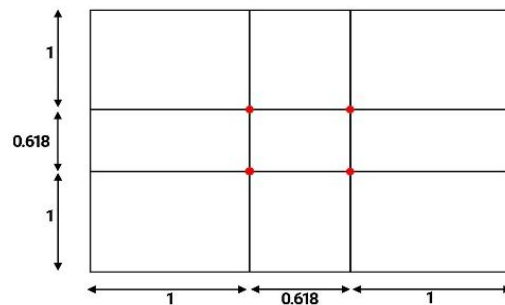


Figure 3 -The PHI Grid.<sup>6</sup>

<https://progradedigital.com/composing-balanced-images-the-golden-ratio/>

#### 1-1-2 Golden Rectangular (Fibonacci squares).

A key feature of golden rectangles is their unique self-similarity. figure (4) shows If you add a square to a golden rectangle or remove a square from it, the resulting shape is also a golden rectangle. This characteristic holds true no matter how many times you repeat the process of adding or removing squares.

The golden rectangular has mathematical constant that appears repeatedly in a grid.

<sup>5</sup> Livio, M.,2018. The Golden Ratio: The Divine Beauty of Mathematics. New York, NY: Broadway Books.p12,p212

<sup>6</sup> Digital, P.,2024. Composing balanced images: The Golden Ratio: Prograde Digital. ProGrade Digital, Inc. 5 March <https://progradedigital.com/composing-balanced-images-the-golden-ratio/>

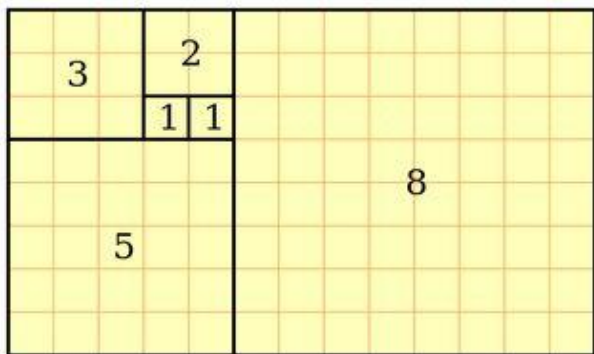


Figure 4- The Golden Rectangular (Fibonacci squares) .<sup>7</sup>  
<https://www.hongkiat.com/blog/golden-ratio-in-modern-designs/>

### 1-1-3 Fibonacci Spiral.

However, the golden ratio doesn't help us just to make rectangles. You can also form a spiral using side lengths based on the decreasing order of the Fibonacci sequence. As figure (5) shows this spiral is also based on the golden ratio and can be more interesting than an equally balanced spiral to the human eye.

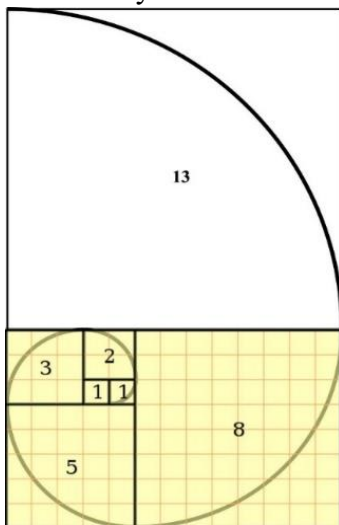


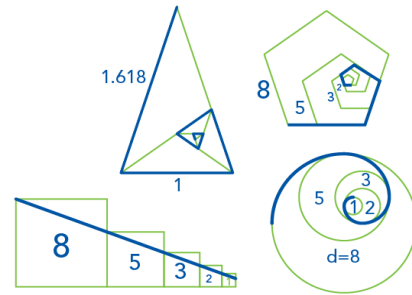
Figure 5 -The Fibonacci Spiral. <sup>8</sup>

It is possible to find golden ratios in patterns involving circles, triangles, pentagons, and other shapes as figure (6) shows.

Golden Triangle: A golden triangle is an isosceles triangle where the ratio of the length

of the longer side to the shorter side is the golden ratio.

Golden Pentagon: A regular pentagon whose side length is in the golden ratio to its diagonal (from one vertex to the opposite side) exhibits properties related to the golden ratio.



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Figure 6- The Golden Ratio shapes (circles, triangles, and pentagons)<sup>9</sup>

<https://letstalkscience.ca/educational-resources/backgrounders/fibonacci-and-golden-ratio-15/5/2024>

### 1-1-4 Golden Circles

In addition to spirals and rectangles, the Golden Ratio can be applied to circles as well.

Figure (7) shows drawing circles within each of the squares of a Golden Rectangle. This will give you circles that are all perfectly proportioned with a ratio of 1.618:1 to the adjacent circle.

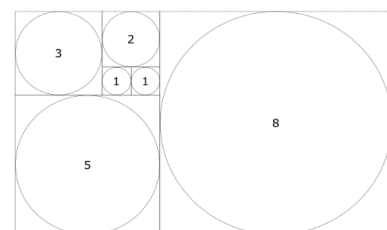
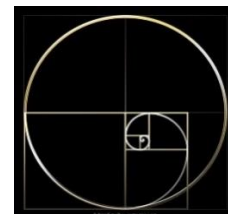


Figure 7 -The Golden Ratio Circles <sup>10</sup>

<https://mightyfinedesign.co/golden-ratio-in-design/>

[resources/backgrounders/fibonacci-and-golden-ratio-15/5/2024](https://mightyfinedesign.co/golden-ratio-in-design/)

<sup>7</sup> Pentagon, C.,2021. Applying the golden ratio in modern designs. Hongkiat.6 December  
<https://www.hongkiat.com/blog/golden-ratio-in-modern-designs/>

<sup>8</sup> Ibidem.

<sup>9</sup> Fibonacci and Golden Ratio. Let's Talk Science. (n.d.).  
<https://letstalkscience.ca/educational->

<sup>10</sup> Mighty Fine, 2024. Golden Ratio in design: What is it and how is it applied. 25May. Available at:  
<https://mightyfinedesign.co/golden-ratio-in-design/> [Accessed 15 July 2024].  
<https://mightyfinedesign.co/golden-ratio-in-design/>

## 2-Applying Golden Ratio Grids to Interior Design Layouts

In general, using grid in designing layouts especially geometric grids considered the easiest way to divide the space and achieve the required balance. Proportional grids determine the relationship between divided areas and corridors. Figure (8) shows golden compound grid with intersections between circles and spiral. A golden grid consisting of a set of intersections between circles and spiral that create different areas of golden division that can be applied to any layout.

This means that the design grid is structured with divisions based on the golden ratio for some elements and divisions.

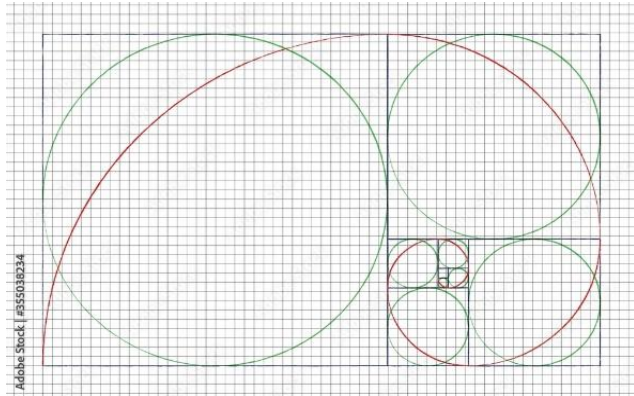


Figure 8-Golden Compound Grid.<sup>11</sup>

[https://stock.adobe.com/eg/search/images?k=golden+ratio+circle&asset\\_id=355038234](https://stock.adobe.com/eg/search/images?k=golden+ratio+circle&asset_id=355038234)

One of the key principles of the golden ratio is balance. When they follow the ratio's proportions, designers can ensure that their designs are visually balanced. This balance creates a sense of order for users. A design can stand, or fall, on its information architecture.<sup>12</sup>

There are many grids of golden spiral as figure (9) shows variety of design grids.

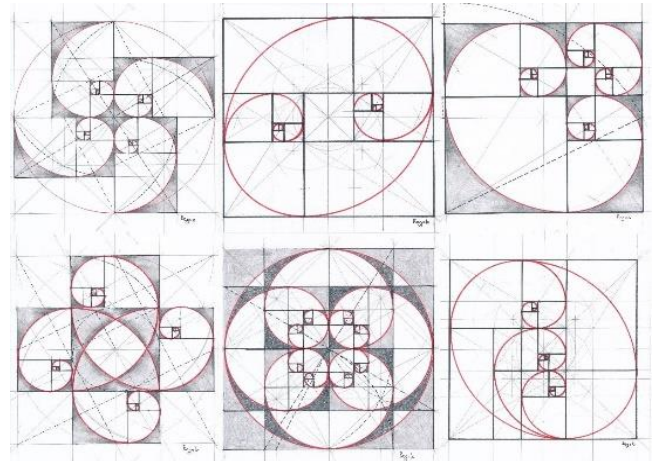


Figure 9-The different grids of golden spiral.<sup>13</sup>

<https://www.pinterest.com/pin/9288742975593358/>

### 2-1 Example no 1

The layout of Homeplace-Keller Plantation home, it is one of Louisiana's oldest and most original large-scale creole homes.

Figure (10) shows the plan of the entire building, that the overall dimensions form one large and exact Golden Section rectangle represented with the Golden Section spiral.

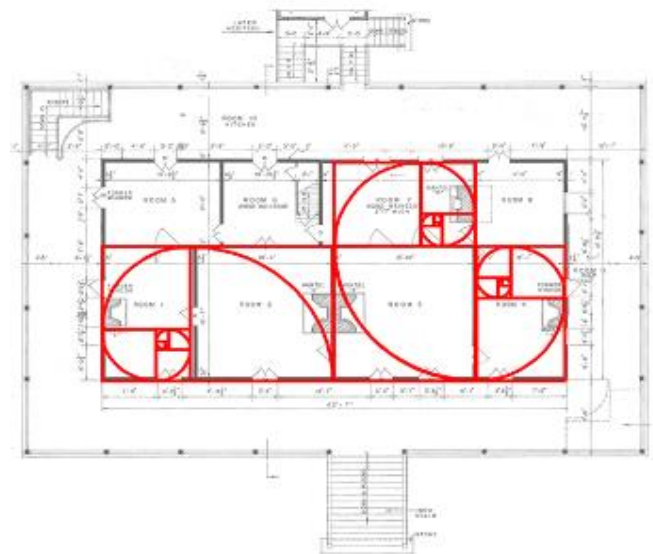


Figure 10-analysis of the layout grid of Homeplace-Keller Plantation home.

<https://jacqueslevetjr.wordpress.com/tag/louisiana/>

<sup>11</sup>

[https://stock.adobe.com/eg/search/images?k=golden+ratio+circle&asset\\_id=355038234](https://stock.adobe.com/eg/search/images?k=golden+ratio+circle&asset_id=355038234) 30/5/2024

<sup>12</sup> Interaction Design Foundation, 2024. What is the golden ratio? - updated 2024. The Interaction Design Foundation, 26 April.

<https://www.interaction-design.org/literature/topics/golden-ratio> 28/5/2024

<sup>13</sup> <https://www.pinterest.com/pin/9288742975593358/> 15/5/2024

The rooms, themselves, are based on two squares, or a 1:2 ratio. The proportional scheme relating the chambre to the hall is seen as the Golden Section. This proportional system and ratio for individual rooms resonates throughout the entire plan of Homeplace-Keller, but with more observations, even more proportional schemes can undoubtedly be found throughout the home.<sup>14</sup>

### 2-2 Example no 2

The 'pinctada house' in chongai, Japan.

Figure (11) shows the building layout as residential proposal evidently influenced by Fibonacci's golden spiral. The stairs, the pool and the small living seat designed according to the grid. Golden division includes the building elements walls, floor, and partitions as a part of the circle.

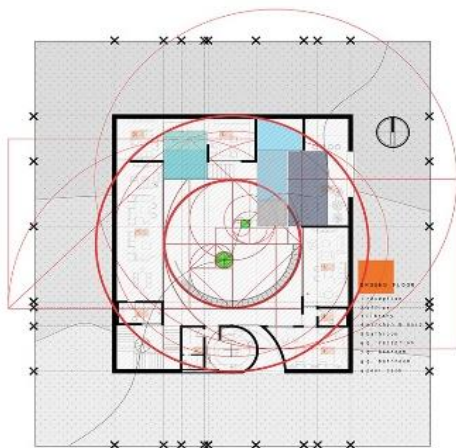
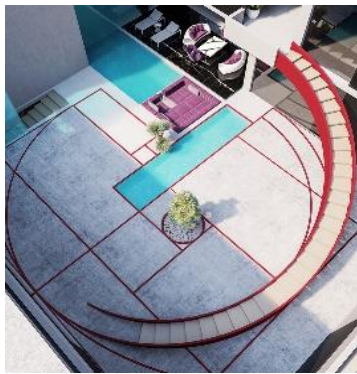


Figure 11-The golden spiral grid of

<sup>14</sup> Louisiana. Jacques Levet, Jr. (n.d.).

<https://jacqueslevetjr.wordpress.com/tag/louisiana/> 3/6/2024

<sup>15</sup> Itafy,2020. Residential proposal in Japan generates central courtyard based on Fibonacci's golden spiral. designboom.10 September.

<https://www.designboom.com/architecture/residential-proposal-japan-courtyard-fibonacci-golden-spiral-09-02-2020/>

the 'Pinctada House' layout.<sup>15</sup>

<https://www.designboom.com/architecture/residential-proposal-japan-courtyard-fibonacci-golden-spiral-09-02-2020/>

### 3-Designing Internal public spaces layout

Designers of these spaces must balance functionality, comfort, and safety to ensure a positive experience for visitors while meeting operational requirements.

Each type of internal public space is designed with specific functions, user needs, and design considerations in mind. Designing internal public spaces involves creating environments within buildings or complexes that are accessible to and used by the public.

The grid layout in architecture and design indoor public space plays a role in controlling the relationship between the distribution of elements within a space and the circulation of people within that space.

Elements Distribution: The grid layout determines how elements such as seating areas, pathways, gathering spaces, and functional zones are organized within the space.<sup>16</sup>

People Circulation: The grid layout also influences how people move through and interact with the space. There are three types of circulations:

1. Private Traffic Circulation, for the employees,
2. Semi-Private Circulation, for (The people who used to visit the place regularly).
3. Public Circulation, for the public visitors.<sup>17</sup>

### 3-1 The most popular grid types which be used in designing public space layout.

Figure (12) shows different types of geometric grids:

- Linear which is Commonly used.
- Radial
- Central
- Clustered
- Axial

<sup>16</sup> The Researcher, Based on multiple readings.

<sup>17</sup> Collynclark,2012. Space planning: Circulation of floors.

Green Stock.15 March

<https://collynclark.wordpress.com/2012/03/15/space-planning-circulation-of-floors/>

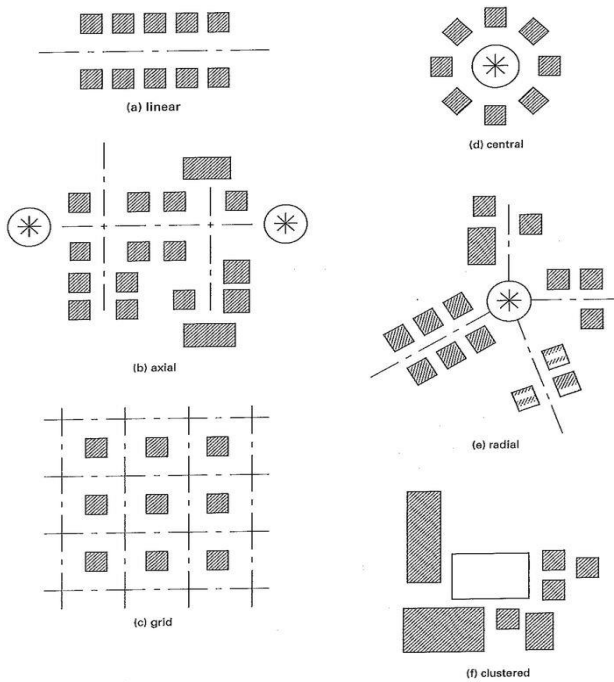


Figure 12- The Different Types of Geometric Grids:<sup>18</sup>  
<https://www.flickr.com/photos/152012189@N03/43254265171>

### 3-1-1 Public library layout as example

Figure (13) shows the library floor plan layout.

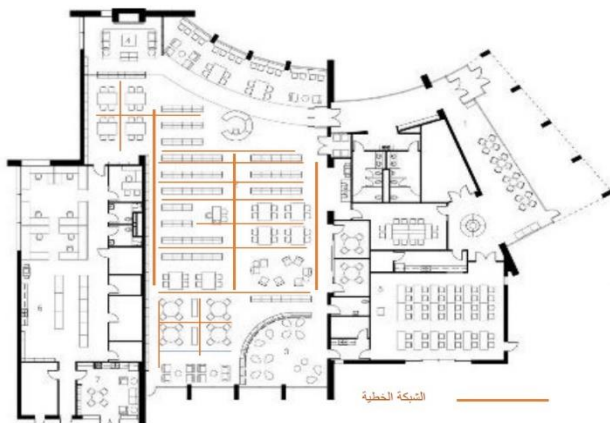


Figure 13-Public Space Floor Plan (Library) in BOISE, UNITED STATES.<sup>19</sup>

[https://www.archdaily.com/898687/library-at-bown-crossing-ffa-architecture-and-interiors?ad\\_medium=gallery](https://www.archdaily.com/898687/library-at-bown-crossing-ffa-architecture-and-interiors?ad_medium=gallery)

<sup>18</sup> Sapphirespringscemetery, 2024. Photo. Flickr, 6 July. Available at:

<https://www.flickr.com/photos/152012189@N03/43254265171>

<sup>19</sup> Tapia, D., 2018. Library! at Bown Crossing / FFA Architecture and Interiors. ArchDaily.27 July

[https://www.archdaily.com/898687/library-at-bown-crossing-ffa-architecture-and-interiors?ad\\_medium=gallery](https://www.archdaily.com/898687/library-at-bown-crossing-ffa-architecture-and-interiors?ad_medium=gallery)

<sup>20</sup> The researcher analysis.

The division of space depends on a linear grid, the lobby, the main reading room, the staff workroom. Therefore, the furniture follows clear lines, which creates intersecting movement paths that may cause unclear directions of movement. Linear layouts are characterized by a linear arrangement of spaces or features, often following a straight or curved path. This layout is efficient for spaces with specific circulation needs or for creating defined zones.

This distribution and circulation may seem to be the most efficient use of space, but it lacks to proportion between furniture and corridors, which affects the movement flow of users.<sup>20</sup>

### 3-2 The main problems in interior design of public spaces layout.

Overexposure, stress, and lacking privacy are main problem of public spaces which effects on users' behavior. Designers are challenged to find a balanced design solution for the complex interaction between spaces, occupants, and their activities.<sup>21</sup>

Design a public space with flexibility is essential for meeting the changing needs of the users. the arrangement of public spaces elements according to functions, selecting furniture and materials that can be moved and transformed depending on the space's need is crucial. Adaptability is needed for a public space to function well. Which starting with layout design.<sup>22</sup>

We can determine the problems of designing public space layout as follows.

- Large spaces that need division.
- How to distribute furniture according to corridors.
- Floor plan with motion path mess
- Ignoring rhythm in design which cause visual clutter.

<sup>21</sup> K. Jens, J.S. Gregg, 2020. How design shapes space choice behaviors in public urban and shared indoor spaces- A Review. Sustainable Cities and Society. 11 November

<https://www.sciencedirect.com/science/article/abs/pii/S2210670720308106>

<sup>22</sup> Becker, E.,2024. Interior Design Trends in public spaces. Design Pool.12 April.

<https://www.designpoolpatterns.com/interior-design-trends-in-public-spaces/>

- Neglect movement flow at peak times. Using grid with module or golden ratio would help to solve most of these problems.<sup>23</sup>

#### 4-Study of Restaurant Layout as A Public Space

The choice of (Restaurant) as a case study for public space stands out due to its prolonged operating hours, leading to consistent user activity, especially during peak times. Therefore, designing the restaurant layout entails a detailed examination of applying the golden ratio grid and its influence on enhancing movement flow.

Restaurants are a prime example of public spaces that require careful consideration of specialized design criteria, placing significant emphasis on the flow of movement during layout planning. This includes managing the movement of customers and servers alike, as well as optimizing operations within the kitchen environment.<sup>24</sup>

There are many diagrams for designing restaurant floor plans. This diagram typically shows the overall layout of the restaurant space, including tables, seating areas, bar counters, and kitchen placement. It helps visualize the arrangement of different sections within the restaurant as figure (14) shows the zoning diagram which focuses on optimizing workflow and efficiency.

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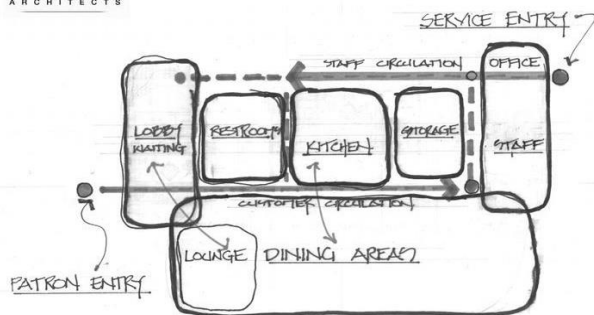


Figure 14- Zoning Diagram Example for Designing a Restaurant Floor Plan.<sup>25</sup>

**Golden Ratio Grid Application Diagram:** This diagram demonstrates how the golden ratio grid is applied to the restaurant floor plan as figure (15) shows. It highlights how proportions derived from the golden ratio can enhance aesthetic appeal and spatial harmony.

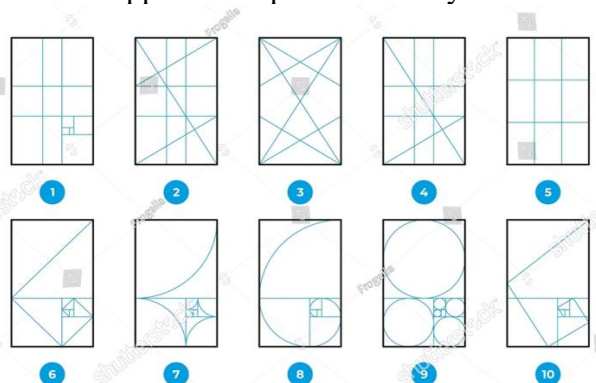


Figure 15- Golden Ratio Grid Application Diagram types.<sup>26</sup>  
<https://nythrosadventures.blogspot.com/2020/05/architecture-zoning-bubble-diagram.html>

#### 4-1 The movement flow as one of the most important considerations in designing restaurant's layouts.

An organized circulation of restaurants elements helps to maximize function. Configuration of the bar, seating areas and kitchen in designing layout makes a huge difference on flow efficiency.<sup>27</sup>

For safety reasons and to allow for the free flow of movement for customers and staff, the traffic path between occupied chairs should be at least 18 inches wide. You should leave at least 4–5 feet per table, including chair space.<sup>28</sup>

#### 4-2 Analyzing an example of restaurant circulation plan.

Figure (16) shows restaurant layout circulation plan with relationships between the space areas. Lines which representing the movement flow of

<sup>23</sup> The researcher's opinion based on several readings.

<sup>24</sup> Researcher Analysis

<sup>25</sup> Architecture zoning bubble diagram. web hit counter. (n.d.). <https://nythrosadventures.blogspot.com/2020/05/architecture-zoning-bubble-diagram.html> 1/6/2024

<sup>26</sup> Composition rules geometric formula math science stock vector (royalty free) 2261326969. Shutterstock. (n.d.).

<https://www.shutterstock.com/image-vector/composition-rules-geometric-formula-math-science-2261326969> 2/6/2024

<sup>27</sup> CreedStudio.2021. 5 most important factors in designing your restaurant interior. Creed Design. 18 February <https://www.creeddesign.co.uk/post/5-most-important-factors-in-designing-your-restaurant-interior>

<sup>28</sup> Total Food Service,2023. The technical know-how of creating a restaurant floor plan. Total Food Service.30 October <https://totalfood.com/how-to-create-a-restaurant-floor-plan/>



customers and staff. The layout is divided to 2 main areas, the preparation/cooking area, and the dining area. It's hard to achieve balance without using clear grid to distribute seating in lines and create required corridors.

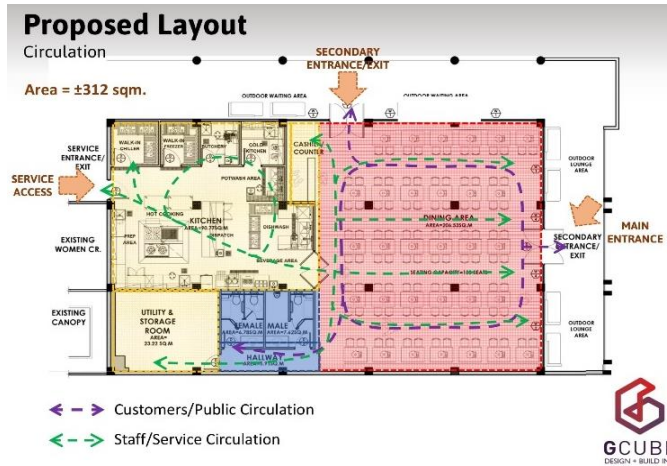


Figure 16- Circulation Plan for Proposed Restaurant Layout.<sup>29</sup>  
<https://gcubedesignandbuild.com/important-things-to-consider-when-designing-a-restaurant/>

Configuration of the Path has many types as we present before, so that circulation of space has just one goal no matter what type of it we implement in our design, to be a guideline to distribute the space elements.<sup>30</sup>

How to design the movement flow directions to maximize efficiency. Using golden ratio grids with different positions would change the layout, the areas division, the seating distributes, the corridors and the kitchen.

Choosing the golden grid which suit the space layout is the first step, the next step is design corridors according to the grid lines which leads to the third step the distribute of plan elements.

### 5-Applying golden ratio grids to restaurant's layout

Using different types of golden grid which we study at the research. Applying golden grids on the layout includes dividing the space into zones, designing the floor according to the grid,

and then distributing the furniture pieces (dining tables, bar table, and service tables), which affects the movement paths and directions to and from the service areas (kitchen and toilets). The golden grids work to coordinate the relationship between the elements of space and circulation, which enhance movement flow at peak times.<sup>31</sup>

It is common among most restaurants and coffee shops to average around 15 sq. ft. per person. Seating capacity also takes the space needed for traffic corridors into account. The general seating capacity regulations you should apply to your restaurant floor plan for full-service restaurant required around 12 – 15 sq. ft. per person. For the free flow of traffic for customers and servers there needs to be a minimum space allowance for the traffic path between the various furniture items. As shown in the following figure (17)

Diagram	Setting	Space between each
	Occupied chairs	18" - 20"
	Tables set in parallel	42" - 60" between sides
	Tables set on a diagonal	24" - 36" between corners

Figure 17-the relationship between restaurant seating capacity and space required per person.<sup>32</sup>

<https://www.affordableseating.net/resources/guides/restaurant-design-guide>

By determining the optimal spatial requirements for individuals within a restaurant and assessing the available space area, it is possible to calculate the amount of occupancy. Utilizing golden ratio principles can enhance flow of movement which support the functional aspects. This analysis should be conducted alongside the plan layout, side by side to aesthetic aspects of

<sup>29</sup> Webadmin,2022. Important things to consider when designing a restaurant. G Cube Design + Build Inc. 19 May <https://gcubedesignandbuild.com/important-things-to-consider-when-designing-a-restaurant/>

<sup>30</sup> 5 types of circulation in architecture with examples. WhereIsTheNorth. (n.d.). <https://www.wheresthenorth.com/article/5-types-of-circulation-in-architecture-with-examples> 6/6/2024

<sup>31</sup> The researcher.

<sup>32</sup> Affordable Seating ,2023. Restaurant Design Guide, Restaurant Furniture: Commercial Seating, Tables and Chairs. <https://www.affordableseating.net/resources/guides/restaurant-design-guide> 9 /10/ 2024

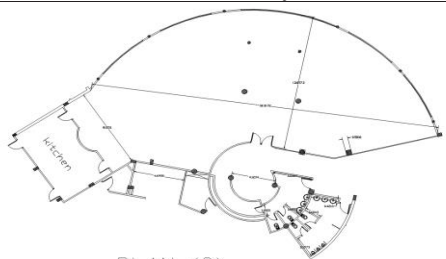
the design. This is what we will try to apply in the project.

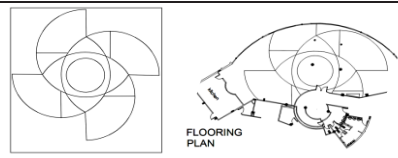
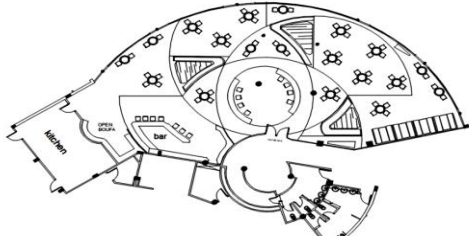
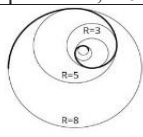
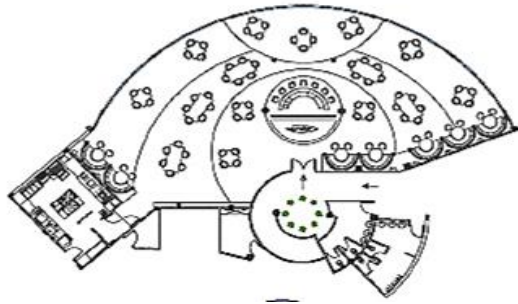
### 5-1 The Practical Application

I will present two different experiments of students' applications of the golden ratio in designing the restaurant layout, where different applications have different results.

#### 5-1-1 The first practical application in 2020

The experiment was based on choosing a restaurant layout one plan for all students, while applying different golden grids to the same space size. As shown in the following table (1) The applied study carried out by the students under the supervision of the researcher, which is a practical application of what was reviewed in the research by choosing a plan for the restaurant and using different golden grids, which resulted in the designs shown in the table, there are three different designs with analysis of each one. Designing this space in accordance with the standards of public spaces was the challenge faced by the students. Therefore, different golden ratio grids were applied to facilitate the design of the floor plan.

<b>Restaurant layout</b>	
	
<b>Description</b>	
<ul style="list-style-type: none"> <li>• Hotel restaurant, the plan layout shows dining area as one space without division.</li> <li>• The plan layout has huge, curved glass line, so we can't deny the view.</li> <li>• The entrance in the middle of the space which make directions of circulation unclear.</li> <li>• The kitchen location on the far left and the toilets outdoor the dining area.</li> </ul>	
<b>Design no1</b>	
<p>By Sara Khaled, student at level 5, Interior and furniture design department, faculty of applied arts, O6U university ,2020</p>	

<b>Type of golden grid</b>	 <p>Compound Spiral golden grid</p>
<b>Design layout</b>	
<b>Design Analysis</b>	<p>According to the grid layout design was divided into zones, so the distribution of dining tables in different directions according to each area or zone is clear, with flower boxes dividers units. Some of them were also distributed near the glass facade in proportion to the movement corridors. The compound spiral golden grid allowed movement paths proportional to the movement of users, which enhance the flow and achieves a proportional relationship between the zones ( tables, bar area, and the kitchen ) and corridors witch connect the door, the seating areas, with the service areas (kitchen and toilets).</p>
<b>Design no2</b>	
<p>By Merna Mahmoud, student at level 5, Interior and furniture design department, faculty of applied arts, O6U university ,2020</p>	
<b>Type of golden grid</b>	 <p>Circular golden grid</p>
<b>Design layout</b>	
<b>Design Analysis</b>	<p>According to the grid the circular golden grid which allows radial division of the space with a regular distribution of dining tables, a rhythm with movement circulation according to the grid lines. Which is arranged with clear, frequent, and regular movement paths in curved direction. It also allows for a variety of table sizes and the location of the bar area within a central circle in the middle. The relationships are simple, the flow of movement is smooth, the corridors</p>

<sup>33</sup> <https://cadbull.com/detail/37003/Multi-cuisine-restaurant-architecture-layout-plan-details-dwg-file> 1/7/2024

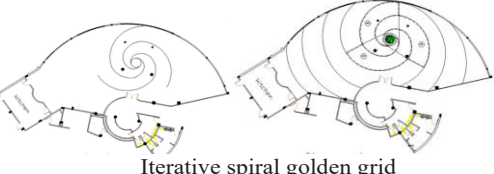
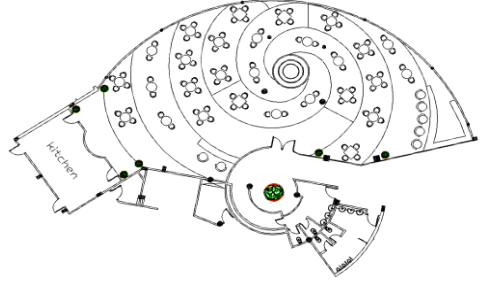
	are visually comfortable with movement to and from the service areas is easy.
<b>Design no3</b>	
By Rawya Hassan , student at level 5, Interior and furniture design department, faculty of applied arts, O6U university ,2020	
<b>Type of golden grid</b>	 Iterative spiral golden grid
<b>Design layout</b>	
<b>Design Analysis</b>	According to the grid layout design are in balance through regular repetition with a larger number of dining tables. The use of iterative spiral created a kind of circular motion that was visually balanced, making the motion paths clear and circular, so the flow of motion is easy and quick. The design tends to be central, as there is a point in the middle from which the tables begin to be distributed in a more circular manner towards the bar area. The relationship between tables and service areas is regular circular lines, which enhance movement flow at peak times.

Table 1- Applying Golden Ratio Grids to a Restaurant Layout.<sup>34</sup>

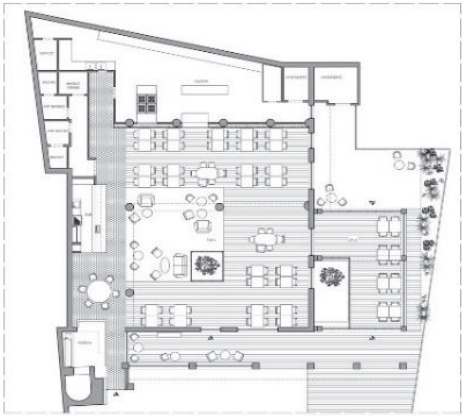

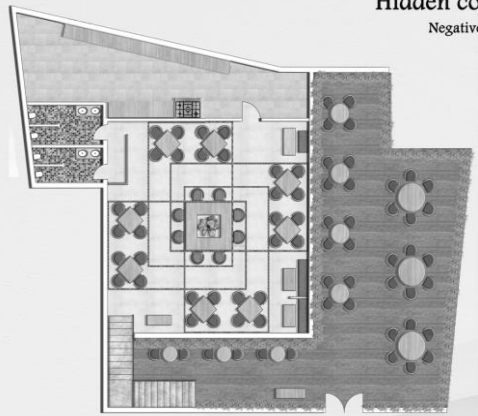
### The first experiment results:

Distributing dining tables along the grid lines creates clear movement paths that are proportional to the number of users. Consequently, movement flow is affected.

These applications resulted in a wide range of ideas and solutions, but the results remained limited, so it was better to use more than one plan with different areas, which is what was applied in the second experiment.

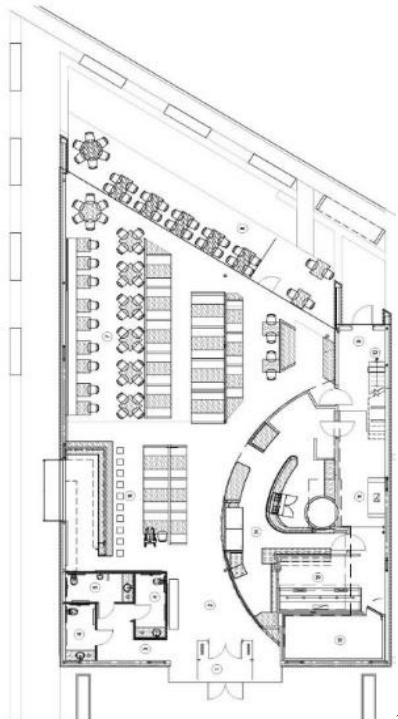
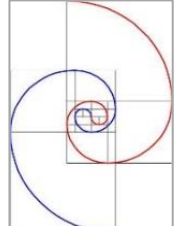
### 5-1-2 The second practical application in 2023

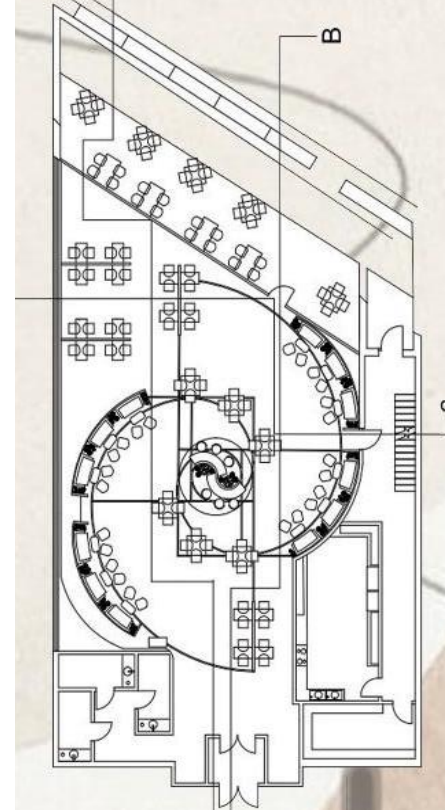
While the second experiment included a set of layouts for many restaurants of different space sizes. As table (2) shows different golden grids were applied, which resulted in more diverse results.

<b>Restaurant layout first example</b>	
<b>layout before</b>  (Design follow linear grid)	 35
<b>Type of golden grid</b>	 Iterative Spiral golden grid
<b>layout after</b>  (Design follow golden grid)	 Hidden co Negativ

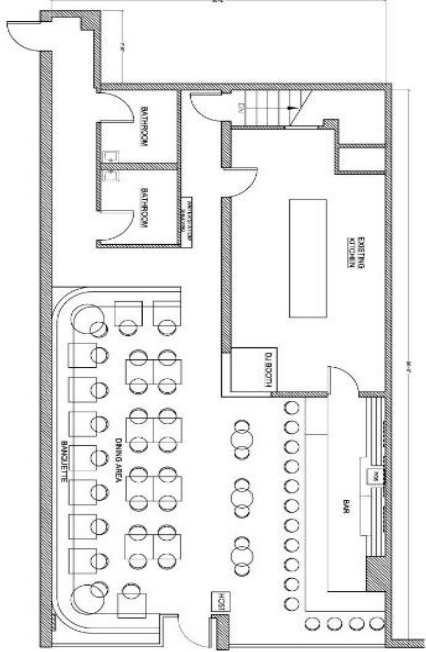
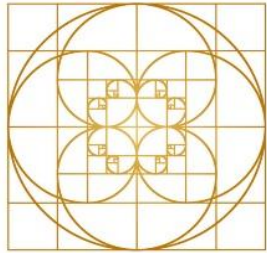
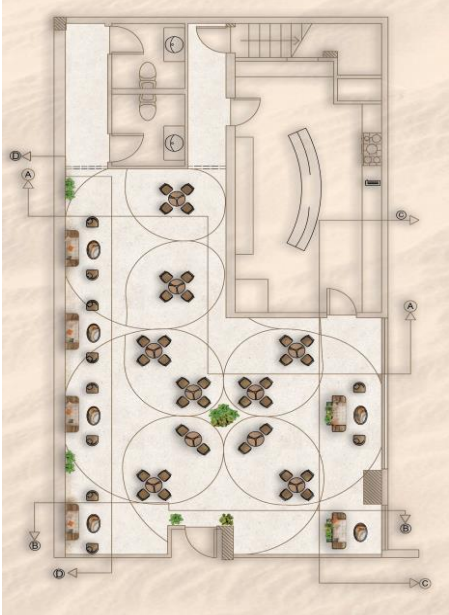
<sup>34</sup> The Researcher Design and Analysis.

<sup>35</sup> <https://www.archdaily.com/397853/kook-restaurant-noses-architects/51d4d481b3fc4b5834000225-kook-restaurant-noses-architects-floor-plan>

	By Farah Hazem, Naden Mohmed ,Manar Mahmoud, Nada Mohmed , Students at level 5, Interior and furniture design department, faculty of applied arts, O6U university,2023
<b>Design Analysis</b>	The students changed the design of the restaurant layout by applying the iterative golden spiral grid, where there is a harmony between the different relationships and a proportional organization of the space elements. The different distribution of dining tables created clear movement paths, with a central point in the bar area as a spiral center, which create a sense of movement and rhythm. Compared to the original layout design, this design is better because it enhances the user's movement flow.
<b>Restaurant layout second example</b>	
<b>layout before</b>  (Design follow linear grid)	
<b>Type of golden grid</b>	 spiral golden grid

<b>layout after</b>  (Design follow golden grid)	
	By Zeinab Ahmed, Rahma Shrif, Nada Mamoun,Mira Samy,Ezzat Samy , Students at level 5, Interior and furniture design department, faculty of applied arts, O6U university,2023
<b>Design Analysis</b>	The students changed the design of the restaurant layout by applying the spiral golden grid. From the typical linear design to a dynamic spiral design, where the dining tables are distributed along the curve, creating a wider movement corridor, and allowing for a greater number of fixed dining tables. Also, the relationship between the tables have become more proportional to the paths. Dividing the space according to the ratio provides more privacy for the guests and achieves rhythm in movement. Compared to the original layout design, this design is better because it enhances the user's movement flow.
<b>Restaurant layout third example</b>	

<sup>36</sup><https://www.archdaily.com/214484/cafe-501-elliott-associates-architects/5005e06d28ba0d0779001fec-cafe-501-elliott-associates-architects-floor-plan>

<p>layout before  (Design follow linear grid)</p>	
<p>Type of golden grid</p>	 <p>Compound spiral golden grid</p>
<p>layout after  (Design follow golden grid)</p>	 <p>By Sara Ismail ,Shahd Mohmed ,Israa Ihab, Noran Mahmoud, Shayma El -Nadi , Students at level 5, Interior and furniture design department, faculty of applied arts, O6U university,2023</p>

<p><b>Design Analysis</b></p>	<p>Narrow movement corridors combined with a linear design made the layout lack to visual comfort, so that the students changed the design of the restaurant layout by applying the Compound spiral golden grid. Dividing the space according to the grid into zones that include dining tables with intersecting movement paths. The compound design of the spiral grid adds a kind of mystery, but maintaining the proportion creates clear movement paths. Also, spacing the tables apart affects circulation. Compared to the original layout design, this design is better because it enhances the user's movement flow.</p>
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Table 2- Comparative Analysis of Restaurant Layouts Before and After Applying Golden Ratio Grids.<sup>38</sup>

### The second experiment results:

The comparison showed that the design according to the golden grids is another option that can be better than the traditional design on several levels.

1- Changing the tradition design the frequent use of a linear grid in layout design, designing with golden grids enhances the flow of movement within the space compared to traditional layouts. It facilitates better circulation paths for both customers and staff, contributing to a more efficient and pleasant dining experience.

2- The golden division of spaces creates zones and allows for a better distribution of furniture pieces, maintaining the ratio between design elements and corridors Which leads to an increase in the number of individuals.

3- Applying the Golden Grid results in clear paths and smooth circulation between tables and service areas, which enhances the flow in peak times.

### Research Results and Recommendation

- There are many golden ratio grids that allow for unlimited layout space designs.
- Using golden ratio grid is a good solution for public spaces layout problems.
- The use of the golden grid has a direct impact on the circulation which includes the connection of the space elements and users' paths.
- The design and application of proportions resulted in an increase in the number of individuals. This expansion created larger spaces, leading to the development of main and subsidiary corridors.

<sup>37</sup> [https://search.yahoo.com/yhs/search; vlt=AwrBXeieBvFaiQ\\_wA02rzm4IQ?type=pr alt ddc dss bd com&hspart=ddc&h](https://search.yahoo.com/yhs/search; vlt=AwrBXeieBvFaiQ_wA02rzm4IQ?type=pr alt ddc dss bd com&hspart=ddc&h)

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<sup>38</sup> The researcher design and analysis.

- The application of golden ratio grids in public space layouts significantly improves user movement flow, particularly during peak times. It ensures that space is utilized efficiently, enhancing both aesthetics and functionality.

So, we recommend designers to consider using golden ratio grids in interior design in general, and specifically when designing public spaces, and to avoid the typical use of linear grids.

Also, We advise designers to consider the flow of movement as a primary consideration when designing the layout of restaurant spaces. This involves circulation plan with clear paths that facilitate user movement during peak times.

### Conclusions

This research study and its applications conclude that the importance of using golden ratio grids in interior design, especially in layout design, solves many design problems. There are many types of simple and compound golden ratio grids that can be widely used in designing internal layouts, which is considered the best option that changes the design vision in the future. Finally, the use of golden ratio grids may indeed be the best solution for designing the layout of public spaces, such as restaurants. This approach ensures proportional division of space zones and balanced proportions between furniture and movement corridors, thus enhancing the flow of movement for users.

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