

Optical Illusion Resulting from The Use of Reflective Surfaces and The Importance of Applying it in Various Interior Spaces

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ABSTRACT:

Optical illusions in interior design are one of the subjects that deserves study, it is a design solution to many problems related to space elements and has an effect on the shape and space in the various interior spaces. There are many types of optical illusions by shape, color, and material, as, for example, the use of reflective surfaces in interior spaces that may lead to a change in the perception of size, lighting, colors, as well as the location of furniture pieces, because of the effect of the reflection, such as the illusory feeling of extra space or increase in depth or height. Therefore, the reflective surfaces are an important type of optical illusion, where the reflections of mirrors change the relationships between the elements of space and the pieces of furniture, which gives new and imaginary dimensions to the inner space.

Research Problem:

Reflective surfaces as a type of optical illusion and its role to change space dimension as a deception especially in narrow interior spaces.so more attention should be paid to the application of optical illusion when designing interior spaces.

Research Objective:

- Referring to how the illusion resulting from using reflective material surfaces have various effects on the internal space.

Research Methods:

Analytical Approach

Projects Analysis / Case Studies

Research Limits:

- Formulation of research aims and objectives.
- Implementation of data collection method.
- A direction for future studies and present alternatives.

Research Procedural Steps:

- Studying of Optical Illusion Concept and Its Applications in Interior Design
- Reflective materials Surface types and applications.
- Optical Illusion Resulting from The Use of Reflective Surfaces
- Practical application related to the study results.

KEYWORDS:

Optical Illusions; Reflective Surfaces; The Concept of Reflection ; Reflective Furniture.

المستخلص

الخداع البصري في التصميم الداخلي هو إحدى الموضوعات التي تستحق الدراسة لأنه يعد حل تصميمي للعديد من المشكلات المرتبطة بعناصر الفراغ وله تأثير على الشكل والمساحة في الفراغات الداخلية المختلفة. وهناك العديد من الأنواع للخداع البصري بالشكل واللون وأيضا الخامات حيث أنه على سبيل المثال عند استخدام الأسطح العاكسة في الفراغات الداخلية يحدث تغييرات في كل من الحجم والإضاءة والألوان وكذلك أماكن قطع الأثاث لما يسببه الانعكاس من تأثير وهمي بوجود مساحات إضافية وزيادة العمق أو الارتفاع. لذا فإن أهم المعالجات التي تحققها الأسطح العاكسة هو الخداع البصري حيث تعمل انعكاسات المرايا على تغيير العلاقات بين عناصر الفراغ وقطع الأثاث من خلال انعكاسها للصورة مما يعطى أبعاد جديدة وهمية للفراغ الداخلي. كذلك لا يجب اغفال دور الأسطح العاكسة كنوع من الخداع البصري في إضافة بعد جديد داخل الفراغ سواء عمق أو ارتفاع أو مساحة إضافية وهمية خاصة في الفراغات الداخلية الضيقة.

لذا نفترض أن هناك أثر جمالي ووظيفي لاستخدام الأسطح العاكسة كنوع من أنواع الخداع البصري في الفراغ الداخلي. وأن تطبيق الخداع البصري يعد حل لبعض مشكلات الفراغات الداخلية ويخلق أبعاد جديدة لنفس الفراغ. ويجب أن يهتم المصممين باستخدام الخامات المختلفة للأسطح العاكسة في التصميم الداخلي لعمل تصميمات جديدة والتي تعد حلول لمشكلات بعض الفراغات.

لذا فإن الغرض من هذا البحث هو إلقاء الضوء على تأثير الخداع البصري الناتج عن استخدام الأسطح العاكسة بما تشمله من عناصر التصميم الداخلي والأثاث في تغيير شكل الفراغ لتجعله يبدو أكبر أو أطول أو أوسع.

هناك العديد من الأنواع المختلفة للأسطح العاكسة التي يمكن تطبيقها في التصميم الداخلي (سواء المسطحة أو المقعرة أو المحدبة) حيث أن لكل منها تأثيراً مختلفاً على شكل المساحة. ولا يقتصر الأمر على المرايا فحسب، بل هناك أيضاً العديد من المواد العاكسة التي يمكن استخدامها في عناصر الفضاء المختلفة مثل الأسقف والأرضيات والجدران والأثاث، ولكل منها تأثير في تحقيق الخداع البصري للمستخدمين. إذاً إلى أي مدى يمكن للأسطح العاكسة أن تضيف مساحة إضافية زائفة إلى الفضاء الداخلي، وهل هي حل مناسب للمساحات الضيقة؟

الكلمات الرئيسية

الخداع البصري، الأسطح العاكسة، مفهوم الانعكاس، الأثاث العاكس

Introduction

This research discusses the possibility of achieving visual deception with materials or reflective surfaces with a view to applying them to an expansion of interior design and to benefit from their effect on the user within the space.

There are many different types of reflective surfaces that can be applied in interior design (either flat, concave, or convex) as each has a different effect on the shape of the space. Not only mirrors, but there are also many reflective materials that can be used in various space elements such as ceilings, floors, walls, and furniture, and each of them has an effect in achieving visual deception for users. So how far can the reflective surfaces add a false extra space to the inner space, and is it an appropriate solution to narrow spaces?

First: Optical Illusion Concept and It's Applications in Interior Design

Optical illusion is a concept depends on our perception. Perception is turning what we see into what we understand. Usually, we see what we expect to see, but sometimes our perception lets us down and we perceive something to be so that isn't so.¹

An optical illusion (also called a visual illusion) is characterized by visually perceived images that differ from objective reality. The information gathered by the eye is processed by the brain to give a perception that does not tally with a physical measurement of the stimulus source for example using geometric patterns and complementary colors to create the illusion of movement in artworks. This type of art is known as optical art.²

There are three types of illusion.

1-Literal Optical Illusions

A literal illusion is when the image you see is different from the images that make it up. The end result you see in a literal illusion is based on your perception.

2- Physiological Optical Illusions

These types of optical illusions are more complex because they reply on the over stimulation of the brain's senses. At first glance, a two-dimensional figure looks like it's three-dimensional. Upon further investigation, the brain realizes what the eye is actually seeing. The image in question does not exist in nature.

3- Cognitive Optical Illusions

It is the most complex type of trick the eye can play on the brain. These illusions rely on what the subconscious mind thinks and how it relates one object to another. It uncovers what your brain infers and understands about something that has not been explained.³

Elements of Optical Illusion in interior design (Lines, Shapes, Colors ,Lights ,Mirrors)

Horizontal or Vertical Lines

Line in interior design is the heart of form. Its characteristics comprise straight, vertical, horizontal, diagonal, and curved forms and define the shape and volume of space. Other elements of design include space, texture, form, color, light and pattern. The right balance of all interior design elements is vital to every design scheme. Pic no.(1) shows the illusion using different types of lines.

Use vertical lines to make the interiors appear higher. For example, to make a small room looks larger by using vertical lines hang the curtains up to the ceiling, not where the windows stop. By doing this, you will visually feel that the space has been expanded. Patterned wallpaper or painted stripes on a wall also help do the trick. Also, rectangular tiles vertically will make these spaces appear wide and elongated.



Pic no. (1): Optical Illusion using different types of lines.

On the other hand, long horizontal lines are known to visually expand a space, making rooms appear longer and wider, with the ceiling height seeming lower.⁴

Shapes Illusion

Geometric and Free forms shapes have different illusion in interior spaces, pic no. (2) shows how changing the forms and orientation of simple design elements can achieve illusion in the space. This modern home designed by distorting the circular or rectangular seating into a more angular form which goes in and out, this is an example of how the tightest spaces can be played with using shapes to fit activities.

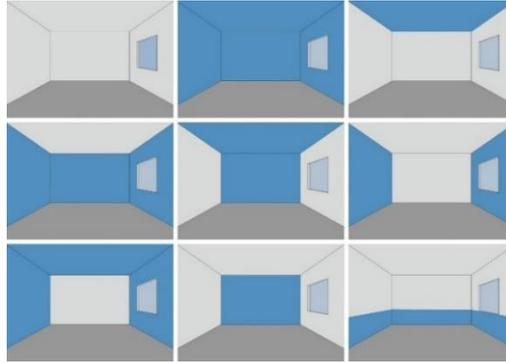


Pic no. (2): Optical Illusion using geometric shapes with different angles.⁵

Colors Illusion

If a room has unusual proportions, then color is the cheapest way to improve it without structural alterations. Light colors reflect the lightest, making rooms appear bigger and brighter, while dark colors have the opposite effect.⁶

This can be done by painting surfaces, using different materials, or applying different coatings. Lighter and cooler colors make the space appear larger. Darker colors make them appear more closed and smaller to the eye. Shape no. (1) shows illusions by colors that the arrangement of colors or textures in an environment changes the perspective, making the room appear taller, longer, wider, or highlighting a particular element.



shape no. (1): Optical Illusion using different arrangement of colors and its effect on the interior perspective.⁷

For example, pic no. (3) design 'Red Blue Motion Totem' showcases the trend of incorporating optical illusions into art, creating a sense of depth and movement that engages the viewer in a unique and interactive way.



Pic no. (3): Optical Illusion using a collection of wall paintings combined with mirrored columns.⁸

Lights Illusion

Backlighting trick doesn't only eliminate darkness behind furniture, it creates an extra sense of depth to help the space feel larger. This lighting technique can be used in various locations, such as: (Behind TV screens, Behind mirrors, Behind bed headboards, Behind wardrobes, Behind sofas, Behind shelving units).⁹

Although, the intricate interplay between illumination and shadow can have an infinite number of patterns and, as such, gives you just as many options for illusions. Pic no. (4) shows using unique design of lighting units which allow different effects simply because of how they spread their light around the room.



Pic no. (4): Optical Illusion using unique lighting units. ¹

Mirrors Illusion

The mirror increasingly becomes a material, or rather a tool for creation of interior space. The effect can be a result of the material texture, pattern, color, gloss, etc. There are many mirror tricks that can improve the real interior proportions, modify the room in terms of spaciousness. The first, and perhaps the most famous trick is gaining of enlarged room through the large mirror surfaces. Reflections and optical illusions they provide an opportunity to significant visual enlarging of room space.¹ For example, pic no. (5) shows An extra-large mirror reflecting huge amounts of light off the glass and back into the space, creating the illusion of bigger and brighter spaces.



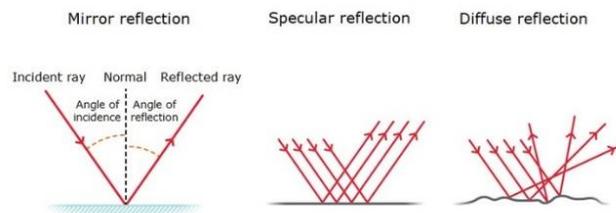
Pic no. (5): Optical Illusion using mirrors.¹

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Second: Interior and Furniture Design by Using Reflective Surfaces

1-How Do Reflective Surfaces Work?

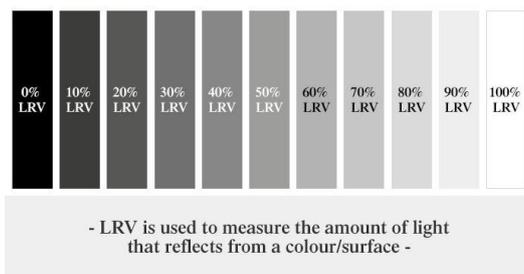
Reflective Material means material which, in all conditions, is capable of reflecting light.¹ Shape no(2) shows that there are 3 types of reflection according to different surfaces.



Shape no. (2): types of reflection according to different surfaces.

- 1-Mirror reflection: Light reflects from a smooth surface at the same angle as it hits the surface.
- 2-Specular reflection: For a smooth surface, reflected light rays travel in the same direction.
- 3-Diffuse reflection: For a rough surface, reflected light rays scatter in all directions.¹

Shape no. (3) shows the main factor of reflection (The Light Reflective Value), or LRV, is used frequently as an industry standard in architecture and interior design, used to make decisions regarding how different colors are paired. This is a measurement of the amount of visible light reflected by an illuminated surface or object.



Shape no. (3): The Light Reflective Value.

Referring to the difference in the surface of the material used in the final finishing, we find that the rough surfaces cause light to be reflected in multiple directions. By contrast, light bouncing off smooth objects will be less scattered.¹

2-Types of Reflective Material Surfaces

Table no. (1) shows the most famous types of reflective material surfaces which could be use in interior and furniture finishing.

| Material | Types of surfaces | |
|----------|---|---|
| Glass | Mirror |  |
| | Acrylic Mirror/ Silver mirror |  |
| Metal | Polished Aluminum |  |
| | Polished chrome |  |
| | Stainless Steel (polished/brushed/ water ripple) |  |

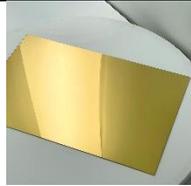
| | | |
|-------------|---|---|
| | Polished brass sheet |  |
| Mayler Film | Mirror Roll / sheet |  |
| Astro Foil | Insulation foil sheet |  |
| Coating | Aluminum powder coating Liquid Glass coating/High gloss finishing Epoxy | |

Table no (1) Types of Reflective material Surfaces.¹

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3- How Could Reflection be Applied in More Than One Space Element (Ceiling, Floor, Walls, and Furniture)? The glass surface comes first, while metallic items are typically among the most reflective materials. The mirror can therefore be viewed as an instrument that reveals the presence of light, giving it a precise measure and place in our conception of interior space. By using mirrors, we purposely break the reflected surface, to redirect light, and to offer an altered sense of perspective.

Ceiling Reflective surfaces:

For example, pic no (6) shows **Reflective Laqfoil Stretch Ceiling** as a new material with reflection Feature. Reflective ceilings not only help to make a room appear larger, but they also increase light levels in a space, when used in conjunction with the correct lighting.

Pic no. (6): Reflective Laqfoil Stretch Ceiling.¹

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Another example, pic no (7) shows **Water Ripple Stainless steel ceiling**. The effect created with water ripple sheet is to reflect the dynamism. Strong 3D effect with metal texture and light and shadow resulting in an attractive visual effect that can add a touch of elegance and sophistication to any space which make people feel peaceful and comfortable.

Pic no. (7): Water Ripple Stainless steel ceiling.¹

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Mirrors positioned close to the line of a ceiling visually mobilize illusionary volume and depth into an implied space beyond.

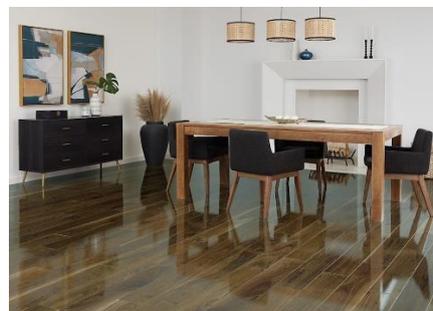
Floor Reflective Surfaces:

For example, pic no (8) shows **Metallic/Reflective Epoxy Floor** as floor material can be added to the concrete surface. A reflective surface creates an illusion of depth and space beyond what your room may already have since the reflections in the surface can the impression in your mind of an open space larger than the room actually is.

Pic no. (6): Reflective Epoxy Floor.¹

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Another example, pic no (9) shows **High Gloss Honey Walnut Laminate** as type of Melamine High Gloss Wood Polish floor. A High Gloss finish provides a very shiny, reflective finish for timber floors. It highlights the unique details in the floorboards and provides a very attractive feature.

Pic no. (9): Reflective High Gloss Laminate floor.²

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Wall Reflective Surfaces:

For example, pic no (10) shows **Dior Glass Mirror Brick Metro** tile measuring at stunning size of 7.5cm x 30cm. 5mm thickness. Sleek re design using real high-quality glass to create a mirrored surface on the brick tile. The highly polished surface reflects light giving the appearance of more space.



Pic no. (10): Reflective Dior Glass Mirror Brick wall.²

1

Another example, pic no (11) shows **High Gloss Lacquer Wall Paint** as a reflective material. Gloss paint is essentially a finish with a high paint sheen level. This means it reflects or bounces light around a room and can make smaller areas feel larger.



Pic no. (11): Reflective High Gloss Lacquer Wall Paint.²

2

It's also easier to clean and more hardwearing than other finishes which making it perfect for hallways and can be used on all the same surfaces such as woodwork and metal.²

3

Furniture Reflective Surfaces:

One of the biggest advantages of mirrored furniture is the fact that it visually expands the space. It reflects light Which has different effects on the other space elements.

For example, pic no (12) shows stunning **Venetian Mirrored Furniture** is modern and clean in design with simple straight edges and beautiful beveled edges. Due to the reflective mirrored finish this furniture helps give rooms the feeling of more space due to the reflection of light.



Pic no. (12): Reflective Mirrored Furniture.²

4

Also, Acrylic Mirrors are functional in various settings and have a clear benefit over glass. Its durability and impact resistance makes it safe for use in high-traffic regions. Additionally, the flexibility of acrylic mirrors makes them useful in applications where curved or bending mirrors are required, whether for functional or decorative reasons. They're also simple to transport, install, cut, and maintain.²

Another example, pic no (13) shows **Mirror-Finished Acrylic** is used to create furniture that reflects the room it is in.



Pic no. (12): Reflective Mirrored Furniture.²

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The last example pic no (14) shows modern coffee table is crafted from highly **Polished Stainless-Steel**, segmented pieces that are reflective like a mirror.



Pic no. (14): Reflective polished Stainless-Steel Furniture.²

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Third: Optical Illusion Resulting from The Use of Reflective Surfaces

Designing with reflective surfaces invites a space to open and transform. The use of a large statement mirror can make a small room appear much larger, particularly if the mirror encompasses an entire wall; is placed in a central location; or is shaped like a window, to create the illusion of boundless space beyond.²

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How Do Reflective Surfaces Create an Illusion of Interior Design?

Reflective Surfaces which use in interior design create many illusion types by several ways.

1-Reflecting Natural Light

Placing mirrors opposite windows or sources of natural light allows them to reflect the light throughout the space which creates illusion sense of openness.

2- Expanding Visual Space:

Hang a mirror on a focal wall to create the illusion of an extended area beyond what the eye can see. Also, using reflective furniture, can make a room feel more expansive without adding visual clutter.²

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3-Maximize Small Spaces:

Hanging mirrors in small spaces like a narrow hallway, they make spaces look bigger. Strategically placed mirrors are a great trick to achieve just that.

4-Change the size of the space:

To increase the height of a room, use a vertical mirror to create an illusion of height. Similarly, a horizontal mirror makes any space appear wider. For example, if you have a fireplace in the room, hanging or placing a wide mirror on the mantelpiece will reflect the wider essence of the room and make it appear more spacious.³

The Importance of using reflective surfaces in interior and furniture design

Mirrors and Reflective Surfaces can help to create the illusion of more space, add light to a room, and create interesting visual effects.

A large reflective surface like mirror can make a small room feel much larger than it is, particularly if the mirror encompasses an entire wall, is placed in a central location, or even if it is shaped like a window to create illusion, however, consider the lighting. Mirrors can also be used to make a room feel taller by placing them vertically.

Mirrors should be placed in areas where they can best reflect natural light coming in from windows, making the space feel both more open and brighter. pic no (15) shows how could the mirrors reflect the convergence of three different colors and materials from the walls and ceiling of the room, accentuating the angularity and materiality of the design.



Pic no. (15): Reflective Effects of Mirror Surfaces in interior design.³

1

Illusion of Depth

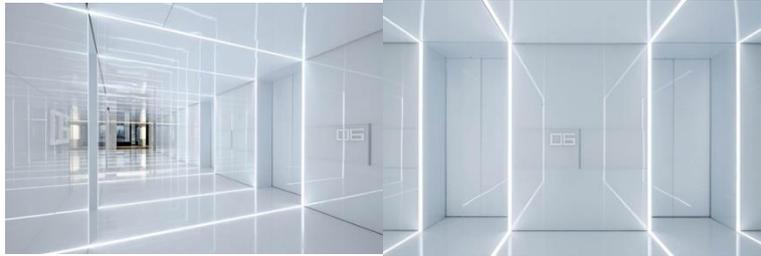
Normally, people prefer placing mirrors above their furniture but when it is positioned behind some furniture instead, that is where the real illusion of depth takes place. Not only are mirrors able to make a room seem bigger, but it can also reflect various accents of a room, allowing color themes and design styles to echo from one point to another.

Ability of Double

Mirrors also have the incredible ability to double the visual impact of anything you want. If you have a unique piece of decoration in your room and want it to stand out even more, just place a mirror at your desired spot and it will help you enhance the object by making it appear in twos.³

Some Applications of Using Reflective Surfaces with Illusion in Interior Design

Example no1 The Glass office for Soho China by AIM Architecture, Pic no (16) shows Mirrored walls transform this office interior in Shanghai into a labyrinth of reflected light. That Mirrored partitions alternate with glass screens and windows. The entrance to the office is via an all-white corridor, where strips of light are reflected to create the illusion of a never-ending grid.



Pic no. (16): Reflective Mirrors Partitions with illusion of a never-ending grid. ³

Example no2.... The Infinity Mirror (a half-silvered surface). Pic no (17) shows one in the elevator, A half-silvered surface only reflects about half the light that strikes the surface, allowing the other half to go through. This allows you to see your reflection in all the surrounding mirrors with great illusion. Infinity mirror is built with two or more mirrors positioned parallel or nearly parallel to each other. This construction creates a series of increasingly smaller reflections that seemingly retreat to what appears to be infinity.³



Pic no. (17): Reflective Infinity Mirror (a half-silvered surface) with illusion of infinity.

The image reflects repeatedly into the distance, getting smaller, hazier, and darker, as it recedes. Those effects occur because the mirrors cannot perfectly reflect all the light each time. The images degrade into a dim, fuzzy haze.³

Example no3. ... Liquid Glacial Furniture (Transparent Acrylic Furniture) which follow similar forms to the coffee and dining tables. The curved shapes are intended to mimic the forms of melting glacial ice. This Sens of illusion intended to evoke the appearance of rippled water frozen. pic no (18) shows The Liquid Glacial dining table designed by Zaha Hadid embeds surface complexity and reflection within a powerful fluid dynamic. The lighting is reflected on the floor to give an illusion of flowing water.



Pic no. (18): Reflective Liquid Glacial dining table with illusion of fluid.³

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Example no 4.... Office display model of Suzhou Del No. 1 Courtyard, Suzhou City, East China. As a medium that connects reality and illusion, light perfectly encloses the reflected image in the space and real light and shadow, interchanges virtual and real, and creates an infinitely extended dimension of art. Pic no (19) shows the staggered reflections are reflected on the water ripple ceiling. The reflection of the silver wave, it forms a dynamic decorative painting. the sense of illusion resulting of the texture mixed with rippling light and shadow combines far and near, virtual, and real, and dynamic and static.



Pic no. (19): Reflective Water Ripple Ceiling with illusion of dynamic waves.³

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Example no5.... Black Mirrored Floor, Bookstore, Zhen Yuan, China. Its lobby is a cave tunnel with striking black mirrored flooring. Pic no (20) shows how both the reflective floor, and curved shelving creates the illusion of feeling that you have stepped into a perfectly circular room. With its black mirrored flooring, the entrance of the bookstore is a giant optical illusion.



Pic no. (20): Reflective black mirrored floor with illusion of giant cave tunnel.³

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The dangers of using reflective surfaces in interior design:

First: fires caused by direct sunlight refracting through glass. This is a risk all year round, not just in the summer.so, Do not leave mirrors or glass ornaments on windowsills. That sunlight reflecting off a mirror onto curtains or the other fabrics may result in a fire.³

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Second: The risk of colliding with pieces of furniture resulting from the illusion of distance and depth created by reflective surfaces. Therefore, the appropriate place to use the reflective surface must be chosen, which ensures sufficient safety for individuals using the space.⁴

Fourth: Practical application

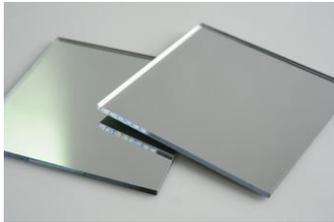
A proposal to design a piece of furniture (Console) using reflective material and reflective wall background.

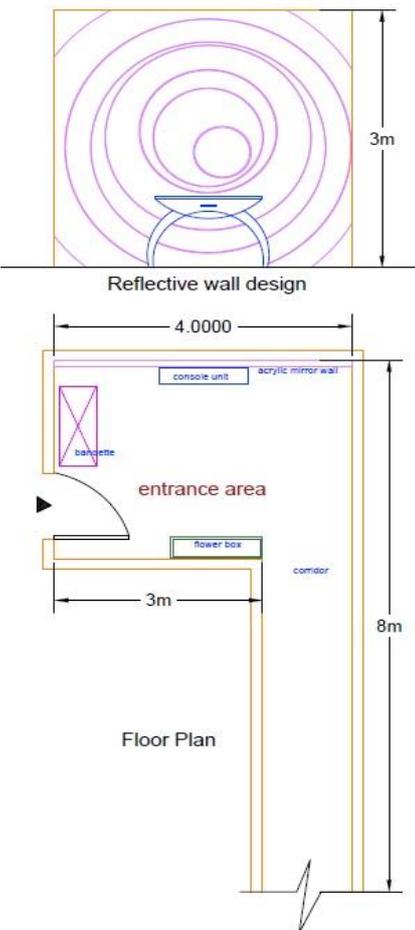
The main purpose is to find the optical illusion resulting from its use on the entrance area.

Practical application steps:

- 1- Determine the problem. That the entrance area is narrow and leads to narrow corridor.
- 2- Design idea. Using reflective material like acrylic mirror to design the console with huge background from the same material.
- 3- Notice the effect on the entrance area. Optical illusion of depth resulting from the reflections of the mirrors.
- 4- Results ...

Table no (2) shows the researcher design study and analysis.

| | |
|-----------------------|---|
| Description | Piece of furniture (Console) With reflective wall background |
| Designer | The Researcher |
| Design Form | Geometric form |
| Design Concept | Expanding the entrance area by adding an illusion of depth using reflective surfaces. |
| Materials | Reflective surface (Acrylic Mirror)  |
| Lines | Circular grid |
| Color | Silver |

| | |
|----------------------------|--|
| <p>Sketches</p> |  <p>Reflective wall design</p> <p>Floor Plan</p> |
| <p>Final design</p> |  <p>Shot 1 ...using reflective console with a mirror wall background make the entrance area looks bigger which resulting from the illusion of the ability of double the space.</p> |

| | |
|-------------------------------------|---|
| |  <p>Shot 2 The position of the reflective wall face to the corridor make it looks longer which resulting from the illusion of depth.</p> |
| <p>Optical Illusion type</p> | <p>Illusion of depth</p> |
| <p>Results</p> | <p>1-The entrance area looks bigger and wider, and the corridor reflected on the mirror with huge depth. 2-Adding depth change the vision of the space and make it more comfortable.</p> |

Table no (2) Practical Application Study and Analysis.⁴

It is clear from the practical application that there is an effect that cannot be overlooked using reflective surfaces in the internal spaces, especially those that use reflection to change the dimensions of real space. As well as the importance of the optical illusion resulting from these reflections.

First, the surface area used to achieve the reflection, as it is not only the piece of furniture made of acrylic mirror but adding the background reflective wall behind it, achieves more space of reflection.

Second, the illusion of depth gives new vision to the entrance area to appear wider and larger. Also, the corridor may seem shorter. That's why we need the illusion effect using reflective interior design and furniture.⁴

2

Results and discussion

- 1- Reflection could be Applied in More Than One Space Element (Ceiling, Floor, Walls, and Furniture).
- 2- There are many types of reflective material Surfaces which can be widely applied in interior design.
- 3- Using reflective surfaces in interior and furniture design creates optical illusion (illusion of depth or ability of double the space).
- 4- Achieving the illusion through mirrors and reflective surfaces depends mainly on the reflections of light.

5- The illusion resulting from using reflective material surfaces have various effects on the internal space. It changes the visual of the space to look much (bigger, smaller, taller, wider, shorter...etc.)

Conclusions

We conclude from this research that there is an aesthetic and functional effect of using reflective surfaces as a type of optical illusion in the interior space. so may be using the optical illusion is a solution to some of the problems of internal spaces which adding new space for the same space. Change the size of a room space may require time, efforts, and cost so much While the use of a reflective surface may limit all this in one step. Perhaps more attention should be paid to the application of optical illusion when designing interior spaces, especially through using materials. Its effect may exceed user expectations by giving different and modern vision for the space.

Recommendation

- Designers to apply the concept of optical illusion in different interior design spaces as a new vision to change the space size.
- Designers to use different reflective surfaces materials in interior design and furniture.
- The furniture companies to adopt the manufacture of glass furniture and promote it more widely.

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