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AS FÓRMULAS NA ARQUITETURA

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CHROMATIC AND GEOMETRIC HARMONY IN ARCHITECTURE: A CONTEMPORARY PERCEPTION

HARMONIA CROMÁTICA E GEOMÉTRICA NA ARQUITETURA: UMA PERCEÇÃO CONTEMPORÂNEA

10.34628/7KQD-CS35

Abstract: The text examines the interplay between chromatic and geometric harmony in architecture, emphasizing how color and form shape perception, emotion, and spatial functionality. Color is presented as a psychological, cultural, and environmental tool that enhances shapes, creates atmospheres, and responds to context. Geometry, through proportion, symmetry, and rhythm, provides visual coherence and functional clarity. A historical overview shows how different periods—from ancient Egypt to Modernism and contemporary architecture—integrated color and geometry in diverse ways. Through notable architectural examples, the text highlights that the balanced combination of color and form remains essential for creating meaningful, sustainable, and emotionally resonant spaces.

Keywords: Chromatic harmony | Geometric harmony | Color theory | Proportion and symmetry | Architectural perception | Color psychology | Contemporary architecture | Form-color relationship.

Resumo: O texto explora a relação entre harmonia cromática e geométrica na arquitetura, destacando como cores e formas influenciam a percepção, a emoção e a funcionalidade dos espaços. A cor é apresentada como elemento psicológico, cultural e ambiental, capaz de reforçar formas, criar atmosferas e dialogar com o contexto. A geometria, através de proporção, simetria e ritmo, estrutura a coerência visual e funcional dos edifícios. A análise histórica mostra como diferentes períodos — do Egito ao Modernismo e à arquitetura contemporânea — integraram cor e geometria de modos distintos. O texto evidencia ainda exemplos emblemáticos e sublinha que a combinação equilibrada entre cor e forma continua essencial para criar espaços significativos, sustentáveis e emocionalmente impactantes.

Palavras-chave: Harmonia cromática | Harmonia geométrica | Teoria da cor | Proporção e simetria | Percepção arquitetónica | Psicologia da cor | Arquitetura contemporânea | Relação forma cor.



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1. INTRODUCTION TO CHROMATIC AND GEOMETRIC HARMONY

Chromatic harmony in architectural design is a concept that revolves around the strategic and artistic use of color combinations that aesthetically complement each other, thereby enhancing the visual and experiential quality of a structure. This approach is grounded in the principles of color theory and plays a critical role in creating visually cohesive and appealing architectural spaces.

In the realm of color relationships, several key schemes are commonly employed. Complementary colors, which are directly opposite each other on the color wheel, can create a visually striking effect when used in architecture, especially if

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balanced properly. Analogous colors, being adjacent on the color wheel, tend to produce a harmonious and serene effect and are often used to forge comfortable and unifying environments in architectural design. Meanwhile, triadic color schemes involve colors that are evenly spaced around the color wheel, leading to a vibrant yet balanced aesthetic in architectural applications.

Beyond mere aesthetics, the colors used in architecture significantly impact psychological responses. Tom Porter and Byron Mikellides in the book “Colour for Architecture Today” (2009) wrote that visual perception is an imaginative process; every time we observe our surroundings, information is sent through the optic nerve to the brain’s visual cortex. Here, the observed image is rapidly reassembled and interpreted. A crucial aspect of this process is its occurrence in color – the ability to see in color is a fundamental component of the creative act of vision. How we perceive color is affected by several factors: the light source’s spectral composition, the properties of the object related to absorption, reflection, and transmission, the activities within the eye and brain, and ultimately, our individual experiences.

Warm colors, like reds and oranges, may evoke feelings of warmth and activity, whereas cool colors, such as blues and greens, are often perceived as calming and soothing.

Various emotions are commonly represented by specific colors, like green symbolizing envy, red indicating anger, and blue associated with sadness (Carruthers, Morris, Tarrier, & Whorwell, 2010).

The surrounding environment and cultural context also play a crucial role in determining appropriate color schemes for buildings. This contextual use of color ensures that the building complements its surroundings and respects its cultural setting. Additionally, the interaction between light and color is vital in architecture, as natural light can significantly alter the appearance of colors throughout the day.

The materiality and texture of building surfaces further influence the perception of color. Glossy and matte finishes can alter the visual impact of colors, with glossy surfaces making colors appear more vibrant and matte surfaces lending a more subdued appearance.

Lastly, the choice of colors in architecture can also be linked to sustainability. Lighter colors, for instance, can reflect more sunlight, thereby reducing cooling costs in hot climates. Conversely, darker colors can absorb heat in colder climates, contributing to heating efficiency.

When we talk about colors, we can’t avoid thinking that in architecture, colors are perceived because they are applied to surfaces. The associations between colors and emotions that consumers experience are the result of a neurological and cognitive process. This process involves the brain interpreting colors as information, which is perceived through the sense of sight (Labrecque and Milne, 2011). Without these surfaces – walls, ceilings, floors, etc. – colors would have no medium for expression or interpretation in an architectural setting. direct correlation between the shapes of

these surfaces and the colors chosen for them. This implies that the design and form of a surface can influence the choice of color, and vice versa. For example, a curved wall might be painted differently from a flat one to emphasize its shape.

Our perception assesses and understands architectural space based on a proportionality between two factors: one is the Level of Luminosity of the Surface: This refers to how much light a surface reflects or absorbs, which is directly affected by the color it is painted. Lighter colors reflect more light, making a space feel brighter, while darker colors absorb more light, which can make a space feel more enclosed.

The second factor is about the Meaning Acquired by the Shape Once Painted: The color chosen to paint a surface can alter or reinforce the perceived meaning of that surface's shape. For instance, painting a tall, narrow window a dark color might emphasize its verticality, affecting how we interpret its role in the space.

Colors engage the visual senses of consumers, and sight is regarded as the most predominant sense in humans. It means that when we talk about the importance of sight in the context of colors, we're referring to how the human sense of vision is crucial for perceiving and being influenced by colors, which is a key consideration in various applications from art and design to consumer behaviour. (Ndom, Elegbeleye and Ademoriti, 2011)

Geometric harmony in architecture is a concept that emphasizes the balanced and thoughtful integration of geometric shapes and forms to create spaces that are aesthetically pleasing, functional, and coherent. This approach is grounded in various principles of geometry and design, ensuring that architectural elements work together harmoniously.

One of the fundamental aspects of geometric harmony is the relationship between different elements of a building, known as proportion and scale. Pleasing proportions often follow specific mathematical ratios, such as the Golden Ratio, which is approximately 1:1.618. This ratio, prevalent in many natural forms, has been historically used in architecture to create visually balanced structures.

Symmetry and asymmetry play a crucial role in geometric harmony. Symmetry, where elements are mirrored on either side of an axis, creates a sense of balance and formality. In contrast, asymmetry involves balancing elements that are not identical but have equal visual weight, offering a different kind of balance that can be more dynamic and intriguing.

The repetition of geometric forms or motifs can establish a sense of rhythm and movement within a space, adding a dynamic element to architecture. This can manifest in the repeated use of shapes such as arches, columns, or window patterns, guiding the viewer's eye and enhancing the architectural narrative.

Balancing simplicity and complexity in geometric forms is another key aspect. Simple shapes can impart a sense of clarity and calm, while more complex forms can introduce interest and vitality. Architects often strive to find the right balance, catering to the building's purpose and context.

Geometric harmony also extends to the integration of a building with its environment. This might mean aligning a building's geometry with the natural landscape or designing geometric forms that complement urban surroundings, ensuring that the architecture respects and enhances its setting.

Beyond aesthetics, geometric harmony is crucial for ensuring that a building's geometry serves its intended function. This means designing spaces that are not just visually appealing but also practical and suited to their intended use, whether it's a residential home, a public building, or a commercial space.

We can say that chromatic harmony in architecture involves creating a color scheme that is not only aesthetically pleasing but also emotionally resonant and functional, taking into consideration the building's context and its environmental sustainability. And when we talk about geometric harmony in architecture, we refer about creating a sense of unity and coherence using geometric shapes and forms, encompassing aesthetic, functional, and contextual considerations to create spaces that are both beautiful and practical.

2. HISTORICAL CONTEXT

The concept of proportion in the use of colors has been a subtle yet integral part of architectural evolution. In ancient civilizations, the proportion of colors was often dictated by cultural and symbolic significance. For example, in Egyptian architecture, the amount of gold and blue used was not just a matter of aesthetic choice but also a reflection of their religious and cultural values.

During the Renaissance, the notion of color proportion took on a more disciplined approach, aligning with the era's emphasis on balance and symmetry. The Renaissance masters employed color with a keen sense of proportion, ensuring that their buildings achieved a visual harmony that complemented their geometric precision. This era demonstrated that the proportion of colors used in architecture could profoundly influence the perception of space and form.

During the Renaissance period, a significant shift occurred in architectural design, focusing more on symmetry, proportion, and the use of classical elements, rather than on the use of vibrant colors as seen in later periods. However, color was still an important aspect, often used more subtly compared to the bold applications in later architectural movements. As an example, Brunelleschi, one of the pioneering figures of the Renaissance, is known for his work on the Ospedale degli Innocenti (Hospital of the Innocents) in Florence. While the building is primarily noted for its harmonious proportions and the introduction of classical elements like columns and round arches, color played a subtle yet integral role in its design. Brunelleschi used a limited palette that complemented the architectural forms, with the use of grey stone and terracotta elements. The blue and white glazed terracotta tondi added subtle color accents to the façade, enhancing the building's aesthetic appeal without overwhelming the ar-

chitectural design. This use of color in the Ospedale degli Innocenti is a fine example of the Renaissance approach, where color served to accentuate and harmonize with the building's geometric forms, rather than dominate the design.

This approach to color in the Renaissance period was more about complementing the architectural forms and contributing to the overall sense of harmony and proportion that was central to the Renaissance aesthetic, rather than using color as a primary expressive element.

In the Baroque period, the dramatic and emotive use of color was often achieved by carefully balancing intense colors with more neutral tones, maintaining a visual proportion that heightened the overall impact of the architectural design. The proportion of bold colors to more subdued hues was meticulously planned to create the desired dramatic effect.

The 19th and early 20th centuries saw further exploration of color proportion. Art Nouveau, with its vibrant and organic forms, often employed a balanced proportion of vivid colors against more muted backgrounds, creating a sense of harmony amidst the flamboyance. Conversely, the Bauhaus and Modernist movements later adopted a more restrained palette, where the proportion of color was minimal yet impactful, adhering to their principles of functionalism and simplicity.

In contemporary architecture, the proportion of colors is often a reflection of both aesthetic and functional considerations. Architects use color proportion to create spaces that are not only visually appealing but also conducive to their intended use. For example, in spaces meant for relaxation or contemplation, the proportion of cool, subdued colors might be higher, whereas vibrant and contrasting colors may be used more proportionately in spaces designed for interaction and energy.

Antoni Gaudí's Casa Batlló in Barcelona, built between in the beginning of the 20 Century, is a testament to his unique style, characterized by vibrant colors and organic forms. The building's façade, created using the *trencadís* technique of broken ceramic tiles, is a striking example of Gaudí's innovative use of color in the early 20th century. Similarly, Le Corbusier's La Tourette Monastery in France, constructed in the end of 50s, from the 20 century, reflects his functional use of color. He employed a bold palette, including primary colors for windows, doors, and floors, to distinctly define different spaces within the modernist structure.

Frank Lloyd Wright's Fallingwater in Pennsylvania, built almost in the beginning of 40's, from last century, showcases his approach to using colors that complement the natural surroundings. The color scheme of Fallingwater blends seamlessly with the site's natural elements, harmonizing the building with its environment in the late 1930s. In Mexico City, Luis Barragán's house and studio, completed in 1947, are renowned for their vivid colors. Barragán's design, featuring vibrant pinks, oranges, and yellows, creates spaces that are simultaneously dynamic and tranquil.

At the beginning of the 21 Century, Zaha Hadid's Rosenthal Center for Contemporary Art in Cincinnati demonstrates her futuristic design approach, with a stark black and

white exterior that contrasts sharply with the colorful art installations inside, marking a distinct early 21st-century architectural innovation. In 2005, Jean Nouvel's Agbar Tower in Barcelona introduced a color-changing façade equipped with LED lights capable of displaying over 16 million colors, making it a dynamic element of Barcelona's skyline.

That same year, Herzog & de Meuron's Allianz Arena in Munich, with its innovative façade of illuminated ETFE plastic panels, showcased their application of color-changing technology in architecture. More recently, in 2016, the Bjarke Ingels Group's VIA 57 West in New York, primarily featuring a glass façade, incorporated color into the courtyard and interior spaces. Using a palette inspired by natural elements, they created warm and inviting living spaces.

In essence, the historical journey of color use in architecture is not just about the colors themselves but also about their proportionate application. This aspect of chromatic harmony is crucial in achieving the desired aesthetic, emotional, and functional outcomes in architectural design, demonstrating that the power of color lies not only in its presence but also in its proportional balance within the architectural canvas. Between painted colors or lighting colors.

3. PRINCIPLES OF COLOR THEORY IN ARCHITECTURE

In the realm of architectural design, color is not merely a decorative element but a fundamental aspect that shapes the experience, mood, and identity of a space. This chapter delves into the principles of color theory as applied in architecture, examining how the color wheel, color harmony, and contrast are utilized to create meaningful and engaging environments.

THE COLOR WHEEL IN ARCHITECTURAL CONTEXT

The color wheel is a pivotal tool in understanding color relationships in architectural design. Originating from Isaac Newton's color circle, the modern color wheel includes primary (red, blue, yellow), secondary (green, orange, violet), and tertiary colors. In architecture, the color wheel aids in the selection of palettes that are coherent and aesthetically pleasing. The strategic use of this spectrum can influence the visual impact and ambiance of a structure.

HARMONIZING ARCHITECTURE WITH COLORS

Color harmony in architecture is achieved through balanced and appealing color combinations. Harmony can be attained in several ways:

Complementary Colors: This approach involves using colors that are opposite each other on the color wheel. The use of complementary colors, such as blue and orange, introduces a vibrant and energetic quality to architectural spaces, often used to create focal points or highlight structural elements.

Analogous Colors: These are colors adjacent to each other on the color wheel. In architectural design, analogous colors, like variations of blue and green, can evoke a sense of tranquility and natural flow. This scheme is often employed in spaces designed for relaxation and contemplation.

Triadic Colors: This scheme consists of three colors that are evenly spaced on the color wheel. The use of triadic colors can create a lively yet balanced environment, suitable for spaces that require dynamism without visual overload.

CONTRAST: DEFINING SPACES AND ELEMENTS

Contrast in color theory is a powerful tool for defining and differentiating spaces within architecture. High contrast, involving colors that are far apart on the color wheel, can dramatize and accentuate architectural features. Conversely, low contrast, with closely related colors, can unify and soften the overall look of a space. Strategic use of contrast can guide the viewer's eye and enhance the architectural narrative.

COLOR IN MOOD AND PERCEPTION

The psychological impact of color is a critical consideration in architectural design. Warm colors, such as reds and oranges, are associated with energy and warmth, making them suitable for spaces that encourage activity and interaction. Cool colors, like blues and greens, are perceived as calming and restorative, ideal for serene environments such as healthcare facilities and residential areas.

ARCHITECTURAL IDENTITY THROUGH COLOR

Color is a defining element in establishing the identity of a building. A well-considered color scheme can make a structure iconic, enhance its branding, or reflect its function. For instance, educational buildings might utilize stimulating colors to encourage creativity and alertness, whereas corporate buildings may opt for more subdued, professional tones.

In summary, the application of color theory in architecture transcends aesthetic considerations, playing a pivotal role in shaping the user's experience. By skillfully applying principles of the color wheel, harmony, and contrast, architects can create spaces that not only appeal to the senses but also serve their intended purpose, reflecting the ethos and identity of the structure.

4. GEOMETRIC CONCEPTS IN MODERN ARCHITECTURE

In contemporary architectural discourse, the application of geometric principles extends beyond mere aesthetic enhancement, serving as a foundational element in the creation and interpretation of modern structures. This chapter explores how sym-

metry, proportion, and the golden ratio, key geometric concepts deeply rooted in historical architectural practices, are ingeniously recontextualized in the fabric of modern architecture.

Symmetry, traditionally associated with balance and harmony, has been a long-standing principle in architectural design. Its role in modern architecture, however, transcends conventional applications, often serving as a bridge between historical context and contemporary innovation. A quintessential example is I. M. Pei's Louvre Pyramid in Paris. This structure demonstrates an exemplary integration of symmetrical design, marrying the classical symmetry of its historical surroundings with a distinctly modern form. The result is not merely a fusion of styles but a dialogue between eras, achieved through the strategic application of symmetrical design principles.

Proportion, another fundamental aspect of architectural design, involves the relationship of different parts of a structure to each other and the whole. In modern architecture, the manipulation of proportions is often employed to challenge traditional perspectives and create unique spatial experiences. The Shard in London, designed by Renzo Piano, is a paradigmatic example. Its elongated, tapering form redefines urban scale and perspective, illustrating how contemporary architects utilize proportion to craft visually striking and contextually harmonious structures.

The golden ratio, approximately 1.618, is a mathematical principle historically associated with aesthetically pleasing compositions. Its utilization in modern architecture underscores a continuity with past architectural practices, harmonizing form and function. Norman Foster's design of 30 St Mary Axe, commonly known as The Gherkin, in London, exemplifies the modern application of the golden ratio. The building's curved geometry and spiralling design elements resonate with this ratio, underpinning a design that is both visually appealing and functionally efficient. The application of the golden ratio in The Gherkin illustrates the enduring relevance of this principle in contemporary architectural design, providing a link between innate human perceptions of beauty and modern construction.

In summary, the integration of geometric concepts such as symmetry, proportion, and the golden ratio in modern architecture is not merely a continuation of historical practices but a reinterpretation and reapplication in contemporary contexts. These principles contribute to the creation of buildings that are visually appealing, functionally effective, and contextually relevant. Modern structures like the Louvre Pyramid, The Shard, and The Gherkin are emblematic of how geometric harmony is achieved in contemporary architecture, blending timeless principles with innovative design to create spaces that resonate with both the past and the present. As the field of architecture evolves, the strategic application of these geometric concepts will continue to play a crucial role in shaping the built environment.

5. RESEARCH EXPERIENCE: WORKSHOP - SHAPING URBAN ARCHITECTURAL SPACES THROUGH GEOMETRIC AND CHROMATIC EXPERIENCES

Urban areas are increasingly employing digital tools, including mobile and computer apps, to promote their events and activities. These technologies also serve to showcase the city's offerings on a global stage, drawing more visitors. Considering recent periods of isolation, there's a growing need to reimagine urban spaces to encourage people to return to public life and engage in community activities. Strolling through a city's streets immerses us in diverse emotional experiences shaped by the unique ambiances of different areas. The design and nuances of each urban space evoke a tapestry of memories, intertwining with our personal histories and cultural backgrounds. This is precisely why the streets that resonate with some individuals may not be the same ones favoured by others.

The appreciation of urban art among the public has surged recently. What was once viewed as a rebellious act is now acknowledged as a legitimate artistic form. A prime example is the artist Vills, who evolved from making unauthorized art in derelict buildings to becoming a globally recognized artist, celebrated for his artistic and creative flair. Urban art has played a pivotal role in transforming neglected or unsavoury urban areas into trendy hubs of fashion and nightlife. These spaces have turned into popular city "hotspots", attracting visitors, boosting local businesses, and revitalizing the footfall in areas where such art is present (Jenks, A., 2020).

For this reason, we believe that architectural education should encourage students to understand the importance of bringing people back to the streets of empty urban centers, revitalizing them. Therefore, we have designed a workshop aimed at promoting the street and attracting people to experience new aesthetic encounters, transforming the street into a city hotspot. Tourism capitalizes on these emblematic locations, transforming them into visual representations that eventually emerge as strong attractions, drawing visitors to experience and enjoy these sites. (Jenkins, 2003) In this workshop, students should understand and research about the importance of the meaning of shapes and colors at the urban place. They should create an iconic place, itself a hotspot of the street. Henri Bergson (1859-1941) theorized that memories are tied to specific instances or human activities and are associated with a form of representation. These representations are closely connected to the symbols that act as landmarks for a city, distributed throughout its area.

Innovative thinking and the adoption of advanced technologies are crucial for restructuring urban areas, focusing on traffic management, safety regulations, and circulation policies. Additionally, inventive approaches are needed to rebuild trust and allure, drawing locals and tourists alike to urban centers. This will be instrumental in revitalizing trade and the broader economy. Artificial intelligence is set to become increasingly pivotal in this process, and it will be essential to keep this technology updated. Instagram, leveraging the internet, stands as a vital application connecting

people globally, and numerous cities are utilizing it to enhance their global presence. The platform boasts over a billion active users each month, with daily shares exceeding 95 million photos and videos. These posts collectively attract over 4.2 billion 'likes'. (Davis, 2020.)

The increasing influence of Instagram on city marketing is a notable phenomenon in today's digital age. This social media platform has become a powerful tool for cities to showcase their attractions and unique qualities, appealing to potential visitors. Individuals are now more inclined to visit photogenic locations in cities, seeking Instagram-worthy experiences. Consequently, city marketing strategies are evolving to capitalize on Instagram's reach and visual appeal, focusing on creating picturesque spots and engaging with influencers. Beyond individual experiences, Instagram's role in the broader context of information sharing and communication is significant, marking a shift in how cities interact with their audience and share their stories in the digital world. (Frikkee, 2019)

The Stockholm School of Economics posits that art, through its sensuous capacity and the employment of artistic tools, not only stimulates and challenges but also fosters critical thinking and a deeper comprehension of ourselves within a societal framework (Stockholm School of Economics, 2018). Our study adopts a similar stance, offering a strategy for Urban Architectural Design through the lens of geometric forms and their influence on human emotion.

Our exploration hinges on the interpretive interaction between spatial design and emotional response, emphasizing the role of architectural geometry, urban planning, and the significance of historical and heritage structures in juxtaposition with cultural landmarks. This approach underscores the synergy between the tangible and intangible aspects of urban spaces, advocating for a dialogue that enhances the memory and emotional resonance of a place.

To delve deeper into the influence of shapes and colors on mood, we initiated the workshop "Shapes and Colors Vs Mood" in 2016, targeting two distinct age groups: children aged 6 to 11 and university students aged 18 to 30. The objective was to identify the ideal color for each primary geometric shape based on its impact on mood.

Participants were instructed to draw three fundamental shapes – triangle, square, and circle – and articulate the emotions these shapes evoked. They were then asked to identify the shape that represented happiness, calmness, and irritation the most. Following this, a similar exercise was conducted with colors, focusing on the primary hues of red, blue, and yellow, and their associated moods.

Subsequently, an open discussion led to a consensus on the most suitable color for each shape. This exercise paralleled an online survey conducted with a broader demographic, encompassing 120 individuals of varying ages and genders.

Ellen Lupton, in "el ABC de la Bauhaus," (2008) asserts that our perception of the world is intricately linked to our cultural background. The first objects we encounter are categorized in our minds under various subjects, each containing numerous 'files'

or memories. This theory suggests that the responses from our workshop and survey are deeply intertwined with individual cultural backgrounds and the plethora of images stored in one's memory.

Conducted in Lithuania, Poland, Portugal, Italy, and Latvia, the workshop began with participants drawing the three primary shapes and discussing their emotional connotations. This evolved into a more hands-on activity where participants created 'happy' shapes using cardboard cutouts of triangles, squares, and circles, which were then painted in primary colors.

Initially approached with hesitation, the exercise soon sparked lively discussions, as participants interpreted the shapes through various emotional lenses. The session culminated in individual presentations of their creations (Fig.1).

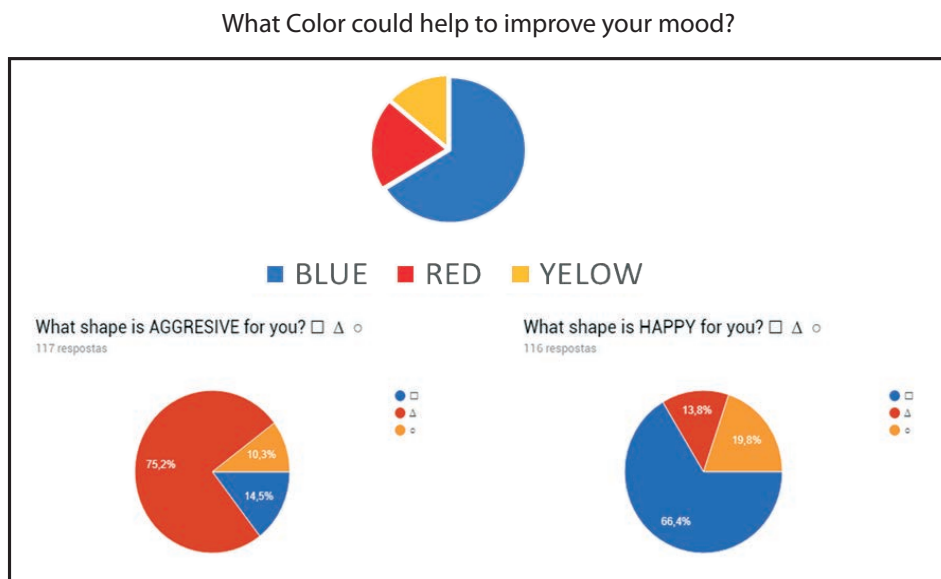


Figura 1 - Mood meaning about shapes and colors – On-line survey (Luis Pinto, March 2018)

An intriguing observation emerged regarding the color association with shapes. A significant majority associated the triangle with the color yellow, a deviation from the common perception of yellow as a 'happy' color. The brightness of yellow, juxtaposed with the sharp, potentially discomforting angles of the triangle, led to an unexpected correlation where the vividness of the color was perceived as equally jarring.

This workshop not only provided insightful data for our urban architectural strategy but also highlighted the profound impact of geometric shapes and colors on human emotion, underlining their importance in shaping the mood and memory of urban spaces.

After our starting research, we decided to create a teaching methodology in such a way that we could check results, in real time, about the link between colors and shapes and the way to promote a street.

Art, serving as a symbol of urban identity, holds the ability to enhance and engage with communal enjoyment, as it resonates on a scale that is perceptible and relatable to humans. Additionally, art fosters local culture and possesses the potential to cultivate and advance the area or region in which it is situated. (Gardner, 2012)

The “Color and Geometry in Architecture: Enhancing Mood and Visual Appeal in Urban Spaces” workshop is a three-day educational event designed for architecture students. It uniquely combines the study of color theory, psychological impacts of architectural shapes, and the latest social media trends to guide the creation of visually appealing and emotionally engaging urban spaces. The workshop begins with an introduction to color theory and the psychology of colors, exploring how different hues can influence emotions and behaviours. This is followed by a session on geometric shapes in architecture and their impact on visual perception.

Participants will engage in practical activities including the use of software tools and physical models to design projects, emphasizing the use of color and geometry. These sessions are enriched by guest lectures from experienced urban designers and architects who share real-world applications and case studies. The workshop (Fig.2) also delves into the strategies for using colors and shapes to enhance mood and well-being, along with a focus on making urban spaces more ‘Instagrammable’, aligning them with current digital trends.



Figura 2 - Example of student's workshop results, UBI University, Portugal, November of 2023.

The final day of the workshop is dedicated to group projects (Fig.3), where students collaborate to redesign a given urban space, incorporating the concepts learned. These designs are then presented to peers and instructors for feedback. The workshop is designed to be interactive and multidisciplinary, featuring a blend of lectures, hands-on activities, field trips, and discussions with experts. It aims to provide the students with practical skills and knowledge that are directly applicable to modern urban design and digital trends in architecture.



Figura 3 - Example of student's workshop results, UBI University, Portugal, November of 2023.

After the workshop results, we developed a SWOT analysis (Table 1) for the proposed workshop “Color and Geometry in Architecture: Enhancing Mood and Visual Appeal in Urban Spaces” involves evaluating its Strengths, Weaknesses, Opportunities, and Threats. We concluded that while the workshop has strong potential benefits in terms of relevance, practical learning, and industry engagement, it must also navigate challenges related to resources, content balance, and adapting to rapidly changing technology and social media landscapes.

The workshop presents a promising opportunity to equip architecture students with contemporary skills that blend traditional architectural design with emerging trends in psychology and social media. The workshop's innovative focus on the interplay between colors, geometric shapes, and human emotions in urban spaces sets it apart, offering a unique and multidisciplinary learning experience. The practical and

interactive approach, coupled with expert involvement, ensures that the learning is both engaging and grounded in real-world applications.

However, the workshop faces challenges, primarily in terms of resource requirements and time constraints. Ensuring that the workshop content is comprehensive yet feasible within the allocated time frame, and balancing the need for adequate resources with accessibility, will be crucial for its success. Additionally, the potential overemphasis on aesthetic elements at the cost of practical functionality needs careful consideration to maintain a balanced approach in urban design education.

Opportunities for collaboration with industry and expansion to online platforms can significantly enhance the workshop's reach and impact. These collaborations could not only provide practical insights and resources but also open up avenues for future employment and research for the participants.

On the threat front, staying current with rapid technological advancements and shifting social media trends will be essential to keep the workshop relevant and appealing. The competitive landscape also calls for continuous innovation and differentiation in the workshop's content and delivery.

In summary, the workshop is well-positioned to offer valuable insights and skills to architecture students, preparing them for the evolving demands of urban design. By addressing its weaknesses and threats while capitalizing on its strengths and opportunities, the workshop can become an influential educational program that shapes future architects capable of creating spaces that are not only visually stunning but also emotionally resonant and socially relevant, also we can underscore the complex relationship between color, surface, and perception in architecture. The results suggests that our understanding and judgment of architectural spaces are influenced not just by the colors and shapes themselves, but by how these elements interact, particularly in terms of light and visual emphasis.

Strengths	Weaknesses
Innovative Focus: Unique blend of architectural design, psychological aspects, and social media trends.	Resource Intensive: Requires significant resources for tools, trips, and speakers.
Practical and Interactive Approach: Hands-on sessions with tools, models, and field trips.	Time Constraints: Limited time for in-depth understanding of broad topics.
Multidisciplinary Perspective: Insights from architecture, psychology, and social media.	Potential Overemphasis on Aesthetics: Risk of prioritizing visuals over functionality.
Expert Involvement: Guest lectures and discussions with professionals.	Participant Diversity: Might attract a niche audience, limiting appeal.
Enhanced Employability: Skills applicable to modern urban design projects.	
Opportunities	Threats
Emerging Trends in Urban Design: Interest in creating 'Instagrammable' spaces.	Technological Obsolescence: Rapid changes in tools and social media trends.
Collaboration with Industry: Partnerships for internships or sponsorships.	Competing Workshops: Increased competition from similar workshops.
Publicity and Brand Building: Unique nature can attract media attention.	Economic Factors: Budget cuts could affect funding and feasibility.
Expansion to Online Platforms: Wider reach and engagement through online versions.	Changing Social Media Dynamics: Shifts in trends could reduce relevance.

Table 1. SWOT analysis for the proposed workshop “Color and Geometry in Architecture: Enhancing Mood and Visual Appeal in Urban Spaces”

6. CONCLUSION

The meaning of colors and their direct relationship with geometric shapes has always been a constant throughout the history of architecture. Colors have always played a fundamental role in the architectural space.

The essay “Chromatic and Geometric Harmony in Architecture - A Contemporary Perception” comprehensively explores the intricate relationship between colors, geometric shapes, and their impact on architectural spaces, culminating in a practical application through a workshop. The conclusion, drawing on the rich historical context and theoretical foundations presented, emphasizes the enduring significance of color and geometric shapes in architecture.

Throughout history, colors and shapes have been instrumental in defining the aesthetic, emotional, and functional aspects of architectural spaces. From the symbolic use of colors in ancient civilizations to the disciplined application during the Renaissance, and the dramatic expressions in the Baroque period, the essay traces how these elements have evolved to complement architectural forms and contribute to the overall sense of harmony. In contemporary architecture, this tradition continues, with color and geometry playing pivotal roles in creating spaces that are not only visually appealing but also functional and emotionally resonant. The color in our environment stands out as one of the most distinct aspects affecting our perception. It is also among several elements that enhance the aesthetic appeal of urban design.

The workshop “Color and Geometry in Architecture: Enhancing Mood and Visual Appeal in Urban Spaces” builds on these concepts, offering a unique educational experience for architecture students. By combining theoretical knowledge with practical application, the workshop underscores the importance of color theory and geometric principles in modern urban design. It also addresses the challenges of adapting to rapidly changing technology and social media trends, suggesting opportunities for collaboration and innovation.

In conclusion, the essay and the accompanying workshop underline the timeless relevance of chromatic and geometric harmony in architecture. They highlight the need for architects to not only create visually stunning spaces but also consider the emotional and social impact of their designs. By bridging historical insights with contemporary applications, the essay and workshop offer a comprehensive view of the critical role colors and shapes play in shaping our built environment, preparing future architects for the evolving demands of urban design.

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REFERENCES

- BERGSON, H. (1999), *Matéria e memória*. São Paulo: Martins Fontes.
- CARRUTHERS, H. R., MORRIS, J., TARRIER, N., & WHORWELL, P. J. (2010). The Manchester color wheel: Development of a novel way of identifying color choice and its validation in healthy, anxious and depressed individuals. *BMC Medical Research Methodology*, 10 (1), 1–13.
- DAVIS, N., *Instagram marketing in 2020: The do's and don'ts of posting and driving engagement*, I. - I. Center, Ed., 2020.
- FRIKKEE, I., "The increasing influence of Instagram at city marketing," Medium.com, 5 May 2019. [Online]. Available: <https://medium.com/@isabel.frikkee/the-increasing-influence-of-instagram-at-city-marketing-e97fd401c3d4>. [Accessed 4 June 2022].
- LINTON, H. (2003). *Color in Architecture: Design Methods for Buildings, Interiors, and Urban Spaces*. McGraw-Hill Publisher
- GARDNER, H. T., (2012) *Beauty, and goodness reframed*, New York : Basic Books.
- LABRECQUE, L.I. and MILNE, G.R. (2011) Exciting Red and Competent Clue: The Importance of Color in Marketing. *Journal of Academy of Marketing Science*, 40, 711-727.
- LUPTON E. and MILLER A. (2019), *O Abc da Bauhaus. A Bauhaus e a teoria do design*, Editorial Gustavo Gili
- JENKS, A. (2020). A arte urbana e o renascimento de espaços degradados. *Arte Urbana*, 10(2), 11-17.
- JENKINS. O. (2003), "Photography and travel brochures: The circle of representation," *Tourism Geographies*, vol. 5, no. 3, pp. 305-328.
- NDOM, R.E., ELEGBELEYE, A. and ADEMOROTI, A. (2011) The Effect of Colour on the Perception of Taste, Quality and Preference of Fruit Flavored Drinks. <http://www.readperiodicals.com/201109/2464158461.html>
- ELAM, K. (2001). *Geometry in Architecture: Studies in Proportion and Composition*. Princeton Architectural Press.
- PALLASMAA, J. (2012). *The Eyes of the Skin: Architecture and the Senses*. Wiley Publisher; 3rd edition.
- PORTER Tom and MIKELLIDES Byron (2009), *Colour for Architecture Today*, Taylor & Francis Published