

# Sustainable Interiors

A PRACTICAL GUIDE FOR ARCHITECTS AND DESIGNERS



FILIFE BONI

# Term of Responsibility

All the information and strategies you will see in this book result from research and practical experiences in projects or consultancies.

While we have strived to present a compendium of tips based on current standards and best practices for your projects, we do not guarantee that all results will apply to your current situation or specific project.

Each situation should be individually analyzed, as well as any architectural project. Even knowing that we have hundreds of students within UGREEN who have obtained excellent results using these strategies, each professional should use these concepts according to their needs.

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# About The Author

The story behind the strategies I'm going to teach you.

My name is Filipe Boni. I am an architect and LEED AP BD+C. During my professional career, officially started in 2005, I always tried to look for ways to extract more of my projects, both in design and functionality.

After five years, I felt something was still missing. I worked in building architecture consistently, working in 7 cities in 3 Brazilian states, but I knew I needed to go further. After all, the market was becoming increasingly competitive and demanding.

At this moment, I began an intense search for techniques of comfort, efficiency, and sustainability. With the deepening of these studies, I discovered hundreds of strategies to apply to any project. Several of these have become UGREEN courses – our teaching platform in sustainable constructions that I lead together with my partners.

This ebook describes seven strategies that I consider fundamental in sustainable architecture, focusing on interior design. Interior designers have a massive role in creating high-performance spaces. At the same time, there are several mistakes that these architects often make during their projects, and that I try to avoid them.

I hope that once you have read this content and found new ways of acting on your projects, you can feel more confident that you are on the right track to achieve more sustainable, comfortable, and efficient projects.

Enjoy!

Filipe Boni  
ugreen.io

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# 1. Biophilia



## *How to Incorporate Nature into My Project?*

If you work with interior design, you should be aware that every decision about a project is responsible for significant impacts on people's lives. Considering we live 90% of our lives indoors, this is as important to our health as eating healthy or exercising.

However, many people are not aware of the factors that make our internal spaces healthier. This lack of knowledge leads to error, but if we learn more, our projects could provide benefits to our clients.

One of the essential strategies you should take into account is the use of Biophilic Design.

## *What is Biophilic Design?*

The concept of biophilic design comes from the idea that 99% of our biological development directly responds to the forces of nature – gravity, light, air, plants, animals – and just a little from artificial sources such as buildings or technology.

After all, we know that constructions are very recent elements when we observe our evolution broadly. It becomes evident when we evaluate our evolutionary chronology:

## *Human Evolution*



If all of our human evolution were 24 hours, we could say that:

- Our biology lived with cities for only 43 minutes.
- Our biology benefited from the abundance of food for only 3 minutes.
- Our biology lived with electricity for only one and a half minutes.
- We discovered the hours through a wristwatch (not by sunlight) for only 40 seconds.

Do you realize that all the rest of our evolution happened before our first human inventions? Our ability to breathe, see, perceive space, and develop our bodily functions arose from direct contact with nature.

For this reason, it becomes essential not to ignore nature, seeking spaces that seek more synergy with this good that we evolved together for so long.

Scientifically understanding these benefits is that the concept of biophilic design emerged.

The main aspects of interior design that biophilia uses are:

1. The search for a repeated and continuous involvement with nature;
2. The concentration on human adaptations to the natural world that, over evolutionary time, has improved its health and well-being;
3. The stimulation of emotional connections with specific settings and places;
4. More significant interactions between people and nature, stimulating a sense of relationship and responsibility for human and natural communities;
5. The stimulation of architectural solutions of mutual reinforcement, interconnected and integrated.
- 6.

### *Why Promote Biophilia in our Projects?*

The project that contemplates biophilia does not only promote an improvement of the environment. It also encourages more productivity and a broad spectrum of physical, mental, and behavioral benefits.

Physical results include better physical fitness, lower blood pressure, greater comfort and satisfaction, fewer illness symptoms, and better health. Mental benefits range from greater satisfaction and motivation, less stress and anxiety, a high facility to solve problems, and more creativity.

Behavioral results include improving learning skills, attention, concentration, social interactions, less hostility, and aggressiveness.

In short, we earn both physically and psychologically using these strategies.

## *What are the aspects of a design that promotes biophilia?*

There are several aspects, but, as stated by Stephen R. Kellert and Elisabeth F. Calabrian in the book "The Practice of Biophilic Design," we can list them as:

### 1. Direct Nature Experiences

Here we are talking about the primary elements such as light, air, water, plants, animals, climate, natural landscapes, and fire.

We know the sun reinforces our biological rhythms, which our body built for an extended period – well before we take the phone out of our pocket every 10 minutes to see what time it is.

Natural ventilation is essential for human comfort and productivity. You can enhance it by variations in airflow, temperature, humidity, and barometric pressure.

The water flow calms our senses, improving our understanding of well-being and consequently our productivity.

### 2. Indirect Experiences of Nature

Example of direct experiences with nature. Source: International Living Future Institute.





It is about images of nature, the use of natural materials, natural colors, the simulation of natural light, contact with natural forms, elements that evoke the spirit or that denote the passage of time.

Nature images are great for both our intellectual and emotional senses.

Natural materials can be incredibly stimulating, reflecting the dynamic properties of organic matter in the adaptive response to the stresses and challenges of survival over time.



The transformation of nature's materials often provokes positive visual and tactile responses, which few artificial materials can duplicate.

Shapes that evoke nature provoke our imagination and stimulate creativity. They don't have to be overly complex. Simple shapes already provide outstanding results.

### 3. Space and Place Experiences

Interior Designers can seek refuge, organized complexity, integration of people and feeling of place, transition spaces, mobility, and orientation.

Parede verde adjacente ao muro de alvenaria, Paris – Essas fachadas contrastantes empregam estratégias diretas (plantas) e indiretas (trabalho de alvenaria e grade que simulam formas orgânicas) para obter efeitos biofílicos bem-sucedidos. Fonte: Stephen R. Kellert e Elisabeth F. Calabrese, *The Practice of Biophilic Design*.

Providing broad views, both in and out, gives us a more overall sense of the "opportunities and

Central Atrium, Genzyme Building, Cambridge, MA – The interplay of daylight, plants and water in a central atrium can simulate the qualities of an outdoor environment in an indoor space. Source: Stephen R. Kellert and Elisabeth F. Calabrese, *The Practice of Biophilic Design*.



dangers" of space and a greater understanding of refuge and security.

People who enjoy spaces with a defined sequence and meeting points get a greater sense of place and integration with people.

With different paths and the rise of free walking, mobility promotes more security, while its absence promotes confusion and anxiety.

### *How to Deploy a Biophilic Project?*

You can work with the client and all involved in project decisions.

Here we can include in this decision-making process the management, finance, human resources, or others.

With these strategies, we can build a complete picture of architectural needs and possibilities.

All this analysis will lead the interior designer to understand spatial and human opportunities. Then they can obtain results closer to the tripod of sustainability: people, planet, and profit.

It is essential for those who search for healthy and sustainable interior design to promote integration with our cities' architecture and even urbanism.

We need to take advantage of what our cities provide – or do not provide – to establish highly healthy and productive spaces.

## 2. Energy Efficiency



## *How do I reduce my client's electricity bill?*

Many architects consider that achieving energy efficiency is a simulation job for nerds inside offices or technology centers.

Although it is partially true — and this author is one of those people — we can significantly improve building performance if we carry out an efficient interior design.

## *Why is this important for an Interior Designer?*

We know that energy consumption is a significant contributor to climate change. Buildings account for a large share of global greenhouse gas emissions caused by this excessive consumption.

An architect or interior designer can do a lot to improve the energy efficiency of a building, especially when we consider reducing the amount of energy required for heating, cooling, lighting, appliance operation, among others.

## *Critical Factors for Energy-Efficient Projects*

Understanding how to mitigate consumption related to Heating/Cooling and Lighting will significantly benefit your project. Consequently, you can make better proposals and differentiate yourself from competitors since these spaces will be more economical.

We will now see how to treat these two elements in our projects.

## *Heating and Cooling*

As most of the cold resulting from air conditioning escapes through the building windows in hot climates – or the other way around in cold temperatures – it is essential to consider high-quality windows and efficient insulation.

We have already discussed a bit of this U-Factor issue in an article in UGREEN. Still, it is essential to understand that the lower this factor in a building, the more it aid to maintain the temperature we seek, helping spaces prevent excessive energy use.



Horizontal and vertical brises, curtains, and blinds also help keep the air warm (or cold) and the sun's heat outside, allowing residents to control the building temperature more efficiently by opening or closing them as needed.

Another great way to control our environments is through efficient automation systems, which the user can activate if the temperature reaches undesirable levels within the building. However, it is crucial to predict that depending on usage, such as a commercial building. Also, the user can turn the automation off to avoid unnecessary use if unoccupied.

In cold climates mainly, carpets can be considered excellent thermal insulators. According to estimates, a rug can retain up to 10% of the heat of a room. They will provide even a more incredible psychological feeling of warmth, which helps save energy for heating.

## *Lighting*

When we work on energy simulations, lighting is often considered the main factor for energy consumption. How can an architect or interior designer contribute to this aspect?

You can do a lot to save the energy used in lighting, only with the school of correct colors. Lighter colors reflect more light, while rooms with darker walls and furniture generally need more artificial lighting. Using reflective surfaces increases

light in an environment (read more about this in Item 6. Environmental Comfort), reducing artificial lighting.

However, it is essential to understand the contrast relationships between each element so that excess lighting does not harm daily tasks. If you consider the level of darkness from bottom to top, floors tend to be darker, walls and tables an intermediate level, and the ceiling are lighter. It is crucial to consider when we seek to obtain a good level of natural lighting.

The specification of lamps and luminaires will also make all the difference, and here it is essential to understand that each user requires a specific illumination level (see item 6).

Automation will again help energy efficiency by remotely controlling lighting systems and assisting residents and occupants in using the building's energy more efficiently and cost-effectively.



### 3. Longevity and Flexibility



Science Park Drive , em Singapura. Foto por Joseph Silver



## *How to make our spaces more resilient?*

The change of our spaces is an intrinsic factor of interior architecture. However, this is not a justification for disorganized, unproductive, and resource-wasting spaces.

In this third part about sustainable interior projects, we discuss the importance of working for our spaces' longevity and flexibility.

## *Por que isso é importante?*

The disposal of materials is one of the main factors that generate the increase of waste that will end up in landfills.

Therefore, investing in a flexible design, robust, durable, replaceable, or even easy to clean materials aims to reduce the interventions. Consequently, there will be less waste.

Another benefit of projects that seek longevity and durability is that we can save on maintaining these materials or additional cleaning.

Mas...como podemos mitigar estes efeitos?

But how can we mitigate these effects?

The goal of designing for longevity is to seek durable and timeless spaces, suppressing the constant desire to "be fashionable" and therefore need a sudden change of the environment in a few years.

We know that this is not an easy task, as we architects are practically programmed to look for the latest trends all the time. However, the best way to achieve timelessness is to choose quality over quantity—the classic within modernity and simplicity over many adornments.

To prevent materials from being disposed of too often, interior architects should consider the life cycle of any material they plan to use, especially elements that suffer from abrasion—such as floors.

## *Adapting to changes*

Over the years, families or companies grow, needing changes and consequently changing these spaces to meet their new needs.

Anticipating this fact, interior designers should consider the flexibility of these spaces—or even consider the extent to which they can be adapted to meet the demands.

The architect or decorator who knows how to design flexible spaces has a crucial role in this longevity. When we can easily replace or adapt elements, there is no need to demolish and renew them abruptly.

One way to make changes is to think about that family or company within 10 or 15 years. Is there a possibility of new children occupying that space? What is the growth expectation of this company?



Simple issues like these can help delineate flexibility strategies with a higher chance of a hit.

## *Trends in Interior Architecture*

Innovation has brought many options for a more flexible design in the most diverse types of use:

- You can modify drywalls to create more spaces when children grow up and need their rooms.
- In offices, mountable adjustable furniture is more likely to provide flexible work environments, allowing customization and easy replacement of individual parts.
- Hospitals are environments where many changes occur. Providing flexible medical furniture and asking the architect responsible for the architectural design to provide a more flexible architecture will help keep the spaces highly useful in the long run.

When we choose floors, we can select modular floors or carpets. Some models make it possible to replace individual parts, making them easier to maintain and facilitating the exchange, avoiding waste.

Considering maintenance in interior architecture is another significant factor for the longevity of our spaces. Using modular parts will help reduce consumption and waste creation.

Using materials that require fewer cleaning products will provide more significant benefits to the environment, especially if accompanied by a cleaning procedure within green-cleaning standards.

# 4. Air Quality



## *How to improve health in our buildings?*

According to the U.S. Environmental Protection Agency, indoor air pollution is one of the top five human health threats.

It can generate allergies, headaches, asthma, throat, nose, eye irritations, and even more severe lung cancer diseases.

As we spend most of our time indoors, understanding and mitigating air pollution become extremely important to our homes.

But how can we carry out a sustainable project that promotes better air quality?

First, we need to understand where comes from indoor air pollution.

Indoor air pollution is the result of three main factors:

- External particles.
- Products and materials with high levels of toxic emissions.
- The lack of maintenance.

Let's better understand how each of them works?

### *External particles*

If we seek to carry out a sustainable project maintaining good air quality in our environments, it is essential not to bring contaminants into the settings.

Among the primary contaminants are:

- Air pollution in densely urbanized regions or industrial areas.
- Smoke, which harms both occupants and the air conditioning system.
- Vehicles, especially in areas where their passage is constant.

For all these contaminants, you need to predict openings that minimize the entry of pollutants.

We can first provide the system's proper design for air-conditioned environments to re-set the air rate to adequate levels.



After this verification, an efficient strategy is to install filters with a reasonable efficiency factor in air conditioning equipment — LEED certification suggests a MERV efficiency factor of 13. Constant maintenance will be another essential factor in preventing long-term system failures.

Another “simple” solution is to keep smokers away from the building entrances, especially inside. The LEED here suggests a distance of at least 7.5 meters from all available doorways and building openings.

For those looking for more strategies to keep pollution away, the great idea is to use the famous doormat at our residences’ entrance doors.

We can use the same condition for offices, but LEED suggests here at least 3 meters wide at each functional entrance to obtain more efficient retention of contaminants.

### *Products and materials with high levels of toxic emissions*

Furniture or equipment made from harmful chemicals has a chance to release dangerous toxins into the air, the so-called Volatile Organic Compounds (VOC’s). For this reason, the use of materials that minimize these compounds is paramount.

Among the applications, it is essential to think about the elimination of VOC's throughout the building construction system, such as:

- Paints and internal coatings applied on site.
- Adhesives and internal sealants used on site.
- Internal paving.
- Composite wood.
- Thermal and acoustic insulation for walls, floor, and ceiling.
- Furniture

It is essential to understand that externally applied products can also negatively influence VOCs, especially in hospitals and schools. That is why you need to redouble care here.

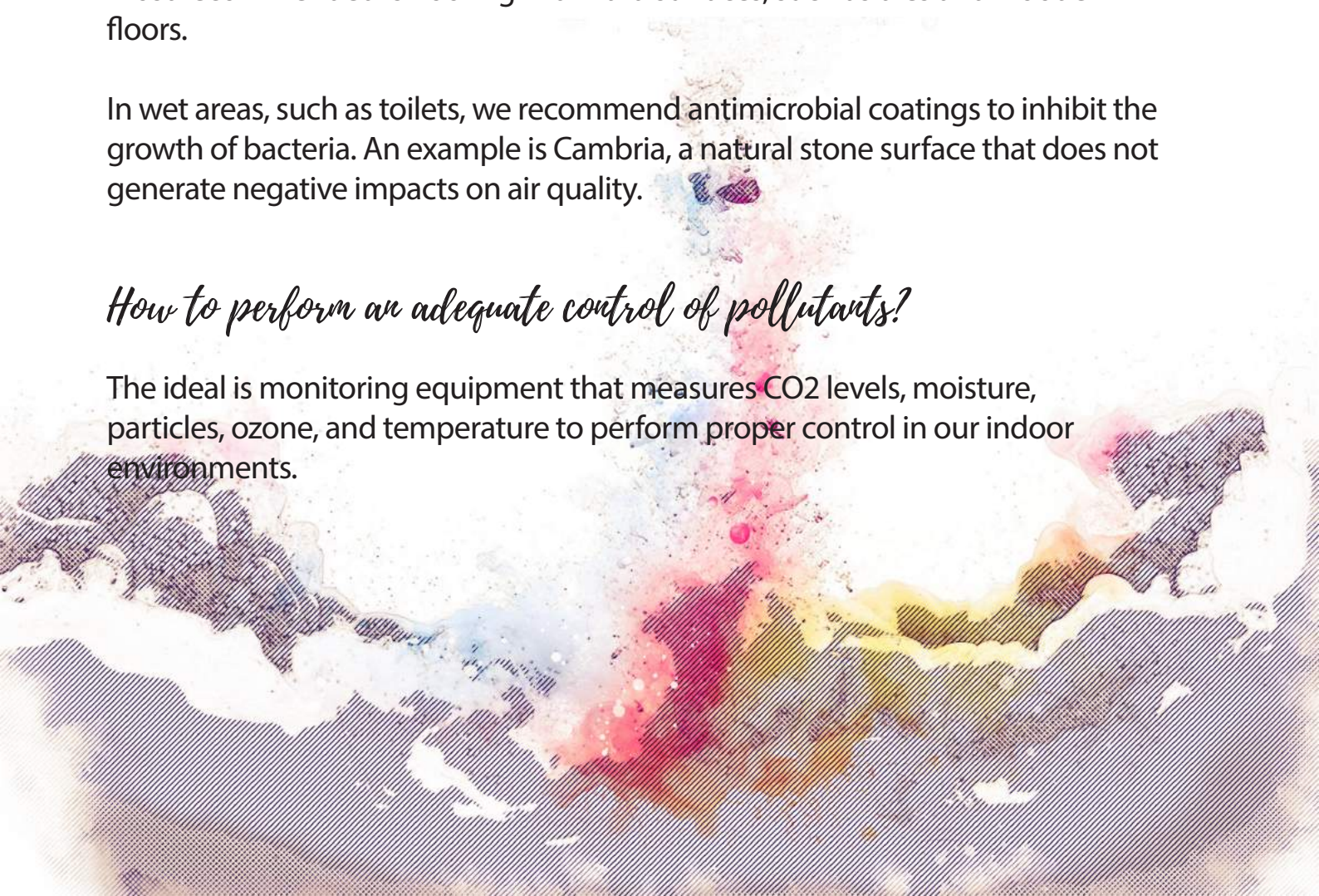
To improve air quality, it is essential that a room's air circulates regularly and remains fresh. Contrary to common beliefs, carpets can offer an excellent filtration system if they have good quality.

They tend to improve air quality by trapping dust particles from the air and holding them until they are aspirated. If there is no such quality in carpets, the most recommended is flooring with hard surfaces, such as tiles and wooden floors.

In wet areas, such as toilets, we recommend antimicrobial coatings to inhibit the growth of bacteria. An example is Cambria, a natural stone surface that does not generate negative impacts on air quality.

### *How to perform an adequate control of pollutants?*

The ideal is monitoring equipment that measures CO2 levels, moisture, particles, ozone, and temperature to perform proper control in our indoor environments.



Periodic inspections of filters and also in environments, looking for adequate humidity control is also essential. Another critical factor is the use of cleaning products that do not harm human health.

One element that can contribute to removing pollutants is suitable plants, with the added benefit that they can provide a touch of color and life for interior decoration.



Oswego Vadoud Niri, a chemist at New York State University, presented research supporting domestic plants' effectiveness in removing VOCs for the American Chemical Society. Such a phenomenon is called biofiltration. Niri tested five different plants in sealed containers containing eight VOCs and measured the quantity on additional days of the year.

Each plant tested removed much of the acetone, which proved to be the easiest VOC to eliminate. The bromeliad of pointed leaves showed the best performance and drew six of the eight VOCs' significant levels.

The result is that plants can be a cheaper and easier solution for reducing internal pollution than installing ventilation systems, depending on the case.



# 5. Reduction of Environmental Impacts



## *How to contribute more to the environment?*

When we design internal spaces, we can't think only of the latest trends or our customers' benefit.

It is essential to understand that our interventions in interior design directly or indirectly affect the environment. That is why it is crucial to reduce our environmental impacts, seeking a balance between beautiful results in the project with our contribution to space.

Yes, you can contribute even more to your projects by performing sustainable decoration!

## *How can we do that?*

The use of organic materials (wood, natural stone) or rapidly renewable materials (bamboo, linoleum, cork, which regenerate over a maximum period of 10 years) are obvious choices. However, it is essential to understand further environmental responsibility in the extraction and handling of these elements.

The material can be sustainable in its composition, but the near-slave workforce extracts it.

A material can be sustainable, but coming from very far away places, using a lot of fuel.

The material can be sustainable but manufactured with toxic components that can affect human health.

Do you understand how far the problem is going?

For this reason have emerged several labels, standards, and certifications that provide reliable information about the origin of the products, helping you to identify those ecologically correct to apply in your sustainable decoration.

The most common example is the FSC label on wood products, ensuring that their extraction and manufacture have been sustainable.

Another certification growing a lot in this aspect is Cradle to Cradle (C2C), which seeks to establish "closed systems" to manufacture a material until its disposal.

It means that if traditional materials comply with the summarized process of “manufacturing > use > landfill,” we now have materials that use the process of “manufacturing > use > reinsertion in the market” without requiring major chemical or physical interventions for this product to return to its use in society.

In the Cradle to Cradle process, many ordinary wastes are avoided in the industrial revolution and are a strong trend for new furniture that we will see at fairs worldwide.

There are also certifications for buildings, such as LEED. Version 4 has brought a significant advance by adding a series of certificates of products that positively impact the market. Some examples are EPD's, Greenscreen, Declare of the Living Future Institute, in addition to FSC and C2C already mentioned above. These certifications are encouraging companies to communicate more transparency within their processes.

LEED has divided these environmental statements by the EPD's in terms of raw material extraction and the health of these products. If you want to understand this theme in the LEED concept, we have a series of articles discussing this topic more broadly.



## *Understanding the Life Cycle of Materials*

The environmental impact of materials and products should be assessed throughout their life cycle – from their extraction, production, transportation, processing, and how they are discarded after use.

Some tools and certifications help designers understand, compare, and evaluate the environmental impact at various life cycle stages, such as life cycle assessment (LCA).

These tools are usually far from the reality of interior designers, and in a way, the industry needs to evolve a lot to communicate transparently and practically. However, we can use common concepts when we go looking for materials for sustainable decoration.

The first is the relationship with existing certifications, as stated above. Yes, certificates cost more to the industry and generally end up making the product more expensive. Still, it is the only proof we have of compliance with this product with sustainable initiatives.

It is essential to understand that certifications are diverse, and those performed by third parties are more valuable than certificates themselves. After all, our mummies saying we're cute doesn't prove anything.

Product reuse is another valuable strategy to reduce environmental impacts. It applies both to products within the project and to products that would be discarded in another work.

The regionality of materials is essential for sustainable decoration. Seeking products extracted, manufactured, and sold in nearby regions prevents excessive consumption in transport. A sustainable material made in China will reach Brazil less sustainable.

When we can not reuse and purchase new products, we can prefer those made with recycled products or easily recycled products. And we need to value recycled products mainly after use since they are much more challenging to manufacture than recycled products using others recycled products within the manufacturing process itself.

## *Conclusion*

Interior designers have a lot of power on their hands when we talk about reducing environmental impacts. The planet's precious resources are limited, so the mindset of merely discarding products for a replacement so it goes out of fashion is not justifiable these days.

Fortunately, designers who follow global trends in sustainable decoration are becoming increasingly aware of the need for sustainable thinking and are interested in movements such as recycling and reuse. Rather than discarding "out of fashion" objects, but simultaneously very functional, they create new ways to bring these products a new life.

With an approach more connected to the cradle-to-cradle concept, we can dramatically reduce the environmental impacts of our products, minimizing or even eliminating waste, generating savings not only for our customers but greater resilience of our society.



## *6. Environmental Comfort*



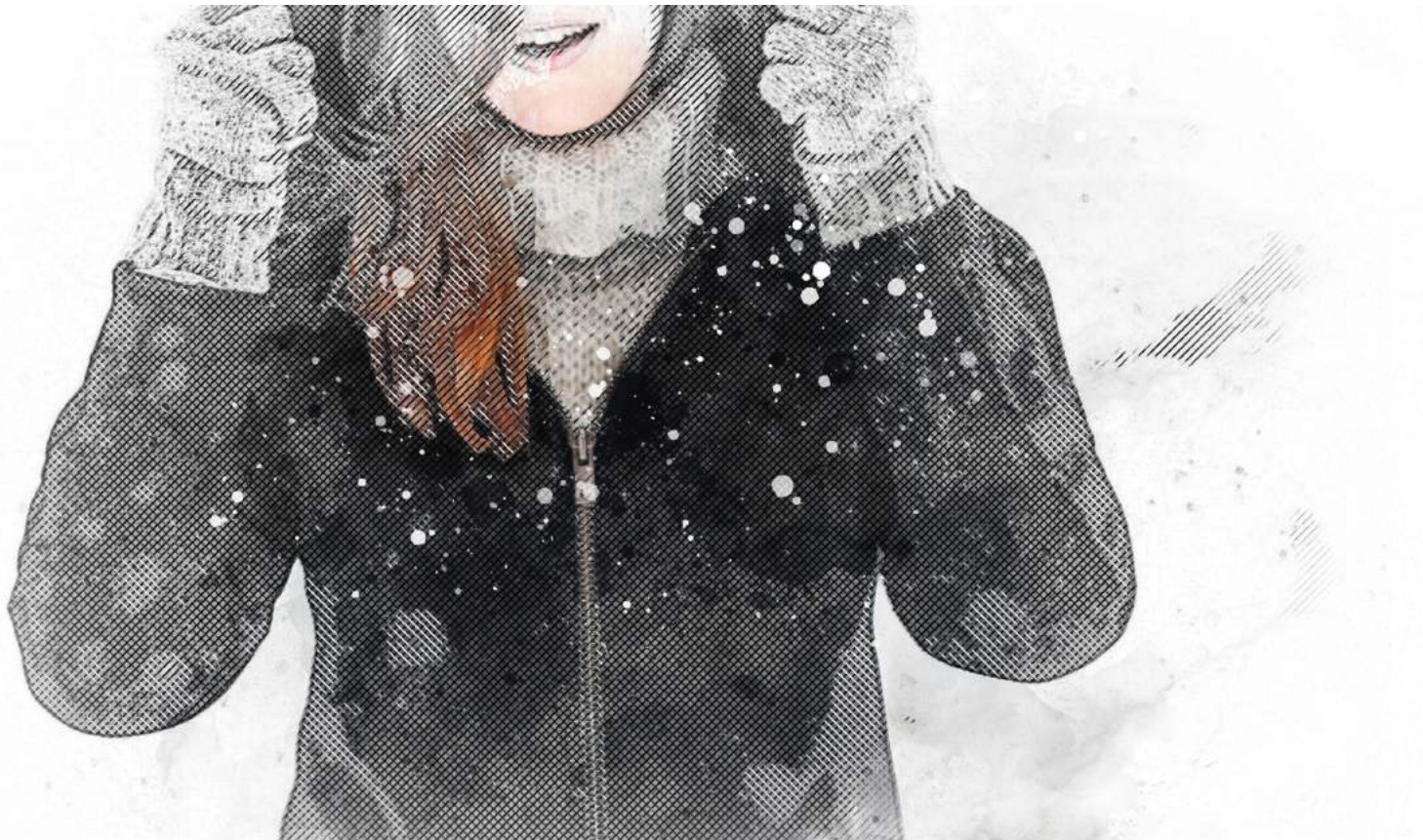
## *How to obtain spaces of greater thermal, acoustic, and luminance comfort?*

Environmental comfort is the level of satisfaction of a human being within a space.

A space that complies with environmental comfort provides good psychological, acoustic, visual, thermal, air quality, and ergonomic conditions for a human task's performance, whether leisure, work, rest, or study.

But how can we do that in interior design?

This article presents essential strategies within 3 of these critical pillars in environmental comfort: thermal, acoustic, and lighting comfort.



### *Thermal Comfort*

Anyone who has tried to work when it is too hot or cold knows how much thermal comfort affects productivity.

Essential studies, such as the image below, show that the higher the discomfort level, the greater the productivity.

Have you ever thought you own a company paying ten employees, but just 6.5 employees work?

That's it. Because people do not know the harm that inadequate temperatures can harm their employees, many companies throw your money away.

And that's why thermal comfort is so important.

The problem is that the definition of thermal comfort is subjective. There are variations such as clothing and human metabolism itself. It is up to each person to evaluate their thermal comfort, making it difficult to standardize dwell for everyone.

For this reason, the standards act with strategies to minimize the state of comfort. The main one is ASHRAE 55, a thermal comfort by the Predicted Middle Vote (PMV). It has a scale from -3 (very cold) to +3 (very hot). The objectives of comfort analyses are to maintain the maximum dissatisfaction index between -0.5 (slightly cold) and +0.5 (slightly hot).

If the strategies fail, an expected percentage of unsatisfied people will occur. The goal of any professional in the field is to keep a PPD below 10%.

Thermal comfort components

We need to take into account six thermal comfort parameters.

- Convection: is the transfer of energy through the airflow. In our spaces, it is related to air temperature and ventilation rate.
- Driving: it is energy transfer through direct contact with the surrounding surfaces.
- Our spaces happen when we get direct contact with these elements, such as tables or chairs.
- Radiation: is the transfer of energy via radiation from surrounding surfaces such as floor, wall, and ceiling. It is undoubtedly the component that most affects thermal comfort.
- Relative humidity: it is about the efficiency of heat dissipation. When our body needs to dissipate air by evaporation, it is harder when the humidity is high.
- Metabolic heat production: each occupant has its own, making it difficult to have a unique solution.
- Clothing: they are also individual per occupant and can generate divergence on personal thermal comfort.



All these factors interact to regulate thermal comfort, and understanding each of them is essential for good architectural design.

### *How can an interior architect intervene in environmental comfort?*

Essentially, there are four ways to get thermal comfort through a good design.

#### 1. Use an HVAC system that regulates the Average Radiant Temperature

It is a great way to achieve thermal comfort for the vast majority of occupants. Standard systems do not have the measurement component of environments. Still, when we use a plan in conjunction with a measurement, spaces can be optimized energetically and in user satisfaction.

#### 2. Minimize leak in the building envelope

If the building envelope leaks, air currents at inadequate temperatures or humidity may enter the building, causing discomfort in the previously designed environment with specific thermal loads. As an additional problem, it can compromise the efficiency of the HVAC system.

#### 3. Provide control to occupants

Obtaining thermal comfort will often have a direct relationship with the level of control you give to people. When they have access to the thermostat, windows, or operable shutters, they can improve your level of thermal comfort. Studies show that people feel comfortable under slightly different conditions, and as much as allowing individual control can generate conflicts, this is usually the best way.

#### 4. Maintain the thermal environment and make the necessary changes

Good maintenance is critical for the proper functioning of HVAC equipment. Care may also require being aware of and reacting to seasonal changes. For regions experiencing hot summers and cold winters (as is typical of temperate zones), the HVAC system's Temperature Control's seasonal adjustment is vital for maintaining thermal comfort.

## *Acoustic Comfort*

Acoustic comfort is an essential theme when we talk about productivity, especially in environments such as schools.

Certifications, such as LEED, take acoustic comfort very seriously for improving student learning and teachers' vocal health, establishing essential prerequisites for external noise, air-conditioning noises, and reverberation. Setting the minimum criteria for each item is critical to an interior design that considers a high quality of learning.

For other types of buildings, control should also be present, using the same strategies applied in schools but with slightly differentiated regulations depending on the case.

### *What can the interior architect use to your advantage?*

Understanding the basic phenomena can help a lot in decision-making in most projects. In cases where acoustic performance means a significant leap in performance or quality of life, the help of a specialist will be paramount.



The main strategies that interior architects can work on, in order, are as follows:

### 1. Reduction of reverberation times

The concept is the decrease of “traffic” of sound by the environment. Understanding the minimum values (usually close to 0.6 or 0.7 in most cases) and mitigating it using absorption surfaces on the floor, wall, and ceiling make the environment more efficient.

### 2. Use of sound reinforcement and masking systems

It is applicable for auditoriums or rooms that house more than 50 people. Achieving at least 70 dBA levels plus minimum speech intelligibility levels is essential and should be evaluated cautiously. In some cases, the use of white noise may be desirable as long as it does not pass maximum levels in dBAs.

### 3. Air-conditioned background noise

We can evaluate the system’s noise and ask the mechanical engineer for an optimization, considering ASHRAE criteria. Each user will have maximum acceptable noise levels, and schools do not allow more than 40dBA.

### 4. Reduced sound transmission between elements

We need to find minimum STC coefficients (sound transmission class) to lower the noise level between external/indoor or internal environments.

Often the project will be built, and the interior architect will not make significant changes. However, in more substantial changes, such as internal renovations or the use of movable walls, knowledge of minimum coefficients is essential to achieve an acceptable level of performance for each environment and its specific use.

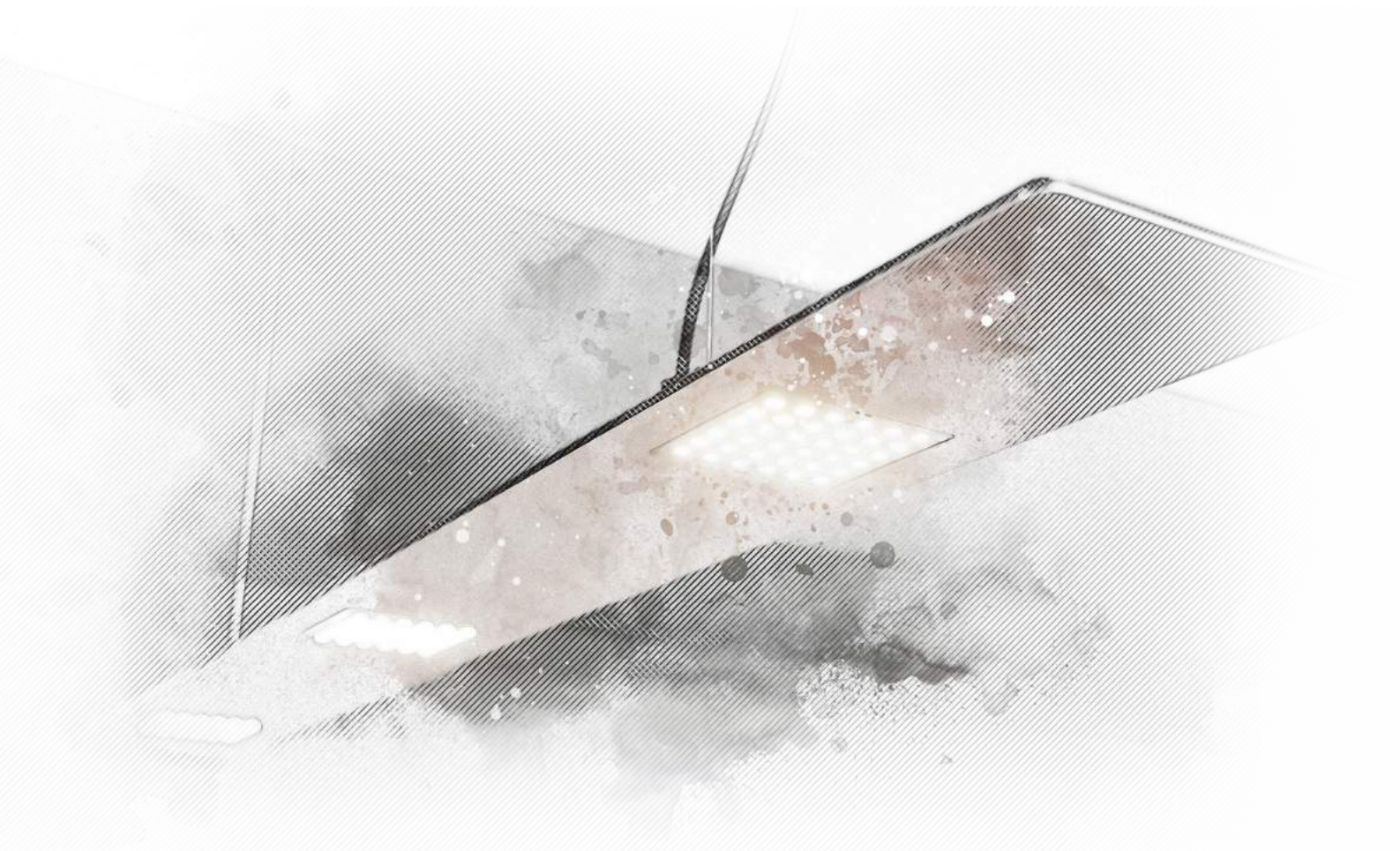
## *Lighting Comfort*

Lighting is one of the essential qualities in environmental and critical comfort in an indoor space. The difference between good and bad lighting can generate impacts on comfort, mood, and overall happiness in your home.

Exposure to natural light affects the immune system and circadian rhythms, sleep cycle, and hormones. Studies have linked the lack of sunlight to depression, immune problems, heart disease, diabetes, and cancer.

We have already talked about natural lighting in other articles and know that interior designers often have few changes made when the architecture is defined. So it is crucial to understand that, yes, you still have control over issues such as an adjustment in the management of the amount of natural lighting that enters the environment and its distribution within the spaces.

One way to distribute lighting is to use light colors in our environments. To mitigate the intensity of heat in specific spaces, we can use appropriate blinds,



with the possibility of automation systems included, if necessary.

Understanding artificial lighting is crucial for any interior design. Understanding these concepts can propel the results of your design drastically. Make everything more efficient and sustainable, far beyond an exchange of LED lamps.

*What can an interior architect do?*

## Provide Lighting Control

One of the fundamental concepts for more efficient and sustainable workspaces is to provide occupants with control over their lighting systems. Not all spaces are crucial, so focus on regularly occupied areas and not forget to make these controls accessible to everyone.

Interestingly, it has three levels (on, off, and half level) that people can control light intensity when natural lighting is more or less active.

## Provide Luminous Quality

After implementing control strategies, we can seek light quality. There are several requirements here, from the luminous intensity required for each type of approach (such as 500 lux in offices, 750 lux for supermarkets, among others), in addition to the use of lamps with the CRI (color reflectance index) above 80, which makes lighting more natural. We can still think about the lamps' lives and look for specifications that meet above 2,400 hours to help the entire environment's long-term economy.

As we comment on light colors for natural lighting, artificial lighting will also benefit the environment. It is crucial to obtain indexes higher than 85% reflectance for the ceiling, 60% for the walls, and 25% for the floors.

However, it is essential to calculate these factors by simulations. DiaLUX is one of the most suitable software in this area, and this analysis can result in significant savings in a lighting system and greater environmental comfort in your projects.

## *Conclusion*

Understanding the benefits of environmental comfort is not just associated with architects or consultants.

Architects who work with interior design or even decorators need to know these aspects that make projects more sustainable, obtain clarity, and create a transparent methodology in their analyses.

# 7. Ergonomics and Accessibility



## *How to make our spaces more equitable?*

Ergonomics is a branch of science that seeks to understand human abilities and limitations and improve people's interaction with products, systems, and environments.

Most people who hear about ergonomics consider it something to do with chair seats or the height of their work desk, but there's a lot more behind it!



## *Why is ergonomics important?*

Ergonomics applies to the design of anything involving people: workspaces, sports, leisure, health, and safety.

Ergonomics becomes an indispensable tool in interior architecture when considering the greater work mobility achieved in recent years and increasingly dynamic spaces.

The intention is to create safe, comfortable, and productive workspaces, integrating human skills and limitations into a workspace's design, including body size, strength, agility, speed, sensory skills (vision, hearing), and even attitudes.

It is no secret that ergonomically related injuries can affect employees in all sectors, regardless of the work environment.

It is also the most prevalent form of injury, representing 1/3 of all workers' injuries and illnesses. Low back pain is the most frequent problem worldwide, affecting employees in all sectors of the economy.

As a result, companies must invest in appropriate measures that protect their most valuable assets: their employees. Several begin to understand that it is not only something right to do, but it is also a good thing for business: healthy employees have a more productive workforce, make the work environment more collaborative, and reduce costs for shortages.

## *Symptoms of Lack of Ergonomics*

The main symptoms include:

- Pain in fingers, hands, forearms, neck, lumbar, or shoulders.
- General weakness in the hands and forearms.
- Tingling, numbness, or loss of sensitivity in the hands or arms.
- Difficulty in opening and closing hands or more incredible difficulty in manipulating objects.

If you, a colleague or customer, have any of these symptoms, check these spaces and read them. Create strategies to reduce the amount of time of aggravating activity.

If these problems continue or worsen, it is essential to contact a doctor for an evaluation.

## *How does ergonomics work?*

To achieve best practices in interior design, architects and decorators can use techniques from various disciplines:

Anthropometry: body sizes, shapes, populations, and variations.

Biomechanics: muscles, levers, forces, and strength.

Environmental physics: noise, light, heat, cold, radiation, body vibration system, hearing, vision, and sensations.



Applied psychology: skill, learning, mistakes, and differences.

Social psychology: groups, communication, learning, and behaviors.

## *Strategies for Ergonomic Design*

To get an ergonomic design in our workspaces, we need to look at the following aspects (extracted from WELL certification):

### Visual Ergonomics

All computer screens, including laptops, must be adjustable in user height and distance.

### Flexibility at table height

At least 30% of workstations must have the ability to switch between “sitting and to stand” positions using the following combinations:

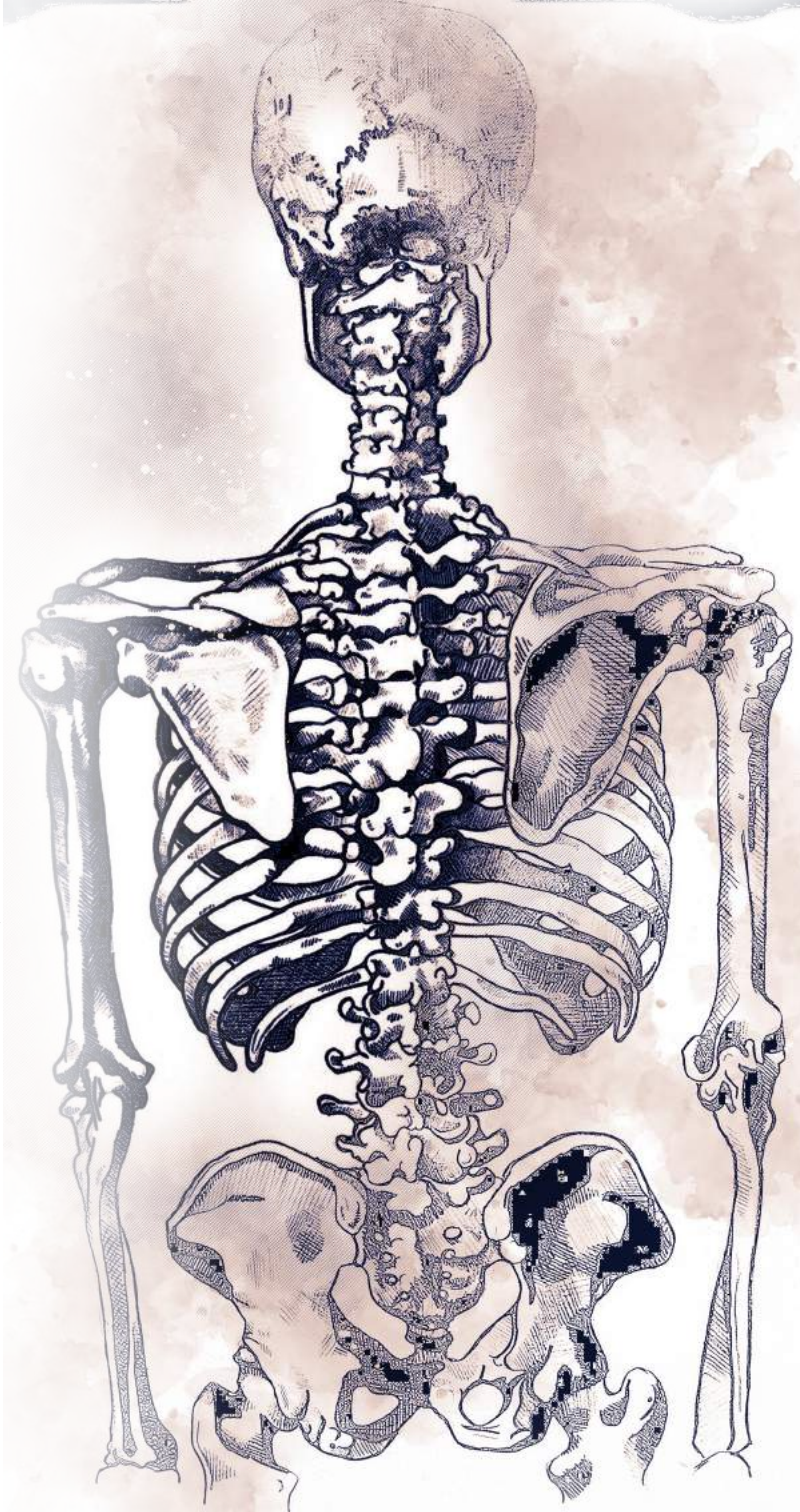
- Adjustable height support tables.
- Adjustment brackets for table height.
- Pairs of tables of fixed heights, standing and sitting — not needing to be located adjacent.

### Seat Flexibility

The occupants’ furniture must be adjustable in the following ways:

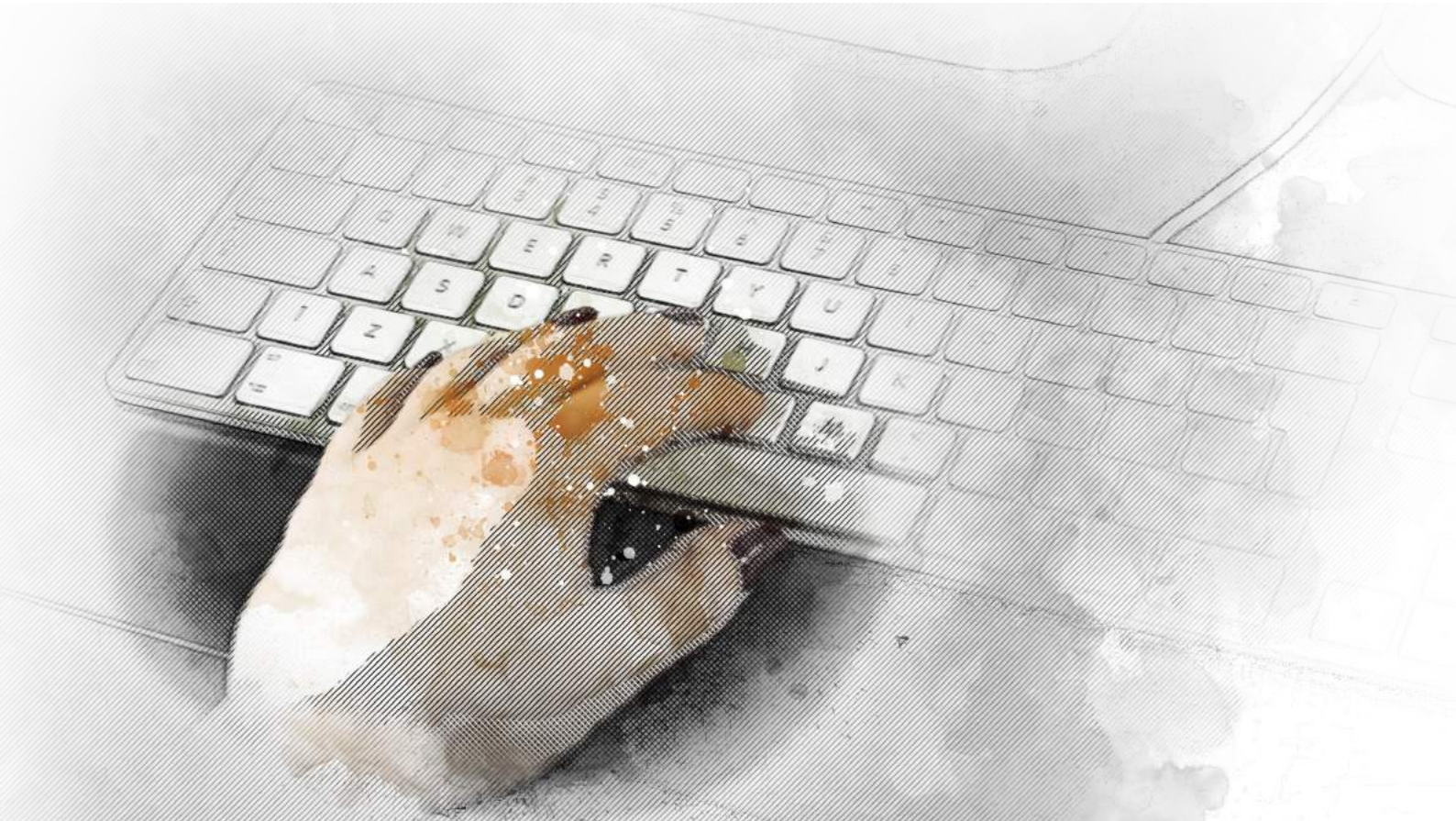
- Search for furniture whose height adjustment capacity of the workstation chair complies with HFES 100 or BIFMA G1.
- Search for furniture whose workstation seat depth adjustment is also consistent with the above guidelines..

### Permanent Support



Workstations, where occupants are required to stay for long periods must include the following services:

- At least 10 cm of space at the base of the workstation to reduce reach needs for occupants.
- A footrest to allow occupants to switch feet when they are at rest.
- Anti-fatigue mats or pads.



## *Ergonomics and Accessibility*

Ergonomics has a solid connection with Accessibility. The reason is simple: in several countries, the number of older people begins to occupy a large part of the population.

With this, equipment, services, and systems also need to be designed to accommodate the aging population's growing needs: public transport, buildings, and living spaces.

We can't think about ergonomics, just about workspaces. We also need practical applications in residential design. When it has an ergonomic and accessible

concept, interior design produces easier spaces to live in that provide more joy.

Molly Story, Ronald Mace, and James Mueller published an article in 1998 that became quite famous, called "The Universal Design Archive: Designing for People of All Ages and Abilities," in which they describe the seven fundamental principles of what came to be known as "Inclusive Design."

Fundamental concepts are essential for all architects or interior designers:

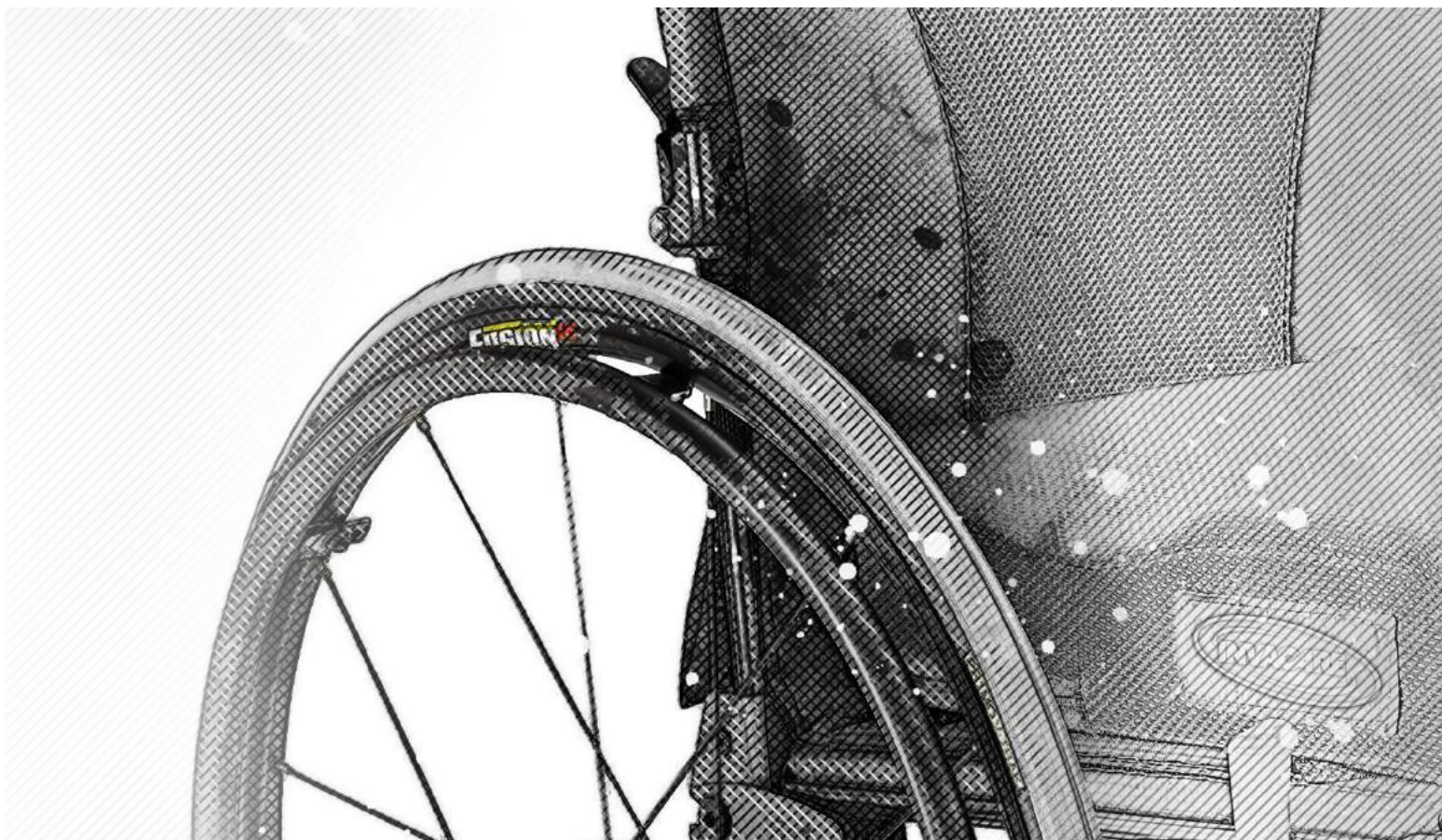
### Principle 1: Egalitarian Design

The design of the building should propose equal use by all. Ideally, how people use a building should be the same, without targeting. Equivalent in terms of privacy, security, and convenience. The facility should never employ means that isolated or stigmatize any group of users or privilege one group.

### Principle 2: Flexibility in Use

The project should allow people to use the design in more than one way.

An example is a bench that allows the use of both sitting and standing. Another is the ease of use by both right-handed and left-handed people.



The project must have built-in flexibility to be usable, even if in an unconventional or unforeseen manner.

### Principle 3: Simple and Intuitive Design

The building should make it easier to understand each design feature's purpose and how to use it. One example is washbasin faucets, which should have their method of operation facilitated.

Their means of use must be intuitively evident to function as expected and can be used spontaneously.

### Principle 4: Perceptible Information

The building should provide all essential information in various ways (written, symbolic, tactile, verbal), ensuring effective communication with all users, regardless of their sensory abilities.

The information provided should be presented in sufficient contrast with the surrounding conditions. It is distinguishable from its context and decipherable in all its various modes of presentation.

### Principle 5: Error tolerance

Ideally, the building project will eliminate, isolate, or protect any design features that may be dangerous or inconvenient for any user.

When potentially dangerous conditions are unavoidable, users should receive warnings as they approach the element. An example is proximity warnings near the top of the stairs. The design of the building should also anticipate the accidental or unintentional actions of any user. Minimize inconvenience or protect the user from damage.

### Principle 6: Low Physical Exertion

The building design should employ design resources that require little or no physical force to use them. An example is replacing a traditional handle with a lever that does not require grasping and rotating the wrist.

If a low level of strength is required, any user should activate the feature without assuming an awkward or dangerous body position. An example is to provide a

smooth displacement surface with minimal slope along the path that leads to the entrance.

### Principle 7: Size and Space of Approach and Use

The design characteristics should provide an adequate amount of space adequately arranged to allow anyone to use them. One example is to provide space for the knees under a washbasin to enable use by someone in the sitting position.



You also need to organize the space required to provide a clear travel path and essential features for all users.

### *Conclusion*

It is essential to understand that as technologies change, it is necessary to ensure that the tools we access for work, rest, and entertainment are designed for our body's new requirements. It's not hard to see how living spaces that strive to incorporate these qualities will not only be easier to use but would likely increase home productivity.

All architects and interior designers must pay attention to these strategies to promote more productive, happy, and incredibly egalitarian spaces.

# *Let's get to work!*

I know it's not easy to work on more efficient, comfortable, and sustainable projects. If you own an office, have a company, or even work alone, you know how difficult a task can be.

Remember that working on higher-performance projects is not a task that you do overnight.

Want to know the biggest secret of all the strategies presented by this guide? Consistency. It is between architects who work in the past from those who will create our future.

The important thing is to know that I could give you relevant concepts to start with more tools and go through fewer difficulties than I went through to build my business. In this way, we also save resources and energy, one of the principles of sustainability. :)

Any questions, comments, complaints, anyway, anything, contact my team and me, [contato@ugreen.com.br](mailto:contato@ugreen.com.br) email. We will be happy to answer!

Finally, if you want to know more about the work of the UGREEN Team, you can visit our websites and channels at:

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