Improving health in the military and beyond using salutogenic design

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Abstract

Purpose – Service members of the US Department of Defense (DoD) have alarmingly high rates of depression, anxiety, probable stress disorders and suicidality, all of which are negative health conditions exacerbated by various external stressors. High-stress work conditions – to include shift work, hazardous territories, high-stakes mission sets and generally disconnected sites – require a work environment that facilitates, rather than inhibits, stress reduction and mental well-being. This paper aims to present "salutogenic design" as an innovative approach: Salutogenic design offers demonstrated architectural solutions that improve health and well-being.

Design/methodology/approach – This paper describes salutogenic design strategies beginning with the need for such an approach, the call to action to implement strategic and tactical solutions and the challenges and financial impacts of such a broad and innovative strategy to improve workplace health, well-being and performance in the DoD and beyond. Examples of these strategies, via biophilic design solutions, are presented in the central Table 1 as an easy-to-reference tool and supported by the voluminous literature as referenced, in part, through this research paper.

Findings – Salutogenic design strategies offer innovative, financially viable solutions to help mitigate stress and improve workforce well-being while maintaining the highest level of building security requirements in access-controlled spaces and disconnected sites, such as military installations and government compounds.

Research limitations/implications – Issues of mental and physical health are complex and multi-faceted, and they require complex and multi-faceted solutions. Salutogenic design is presented as one facet of that solution: a tangible solution to an often-intangible issue. Further, as a novel approach to address a critical DoD issue, Table 1 bridges the common gap between high-concept design theory and practical construction-application solutions, with positive value to the health, performance, quality-of-life and well-being of service members.

Originality/value – To the best of the author's knowledge, this paper is the first to approach the DoD's imperative to reduce service members' mental stress with "salutogenic design."

Keywords Well-being, Resiliency, IC, Biophilic design, DoD, SCIF

Paper type Research paper

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Introduction

The DoD consistently maintains the number one highest stress job in the USA: military enlistment (CareerCast.com, 2019, 2018a, 2018b, 2017a, 2017b). On a daily basis, service members make, follow and carry out mission-driven, life-or-death decisions to best ensure the safety and freedoms of the USA and its citizens. This includes frequent work in high-stress conditions, from 24-h watchfloors to deployments in hostile areas, and includes traditional warfare defense to global counterterrorism efforts and a new generation of cyber-warfare.

Overwhelmingly, service members are drawn to their jobs and the mission because they care about their country and its well-being (Brennan *et al.*, 2014). But this sense of patriotic duty – a positive drive – can quickly transition into a stressful, self-imposed burden of responsibility to uphold the mission or innocent lives may suffer. During the INSA/AFCEA Intelligence Community (IC) Director's Panel in 2014, the Director of the NSA, in concurrence with CIA and GSA leaders, reflected on his workforce:

> [. . .] I watch them and I think to myself, they will literally destroy themselves, their health, their well-being, in many cases their family relationships. They become so focused [. . .] because they see it as such tangible, immediate threat that, 'If I don't do my job, the implications are a citizen, an ally, a soldier, a member of an embassy is going to die somewhere, and I need to drive at 150%, and I need to do it all the time' (Brennan *et al.*, 2014).

The resulting work culture, most frequently found within restricted-access facilities like the intelligence community (IC)'s and DoD's, is a culture of self-imposed infrequent breaks and high overtime in disconnected environments that are inherently high-stress. Yet, frequently these kinds of environments do not/cannot offer adequate opportunities for mental rejuvenation or restoration.

Furthermore, ample research demonstrates the detrimental affects that certain building designs can have on inhabitants' mental health. Historically, government facilities – like most office buildings – were designed with simple goals as follows: to be easy to maintain, be easy to clean, maximize spatial efficiency and minimize upfront costs. As a result, blank interiors and neutral palettes prevailed, and many office spaces were designed with no windows. However, environmentally deprived spaces like these that lack variability, visual stimulation and aesthetic design can have a negative physiological impact on people (Heerwagen *et al.*, 1995; IWBI, 2016; Stringer, 2013; Terrapin Bright Green, 2012). The endless, barren hallways and blank, white walls – the stereotypical existing interior vernacular of government buildings – are demonstrated to be directly responsible for increasing stress, hindering creativity, reducing energy levels, negatively affecting workers' abilities to stay alert and focused, negatively impacting productivity and increasing boredom/passivity (Heerwagen *et al.*, 1995; IWBI, 2016; Stringer, 2013; Terrapin Bright Green, 2012).

Direct call to action

As a top leadership priority, multiple DoD and IC Directors have been calling for innovative ways to improve the health and well-being of their workforces. Reinforced by the long-held military philosophy "Mission first, people always," leaders continue to emphasize that taking care of people and their well-being is mission-critical (Brennan *et al.*, 2014; DoD amplifies focus on people in executing national defense strategy, 2020; Grinston *et al.*, 2019).

However, where offensive and defensive militaristic strategies continue to be successful, the DoD's success to substantially improve service members' well-being has unfortunately paled in comparison. The DoD Health-Related Behaviors Survey (HRBS) is a flagship survey issued every few years and relied upon for understanding the mental and physical health and well-being of DoD service members. Most recently published in 2018, the current DoD HRBS by Meadows *et al.* shows continued increases in depression, anxiety, probable stress disorders, suicide ideation and suicide attempts over previously surveyed years. Reported as percentages, all are dramatically higher across the DoD than seen in the general American population (Meadows *et al.*, 2018).

This was intended to be addressed, in part, by a 10-year federal initiative to reduce the rate of depression among service members. However, midway through the initiative, this poor mental health rate instead climbed to nearly double its targeted percentage (Meadows *et al.*, 2018). Clearly, current DoD strategies to reduce depression are ineffective relative to its rate of growth.

People working in high-stress conditions, such as service members and those in highly disconnected spaces, are an at-risk population. Stress negatively impacts people's physical health and causes an increased risk for, or direct link to, a variety of diseases and conditions, including mental health disorders, increase in post-traumatic distress (PTSD) symptoms and suicide (Godbey, 2009; Post-traumatic stress disorder (PTSD), 2018; Valderrama, 2016). Overall, research concludes there are direct correlations between increases of stress, depression, or anxiety with an increased risk for comorbid mental and physical health issues (Meadows *et al.*, 2018). Further, chronic unpredictable stress – such as that caused by a high-stress job – can independently cause depression and negatively impact neural activity most associated with suicidality (Fang *et al.*, 2021).

Stress is an epidemic that directly threatens not only the lives of service members but also their abilities to perform their duties, which can have ripple effects across many people's lives. It is imperative to find other, innovative strategies to improve the well-being of service members and build resilience against stress.

The strategic solution: salutogenic design

At the intersection of architecture, psychology and neuroscience is salutogenic design (Figure 1). Salutogenic design an evidence-based design strategy to enhance human health and well-being in the built environment, including in high-stress environments. Its root of "salutogenesis," first introduced by Aaron Antonovsky in 1979, was a paradigm-shift in the medical field that focused on increasing factors supporting health and wellness rather than simply reducing factors that caused disease (Mittelmark and Bauer, 2017). In the context of

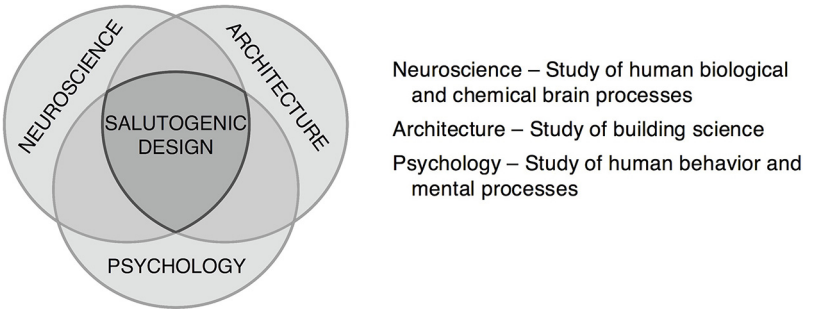


Figure 1.
Salutogenic design concept

the built environment, this translates to designing restorative architecture with a sense of coherence to better connect people to their environment; theoretical and empirical research demonstrates this improves people's well-being (their levels of resilience, stress recovery, health and morale) as well as performance (their focus, cognitive functioning, mental stamina and ability to concentrate) (Heerwagen *et al.*, 1995; von Lindern *et al.*, 2017). A salutogenic model of design – most popular in the healthcare and, increasingly, education sectors – is substantiated by over three decades of research across the medical, scientific and design fields and offers an innovative architectural strategy to aid in the health and well-being crisis facing the DoD.

Many of the existing and, in recent years, newly developed efforts to improve the mental and physical health of service members requires user-conscious action: leaders must be active to spread awareness, organizations must be active to shift culture, individuals must be active to look for warning signs in others or to seek help themselves. To implement salutogenic design requires a series of deliberate design decisions, however, salutogenic design is a uniquely user-passive strategy. By changing the physical environment and space where service members spend the majority of their waking time and/or by providing convenient – even unavoidable – access to areas designed by this method, little to no proactive effort is required by a person to help improve their mental and physical health. Instead, the environment around them contributes to improving their well-being.

The tactical solution: biophilic design

Salutogenic design is a strategic solution; biophilic design is a tactical solution. This is demonstrated, respectively, in Figure 2 and Table 1. Based on Edward Wilson's (1984) Theory of Biophilia, biophilic design, or design that relates to the innate connection humans have with nature, is one of the most common approaches to salutogenic design.

A full literature review of biophilia is outside the scope of this paper, though its holistic health benefits and improvements to quality-of-life have been extensively researched, validated and cited in over 24,000 peer-reviewed publications. While its application within the specific context of architecture is a newer field, the value of biophilic design is supported by literally thousands of studies and papers that document its benefits to human health, well-being and performance (e.g. for reviews, see Browning *et al.*, 2014; Gillis and Gatersleben, 2015; Hall and Knuth, 2019; IWBI, 2016; Kaplan, 1995).

At its most basic level, human interaction with nature decreases stress and increases the ability to concentrate, but the benefits of biophilic design extend substantially further. Well-documented impacts include improved stress recovery rates, reduced symptoms of depression, increased creativity, lowered systolic blood pressure, lowered chronic cortisol levels, improved cognitive functions, enhanced mental stamina and focus, decreased

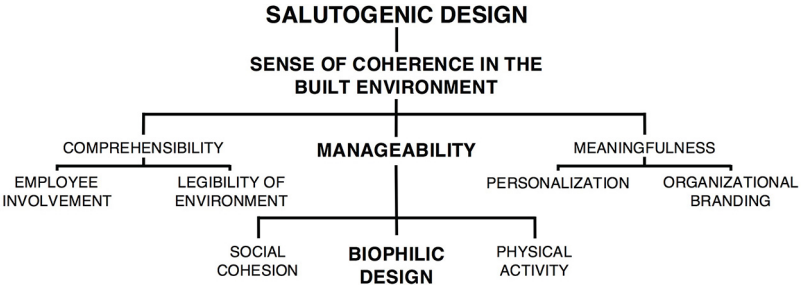


Figure 2.
A tactical solutions framework of salutogenic design, based on the work of Roskams and Haynes (2019)

violence and criminal activity, improved affective responses, elevated moods, increased productivity, decreased anxiety, decreased symptoms of post-traumatic distress (PTSD), increased learning rates and improved resilience (Danilov and Benuzh, 2020; Dijkstra *et al.*, 2008; Ingulli and Lindbloom, 2013; Kotozaki, 2014; Lohr *et al.*, 1996; Nadkarni *et al.*, 2021; Sekiguchi *et al.*, 2014; Terrapin Bright Green, 2012; Ulrich, 1983; Ulrich *et al.*, 1991; Westlund, 2015).

Biophilic design incorporates natural elements into the built environment with literal, represented or abstract connections to nature. This is most colloquially associated with the inclusion of plants in interior spaces but there are over a dozen specifically outlined, descriptive methods to achieve the positive and different effects of nature from within the confines of a built structure (Browning *et al.*, 2014; Cramer and Browning, 2008; Kellert, 2008; Ryan *et al.*, 2014). The most recent landmark publication outlining these methods (also, notably, the most legible to non-design professionals) is *14 Patterns of Biophilic Design* by Browning *et al.* (2014), which offers in-depth architectural analyses of nature in space (e.g. multi-sensory stimuli), natural analogues (e.g. complexity and order) and the nature of a space (e.g. mystery and intrigue) and includes both comprehensive defenses and examples of each.

Biophilic design is one of many tactical solutions within the framework of an overarching salutogenic design strategy (Figure 2). Within this framework, especially in the highly disconnected and environmentally deprived spaces common across the DoD, biophilic design connects people with their built environments by connecting them to the natural environment to establish as a sense of coherence. With a focus to reduce stress (or "manageability"), for the purposes of this paper, all references to salutogenic design as a comprehensive strategy include biophilic design as the proposed tactical solution.

Department of Defense challenges

The fundamental responsibility of any building design is to protect the health, safety and welfare of its inhabitants; this "shelter" is often included among the most basic of human needs. Military installations, government compounds and a large range of other facility types add an additional fundamental requirement that includes both personnel and other assets contained in a building: security control.

The sole purpose of security is the protection of assets (personnel and otherwise) against threat. The DoD defines threats in Chapter 2 of the Unified Facilities Criteria (UFC) 4-020-01 DoD Security Engineering Facilities Planning Manual (2008): They can be reasonably summarized into four basic categories which, subsequently, require control to mitigate. The basic facility requirement categories, as applicable to this paper, include as follows: physical control, visual control, acoustical control and technological control (United States Department of Defense, 2008). In stark contrast to salutogenic design strategies, this control revolves around *disconnection*. [Any facility, installation, compound or part therein with critical security requirements fitting into all four of these categories will herein be referred to as "controlled" spaces, environments, etc. These controlled spaces are, collectively, the sites of focus for this paper, as these are considered the most restrictive: Any buildings or kinds of facility spaces "lower on the pyramid" (Figure 3) or with a different arrangement of priorities may equally benefit from and apply the solutions presented in this paper. Also, see section *Recommendations for Continued Research* for additional definitions of controlled spaces.]

There are inherent challenges in designing innovative solutions for publicly funded facilities with unique security restraints. These challenges include as follows:

(1) *Misconceptions about viable solutions.* Due to the popularity of many solutions that intrinsically – or, at first glance, could merely potentially – conflict with either of the next following challenges, effective strategies and alternate solutions may be readily overlooked, stigmatized, or dismissed without due consideration.

(2) *Perception of unnecessary expenditure.* In addition to high control requirements, tax revenues fund the DoD budget. Any financial spending at the federal level must be done responsibly and with clear justification; the spending of taxpayer dollars must not be – to include the perception of being – wasteful, fraudulent, abusive, or mismanaged in any way.

(3) *Technological control in an age of technology.* Innovative solutions to any problem within a controlled space must, at minimum, not conflict with any of the basic, previously defined design-security/control criteria to be considered for use. Because of today's rapidly advancing technology, that unfortunately precludes many of the otherwise viable solutions often found in or available to typical, non-restrictive (or less restrictive) work environments.

Solutions specifically for controlled environments: Table 1

The gripping data on poor well-being in the DoD has existed for many years, as has the data championing the merits of salutogenic design. However, this paper is the first to approach the DoD's imperative to improve mental and physical health using salutogenic design strategies. Through the lens of unique facility security requirements, disconnected spaces are connected to nature for an improved sense of coherence to support the well-being of highly stressed building occupants.

Table 1, *Improving health, performance and well-being in controlled spaces using salutogenic design*, presents a selection of tactical solutions as an easy-to-read guide accessible to and for utilization by all tiers of DoD leadership, facility/operations professionals, customers and personnel; architects, designers, contractors and agents across or acting on behalf of the DoD, United States Army Corps of Engineers (USACE), etc.; and by others across the IC, executive branch and private sector with highly controlled or uniquely restrictive facility requirements. Those with less restrictive facility/control requirements will benefit from the *Salutogenic Design Examples* section (features, wellness criteria and basic physiological impacts).

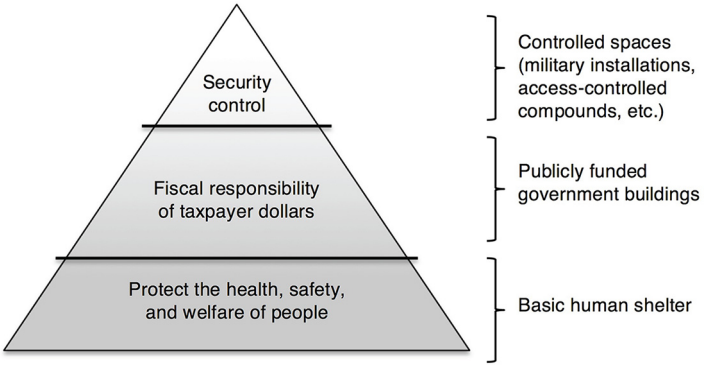


Figure 3.
Facility requirements pyramid of access-controlled government buildings

Table 1. *Improving health, performance and well-being in controlled spaces using salutogenic design*. This table is intended as an industry tool and demonstrates that security and salutogenic design do not have to be mutually exclusive

IMPROVING HEALTH, PERFORMANCE AND WELL-BEING IN CONTROLLED SPACES USING SALUTOGENIC DESIGN

Current to the writing of this paper, all features as described in Table 1 are compliant with the parameters and constraints defined by the Whole Building Design Guide's UFC DoD Security Engineering Facilities Planning Manual (U.S. DoD, 2008). Specific products must be properly vetted and verified prior to procurement for the most up to date manufacturer and installer specifications and screened prior to installation per any/all applicable protocols. Products for consideration must meet all applicable building codes, accessibility requirements, fire safety standards, etc.

The image examples throughout this paper that refer to Table 1 are included only as a visual aid of salutogenic design features (column 1, Biophilic Features A-F). This paper neither endorses, recommends, nor has vetted specific product or manufacturer sources for use.

SALUTOGENIC DESIGN EXAMPLES				SECURITY IMPACT				FACILITY REQUIREMENTS		CAVEATS
Biophilic Feature		Wellness Criteria (Browning *et al.*, 2014; Roskams & Haynes, 2019)	Basic Physiological Impacts (as cited in Browning *et al.*, 2014, p. 12)	Physical	Visual	Acoustical	Techno-logical	Infrastructure/ Installation Work	Special Maintenance	
(A) Green Walls	Living* (Plate 6)	- Multi-sensory engagement (visual, acoustic, olfactory, tactile) - Dynamic (long-term); slowly changes over time - Connection with natural systems	**Stress reduction** (lowered blood pressure and heart rate; reduced systolic blood pressure and stress hormones), **cognitive performance** (improved mental engagement/attentiveness, positively impacted cognitive performance), **elevate emotion/mood/preference** (positively impacted attitude and overall happiness, *enhanced positive health responses, *shifted perception of environment)	Low or no risk	Low risk; possible benefits	Low risk; possible benefits	Low risk	Low to moderate	Low to moderate	- Ensure selection does not have connectivity capabilities to maintain low technological risk - Facility requirements and special maintenance dictated by feature design (modular freestanding unit vs. integrated built-in installation, manual-fill water tank vs. water line wall connection, etc.)
	Preserved (Plate 1)	- Multi-sensory engagement (visual, olfactory) - Overlaid organizational branding opportunity to reinforce pride in workplace		Low or no risk	Low risk; possible benefits	Low risk; possible benefits	Low or no risk	Low	Low	- Maintenance may include periodic patching/replacement of dried-out pieces if installation is accessible to touch - Maintenance may include dusting if feature includes broad leaf-foliage
(B) Virtual Skylights/ Windows (Plate 2)		- Can be static in dynamic spaces or dynamic* in static spaces - Multi-sensory engagement ([visual] or [visual and acoustic]*) - Legibility of environment	**Stress reduction** (*positively impacted heart rate, systolic blood pressure and sympathetic nervous system activity; lowered blood pressure and heart rate; reduced systolic blood pressure and stress hormones), **cognitive performance** (*observed and quantified behavioral measures of attention and exploration, improved mental engagement/attentiveness, positively impacted cognitive performance), **elevate emotion/mood/preference** (positively impacted attitude and overall happiness)	Low or no risk	Low or no risk	Low risk; possible benefits	Low risk	Low	N/A	- Ensure selection does not have connectivity capabilities to maintain low technological risks
(C) Circadian Rhythm Lighting		- Dynamic and diffuse light	**Stress reduction** (positively impacted circadian system functioning, increased visual comfort)	Low or no risk	Low or no risk	Low or no risk	Low risk	Low to moderate	N/A	- Ensure selection does not have connectivity capabilities to maintain low technological risk
(D) Audio Recordings of Nature		- Multi-sensory engagement (visual, acoustic)	**Stress reduction** (reduced stress, increased feelings of tranquility, lower heart rate and blood pressure), **cognitive performance** (improved concentration and memory restoration, enhanced perception and psychological responses)	Low or no risk	Low or no risk	Low risk; possible benefits	Low risk	Low	N/A	- Ensure media does not have connectivity capabilities to maintain low technological risk - Ensure media recording quality is professional-grade to achieve maximum sound clarity and effectiveness
(E) Synthetic Water Fountain or Wall (Plate 5)		- Multi-sensory engagement (visual, acoustic) - Bluespace	**Stress reduction** (reduced stress, increased feelings of tranquility, lower heart rate and blood pressure), **cognitive performance** (improved concentration and memory restoration, enhanced perception and psychological responses), **elevate emotion/mood/preference** (observed preferences and positive emotional responses)	Low or no risk	Low or no risk	Low risk; possible benefits	Low or no risk	Low	Low	- Ensure liquid is non-toxic, fully synthetic, non-petroleum based, and requires no sanitation to sustain low maintenance
(F) 2D Biophilic Design Applic-ations	Acoustic Ceiling Tiles (Plate 4)	- Biomorphic materials and patterns - Prospect/refuge biophilic pattern - Visual engagement	**Cognitive performance** (decreased diastolic blood pressure, improved creative performance), **emotion/mood/preference** (observed view preference, improved comfort)	Low or no risk	Low or no risk	Low risk; possible benefits	Low or no risk	Low	N/A	- Features with visual connection to nature, more than simply material connection to nature or biomorphic pattern, will further **reduce stress** (lower blood pressure and heart rate), **improve cognitive performance** (improve mental engagement/attentiveness), and **elevate emotion/mood/preference** (positively impact attitude and overall happiness) (as cited in Browning *et al.*, 2014, p. 12)
	Acoustic Wall Panels	- Biomorphic materials and patterns - Multi-sensory engagement (visual, tactile)	**Cognitive performance** (decreased diastolic blood pressure, improved creative performance), **elevate emotion/mood/preference** (observed view preference, improved comfort)	Low or no risk	Low or no risk	Low risk; possible benefits	Low or no risk	Low	N/A	
	Partitions (Plate 3)	- Prospect/refuge biophilic pattern - Biomorphic patterns - Visual engagement	**Stress reduction** (reduced stress), **cognitive performance** (reduced boredom, irritation, fatigue; improved concentration, attention and perception of safety), **elevate emotion/mood/preference** (observed view preference, improved comfort and perceived safety)	Low or no risk	Low risk; possible benefits	Low risk; possible benefits	Low or no risk	Low	N/A	
	Glazing Films/3D Wall Wraps (Plates 7, 8)	- Biomorphic patterns - Visual engagement	**Elevate emotion/mood/preference** (observed view preference)	Low or no risk	Low risk; possible benefits	Low or no risk	Low or no risk	Low	N/A	

Table 1 presents salutogenic design strategies specifically as biophilic feature solutions that align with the predefined design-security/control criteria to demonstrate how these solutions can effectively improve health and performance while maintaining strict security requirements. To address the three challenges defined in the previous section of this paper, Table 1 is arranged to present examples of feature solutions followed by their physiological impact on stress/well-being/performance, security risks and infrastructure impact to help anticipate associated costs. As a resource, Table 1 is intended to act as a guide and starting point, and it is not inclusive of every available solution.

The frequently observed gap between good academic design theory and practical, professional application led to the research and development of this evidence-based, easy-to-use reference tool. Table 1 communicates a novel approach to address a critical DoD issue with literal, descriptive examples of *how* to improve well-being in controlled spaces. This presentation of data does not otherwise exist in the industry yet is crucial for design in controlled spaces to progress forward with positive value to human health, performance and well-being.

Integration considerations

As with most design strategies, those presented in Table 1 are easy to integrate into new construction and should be incorporated as a priority early in the design planning process. However, the GSA currently owns and leases over 9,600 existing buildings, with roughly 28% of all government-owned facilities built during the Great Depression (United States General Services Administration, 2017a, 2017b, 2018). Therefore, it is prudent to consider solutions that are viable for both new and existing construction. The features suggested in Table 1 can easily be integrated into existing controlled spaces in three ways to the benefit of service members as follows:

- *Retrofit-integration into existing work areas*, to include open-plan offices, 24-h watch floors, conference rooms, classrooms, break rooms, etc. This option maximizes exposure/benefit to specific sets of service members within their own spaces where they perform deskwork and related duties. It is especially well suited for those with an exceptionally high-stress mission set or showing evidence of high-stress (perhaps through, i.e. high turnover, etc.).
- *Installation in facility common areas*, to include shared spaces, such as cafeterias, corridors, gyms, lobbies and administrative areas for exposure/benefit to the maximum overall number of service members.
- *Dedicated destination-space installation*, to include the complete renovation of existing spaces for sensory-immersive experiences to maximize benefit/exposure to and access by service members. Fully renovating, and subsequently redefining/reallocating, an existing room (e.g. an underused space, trailer, or vacant office) into a restorative, salutogenic design space for rejuvenation falls under this category. Assigning new space in this manner grants a workforce with limited access to nature comparable benefits from biophilic design in a multi-sensory (a critical factor) environment, at a minimum during breaks, between meetings and between shifts. Though the well-being benefits remain user-passive, the decision to enter a space like this is more active than the preceding integration recommendations. As such, additional strategies to maximize convenience, inclusion and access (to include physical and perceived barriers) should be considered in the design.

Whether considering features for new construction or for renovation, salutogenic design solutions are not one-size-fits-all: Not every solution will work well in every type of space or for every type of occupant.

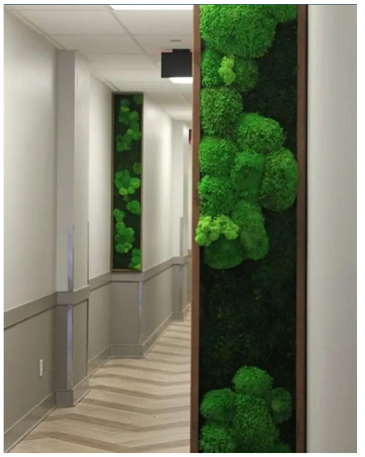
For example, a basement office will see greater benefit from virtual windows than an exterior office that already has real windows, and static skylights (Plate 2) will be more effective in a busy corridor than an acoustically pleasing synthetic water feature (Plate 5). The surrounding facilities and usage patterns within facilities should be assessed for effectiveness prior to committing to an installation, namely, foot traffic patterns, available sitting areas, workstation orientation, open wall/ceiling space, etc., should factor into the decision-making process (Plate 3).

Similarly, not every feature will offer the same health, well-being and performance benefits (though there is substantial overlap). For example, Table 1 shows that if the specific goal is to reduce stress, green walls (Plate 1, Plate 6) will be a more effective solution than biomorphic window glazing (Plate 8), but to improve a sense of calm and lower blood pressure, hearing recordings of nature will be more effective than circadian rhythm lighting. Designers and customers tend to gravitate to visual features of interest but multi-sensory solutions must be considered for the most holistically effective and inclusive design experience. Multi-sensory design is not exclusive to certain work tasks (which may require visual or acoustical focus) or demographics (active-duty military versus veteran or civilian service members, who may be differently-abled): it allows for all building occupants to benefit from salutogenic design.

To maximize direct exposure to those in need, care should be taken to ensure the appropriate solution addresses both the facility and human conditions/issues. Taking this care and using Table 1 as a tool will help maximize the effectiveness of a salutogenic design strategy which, in turn, will yield the highest return on investment.

Fiscal responsibility and impacts

More than simply judicious practice, it is mandated by the Office of Inspector General to be fiscally responsible with the use of federal funds. This is often mistranslated and misrepresented as a requirement for buildings to look strictly functional, with any decorative features perceived as non-utilitarian and, therefore, wasteful; to reiterate, this is incorrect and an unsound argument against the case made by this review. The negative health impacts of stress can be caused, exacerbated, facilitated, or inhibited by environmental conditions and design: Improving environmental conditions, through salutogenic design strategies to improve service members' health and well-being, is not wasteful.

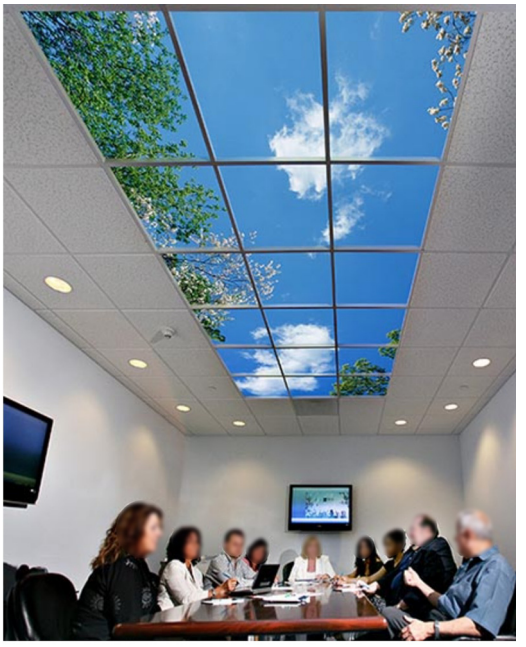


Source: Kerem Ozseker, Flowerbox Wall Gardens

Plate 1.
Example of a preserved green wall feature (refer to Table 1, Feature A)

Using salutogenic design strategies is demonstrated to significantly mitigate stress, reduce symptoms of depression and induce calm to improve overall well-being. [For extensive academic treatises on the clinical effectiveness of salutogenic design see, for example, Dijkstra *et al.* (2008), Hall and Knuth (2019), Heerwagen *et al.* (1995) or Roskams and Haynes (2019)] This is

critically important because service members shoulder an exceptional amount of stress, and it is generally accepted that people do not perform at their best when they are stressed. Not only is stress an underlying threat to mission success (poor mental and physical health can negatively impact service members' abilities to effectively perform their duties) but also more pressingly, it is a direct threat to the DoD's greatest asset and budgetary investment: its people (Blakeley, 2017). While there is compelling evidence of salutogenic design strategies directly lowering health-care costs (Ulrich, 1984), this paper evaluates the financial impacts of employee health in terms of stress levels and depression on workplace productivity and performance, following an absenteeism model presented by Terrapin Bright Green (2012).



Source: Sky Factory, Inc.

Plate 2.
Example of a virtual skylight feature (refer to Table 1, Feature B)

According to the US Department of Labor, the public sector loses over US$3,300 per employee per year due to physical absence from work (United States Bureau of Labor Statistics, 2020a, 2020b). Part of that absenteeism can be directly attributed to employees working in environmentally deprived conditions, as is common in controlled facilities: Incorporating salutogenic design strategies into these spaces can drop absenteeism by an astounding 10% (Terrapin Bright Green, 2012). As the largest government agency in the USA, employing over 2.9 million service members ("About the DOD," 2021), this suggests that incorporating salutogenic design strategies into government spaces could result in savings of about one billion US taxpayer dollars each year.

While this calculation is exciting, it is reductive as stated and does not account for other important factors that could influence the true bottom line. However, to generously compensate for additional variables possibly affecting the reported 10% outcome, *even if only a quarter of the reported absenteeism rate* is affected by the incorporation of salutogenic design elements, it is still reasonable to conclude *this could result in cost savings on the scale of hundreds of millions of taxpayers dollars each year*, which could be put toward more salutogenic design efforts or used to fund other federal programs. Not only is this doable but also it is scalable: The cost savings over 10 years would be, in-turn, 10-fold (or more, accounting for inflation). Based on a growing body of evidence documenting initial investment payback for salutogenic design strategies, even when associated costs of installation are considered, this value proposition remains sound (Terrapin Bright Green, 2012).

These calculations account for productivity measurements in terms of reduced physical absences directly resulting from salutogenic design interventions. However, other measurements should also be considered as follows:

Source: buzzi.space

Plate 3.
Example of an acoustic wall panel/ partition feature (refer to Table 1, Feature F)

- Workplace task performance has been reported to increase 15% because of the implementation of salutogenic design strategies (Human Spaces, 2015).
- General presenteeism (being physically present but mentally absent) costs US $1,250 per average employee per year in the public sector and is also shown to be reduced by salutogenic design strategies (Terrapin Bright Green, 2012).
- Presenteeism among employees with depression has been found to cost 24 days (approximately US $8,000+) of productivity loss per employee per year (United States Bureau of Labor Statistics, 2020b; Wang *et al.*, 2004): With salutogenic design strategies that can help mitigate or – according to the research by Fang *et al.* (2021) and Magalhaes *et al.* (2010, as cited in "Biological link between stress, anxiety and depression identified, 2010)" – even *prevent* the onset of depression, even further resulting recuperation of lost productivity costs can be expected.

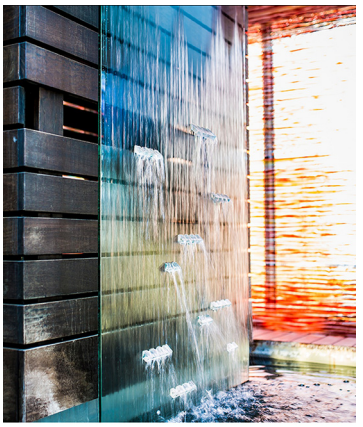
Consideration of these additional cost factors maintains that the calculated savings estimate is conservative.

Additionally, investing in facility design that prioritizes the well-being of the workforce communicates this value to building occupants, and using architecture to reflect the high caliber of work being performed in these spaces can improve morale, make employees feel valued and increase pride in the workplace. While these are traditionally considered "soft" cost values, data finds that 33% of office workers report the design of a place impacts their decision to

Source: armstrongceilings.com

Plate 4.
Example of acoustic ceiling tiles feature (refer to Table 1, Feature F)

work there (Human Spaces, 2015). Where the facility design of private sector moguls is rapidly advancing (e.g. the Googleplex or Amazon Biospheres, both of which compete with the DoD for IT and cybersecurity talent), the public sector can "keep up with the Jones's" by also applying an understanding of neuroscience to not only communicate employee well-being as a value but also a professional, progressive and impressive environment – and therefore, workforce and mission – to prospective employees and other stakeholders (Plate 4, Plate 7). This allows for the recruitment and retention of the top talent in an increasingly competitive job market, as already recognized in and reported by multiple other sectors (Terrapin Bright Green, 2012).



Source: www.llwaterfalldesign.com

Plate 5.
Example of a synthetic water feature (refer to Table 1, Feature E)

Source: Original content

Plate 6.
Example of a freestanding living green wall feature (refer to Table 1, Feature A)

Growing presence in federal and global building standards

As previously noted, the fundamental responsibility of any building design is to protect the health, safety and welfare of its inhabitants. Health [following a narrower definition than defined by the World Health Organization (WHO, 2021)] and safety are each codified at the local, state and larger levels. Human welfare in architecture is not. It is, however, addressed indirectly through sustainable design standards (to the welfare of future generations and occasionally with biophilic design) and, increasingly, salutogenic design building standards.

Sustainable design is an established priority of the US Government. Salutogenic design and sustainable design are two related, but distinct, building strategies: Where sustainable design focuses on a building's impact to its surrounding environment, salutogenic design focuses on a building's impact to its inhabitants (Figure 4). Though one's main focus is external and the other's is internal, they are complementary and both seek to promote healthy, symbiotic places.

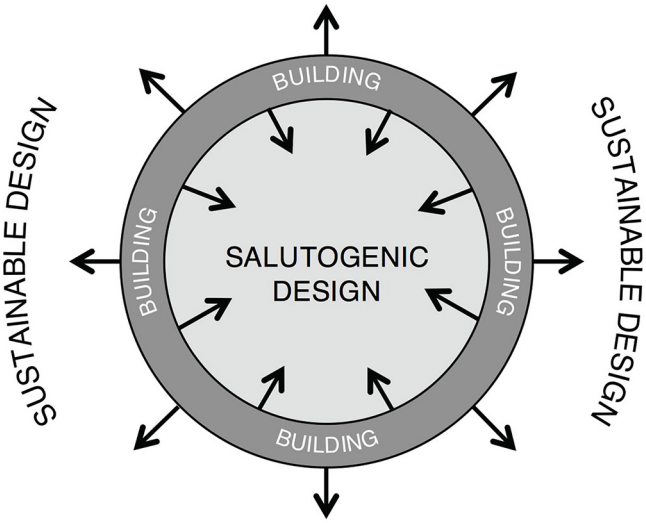
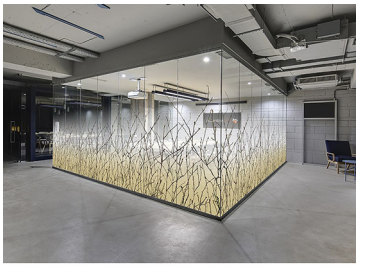


Figure 4.
The complementary perspectives of salutogenic and sustainable design strategies

Source: Original content

Plate 7.
Example of a 3D wall wrap feature (refer to Table 1, Feature F)



Source: Decorative Films, LLC

Plate 8.
Example of a glazing film feature (refer to Table 1, Feature F)

The DoD defines sustainable design as a strategy that "seeks to reduce negative impacts on the environment and on the health and comfort of building occupants, thereby improving building performance" (United State Department of Defense, 2008). Salutogenic design directly supports this imperative. Distinctly, however, the focus of the salutogenic design is on improving *people's*, not a building's, performance and well-being.

In 1998, the US Green Building Council (USGBC) launched Leadership in Energy and Environmental Design (LEED), now the most successful and widespread sustainable building rating system in the world (GBCI, 2021; USGBC, 2021). This rating system finally codified sustainable architecture successfully enough across the industry to propel "green" and "sustainable" design into the household terms they are today. Aligned with the USA's commitment to sustainability, the federal government earned its first LEED certification in 2004, six years after LEED's debut, and the DoD later became the single largest owner of green and LEED buildings in the world (Kaplow, 2013; Payne and Dyer, 2021). The GSA now requires a minimum achievement of LEED Gold on all major renovations and new construction of federal buildings, in alignment with the DoD's Sustainable Buildings Policy and UFC 1-200-02 High

Performance and Sustainable Building Requirements (Conger, 2013; United States Department of Defense, 2020; United States General Services Administration, 2020).

In 2014, the USGBC's Green Building Certification Inc. announced its collaboration with the International WELL Building Institute to deploy the WELL Building Standard: a landmark, evidence-based standard that codified the health and well-being of people within the built environment (USGBC, 2014). Simply put, WELL is to salutogenic design what LEED is to sustainable design.

Following the trail blazed by LEED, WELL is quickly becoming an international symbol of excellence to both design professionals and building occupants. There is an intentionally streamlined overlap between LEED and WELL criteria, making a tandem pursuit of both certifications deliberately easy and accessible ("WELL Crosswalks and Alignments, 2020)." WELL also has designed overlaps with the Living Building Challenge and a variety of other global leadership sustainability programs ("WELL Crosswalks and Alignments, 2020)."

The process to assess and adopt new standards for the betterment of the workplace is continuous and ongoing. Presently, the federal government has not yet adopted WELL, but that does not preclude its use as a guide by professionals to help inform design. It is the recommendation of this paper, to customers and professionals alike, to consider building standards and best practices that support the imperative to improve workforce well-being as a top priority.

Recommendations for continued research

With salutogenic design's conceptual roots founded in the medical world and early studies expounding its acceleration of patient recovery times (see seminal research by Ulrich [1984]), it is no surprise that the healthcare sector was the first to embrace salutogenic design (e.g., Golembiewski, 2010; Ulrich, 2006). Continued research interest in the salutogenic design concept has expanded to public and private school settings, though, specifically for its impact on student learning rates (e.g., Terrapin Bright Green, 2012), and this trajectory continues with steady research interest in application to other settings, such as prison design (another highly controlled setting) and workplace design.

While one could argue that, much like with sustainable design, all building typologies can benefit from salutogenic design, there are a myriad of specific sectors and demographics that can especially benefit from the application of this ongoing research: This paper lays a widely applicable foundation but concentrates on one particular (though still general) demographic group and primarily one kind of tactical solution. Many more demographics and solutions (Figure 2) can and should be explored. Similarly, this paper defines the security of controlled space using UFC 4-020-01; however, the protection of assets against threat is not limited to this definition, and salutogenic design solutions are widely applicable to other kinds of controlled spaces/conditions, as noted below.

Most notably in the context of improving well-being in all forms of controlled spaces and/or the DoD, it is imperative that additional applications of salutogenic design strategies, beyond those expressed in this paper, be considered and explored. At a minimum, this should include continued research to help mitigate circadian rhythm disruption in shift workers; to support recovery from post-traumatic distress (formally referred to as post-traumatic stress disorder, or PTSD); and to create restorative architecture for long-term, highly disconnected mission sets in hostile territories/conditions (such as those in warzones, subterranean, submarine and exo-planetary).

Conclusion

Improving well-being in high-stress work environments is essential to the health, safety and success of service members and their mission sets. Supported by abundant empirical evidence, salutogenic design is demonstrated to improve well-being by enhancing workplaces to create restorative architecture within the built environment. Markedly improved outcomes and results can be achieved through deliberate salutogenic design decisions that maintain good stewardship of taxpayer dollars and offer a viable, adaptable, innovative, scalable strategy to an ongoing, unresolved problem across the DoD and other public and private sector agencies.

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