UBC Social Ecological Economic Development Studies (SEEDS) Sustainability Program

Student Research Report

UBC Green Building Action Plan (GBAP): Health and Wellbeing:

Air, Water, Nourishment, Light and Movement

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AIR, WATER, NOURISHMENT, LIGHT & MOVEMENT

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UBC sustainability

EXECUTIVE SUMMARY

UBC owns and operates many buildings where a large population live, study or work. UBC intends to manage the impact of these buildings on sustainability and wellbeing of the people through Green Building Action Plan (GBAP) towards a human and ecological net positive condition by 2035. Five components including Air, Water, Light, Nourishment and Movement of the GBAP which are under the Health and Wellbeing emergent component are studied in this report. The context of this report is focused on the institutional buildings at UBC.

Through review and analysis of existing UBC standards and guidelines as well as other industry standards and guidelines, this research project has identified recommendations for improvements that support health and wellbeing in UBC buildings. Through a SWOT analysis, it concludes the applicability and its corresponding requirements in relation to UBC's policies.

This report recommends UBC to extend its guidelines to evaluate implementation of established assessment frameworks to the wide range of buildings, focus on retrofit in addition to new design, and raise awareness among stakeholders and collaborators between various disciplines. It is recommended to consider the effectiveness of the certification process on achievement of UBC goals and objectives.

Several gaps and shortcomings have been identified, most notably behavioural requirements, better documentation, and developing measurement and monitoring tools.

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1. INTRODUCTION

UBC owns and operates over 342 institutional buildings. UBC is growing rapidly and is expected to significantly increase the number of new building projects and existing-building retrofit projects over the next 20 years. How these buildings are designed, constructed and operated will have significant impact on sustainability of the campus and the wellbeing of the people who study, work and live there.

UBC Green Building Action Plan (GBAP) is intended to provide guidance to ensure the design and construction of new buildings, renovations and retrofits achieve higher level of performance that advance toward the net positive goal for human and ecological wellbeing and lower total cost of ownership for UBC. GBAP seeks to advance new and existing buildings towards a human and ecological net positive condition by 2035.

The integrated plan addresses 8 components including Health and Wellbeing. The GBAP has identified goals, indicators and targets with supporting actions for some components of the plan, while for some other, including Health and Wellbeing metrics, indicators and targets are still under development.

The scope of the green building plan and hence, this report, includes institutional buildings within the academic campus. The objective of this research project is to identify recommendations for improvements that support health and wellbeing in UBC institutional buildings. This report focuses on Air, Water, Nourishment, Light and Movement components of Health and Wellbeing.

1.1 PROJECT GOALS AND OBJECTIVES

Health and wellbeing in building design includes several subtopics, of which this report concerns Air, Water, Nourishment, Light and Movement which will be elaborated later in this report. The intent of this project is to identify available standards and best practices that can be applied to improve performance of UBC buildings.

This report summarizes and critically analyses guidelines and standards related to this topic and concludes on the applicability and its corresponding requirements in relation to UBC's policies.

1.2 RELEVANCE TO SUSTAINABILITY

To measure the progress under GBAP health and wellbeing component, it is necessary to identify metrics relevant to the components and inform policy for building design to optimize health and wellbeing for students, faculty and staff who occupy the UBC buildings. This report is focused on the Air, Water, Nourishment, Light and Movement section of the component.

2. LITERATURE STUDY: UBC CONTEXT RELEVANT TO INSTITUTIONAL BUILDINGS

2.1 AIR

2.1.1 UBC GREEN BUILDING ACTION PLAN

Air as a component of design has not been considered in any of the components in the GBAP. However, as a design consideration, it can fit partially in both Materials and Resources when it comes to choosing harmless or less harmful materials for the environment, and in Health and Wellbeing as air is vital for all living beings and the quality of it can determine the quality of life.

2.1.2 UBC LEED IMPLEMENTATION GUIDE

Air has been considered in the UBC LEED implementation guide under Indoor Environment Quality along with light and acoustics. As a prerequisite (Environmental Tobacco Smoke Control), smoking is banned 8 meters from any building air intake and there are mandatory credits for indoor air quality as well as using low emitting materials. Indoor air quality assessment is also mandated in the guide[1].

2.1.3 VANCOUVER CAMPUS PLAN

Part III of the Vancouver Campus Plan has only briefly talked about natural ventilation and air quality under Sustainability Best Practice in Building Design (2.3.10). However, it states that the following guidelines do not encompass all the design considerations and features necessary to meet UBC's LEED Gold requirements but should be considered early in the design process to improve energy performance and building comfort in the most cost-effective way. Items a and h touch on "Air" related subjects: Passive Design and Environmental Quality.

In the Passive Design section air tightness of the building envelope and use of naturally occurring air flow patterns for providing fresh air are mentioned. Furthermore, healthy flow of fresh air for comfort and wellbeing as well as minimal use of harmful materials is suggested in the Environmental Quality section.[2]

2.1.4 UBC TECHNICAL GUIDE

Division 23 of the UBC Technical Guide is dedicated to Heating, Ventilating, and Air Conditioning (HVAC). Specific guidelines for HVAC mechanical systems such as piping, air distribution etc. are elaborated in this division, however, no specific requirements for air quality is referenced in the guide. [3]

[1] ***UBC LEED Implementation Guide,* August 2016, pg.46-48.**

[2] **"Part 3 Campus Plan Design Guidelines", The UBC Vancouver Campus Plan, June 2010, pg.18-20.**

[3] **"Heating, Ventilating, and Air Conditioning (HVAC)", *UBC Technical Guidelines,* 2018.**

2.2 WATER

2.2.1 UBC GREEN BUILDING ACTION PLAN

Water is a separate component and not a sub-component of health and wellbeing in the GBAP. Some parts of water as a component are covered in GBAP. They include practise of responsible water management and use at the building and site scale by advancing water conservation and efficiency, exploring alternative water supply and treatment solutions and building water supply resiliency. Secondly, UBC will use a low-impact development approach to rainwater management at the site scale to mitigate risk and respect the natural hydrology of the campus.[1]

2.2.2 UBC LEED IMPLEMENTATION GUIDE

Water has been considered in the UBC LEED implementation guide under the topic of Water Efficiency, as listed below:

• WE Prerequisite: Outdoor Water Use Reduction

As per the UBC Technical Guidelines, automatic irrigation is required in all landscaped areas and drip irrigation is prohibited. Project teams are encouraged to consider high performance and efficient spray head systems, drought tolerant landscaping and include smart irrigation controls including rain sensors. Drip irrigation may be acceptable in some circumstances; teams may wish to propose it where appropriate and discuss with the relevant UBC project managers. All equipment should be consistent with UBC preferred systems. [2]

• WE Prerequisite: Indoor Water Use Reduction

Potable water use reduction is a priority for UBC. Project teams are encouraged to review and identify further opportunities for water use reduction by selecting efficient appliances as per ENERGYSTAR or equivalent standard, and by working with the building users early in the design process to identify unique process water demands. A water assessment is also required as part of the Integrated Process credit to assess early in the design process, specific loads from kitchens, laboratories, laundry, cooling towers, and other equipment demand volumes and reduction opportunities, as applicable.[2]

• WE Prerequisite: Building Level Water Metering

Building level water metering, data collection and reporting is strongly supported and aligned with UBC goals and performance targets. Project teams should refer to the Vancouver Campus Plan Design Guidelines and the UBC Monitoring Based Commissioning Requirements, which require projects to include potable water metering to track water consumption for building and exterior landscape within the project scope.[2]

• WE Credit: Outdoor Water Use Reduction

Potable water use reduction is a priority for UBC, however, as per the UBC Technical Guidelines, automatic irrigation is required in all landscaped areas and drip irrigation is prohibited. Project teams are encouraged to consider high performance and efficient spray head systems, drought tolerant landscaping, and smart irrigation controls and rain sensors to demonstrate additional savings. Drip irrigation may be acceptable in some circumstances; teams may wish to propose it where appropriate and discuss with the relevant UBC project managers.[2]

• WE Credit: Indoor Water Use Reduction

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[1] ***UBC GBAP, Water, p.49***

[2] ***UBC LEED Implementation Guide,* August 2016, pg.27-31**

Potable water use reduction is a priority for UBC. Project teams are encouraged to review and identify further opportunities for water use reduction through selecting efficient appliances as per ENERGYSTAR or equivalent standard, and to identify building typologies or building spaces with specific process water loads. These loads are required to be identified as part of the Integrated Process credit to assess early on, specific loads from kitchens, laboratories, laundry, cooling tower, and other equipment demand volumes and reduction opportunities, as applicable.[1]

• WE Credit: Cooling Tower Water Use

Water in cooling towers is chemically treated to control bacterial growth. Local water is very soft and does not require calcium, calcium carbonate or other minerals be controlled with treatment, and as such cooling tower blowdown rate (wasted water) is minimal. Buildings which do not include a cooling tower may use Pilot ACP "No Cooling Tower". [1]

• WE Credit: Water Metering

Projects with significant water process loads such as laboratories or other high-water load uses are encouraged to comply and consider a metering strategy early.

UBC also requires that each new building on campus consider and manage rainwater within the project site to contribute to campus-wide stormwater management. As per the UBC Integrated Stormwater Management Plan (Draft), the campus aims to keep runoff and overland flow from impacting sensitive adjacent sites, while managing challenging conditions for infiltration across much of the campus where clay soils occur. Projects are encouraged to evaluate integrated strategies that consider the use of rainwater to offset both indoor and outdoor potable water needs, in addition to green infrastructure and low impact development (LID) strategies.[1]

2.2.3 VANCOUVER CAMPUS PLAN

All projects must be designed to integrate best practices in environmental sustainability through energy and water demand management, rainwater management; respect for the forested setting for habitat and recreation; encouragement of horticultural diversity and low water-use landscaping; health and wellbeing; and showcasing of learning, research, and demonstration projects.[2]

All new buildings are to be designed to minimize the consumption of potable water by eliminating its use where and when it is not necessary, and by maximizing efficiencies in its distribution and use.[2]

All new buildings are to be designed to minimize domestic, institutional, and industrial wastewater transported off site by reducing volume, reusing or treating on-site. [2]

In addition to water, there is an integrated plan for stormwater management. Stormwater management has traditionally focused on the safe collection and discharge of runoff to reduce the risk of flooding and minimize impacts on the receiving environment. In future, stormwater management at UBC will shift to a natural systems approach, which values rainwater as a resource.[2]

2.2.4 UBC TECHNICAL GUIDE

The University of British Columbia owns and operates its own water distribution system. The University Endowment Lands (UEL) Administration supplies water to the campus, while the UEL purchases water from Metro Vancouver (GVRD). UEL and UBC are fed from GVRD's Sasamat Reservoir located south of 16th Avenue in Pacific Spirit Park. Ultimately two pipes feed UBC:

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[1] ***UBC LEED Implementation Guide,* August 2016, pg.27-31**

[2] **"Part 2 and 3, The UBC Vancouver Campus Plan, June 2010, pg. 39 and pg.8-9.**

1. 24" (600 mm) water main on University Boulevard, which is the suction line supplying three central booster pumps located in the Powerhouse. The discharge pressure from the Powerhouse booster pumps is set at 100 psig (689 kPa). This supplies UBC's "High-Pressure Zone."

2. 12" (300 mm) water main on 16th Avenue, which supplies UBC's "Low-Pressure Zone." The Low-Pressure Zone is separated from the High-Pressure Zone by eight pressure reducing valve (PRV) stations.

2.3 NOURISHMENT

2.3.1 UBC GREEN BUILDING ACTION PLAN

Nourishment has not been considered in any of the components in the GBAP.

2.3.2 UBC LEED IMPLEMENTATION GUIDE

Food and Nourishment has not been a component in UBC LEED Implementation Guidelines.

2.3.3 VANCOUVER CAMPUS PLAN

As a part of the Vancouver Campus Plan - Part III, in the perspective of health and wellbeing, it is mandated for Food Service adjacency of Open Spaces. It means that in academic spaces where food services form part of the building program, they shall be located so they are physically connected to, and provide strong visual oversight of, the outdoor commons.[1]

2.3.4 UBC TECHNICAL GUIDE

There are no guidelines for Nourishment in UBC Technical Guidelines.

2.3.5 20-YEAR SUSTAINABILITY STRATEGY

As a part of UBC's 20-year Sustainability Strategy, under the topic UBC Community by 2035, UBC visions to model a sustainable rated food system that equally values environmental, social and economic outcomes and assesses the impacts of food production, transformation, and consumption on environmental, personal and community health. However, there are no specific pathways mentioned to achieve the model. [2]

[1] **"Part 3 Campus Plan Design Guidelines", The UBC Vancouver Campus Plan, June 2010, pg.22.**

[2] **"UBC Community" UBC 20-year Sustainable strategy, 2014, pg.12.**

2.4 LIGHT

2.4.1 UBC GREEN BUILDING ACTION PLAN

Daylighting as a component of design has been considered as one of the components under health and wellbeing in the GBAP.

2.4.2 UBC LEED IMPLEMENTATION GUIDE

There is an optional requirement for interior lighting with two options of lighting control and/or lighting quality as per the requirements of LEED BD+C v4. The intent of this requirement is to promote occupants' productivity, comfort and wellbeing by providing high-quality lighting. The first option is to provide individual lighting controls with at least three lighting levels (on, off and mid-level) and the second option is to provide a strategy for lighting quality i.e. light sources, light fixtures and maximum luminance. [1]

There is no requirement for daylighting in the guide.

2.4.3 VANCOUVER CAMPUS PLAN

Vancouver Campus Plan I and II are about outdoor lighting. As per Policy 32 lighting on campus will be improved with attention to improved night lighting for safety and security and to enhance lighting for special features on campus such as ceremonial walkways. The Design Guidelines for lighting address the following campus design features within the best possible standards of sustainability: [2][3]

- accentuate gateways
- reinforce the hierarchy of all corridors and commons
- accentuate character districts and hubs
- connect all residential areas safely to the campus core and its facilities
- appropriately light all building entries and circulation
- reinforce the connections between the Main and South campus
- accentuate the campus character, beauty and sense of place

Vancouver Campus Plan III, section 2; Campus-wide design guideline - item 2.3.10 - Sustainability Best Practice in Building Design [4], has some mentions of lighting. There is a requirement under section A "Passive Design" to optimize daylight and views for occupants. Although its focus is on energy saving, it improves health and wellbeing of the occupants as well. There are requirements under section B "Orientation" regarding building orientation, windows and lighting level to provide comfort and lower energy consumption which also improves health and wellbeing. Item 2.5.2 - lighting, has details and requirements for lighting on campus to provide safety at all hours of day and night. [4]

[1] **UBC LEED Implementation Guide, August 2016, pg.48-49**

[2] **"Part 1 Campus Plan Synopsis", The UBC Vancouver Campus Plan, June 2010.**

[3] **"Part 2 Campus Plan", The UBC Vancouver Campus Plan, June 2010.**

[4] **"Part 3 Campus Plan Design Guidelines", The UBC Vancouver Campus Plan, June 2010, page 18-20.**

2.4.4 UBC TECHNICAL GUIDE

In UBC Technical Guideline Section 2.0 Material and Design Requirements, there is a general requirement for incorporating of the principles of sustainability in lighting design with the focus on energy conserving, long lasting, having a low cost of ownership and being accessible for service and maintenance.

There are some requirements for incorporation of natural daylight and arrangement of lighting equipment in the building as below, which can improve the health and wellbeing as well.

1. Daylight harvesting opportunities shall be implemented in areas where natural daylight is available.

2. All lighting shall be designed to suit the task and task location rather than the general lighting. ASHRAE 90.1, IESNA and WorkSafeBC guidelines shall be taken into consideration. [1]

[1] **"Interior Building Lighting", UBC Technical Guidelines, 2018.**

2.5 MOVEMENT

2.5.1 UBC GREEN BUILDING ACTION PLAN

Movement as a component of design has not been considered in any of the components in the GBAP. As movement can be a vital part of the experience of a place, movement as a design consideration can be fitted in the Place & Experience section of the GBAP.

2.5.2 UBC LEED IMPLEMENTATION GUIDE

Access to quality transport and provision of bicycle facilities has been mandated in the UBC LEED Implementation Guide, Location + Transport section. This credit emphasizes the proximity of the site to the public transportation and alternate ways to provide means of transportation for students, staff and visitors at UBC Vancouver Campus.[1] There are no specific guidelines in LEED for the movement inside the buildings.

2.5.3 VANCOUVER CAMPUS PLAN

Vancouver Campus Plan aims to create a sustainable campus which includes several aspects of movement in the form of accessibility and connections. One of the main strategies of the Campus Plan is to promote pedestrian and cyclist friendly campus. The Campus Plan proposes to achieve this by compact campus design, refining transit routes, improving road safety and design, making paths universally accessible, locating recreational facilities within walking distance from the academic buildings, creating localized centres in hubs and clearly defining the signage systems for easy wayfinding around the campus.[2]

The Campus Plan Policies under universal accessibility that is policy 19 and 20, and movement and section from policy 22 to 31 can be referred for the movement category applied to the UBC context which highlights the considerations for barrier free environment and pedestrian and cyclist friendly campus.[3]

The Campus Plan Design Guidelines gives specifications in addition to BC Building Code to make campus universally accessible. The minimum standards for the width, location, surface treatment, accessible connections to public realm, lighting levels, landings and rest areas, handrails and intersection areas are specified for pedestrian pathways and knowledge walks. To aid wayfinding, signage on campus is mandated to follow UBC Sign Standards and Guidelines. In addition, the guidelines for commercial signage is laid in this guideline. [4]

The movements at building level is considered in the Campus Plan Design Guidelines through providing specifications for building entry locations, stairs and rain protection.[5]

[1] **UBC LEED Implementation Guide, August 2016, pg.20-21**

[2] **"Part 1 Campus Plan Synopsis", The UBC Vancouver Campus Plan, June 2010.**

[3] **Ibid, 15-17.**

[4] **"Part 3 Campus Plan Design Guidelines", The UBC Vancouver Campus Plan, June 2010.**

[5] **Ibid, 16-17.**

2.5.4 UBC TECHNICAL GUIDE

UBC Technical Guidelines 2018 Edition, Section 14 20 00, Elevators mentions the maximum distances permitted to access elevators and number of elevators to be provided based on this distance. [1] UBC Learning Space Design Guidelines 2018, Section 4.1 Steps, Ramps, Accessible Elevators & Aisles, recommends guidelines for spaces required for the wheelchair accessibility. [2]

[1] **"Elevators", UBC Technical Guidelines, 2018.**

[2] **"STEPS, RAMPS, ACCESSIBLE ELEVATORS & AISLES", Learning Space Design Guidelines, 2018.**

3. REVIEW AND ANALYSIS OF STANDARDS APPLICABLE TO UBC INSTITUTIONAL BUILDINGS

3.1 AIR

3.1.1 WELL STANDARD

Air in WELL Building Standard aims to ensure high levels of indoor air quality across a building's lifetime. The following aspects have been covered: [1]

3.1.1.A RELEVANCE TO UBC CONTEXT	**3.1.1.B IMPLEMENTATION REQUIREMENTS**
A01, A05: Improving the quality of indoor air which can have positive effects on health, wellbeing and performance.[2]	A01, A05: Air quality testing and real-time assessment can be beneficial; however, it might need considerable investment for new tools and equipment.
A02: prohibiting indoor and outdoor smoking and implementing a 100% smoke-free environment.[3]	A02: Putting signs inside and outside the buildings that prohibit smoking and raising awareness of harmful effects of second-hand smoke exposure. A complementary strategy is deeper education and interaction with individuals.
A03, A06, A07: Ensure adequate ventilation in both mechanically ventilated and naturally ventilated spaces to avoid sick building syndrome. The use of operable windows is encouraged to naturally ventilate spaces which provides better human experience and higher productivity.[4]	A03, A06, A07: Natural ventilation must be accounted for in early stages of design for new buildings.
A04: Paying attention to details concerning polluting the indoor air quality in the construction stage such as ducts and other equipment.[5]	A04: Proper monitoring during the construction process to minimize polluting indoor air. Use of ducts and other equipment may have to be incorporated into building rules for the university projects.
A08: Installing calibrated sensors and detectors and correctly positioning them in spaces for real-time air quality control in all buildings. Furthermore, educating occupants about the risks associated with elevated air pollutant exposures.[6]	A08: This may be the most expensive requirement, both for the initial investment and the operating cost for maintenance. Conducting a study on appropriately positioning sensors and detectors in different spaces may also be necessary.
A09, A10, A11: Installation of entryway walk-off systems and/or entryway air seals at all main building entrances to capture emissions at the source before they spread to surroundings and opting for non-combustion or low-emission combustion products for reduction of carbon monoxide, nitrogen dioxide, small particles etc. in the air. Physical separation of pollution sources that are inevitable combined with direct ventilation exhaust systems.[7]	A09, A10, A11: Considering double doors for the main building entryway in the design process to lower the chances of bringing air pollutants into the buildings. For older buildings, it may not be practicable and implementing other filtration methods shall be considered.
A12, A13, A14: Selection and installation of proper carbon filters and regular maintenance of them	A12, A13, A14: Conducting research on microbe inactivation techniques and raise awareness of

[1] **"Air", *WELL Building Standard*, Version 2, International WELL Building Institute, 2018, pg 6.**

[2] **Ibid, 7-9, 16.**

[3] **Ibid, 10.**

[4] **Ibid, 11-13, 17-20.**

[5] **Ibid, 14-15.**

[6] **Ibid, 21-22.**

[7] **Ibid, 23-25.**

to avoid the sick building syndrome symptoms such as dry eyes, skin and throat irritation, fatigue and headache. Moreover, eliminating dampness and moisture-related indoor exposures for preventing asthma and other respiratory conditions which can be prevented through a combination of regular mold inspections and microbe inactivation techniques.[1]	sick building syndrome symptoms and other types of air related health risks.

One can see that most recommendations fall into the design category, which means having or adding equipment or building features that increases capital and operating costs. Some of these may have already been incorporated into existing buildings but if not, the extent by which it can be done is unknown. However, one thing seems clear: for a marked improvement, these recommendations / requirements are essential. The second category, operation recommendations, involves individuals inhabiting the building and their behaviour and lifestyle. These recommendations may not be as effective as the first set and require extensive education and interaction. But raising awareness together with working rules to protect people health is fundamental and may also have synergistic effect on other recommendations that require people's involvement for rational use and long-term operation.

3.1.2 LIVING BUILDING CHALLENGE V3

3.1.2.A RELEVANCE TO UBC CONTEXT	**3.1.2.B IMPLEMENTATION REQUIREMENTS**
Healthy Interior Environment is a subcategory of Health and Happiness in the Living Building Challenge that indicates that projects must explain how they will achieve an exemplary indoor environment through compliances with ASHRAE, CDPH and EPA. Smoking ban, Air quality tests before and 9 months after occupancy and dedicated exhaust systems for special areas are also suggested.[2]	To comply with this credit UBC requires a paradigm shift, new protocols and adherence to establish engineering standards for new constructions. Furthermore, implementation of some features may not be possible for some older buildings and some other may be difficult or costly. Thorough documentations are needed to check compliances with ASHRAE, CDPH and EPA.

3.1.3 NINE FOUNDATIONS OF HEALTHY BUILDINGS-HARVARD T.H. CHAN SCHOOL OF PUBLIC HEALTH

3.1.3.A RELEVANCE TO UBC CONTEXT	**3.1.3.B IMPLEMENTATION REQUIREMENTS**
Ventilation and Air Quality are two foundations of the Nine Foundations of Healthy Buildings. Ventilation section talks about the influence of air ventilation on health and how to achieve good ventilation such as meeting the ventilation rate guidelines, filtering outdoor and recirculated air, avoiding outdoor air intakes at street level and regular maintenance and monitoring systems.[3]	Nine Foundations of Healthy Buildings is intended for health centres like hospitals and thus some features might be too stringent to implement for a UBC campus building.
Air Quality section is concerned with supplies, furnishings and building materials with low chemical emissions to limit VOCs along with using	Requires complete documentation for all buildings for annual air quality testing.

[1] **Ibid, 26-29.**

[2] **"Healthy Interior Environment", Living Building Challenge 3.1, International Living Future Institute, 2016, pg 39.**

[3] **9 Foundations of Healthy Buildings, Building Evidence + For Health. 2017, pg. 6, 8-9.**

a vapor barrier to limit vapor intrusion and maintaining humidity levels between 30-60%. It also suggests conducting annual air quality testing and responding to occupant concerns. [1]	

3.1.4 RELI STANDARD

3.1.4.A RELEVANCE TO UBC CONTEXT	**3.1.4.B IMPLEMENTATION REQUIREMENTS**
RELi rating system does not have any metrics for Air itself and refers to LEED for Fresh Air.	RELi is developed primarily for resilience and secondary for health, so some features may not be directly health related or necessary or difficult and costly to implement.

[1] **Ibid 6, 11-12.**

3.2 WATER

3.2.1 WELL STANDARD

The WELL Water concept covers aspects of the quality, distribution and control of liquid water in a building. It includes features that address the availability and contaminant thresholds of drinking water as well as features targeting the management of water to avoid damage to building materials and environmental conditions.[1]

3.2.1.A RELEVANCE TO UBC CONTEXT	**3.2.1.B IMPLEMENTATION REQUIREMENTS**
Fundamental Water Quality	Sediment filters can reduce the turbidity of water by removing suspended solids.[1]
Water Contaminants	Activated carbon filters are made from highly porous material that collects chlorine and disinfectant by products, many pesticides and some pharmaceuticals and personal care products. Reverse osmosis (RO) systems operate by forcing pressurized water through a microscopic mesh to remove suspended solids and some microorganisms and dissolved contaminants.[1]
Enhanced Water Quality	Like pollutants with health-based concerns, the treatment system to address nuisance chemicals depends on the contaminant of interest. Assuming the turbidity and chlorine levels are managed, reverse osmosis can remove most of the aesthetic contaminants from the water.[1]
Water Quality Consistency	To help detect fluctuations in water quality, projects can undertake their own water sampling operations on a regular basis. Or, by installing treatment techniques such as sediment filters, UV disinfection systems, and reverse osmosis, projects can better accommodate water quality variations.[1]
Drinking Water Promotion	The first step toward increasing consumption of plain water is to make it easily available. This includes removing barriers to accessibility. When the addition of drinking fountains is combined with information sessions, consumption of plain water increases. In addition, since poor maintenance of drinking water facilities discourages consumption, it is important to keep water dispensers in a state of good repair.[1]
Moisture Management	Mold can find enough food and shelter on naturally present dust, so the best tactic to combat mold is to control the dampness of building materials. To minimize the negative effects of bulk liquid water, exterior sources of water (including precipitation and groundwater) should drain away from the building and the exterior cladding should block rainwater from

[1] **"Water", WELL Building Standard, Version 2, International WELL Building Institute, 2018.**

	traversing the building walls. In addition, the walls should contain capillary breaks to prevent water from wicking from outdoors to indoors; areas where condensation is likely to occur should use moisture-tolerant materials that dry quickly.[1]
Handwashing	Sinks and faucets should be designed in such a way as to avoid unnecessary contact with the hands. Bathrooms should include paper towels for hand drying, as there is stronger evidence about the ability of paper towels to dry hands and remove bacteria, as compared to air dryers.[1]

3.2.2 LIVING BUILDING CHALLENGE V3

The Living Building Challenge envisions a future whereby all developments are configured based on the carrying capacity of the site: harvesting sufficient water to meet the needs of a given population while respecting the natural hydrology of the land, the water needs of the ecosystem the site inhabits, and those of its neighbours. Indeed, water can be used and purified and then used again—and the cycle repeats. Reaching the ideal for water use means challenging outdated attitudes and technology with decentralized site- or district-level solutions that are appropriately scaled, elegant and efficient.[2]

3.2.2.A RELEVANCE TO UBC CONTEXT	**3.2.2.B IMPLEMENTATION REQUIREMENTS**
Net Positive Water	Project water use, and release must work in harmony with the natural water flows of the site and its surroundings. One hundred percent of the project's water needs must be supplied by captured precipitation or other natural closed-loop water systems,14 and/or by recycling used project water and must be purified as needed without the use of chemicals. All stormwater and water discharge, including grey and black water, must be treated onsite and managed either through reuse, a closed loop system, or infiltration. Excess stormwater can be released onto adjacent sites under certain conditions.[2]

3.2.3 NINE FOUNDATIONS OF HEALTHY BUILDINGS-HARVARD T.H. CHAN SCHOOL OF PUBLIC HEALTH

3.2.3.A RELEVANCE TO UBC CONTEXT	**3.2.3.B IMPLEMENTATION REQUIREMENTS**
Water quality is an important issue. What is less well known is that contaminated drinking water is one of the leading causes of disease globally, responsible for transmitting pathogens (i.e. cholera, dysentery, typhoid, polio). Microbial contamination is by far the largest contributor to the global burden of waterborne disease.	Test water quality regularly. Install water purification system for removal of contaminants, if necessary. Ensure residual disinfectant levels are enough to control microbes, but not in excess. Prevent water stagnation in pipes[3]

[1] **"Water", WELL Building Standard, Version 2, International WELL Building Institute, 2018**

[2] **Living Building Challenge 3.1, International Living Future Institute, 2016, pg. 29-30.**

[3] **9 Foundations of Healthy Buildings, Building Evidence + For Health. 2017, pg. 6, 8-9.**

3.2.4 RELI STANDARD

Resilient design pursues buildings and commodities that can survive, recover, grow and thrive when facing acute shock events or long-term stressors, through a combination of diversity, foresight and the capacity for self-organized and learning. [1]

3.2.4.A RELEVANCE TO UBC CONTEXT	**3.2.4.B IMPLEMENTATION REQUIREMENTS**
Hazard Preparedness	Fundamental Access to First Aid, Emergency Supplies, Water, Food, Communications. Enhanced Access to Emergency Care+ Supplies, Water, Food, Communications
Hazard Adaptation + Mitigation	Advanced Emergency Operations: Back-up Power, Operations, Thermal Safety+ Operating Water, On-Site Water Storage for Operations
Productivity, Health + Diversity	Human + Eco PHD- Reduce Pesticides, Prevent Surface + Groundwater Contamination
Energy, Water + Food: Minimum Water Efficiency + Resilient Water and Landscapes	Plan for Rainwater Harvesting, Resilient Landscapes + Food Production: Water Use Reduction, Near Zero/High Efficiency Water Flows and Resilient Landscapes
Materials + Artefacts	Reduce Net Embodied Energy + Carbon, Water and Toxins.

[1] **RELi 2.0, Rating Guidelines for Resilient Design and Construction, U.S.Green Building Council, INC, 2018.**

3.3 NOURISHMENT

3.3.1 WELL STANDARD

WELL Building Standard™ (WELL) requires the availability of fresh and wholesome foods, limits unhealthy ingredients and encourages better eating habits and food culture.[1]

3.3.1.A RELEVANCE TO UBC CONTEXT	**3.3.1.B IMPLEMENTATION REQUIREMENTS**
N01: Promotes the consumption of fruits and vegetables by making fruits and vegetables easily accessible by ensuring the visibility and accessibility. [2]	N01: Healthy food choices must be placed at dining outlets at UBC at all attention-grabbing areas like positions at eye level or just below eye level, next to cash registers, the end of aisles, beginning of food service lines, visible from the main building entrance, prominently displayed on countertop, table or another visible surface that grab attention.
N04: Food Advertising encourages the selection and consumption of healthier food choices through strategic placement and advertising of healthy food options. [3]	N04: Nutritional messaging in the form of prominent displays such as educational posters, brochures or other visual media at must be incorporated at designated eating. The purpose is to communicate the encouragement of the consumption of whole, natural foods and drinking water.
N08: Encourages mindful eating behaviours and communal dining opportunities. [4]	N08: This can be done by designing designated Eating Space that contains tables and chairs to accommodate at least 25% of regular building occupants at peak occupancy and provides protection from environmental elements.
N10: Provide space and supportive amenities for the preparation of meals on-site. [5]	N10: All dining Spaces must allow individuals to reheat or assemble food prepared at home can support healthy eating habits and cooking skills. Sufficient cold storage space can ensure safe food storage to accommodate the storage needs of individuals who bring meals from home. At least one dining space in each building contains the following supportive amenities a. Cold storage. b. Countertop surface. c. Sink and amenities for dish and hand washing. d. Device for reheating food (e.g., microwave, toaster oven). e. Dedicated cabinets or storage units available for employee use. f. Reusable eating utensils, including spoons, forks, knives and microwave-safe plates and cups.
N12: Improve access to fresh produce and provide opportunities for on-site food production.[6]	N12: The project provides a permanent and accessible space for food production within 800m from project boundary that meets the following requirements:

[1] **"Nourishment", WELL Building Standard, Version 2, International WELL Building Institute, 2018, pg 51.**

[2] **Ibid, 52.**

[3] **Ibid, 56.**

[4] **Ibid, 60.**

[5] **Ibid, 62.**

[6] **"Nourishment", WELL Building Standard, Version 2, International WELL Building Institute, 2018, pg 51.**

	a. Garden or greenhouse with food-bearing plants, Edible landscaping or Hydroponic or aeroponic farming system. b. The space is open to regular building occupants during regular building hours and foods grown are made available to regular building occupants. c. The space is at least 0.09 m2 [1 ft2] per eligible employee or 0.05 m2 [0.5 ft2] per student, whichever area is greater (up to a maximum of 70 m2 [750 ft2]). The area calculated is the actual growing area (vertical or horizontal) used to produce food-bearing plants.

3.3.2 LIVING BUILDING CHALLENGE V3

3.3.2.A RELEVANCE TO UBC CONTEXT	**3.3.2.B IMPLEMENTATION REQUIREMENTS**
It covers the aspect of food waste management by Net zero waste and methane management. [1]	To comply with this credit, if food even after expiry is still safe and edible, then provide them to food donations or for food gleaning. Food waste can also be fed to chickens or other animals or composted and returned to the soil.

3.3.3 RELI STANDARD

3.3.3.A RELEVANCE TO UBC CONTEXT	**3.3.3.B IMPLEMENTATION REQUIREMENTS**
EW05: Edible Landscaping, Urban Agriculture + Resilient Food Production amends regulations that allow On-Site Food Production: On-site Vegetable, Nut + Berry Production [2]	EW05: Fully develop the capacity, plan and implement on-site food production for at least 10% of the site area less the building footprint in the form of vegetable gardens and/or site appropriate edible nut and fruit-bearing plants. The Production must meet organic or transitional criteria.

3.3.4 FITWEL STANDARD

3.3.4.A RELEVANCE TO UBC CONTEXT	**3.3.4.B IMPLEMENTATION REQUIREMENTS**
Farmers Market provides convenient access to healthy food contributes to improved diets for employees. [3]	To comply with this credit, if food even after expiry is still safe and edible, then provide them to food donations or for food gleaning. Food waste can also be fed to chickens or other animals or composted and returned to the soil
On-site fruit and vegetable gardening opportunities contributes to increased physical activity levels and social capital benefits from working in the gardens. In addition, convenient	Support an on-site fruit and vegetable garden, that is at least 1 square foot or .09 square meters per regular occupant, accessible to all regular occupants, and maintained weekly. It is located

[1] **"Materials-Net zero waste and methane management", Living Food Challenge pilot, International Living Future Institute, 2016, pg 60, 61.**

[2] **RELi 2.0, Rating Guidelines for Resilient Design and Construction, U.S.Green Building Council, INC, 2018, pg 75.**

[3] **"Fitwel Food Services Standard" Fitwel scorecard, a1.**

access to healthy food helps improve diets for employees.[1]	within a 1/2 mile or an 800-meter walking route of the main building entrance.
Providing in Vending Machines & Snack Bars to access healthier food and beverage options can reverse the negative health impacts of traditional vending machines.[2]	Sample strategies include pricing incentives for healthy snacks.
Choice Architecture practices related to healthy food selection can increase the consumption of healthy food and beverages, and decrease consumption of competing food and beverages, leading to improved employee wellbeing and decreased obesity and related diseases.[3]	Detailing choice architecture practices employed in all cafeterias or in all on-site restaurants, cafés or prepared food retail areas, to promote healthy food. At least two of the following are required: - providing point-of-choice nutritional labelling - using displays and packaging design that highlight healthy food and beverages options - controlling food and drink portion sizing - increasing healthier food options - prioritizing the display of healthy food options - altering proximity of food options by changing food area layout - featuring healthy food options as defaults

3.3.5 URBAN LAND INSTITUTE

The Urban Land Institute is a non-profit education and research institute whose mission is to provide leadership in the responsible use of land and in creating and sustaining thriving communities worldwide. The recent ULI report, Agri hoods: Cultivating Best Practices, illustrates strategies for creating successful real estate projects centred around farms and other food production spaces.[4]

3.3.5.A RELEVANCE TO UBC CONTEXT	**3.3.5.B IMPLEMENTATION REQUIREMENTS**
Maximize food production spaces and distribution methods.	Food production spaces like Edible landscaping, Vineyards, Orchards/olive groves, Community gardens (professionally managed or community managed), Rooftop farms, Controlled-environment agriculture, such as greenhouses, warehouses and shipping containers
The market for local food consumption can be supported by real estate developments	On-site food halls or public markets; - Access to local farmers markets (either on site or nearby); - Restaurants and retail establishments, including grocery stores, that offer local food projects.

[1] **ibid**

[2] **ibid**

[3] **ibid**

[4] **"Agri hoods – cultivating best practices", The Urban Land Institute, 2018. pg 11-45**

3.4 LIGHT

3.4.1 WELL STANDARD

The WELL standard features as listed below require projects to ensure appropriate light exposure in indoor environments by using daylighting or electric lighting strategies to create lighting environments that are optimal for visual, mental and biological health.[1]

3.4.1.A RELEVANCE TO UBC CONTEXT	**3.4.1.B IMPLEMENTATION REQUIREMENTS**
L01: This feature requires projects to ensure appropriate light exposure in indoor environments by using daylighting or electric lighting strategies. To encourage users to seek light exposure on their own, projects are required to provide users with education about the importance of light for health. Access to appropriate levels of light in indoor environments can be achieved through building design, space layout and lighting design. Windows, atriums and skylights are design features that can be utilized to increase daylight in a space. Project need to provide education regarding circadian rhythm, sleep hygiene, age-related increase in light requirements and/or importance of daylight exposure on circadian and mental health. [1]	L01: Since there are many aspects which need to be considered in improving daylighting in the building, such as building orientation, skylight, size of the windows etc., it will be more effective if daylighting is considered at the design phase. The existing buildings can be improved by upgrading the electric lighting systems and implement some of the ideas in this section to achieve higher light quality. Education is also very important and UBC needs to invest on it. When occupants, designers and contractors have more awareness about its aspect of health and wellbeing, the improvement will be easier and more achievable.
L02: This feature requires projects to provide appropriate illuminances on work planes for regular users of all age groups while considering light levels required for the tasks performed in the space.[1]	L02: New buildings at UBC can consider these concepts along with the required daylighting at the design phase. This concept can be considered by upgrading the lighting strategy in the existing buildings as well.
L03: This feature requires projects to provide users with appropriate exposure to light for maintaining circadian health and aligning the circadian rhythm with the day-night cycle by considering the light levels entering the eye of the occupant and the duration of exposure to light as well as the timing of exposure. [1]	L03: This feature can be improved significantly by upgrading the electric lighting systems.
L04: This feature requires projects to manage glare by using a combination of strategies such as calculating glare, choosing appropriate light fixtures for space and using shading techniques. Space planning and lighting design can minimize the amount of glare experienced by individuals in the space. For electric lighting, the light source, type of luminaires used, and lighting layout can lead to reduced glare. For daylighting, integrating shading for all windows or conducting a daylighting analysis in the space can help manage solar glare.[1]	L04: These concepts can be applied in both UBC new and existing buildings.

[1] **"Light", WELL Building Standard, Version 2, International WELL Building Institute, 2018.**

L05: This feature requires projects to design spaces to integrate daylight into indoor environments so that daylight may be used for visual tasks along with electric lighting. It also provides individuals with a connection to outdoor spaces through view windows. Building design and interior layout have a substantial impact on the amount of daylight in an indoor space. Indoor daylight access should be accounted for at all stages of building planning from architectural and façade design to interior design and layout. Calculation of daylight ingress accounting for seasonal variances and interior design of indoor spaces is required to ensure that users have adequate access to daylight exposure. [1]	L05: The concept of daylighting can be applied in UBC's existing buildings by improving the interior design and usage of spaces to optimize natural light in the buildings. In UBC's new buildings, it is a great opportunity to explore different items and implement them as much as possible.
L06: This feature requires projects to develop and implement strategies that consider the light sources used in a space and create a visually comfortable lighting environment. Development of a lighting layout and operations schedule to complement the lighting design in a space is key to increasing the comfort of users. Evidence suggests that thoughtful planning of lighting in a space that considers colour temperature, daylight, and electric light supports a visually comfortable lighting environment. Consideration of the ages of users, tasks performed and existing physical features in the space are also integral to creating a productive space.[1]	L06: This concept can be achieved by improving or upgrading the lighting systems in UBC buildings.
L07: This feature requires projects to consider characteristics of electric light used in the space such as colour rendering, colour quality, and flicker. Using light sources that have characteristics like daylight can improve the comfort and wellbeing of users in space and contribute to creating a healthy environment. Identifying and utilizing lighting fixtures that emit a high quality of light and do not display signs of flicker contributes to a comfortable and healthy space. Light fixtures with higher colour rendering emit light that shows colours realistically. [1]	L07: This feature can be implemented by upgrading the electric lighting systems.
L08: This feature requires projects to implement innovative lighting strategies that consider personal preferences of users as well as their interaction with the physical space. Developing a lighting environment that not only seeks to satisfy the visual and circadian requirements of individuals but also creates a customizable environment helps to improve the productivity, mood, and wellbeing. [1]	L08: This feature is not easy to implement since there are many people in the building with the different comfort levels. However, it can be achieved by upgrading the electric lighting of UBC's existing buildings and including this feature in the lighting strategy of UBC's new buildings.

[1] **"Light", WELL Building Standard, Version 2, International WELL Building Institute, 2018.**

3.4.2 LIVING BUILDING CHALLENGE V3

3.4.2.A RELEVANCE TO UBC CONTEXT	3.4.2.B IMPLEMENTATION REQUIREMENTS
Section 9 - Biophilic Environment There is a requirement to include elements in design that nurture the innate human/nature connection by deliberately incorporating nature through Environmental Features, Light and Space, and Natural Shapes and [1] Forms. Section 16 - Universal Access to Nature and Place The project may not block access to, nor diminish the quality of, fresh air, sunlight, and natural waterways for any member of society or adjacent developments. [2] Sunlight: The project may not block sunlight to adjacent building façades and rooftops above a maximum height allotted for the Transect. The project may not shade the roof of a development with which it shares a party wall unless the adjoining development was built to a lesser density than acceptable for the Transect.	UBC must define and mandate the minimum requirements for incorporation of natural light in the design of buildings in the UBC Technical Guideline. UBC also needs to consider the concept of Biophilic design in new buildings.

3.4.3 NINE FOUNDATIONS OF HEALTHY BUILDINGS-HARVARD T.H. CHAN SCHOOL OF PUBLIC HEALTH

3.4.3.A RELEVANCE TO UBC CONTEXT	3.4.3.B IMPLEMENTATION REQUIREMENTS
Any electric lighting used should optimize both the visual and non-visual responses to light.[3] Non-visual responses to light: We need appropriate light exposure, otherwise, our internal clock can become disrupted or even drift on its own time, leading to sleep disorders. In addition to its circadian Resetting properties, light is also a stimulant and can directly enhance alertness and performance, or, at the wrong time, disrupt sleep. Light intensity and light spectrum are two important factors in mediating the effects of light. In general, increasing the intensity of indoor light will increase the magnitude of non-visual effects.	To include requirements for lighting in UBC Technical Guidance and to address non-visual responses to light.

3.4.4 RELI STANDARD

3.4.4.A RELEVANCE TO UBC CONTEXT	3.4.4.B IMPLEMENTATION REQUIREMENTS
HA Credit 3: It is required to provide a plan to execute passive thermal lighting, heating and cooling strategies.	There are requirements in the UBC technical guideline for emergency lighting, but they do not address the extreme events as mentioned in RELi.

[1] **BIOPHILIC ENVIRONMENT", Living Building Challenge 3.1, International Living Future Institute, 2016, pg 43.**

[2] **" UNIVERSAL ACCESS TO NATURE & PLACE", Living Building Challenge 3.1, International Living Future Institute, 2016, pg 55.**

[3] ***9 Foundations of Healthy Buildings.* Building Evidence + For Health. 2017**

the intent is to provide opportunities to moderate the indoor building temperatures during normal operation and at times of grid-supplied power and/or fuel outages, heat waves, sheltering-place emergencies and other extreme events when local self-reliance is critical.[1] HA Action 3.2 Passive Lighting: 1. daylighting from Multiple Sides 2. Form for Daylighting 3. Intermediate Light Shelves 4. Side Daylighting 5. Side Daylighting Controls 6. Top Daylighting 7. Top Daylighting Controls	

[1] **RELi 2.0, Rating Guidelines for Resilient Design and Construction, U.S.Green Building Council, INC, 2018, pg 48.**

3.5 MOVEMENT

3.5.1 WELL STANDARD

WELL Building Standard comprises of Movement category which promotes active living and discourages sedentary lifestyle through interventions in design, program and policies.[1] The following aspects for the institutional buildings have been covered in the movement concept:

3.5.1.A RELEVANCE TO UBC CONTEXT	**3.5.1.B IMPLEMENTATION REQUIREMENTS**
V02, V07, V10: Improving the ergonomic comfort in a workplace can reduce the physical strain and injury through ergonomic design, yearly furnishings audit and providing active workstations.[2]	V02, V07, V10: The furnishings provided in the workplace at UBC must be ergonomically tested and should comply to the furnishing requirements provided in the WELL building standards. This can be achieved by making ergonomically tested furnishings mandatory for all the new buildings along with regular testing in every few years. Annual or biannual ergonomic testing of furnishings must be conducted based on the condition of the furnishings and budget of the existing buildings.
V03: Considers the circulation network to promote movement and regular use of the staircase. Few suggestions include enhancing the stairwell, use of directional signage, motivational messaging and gamification strategies can initiate active use of stairs. Active design guidelines recommend locating the stairs close to the entry points and visible before the elevators or escalators. [3]	V03: The new buildings at UBC can consider these concepts at the design phase. The existing buildings can implement some of the ideas to achieve active use of circulation spaces. However, making heavy changes to the existing buildings circulation spaces can be challenging based on the budget and space constraints.
V04: Providing amenities that support cycling and walking to the site through bike parking infrastructure and policies.[4]	V04: The new building projects at UBC must dedicate spaces for bike parking infrastructure as mentioned in the guidelines. The existing building sites at UBC can be redesigned or space around them can be allocated to fulfil this need.
V05: The site location which offers various amenities, is near the transit systems, and provides pedestrian and cycling infrastructure tends to promote active living and healthy neighbourhoods. [5]	V05: The new building site should be located within the recommended range of the transit system and be surrounded by minimum facilities as recommended in the guidelines. For the existing buildings, bus loops can be redesigned within the campus to fall in the proximity zone.
V06, V08, V11: Encouraging physical activities through providing physical activity opportunities, spaces, equipment's, education and awareness at no cost.[6]	V06, V08, V11: The institutional buildings and departments at UBC should dedicate spaces for physical activities and equipment. The existing buildings must allocate space for the physical

[1] **Movement", *WELL Building Standard*, Version 2, International WELL Building Institute, 2018, pg - 97.**

[2] **Ibid, 97-99, 108, 113.**

[3] **Ibid, 100-101**

[4] **Ibid, 102**

[5] **Ibid, 104-105**

[6] **Ibid, 106-107, 109-110, 114-115.**

	activities based on their space and budget constraints.
V09: Pedestrian friendly site design should be integrated in the site planning by considering street lighting, crosswalk safety, sidewalk continuity and pedestrian-scale aesthetics to promote walking as a physical activity. Active facades and street furnishing are few other strategies that can attract pedestrians to the streets. [1]	V09: UBC pathways inside and outside of the buildings should be made pedestrian friendly and easily accessible. The facades of the buildings and street furnishings should be open towards the outside and interact with the street to engage the pedestrians and feel connected.
V12: Self-monitoring is promoted to engage the occupants in keeping the record of their physical activity and access their own data through wearables. [2]	V12: Buildings can have a system to inform the occupants about their physical movements and provide them the data that would further encourage them.

3.5.2 LIVING BUILDING CHALLENGE V3

3.5.2.A RELEVANCE TO UBC CONTEXT	**3.5.2.B IMPLEMENTATION REQUIREMENTS**
Human powered living in the Place category of the guideline aims at creating walkable and pedestrian-oriented communities by letting the team evaluate the potential to provide a mobility plan which addresses the interior and exterior of the project to support human powered lifestyles. [3]	To comply with this credit, each institutional project at UBC must consider the aspects of Human powered living and propose plans to execute them.

3.5.3 NINE FOUNDATIONS OF HEALTHY BUILDINGS-HARVARD T.H. CHAN SCHOOL OF PUBLIC HEALTH

3.5.3.A RELEVANCE TO UBC CONTEXT	**3.5.3.B IMPLEMENTATION REQUIREMENTS**
The '9 Foundations of Healthy Buildings' report specifies active design as an element of healthy living by providing easily accessible staircase, recreational areas, ergonomic furnishings and following occupational safety guidelines.	The new and existing institutional buildings at UBC can create spaces and provide facilities that promote active design and making it an integral and important aspect of spatial design.

3.5.4 RELI STANDARD

3.5.4.A RELEVANCE TO UBC CONTEXT	**3.5.4.B IMPLEMENTATION REQUIREMENTS**
CV2: At the community level, the RELi standard aims at reducing traffic congestion and shifting to non-motorized transportation and public transit. The standard recommends increasing the options of transportation that can be made available during the crisis. The standard focuses on improving accessibility and mobility through locating, designing and constructing projects that avoids urban sprawl and creates liveable communities. [4] This credit refers to the LEED BD+C	CV2: To comply with this credit, the institutional buildings should be located based on a thorough understanding of its surrounding facilities and context. Transportation, amenities, services, surrounding density, street character, connectivity, walkability and mobility needs to be addressed as per the recommended guidelines.

[1] **Movement", *WELL Building Standard*, Version 2, International WELL Building Institute, 2018, pg. 111.**

[2] **Ibid, 116.**

[3] **"Human Powered Living", Living Building Challenge 3.1, International Living Future Institute, 2016, pg. 27.**

[4] **RELi 2.0, Rating Guidelines for Resilient Design and Construction, U.S.Green Building Council, INC, 2018, pg. 53-54.**

V4 (New Construction) and LEED ND V4 (Neighbourhood Development).	
PH2: This credit is divided at building level and community level and aims to promote physical activity by setting up a requirement to follow the Design Categories, Community Group and Urban Environment category from the Centre for Active Design Checklist. [1]	PH2: The buildings at UBC must follow the Centre for Active Design Checklist and include recommended items from the list to gain this credit.

[1] **RELi 2.0, Rating Guidelines for Resilient Design and Construction, U.S.Green Building Council, INC, 2018, pg 62-63.**

4. INFORMING POLICY MAKING AND RECOMMENDATIONS

The UBC guidelines, standards, regulations and plans for new and renovation of existing buildings should be updated to ensure they reflect the best standards to enable improved health and wellbeing, rather than minimum safety levels. The current UBC standards, guidelines and plans do not cover the health and wellbeing component in the buildings. More research, study, education and robust planning is needed to ensure that we close the gap between the current requirements and actual needs for addressing health and wellbeing concerns in the buildings.

In this report, we have identified the gaps in the current standards and guidelines in UBC and provided recommendations to stakeholders the best action or plan to fill the gaps and meet the requirements for incorporation of health and wellbeing components in regard to air, water, nourishment, light and movement.

4.1 GAPS IDENTIFIED

AIR- Indoor air quality is talked about briefly in the Vancouver Campus Plan Design Guidelines but as the guide mentions itself, it is not enough to achieve UBC LEED's Gold requirements. Moreover, UBC LEED Implementation Guide has some specifications about air quality in general that could be modified for only institutional buildings. Unfortunately, as-built documentation of existing buildings is very fragmented and need improvement for better assessment of air quality and potential monitoring and maintenance in buildings.

WATER- The standards propose some ideas for water component, but they do not provide specific information pertaining to institutional buildings. Hence, UBC can extract information from these standards and create its own list of guidelines. The standards have focused on water quality and efficiency, so it may be effective to consider water supply as well. Furthermore, there are no specific guidelines for water fountains and equipment.

NOURISHMENT- There is no standard in place at UBC that covers or encourages nourishment on campus. Though UBC has been taking measures on reducing the consumption of sugary food, it is necessary to look on nourishment in the full ecosystem. Thus, UBC can extract information from these standards and create its own list of guidelines.

LIGHT- There are some requirements in UBC technical guideline and UBC LEED Implementation Guide regarding incorporation of daylighting in the passive design or the minimum requirements for lighting for the occupants in a building to improve energy saving in the buildings. However, the requirements are very general and do not address health and wellbeing concerns.

MOVEMENT- The standards reviewed for movement component has fragmented information and do not provide a holistic information pertaining to institutional buildings. Movement in these standards is limited only to the circulation areas and workplaces and does not include classrooms, libraries, labs, etc. Hence, UBC can extract information from these standards, identify sources for further research and formulate its own guidelines.

4.2 RECOMMENDATIONS

4.2.1 AIR

FOR UBC:

- Planning for better documentation in new construction for realization of real-time monitoring and assessment of air quality.

- Awareness of the implications of bad air quality and air pollutants and its effects on performance and health.

FOR DESIGNERS:

- Implementing guidelines from WELL in early stages of design (IDP) regarding indoor air quality and natural ventilation in all new buildings.

- Paying attention to selecting and proper installation and maintenance of sensors and filters for CO2, VOCs and other pollutants to avoid sick building syndrome in all buildings.

- Familiarization with design provisions necessary for achieving green buildings performance, within or outside UBC context.

- Awareness and encourage to design operable windows for natural ventilation that result in higher performance and better human experience as mentioned in WELL.

FOR CONTRACTORS:

- Familiarization with implications of WELL in design and construction such as attention to details concerning polluting the indoor air quality in the construction stage.

The effectiveness of above recommendations shall be monitored using suitable metrics, as follows:

- For the recommendations requiring additional equipment or building features, a survey must be performed to determine the number of buildings where these are feasible, for planning and budgeting purposes. Therefore, a suitable metric is the number of buildings that have been renovated accordingly versus the number planned.

- For recommendations requiring measurements, the number of measurements and the extent of compliance with standard requirements is the most revealing metric.

- For the recommendations related to lifestyle of inhabitants, surveys can be used to determine acceptability or 'market response.' The number of educational activities (or the number of people covered) and their effectiveness is a good metric for monitoring progress.

- Some recommendations involve modifications to university's building procedures and rules. For this type of recommendations, probably the best metric is the number of modifications actually followed in new projects. A study on practicality of this would be useful.

4.2.2 WATER

FOR UBC:

- All new buildings should be designed and constructed to higher sustainability standards to reduce water consumption and maintenance requirements; and improve liveability.

- Creating developments that operate within the water balance of a given place and climate.

- Following best practices in infrastructure management, the capacity of water systems will be appropriately designed and sized to support current and future development.

- All new buildings should provide performance monitoring (metering) infrastructure for water systems.

- Explore the feasibility of using retained rainwater to supply water features in the public realm.

- Increase the number of water fountains with regards to water needs in different places.

4.2.3 NOURISHMENT

UBC has taken some measures to follow some of these guidelines towards the wellbeing to encourage nourishment. Some of the implementations in place are the development of 20-year sustainable strategy and UBC Farm. While definite metrics to evaluate nourishment as component has not been recognised, some recommendations from other standards aligning to UBC policies and guidelines have been identified.

FOR UBC:

- UBC should meet with all the food providers on Campus and provide regulations based on the analysed standards to promote healthy food consumption.

- Availability of healthy foods containing organically produced fresh fruits and vegetables across all snack bars / vending machines.

- UBC must emphasis to cultivate farm areas, community gardens, rooftop gardens, food producing trees on campus to produce sufficient locally grown healthy fruits and vegetables across campus.

- The fresh food produced on campus or local farms must be made available at a nominal price at a market place located at the centre of campus and made visible to everyone.

- Awareness and educational program should be a part of the curriculum for the students to inform them about the positive implication of healthy eating habits.

FOR PLANNERS & DESIGNERS:

- The new building planning codes must abide to the standards to promote healthy eating.

- Planners and Architects must incorporate spaces for onsite food production like Edible landscaping Rooftop farms, Controlled-environment agriculture in their design.

- Designers must promote Nutritional messaging like consumption of natural foods and drinking water in the form of prominent displays like posters or visual media at all dining areas.

- All measures to promote consumption of natural foods by designing food counters or dining areas visible to natural foods must be incorporated.

4.2.5 LIGHT

In terms of lighting, UBC needs to focus on two main aspects: first to improve and enhance daylighting in the buildings to address the circadian rhythm requirement as per the WELL standard and second to upgrade the lighting system to dynamic circadian rhythm lighting. Improving daylighting can be possible in long term at the design stage of the new building or at the time of major renovation, however,

upgrading the existing lighting is possible in short term with the lower cost which could have higher priority.

Below is a brief review regarding the costs and practicality of upgrading of lighting system to dynamic circadian rhythm lighting:

As an example, the cost of a 4 ft. light bar with controller and power supply is around $700 - $1000, depending on the size of the project excluding taxes and installation. The lights are simple to install and use. Once the lights are plugged in, they can be used. This means that they do not rely on networking (there is no need to rip the ceiling out) and they also do not rely on programming, because they are preprogramed in the factory. Commissioning is about 15-20 minutes per light, which saves substantially on labour costs. The manufacturing and delivering could be within 12 weeks.

As per the specification of one of this type of lighting, there will be around 22% energy saving over static LEDs and 70% energy saving over fluorescent which can also address the requirements of energy components in UBC GBAP.

In parallel UBC need to define and establish clear requirements in its guidelines and standard regarding lighting and define its short- and long-term goals. The following are some recommendations or suggestions:

For UBC:

- Review the WELL standard and Biophilic design and develop the lighting standard for UBC to address the requirements in terms of health and wellbeing.

- Conduct survey for the existing buildings from the students, employees and residents to get a better understanding of the challenges and urgency to address the issues.

- As a pilot project, try to achieve a WELL certificate for one of its new buildings to get a better idea of the challenges, costs and benefits.

- Provide education to students, faculty, employees and residents to understand the importance and quality of good lighting in their health and wellbeing.

- Include the minimum and mandatory requirement in the UBC Technical Guideline.

- UBC encourages contractors, suppliers and designers to provide the best solution in addressing the health and wellbeing requirements in their design or proposal.

FOR DESIGNERS:

- Since the requirements of lighting need to be reviewed and considered at the design stage to be effective, designers need to understand UBC concerns and requirements and address them accordingly.

FOR CONTRACTORS:

- For those items which are not quantified but required, contractors review the requirements in the UBC Technical Guideline and provide their best proposal.

4.2.5 MOVEMENT

The standards referred to study movement component for UBC has unique and overlapping guidelines in the reviewed standards that can be applied at UBC institutional buildings. UBC has taken various measures to follow several of these guidelines to create UBC pedestrian friendly, universally accessible and cyclist friendly campus, and encourage physical lifestyle, but lacks these concepts in many existing institutional buildings. The application of the recommendations for the movement component is dependent on the budget available for each existing and new institutional buildings. The design considerations and furnishings proposed should be economically feasible and locally available. The following are the recommendations for the design of the institutional buildings based on the UBC policies and guidelines, and listed standard's review:

FOR UBC:

- UBC should document all the institutional buildings to check its level of compliance with the list of guidelines mentioned in the reviewed standards.

- A segregation of existing buildings into stages of implementation should be proposed based on its compliance to the standards. This will help to set a plan and timeline to make all the institutional buildings compliant with the movement component.

- The furnishings of the existing buildings should be replaced if they are not ergonomically comfortable. A plan should also be drafted for the disposal of all the old furnishings.

- A system should be generated to initiate measures to inform the occupants about their activity use in the institutional buildings.

FOR DESIGNERS:

- The new building planning and construction should abide by the standards to promote physically active lifestyle.

- Physical activity infrastructure should be allocated in the building design as per the guidelines.

- All the circulation spaces should be well-thought-out in the building design to engage the occupants with the space and encourage movement in the building.

- The physical comfort aspects implemented in the design can be measured through the study of ergonomics.

4.3 FUTURE RESEARCH

4.3.1 AIR

- Extend the WELL implementation study to other buildings, particularly the older ones, to obtain a benchmark for the required investments in the future for achieving green building performance according to GBAP and LEED certification.

- Perform surveys among building inhabitants to get actual performance feedback and raise awareness.

- Investigate incorporation of various tools and frameworks other than WELL to take advantage of their synergistic effects.

- A SWOT analysis for UBC development strategies (not for frameworks like LEED) to determine relevance of emerging ideas like Regenerative or Resilient buildings.

4.3.2 WATER

- It seems like a good idea to conduct a study regarding drinking fountains to consider maintenance, accessibility and tolerance of heavy use of water fountain.

- About the water demand, a pilot study can be started to identify the potential of UBC different places to construct new water fountain.

4.3.3 NOURISHMENT

- There have been studies under some parts of nourishment like food production, food distribution while WELL is the only standard to undertake nourishment fully as one component. Hence research team must actively involve in studying the global best practices on food and nourishment.

- A study on research documents from Urban Land Institute should be taken to see what can changes can be proposed for nourishment during the phases of zoning and master plan design.

4.3.4 LIGHT

- UBC needs to assign a research team to study the requirements and challenges in detail, specify the mandatory and optional requirements and prioritize them.

- Study and review feedback and comments on other WELL certified buildings and apply the lessons learned.

4.3.5 MOVEMENT

- The study on the movement in each of the standards are in bits and pieces and has its own interpretation. A study on projects receiving credits for this component and its success should be considered to select the standard system that is best fitted for UBC institutional buildings.

- A study on movement in all the spaces of an institution should be conducted to promote active lifestyle.

- To prepare for a resilient neighbourhood and buildings, a study on emergency protection plan and design layout on movement should be conducted.

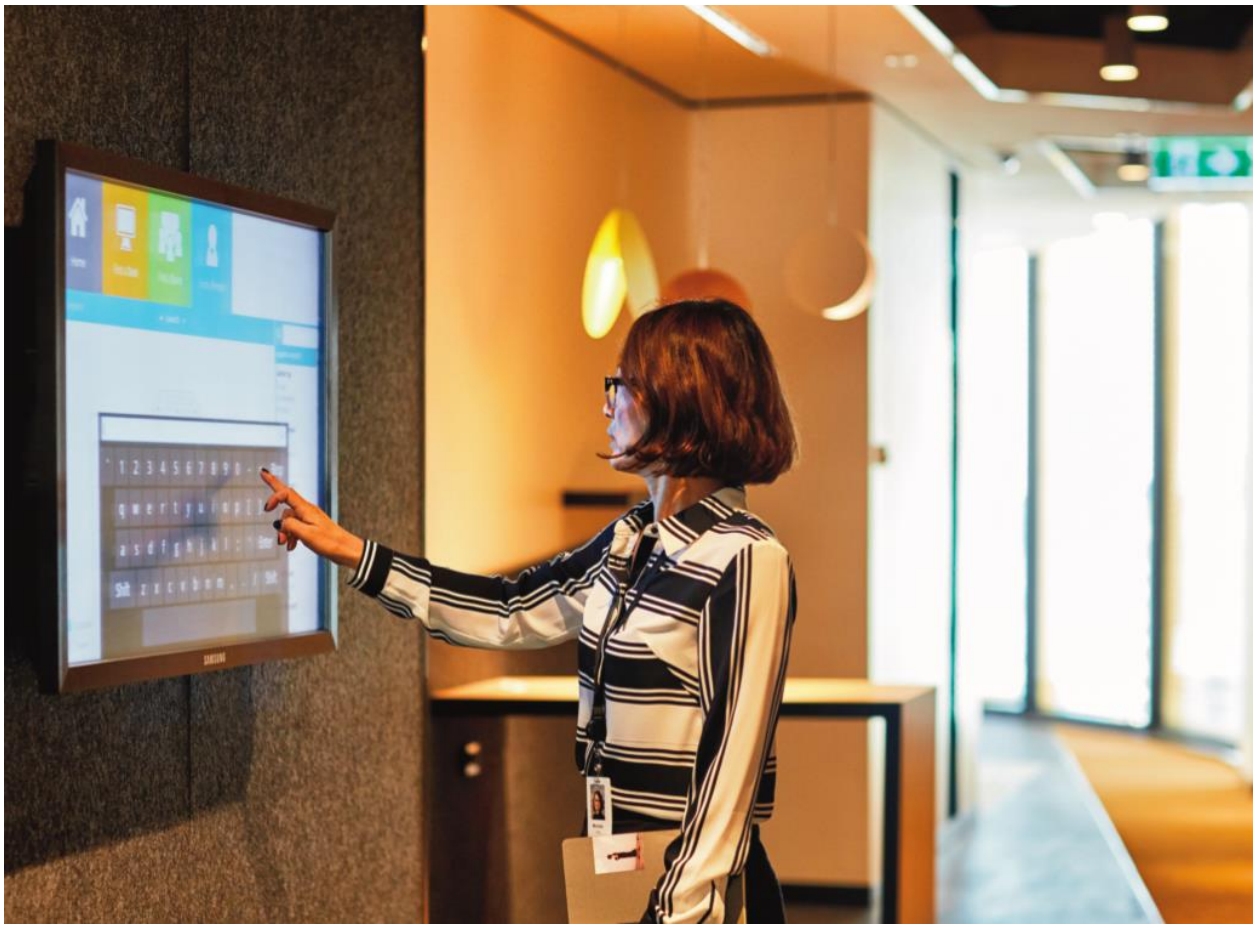
- The measure of social interactions promoted through movement is intangible in nature and hard to measure at the design stage. Hence, further study can be considered to measure social cohesion through design.

5. PRECEDENTS

5.1 AIR

5.1.1 MIRVAC HEADQUARTERS, SYDNEY, AUSTRALIA, WELL GOLD CERTIFIED

To monitor and effectively remediate indoor air quality issues and inform building managers and occupants of the quality of the indoor environment, Mirvac's SAMBA (Sentient Ambient Monitoring of Buildings in Australia) sensors monitor a number of environmental factors, including thermal comfort and indoor air quality. The data is then displayed to staff and visitors on a number of interactive screens throughout the space.



1. SAMBA monitoring system at Mirvac, Sydney Australia

https://www.wellcertified.com/en/articles/mirvac-headquarters

5.1.2 DELOITTE, 1 NEW STREET SQUARE, LONDON, UNITED KINGDOM, WELL GOLD CERTIFIED

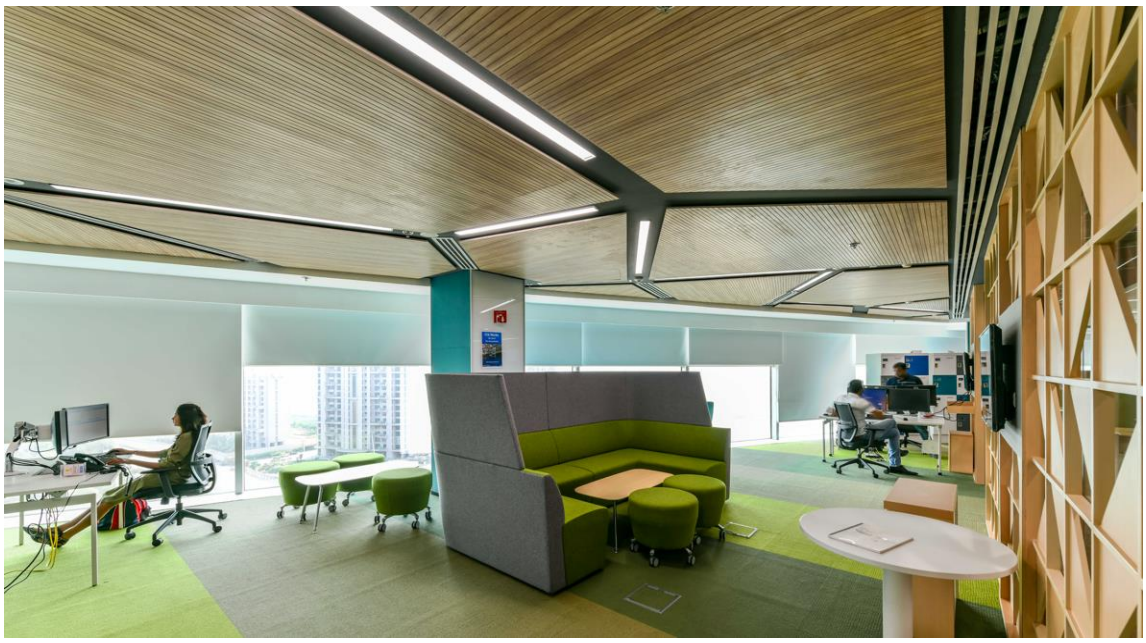
Enhancing air quality by designing out sources of air pollution from construction materials, furniture and equipment; working with our Facilities provider to ensure operational cleaning and maintenance regimes used low-toxicity products; and installing 620 sensors within an innovative Intelligent Building network to ensure temperature, humidity and air quality remain optimal.

2. Deloitte, London, UK

https://wellonline.wellcertified.com/project-profiles/deloitte-1-new-street-square

5.1.3 CITI ENCLAVE PHASE 6C, MAHARASHTRA, INDIA, WELL SILVER CERTIFIED

Citi Enclave 6C has poor outdoor air quality where PM 2.5 and PM 10 levels are not within acceptable range of WELL Air Quality Standards. To remove indoor and outdoor airborne contaminants, the project has introduced an air duct filtration system that reduces PM2.5 and PM 10. This filtration is combined with low-VOC materials indoors to ensure clean, healthy air for all occupants.



3. Citi Enclave Phase 6C, Maharashtra, India

https://wellonline.wellcertified.com/project-profiles/citi-enclave-phase-6-c

5.2 NOURISHMENT

5.2.1 COVENTRY UNIVERSITY, COVENTRY, UNITED KINGDOM, GREEN FLAG AWARD

The university's 'Edible Campus' is one of just nine inspirational parks and green areas in the UK - and the only university space - to achieve the award, which is presented to Green Flag Award or Community Award winning sites that show that they have made changes which have brought outstanding benefits to both their site and the local community.

Campus has 2 areas of green space scattered with edible plants like tomatoes, asparagus, peas and lettuce.

Implementation Strategies:

- No labelling of edible plants – to promote interaction in community, sample the plants or communicate with each other about the plants they have identified.
- No separate/ restricted areas for edible plants – incorporated into existing landscape

4. Edible Landscaping at Coventry University, UK

5.2.2 UNIVERSITY OF MASSACHUSETTS AMHERST, MASSACHUSETTS, UNITED STATES

UMass Permaculture Initiative is a unique and cutting-edge sustainability program that converts underused grass lawns on the campus into edible, low-maintenance and easily replicable gardens. Presently there are 4 permaculture gardens on campus. 4500 pounds of food produce has been cultivated to date. There are more than 2000 fruit trees on campus.

Implementation Strategies:

- Involved more 500 local youths from Schools nearby, 2000 students on campus, incorporated over 1,000,000 pounds of UMass compost, recycled cardboard and wood chips without the use of any fossil fuels on-site.

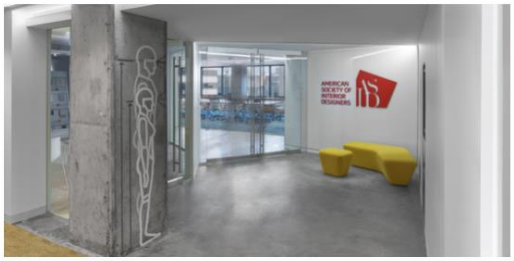
- UMass Amherst participates in the Real Food Challenge, requiring 20% of the university's food purchases be "real food" — local/community-based, fair, ecologically sound, and humane food sources — by 2020

- Students receive class credits for their work at the gardens.

5. Franklin Permaculture Garden at UMass Amherst.

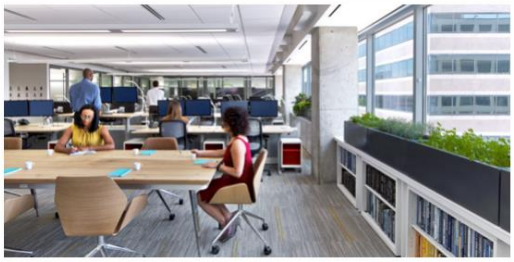
5.3 LIGHT

5.3.1 AMERICAN SOCIETY OF INTERIOR DESIGNERS (ASID) HEADQUARTERS, WASHINGTON DC, UNITED STATES, WELL PLATINUM & LEED PLATINUM CERTIFIED

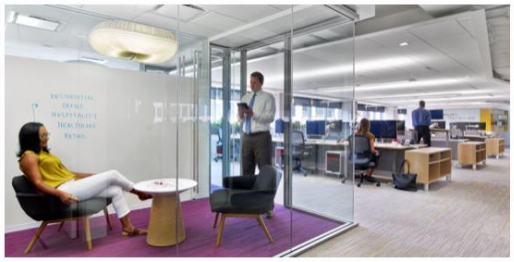


Lobby entrance, ASID DC HQ

Corridor, ASID DC HQ



Open collaborative workspace, ASID DC HQ



Flex conferencing space, ASID DC HQ

6. American Society Of Interior Designers (ASID) Headquarters, Downtown Washington, DC

https://ghtltd.com/asid-dc-hq-earns-platinum-well-leed/

Design aspects of biophilia were used throughout including selecting light fixtures to mimic patterns found in nature similar to how sunlight is scattered through tree leaves. The lighting strategy, from automatic daylight harvesting to automatic shade controls and occupancy/vacancy sensors, is to eliminate eye strain and other negative ergonomic impacts from glare.[1]

The positive impact of the office is demonstrated through some of the pre-/post-occupancy research conducted to-date. The indoor environmental attributes (i.e., lighting, acoustics, and CO2 levels) show that the ASID office is a healthier environment. Additionally, research by Cornell University found that employee satisfaction on the environmental quality of the office increased significantly, as did overall job satisfaction, perceived support by the organization, and perceived organizational productivity.[2]

[1] https://ghtltd.com/projects/american-society-interior-designers-asid-headquarters/

[2] https://ghtltd.com/asid-dc-hq-earns-platinum-well-leed/

5.3.2 MIRVAC HEADQUARTERS, SYDNEY, AUSTRALIA, WELL GOLD CERTIFIED

7. Mirvac Headquarters, Sydney , Australia

https://www.terramai.com/blog/well-building-standard/

The highlights of the project regarding lighting include:

- 75% of workstations are located within 7.5 meters of a window, increasing access to natural light to provide physiological benefits; and

- Lights are also programmed for varying brightness and darkness at appropriate points throughout the day to maintain optimal circadian rhythms.

Over the past few years, Mirvac conducted a series of internal Indoor Environmental Quality ("IEQ") surveys utilizing the Building Occupants Survey System Australia ("BOSSA") methodology. The new BOSSA survey has recorded a significant increase in employee's IEQ satisfaction scores. The BOSSA measurements for overall performance, health and productivity improved by 35 percent since the previous survey.

8. Mirvac Headquarters, Sydney, Australia_https://www.buildaustralia.com.au/news_article/healthiest-workplace-australia-mirvacs-hq-receives-well-certification/

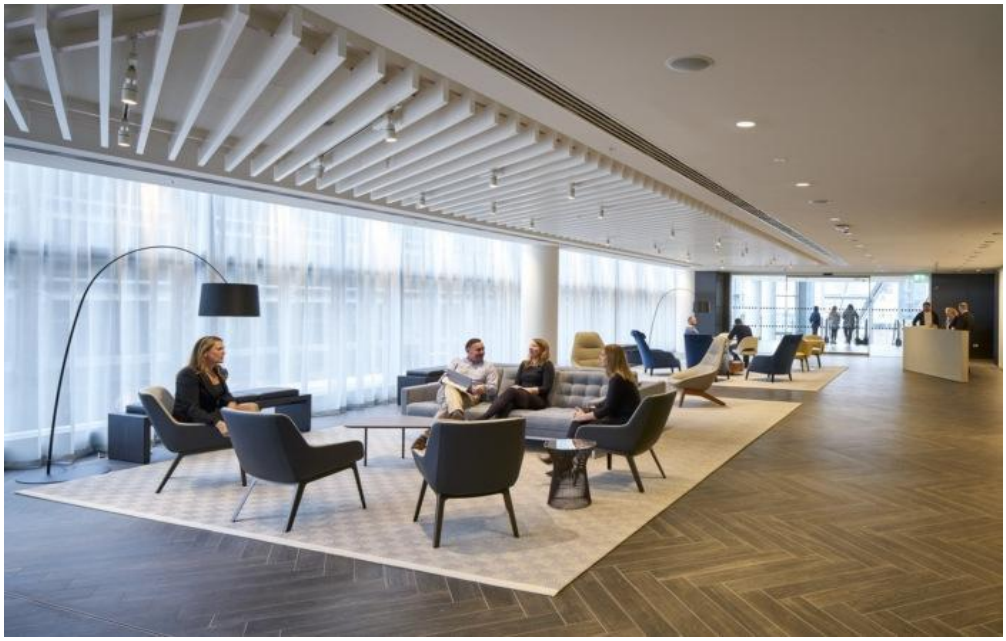
Well scorecard

Left: The features the Mirvac project achieved for light concept

https://www.wellcertified.com/en/articles/mirvac-headquarters

5.3.3 LANDSEC WORKPLACE, LONDON, UNITED KINGDOM, WELL SILVER CERTIFIED & BREEAM OUTSTANDING

9. Landsec Workplace, UK https://www.workplaceweek.com/workplace-week-event/landsec-2018/



10. Landsec Workplace, UK

https://officesnapshots.com/2018/11/09/landsec-offices-london/

Landsec's old office had a number of issues, such as poor lighting and inconsistent temperatures, and they found that only half of their employees thought the office enabled them to work productively.

Today over 400 staff are based on one floor, with no partitions or isolated spaces. The base building is over 10 years old and has been refurbished to the highest standards with a combination of technology, office design and research all contributing to an award-winning modern workplace.

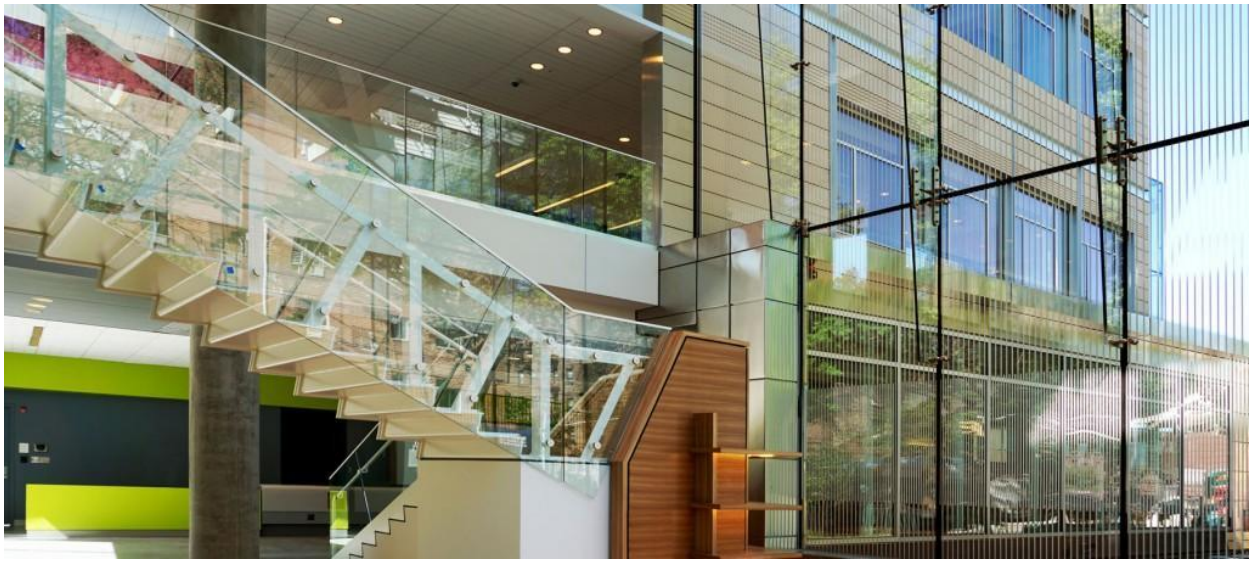
Landsec encourages collaboration by providing plenty of places for teams to get together. That includes meeting pods, comfortable sofa areas and informal presentation spaces. Electronic communication has decreased as a result, with internal emails down by 18% because people are more able to speak face-to-face.

The building has plenty of natural light as well as circadian lighting which controls artificial light, controlling brightness levels, a good range of color and changing to mimic the time of day. [1]

[1]

5.4 MOVEMENT

5.4.1 ELMHURST PUBLIC LIBRARY, QUEENS, NEW YORK, UNITED STATES, 2017 WINNER OF PROMOTING HEALTHY DESIGN FROM CENTRE FOR ACTIVE DESIGN EXCELLENCE



11. Elmhurst Public Library, Queens, New York

Photo Credit: Marpillero Pollak Architects

Elmhurst Public Library designed by Marpillero Pollak Architects is in one of most ethnically diverse and busy neighbourhood. The site is located visibly from the subway station across the street which features 24/7 entry plaza, a learning garden and a historic community park which meets a wide range of needs of the residents. The design of the library focuses on integrating inside and outside spaces and emphasizing on having a transparent centre that creates an active environment through art displays, views to the outside, resource displays and event information boards. The reading rooms also called cubes, glow at night welcoming the residents and providing a safe and secure environment at the night-time.

5.4.2 NORTH KANSAS CITY, GLADSTONE, MISSOURI, UNITED STATES, 2017 WINNER OF PROMOTING HEALTHY DESIGN FROM CENTRE FOR ACTIVE DESIGN EXCELLENCE

12. North Kansas City School, Gladstone, Missouri

Photo Credit: Alistair Tutton Photography / Courtesy of Perkins+Wills

North Kansas City School designed by Perkins+Wills and associate architect Hoefer Wysocki Architects is a redesigned space in a newly constructed office space. The aim of the design was to create learning environments that encourage elementary students to work collaboratively and think creatively. The students at this school spend only 5% of their time in a structured classroom. The school features outdoor patio for open-air lessons, moveable furniture, strategic staircase location and open spaces to create vibrant learning environment. The school restricts desks for teachers and encourages them to share ideas and learn from each other's classes. The school has reported good companionship among each other and has supported collaborations at the school.

6. CONCLUSION

As indicated in the scholarly review of WELL implementation at UBC and with reference also to Vancouver Campus Plan, LEED implementation guide and register of LEED- certified buildings, UBC has taken remarkable steps under its commitments to Okanagan Charter and GBAP. However, the extent by which UBC can claim the targeted performance in its buildings is unclear and requires further detailed studies. UBC has not yet developed guidelines on how to implement the comprehensive requirements of WELL, like what has been done for LEED. Regarding these five components, it requires more field work and interdisciplinary cooperation.

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