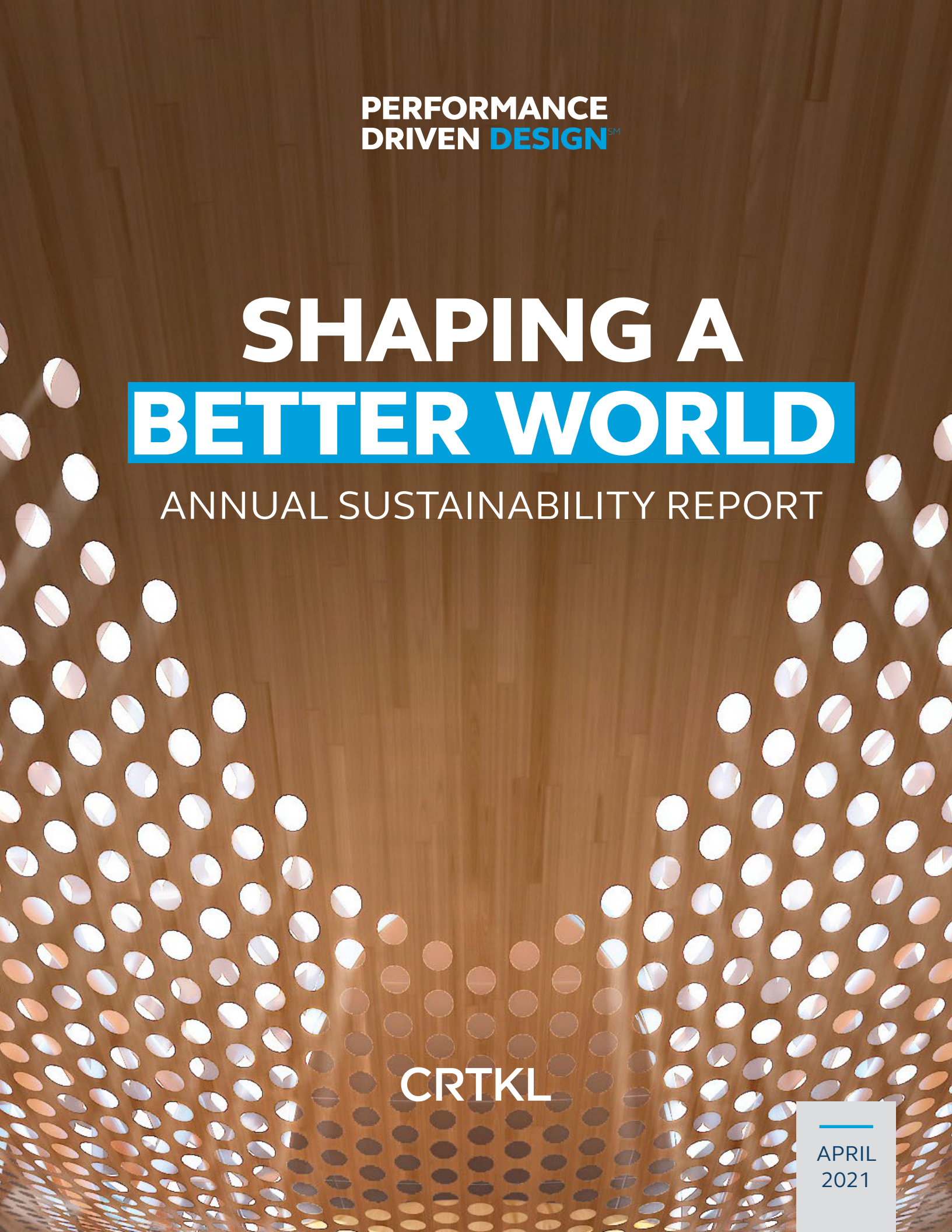


PERFORMANCE DRIVEN DESIGN℠

SHAPING A BETTER WORLD

ANNUAL SUSTAINABILITY REPORT

CRTKL

APRIL 2021

NCI Tower
SHENZHEN, CHINA

CONTENTS

North Hills Innovation District
RALEIGH, NC, USA

FOREWORD

The time to act is now. As architects and planners, we must address pressing issues like climate change, biodiversity loss, social and economic inequity, and global pandemics—and acknowledge their interconnectedness. Making this shift is imperative to correct the built environment's trajectory of impact on our planet. CRTKL is committed to this change in our practice.

The urgency is so immediate that climate change will continue to impact us even if all emissions stop today. Sea-level rise threatens coastal communities. Extreme weather events will continue to impact people's health and way of life and lead to migrations and the irreversible loss of many species of flora and fauna. Everything we design must mitigate the effects of climate change.

This fuels our Performance-Driven Design (PDD) team. PDD works across CRTKL to impact our design processes and create high-performance environments that are respectful of our planet. Our firmwide commitment is to design all buildings for zero-carbon operations by 2030 and carbon-neutral, including embodied carbon, by 2050.

The biodiversity and ecosystem that sustains our global economy and on which humans depend for food, health, recreation, and more, is declining faster than at any other time in human history (IPBES, 2019). To date, humans have caused the global loss of 83% of all wild mammals and half of the plant life (Bar-On, Y. et al., 2018). We must do more to maintain and increase biodiversity in our cities and buildings. For CRTKL, that means advancing design solutions like our prototypes that use living roofs to stave urban heat gain while increasing biodiversity in cities, shown within.

Sustainability is not just environmental; it also must address social inequities. As our urban population grows, so has income inequality—so extreme that according to Oxfam, the 42 wealthiest people in the world control as much wealth as the 3.7 billion that comprise the most deficient 50 percent. Committing to design for those that have the least is critical to global resiliency.

By collaborating with academic institutions and non-profit agencies, CRTKL is developing proposals that will address issues in disadvantaged communities. Our collaboration with Cal Poly Pomona students and the non-profit agency Factor H in Barranquitas, Venezuela, is one such example featured in this report. There is a direct corollary between social inequities and passive design and resiliency. Implementing the right sustainable design strategies can address energy poverty, promote better places to live, work and play.

To solve the complex issues that face the world today, architecture and design firms cannot work in silos—we must seek partners that share our values. For CRTKL, these organizations include the Center for the Built Environment of the University of Berkeley, the United States Green Building Council, the Carbon Leadership Forum from the University of Washington, and Architecture 2030.

It also is imperative to practice our principles actively. CRTKL has now achieved climate neutrality in our own business operations by implementing strategies to reduce emissions and offset the remaining emissions. We are continually exploring creative mitigation strategies as we strive to be a good steward for the planet, our staff and the communities we serve. We are the largest firm to obtain the International Living Future Institute (ILFI) JUST label. This program optimizes policies that improve social equity, environmental stewardship and enhanced employee engagement and agency.

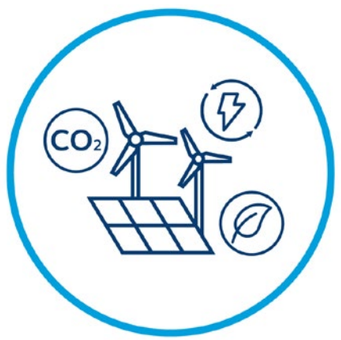
We invite you to explore our path to a more equitable and resilient world within our report.

Kim Heartwell, CEO

01

DESIGN PRACTICE

Our firm's impact is truly global with over 2000 projects under design at any given moment. To improve the performance of our projects and stay below our planetary carbon budget, CRTKL has adopted two important goals for all its projects: a) all projects will be net zero carbon for operation by 2030 and carbon neutral including embodied in construction materials by 2050.



NET ZERO CARBON FOR OPERATION BY

2030

ALL PROJECTS WILL BE CARBON NEUTRAL INCLUDING MATERIALS BY

2050

OUR DESIGN PERFORMANCE TARGETS

Scientists warn that we have 10 years left to avoid the worst consequences of climate change. Understanding how we have handled the COVID-19 crisis offers an opportunity to tackle climate change head-on. The pandemic is showing us that, even with all the mistakes we have made, we have the technology, scientific understanding, financial means and human resourcefulness needed to tackle climate change. Our goal as designers of the built environment should be to contribute towards the Paris Agreement by “limiting warming to well below 2˚C, and pursue efforts to limit it to 1.5˚C,” the IPCC report indicates how much higher the risks of a 2˚C world are than 1.5˚C.

According to the IPCC’s SR15 report, climate models project robust differences in regional climate characteristics between present-day and global warming of 1.5°C and between 1.5°C and 2°C. These differences include increases in: mean temperature in most land and ocean regions (high confidence), hot extremes in most inhabited regions (high confidence), heavy precipitation in several regions (medium confidence) and the probability of drought and precipitation deficits in some regions (medium confidence).

Our goal is to apply our design skills to help flatten the emissions curve by realizing a substantial reduction in carbon emissions in line with the global 1.5 °C temperature rise target, as agreed by all signatories to the Paris Agreement. As we design buildings with a lower carbon footprint we will reduce our emissions which will give us time to protect our coastlines and cities from super storms and adapt our agricultural practices to evolving climates drought and floods.

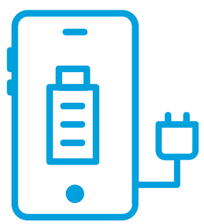
15% IMPROVEMENT

Energy performance from 2019 to 2020

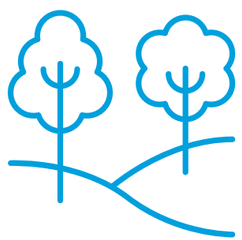
In 2020 we reduced the average Energy Use Intensity of our projects by 15% as compared to our projects in 2019.

THIS 15% REDUCTION IN ENERGY USE IS EQUAL TO:

GHG EMISSIONS FROM:
Driving 75,673 cars in the USA for 1 year



C02 EMISSIONS FROM:
Charging 42,326,105,166 smartphones



CARBON SEQUESTERED BY:
Planting 5,753,501 trees

While this is definitely a step in the right direction, we can and must do better, and commit to continued improvement in the performance of our projects leading up to net zero operations for all of our projects by 2030.

TRACKING OUR IMPACT ON CLIMATE CHANGE

AIA 2030 Commitment

CRTKL has been a signatory of the AIA 2030 Commitment since 2009; as part of this commitment, we report the energy performance of our projects each year. We reported data for 209 projects representing over 254 million square feet of work from all our offices across the globe for the 2020 calendar year.

With such a large body of work comes great responsibility; by reducing the energy consumption of our projects we have the opportunity to help reduce the impacts of climate change in the regions in which we work. In order to reduce our project's energy consumption, we first need to quantify it – that is why we are committed to gathering energy data for every project regardless of how well each project performs.

209
PROJECTS REPORTED IN 2020

254+
MILLION SQ. FT.

The Beacon
AMSTERDAM, THE NETHERLANDS

EMBODIED CARBON

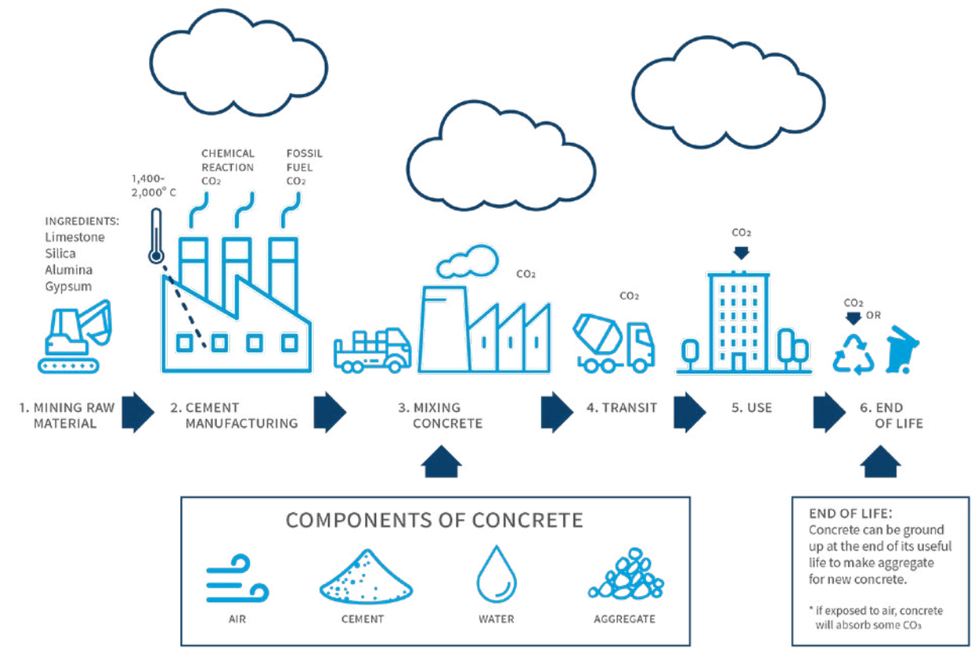
Zero Embodied Carbon

Making building materials and products creates greenhouse gas emissions. Activities such as mining, driving trucks, running factories and combining chemicals result in emissions to the air, earth and water.

Embodied carbon is the sum of all greenhouse gas emissions attributed to the materials throughout their life cycle (extracting from the ground, manufacturing, construction, maintenance and end of life/disposal).

EMBODIED CARBON

Example: Impacts of Concrete



The embodied carbon emissions of building products and construction represent a significant portion global emissions: concrete, iron and steel alone produce ~9% of annual global GHG emissions; embodied carbon emissions from the building sector produce 11% of annual global GHG emissions.

Embodied carbon will be responsible for almost half of total new construction emissions between now and 2050 (architecture 2030).

In several of our projects we are looking at the full life cycle and embodied carbon of all materials.

WE FRAME AROUND UNITED NATIONS GLOBAL GOALS 2018

In our practice we are also framing our work around the United Nations Sustainable Development Goals (SDGs) -- also known as the Global Goals. These were adopted by all United Nations Member States in 2015 as a universal call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity by 2030. The 17 SDGs are integrated—that is, they recognize that action in one area will affect outcomes in others, and that development must balance social, economic and environmental sustainability.

5 UNITED NATIONS STANDARDS

We feel are most directly applicable to our work

The United Nations has developed a series of 17 Sustainable Development Goals to transform the world. We use these as a framework for our own goals for both our projects and our operations.

We have chosen 5 of these which we feel are most directly applicable to our work:

Good Health and Wellbeing: We are committed to designing healthy places to work and live that provide good indoor environmental quality, and connection to nature, and that promote activity.

Affordable and Clean Energy: We must reduce the energy consumption of our projects while also utilizing clean, renewable energy.

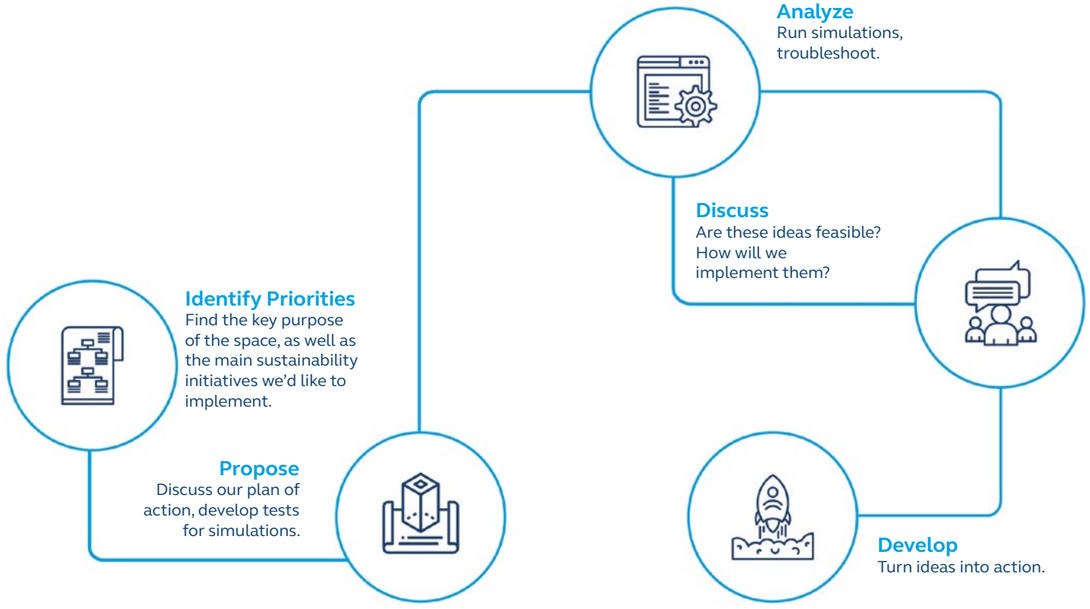
Reduced Inequalities: Social and economic equity are essential components of a sustainable future and the fight against climate change. We must evaluate the social impact of our own operations as well as of our project work.

Sustainable Cities and Communities: No project exists in a vacuum–we must evaluate the impact of our work on surrounding communities.

Climate Action: Buildings and their construction account for 36% of global energy use and 39% of energy-related CO2 emissions annually, according the the UN Environment Programme. As a large global firm, we have a responsibility to be part of the solution to climate change and to work towards net zero energy and net zero carbon for our projects and operations.

PERFORMANCE DRIVEN DESIGN[SM]

Developed by CRTKL professionals, Performance-Driven Design[SM] (PDD) aims to provide as much value as possible by tailoring design solutions to the needs of the specific clients and communities we serve. By drawing on ample evidence about the social, economic and environmental impact of design, PDD seeks to apply the greatest available intelligence to create compelling design with measurable benefits to people, place and planet. PDD is a strategy to improve the value of the built environment while reducing our impact on the natural environment.



CRTKL PERFORMANCE DRIVEN DESIGN PROCESS

Sustaining our future

Performance-Driven Design[SM] (PDD) is a data driven design process that combines analog and digital tools to design low-carbon buildings that are also more resilient and responsive to climate. PDD is a flexible process that can be tailored to any project goal. Bolstered by scientific principles, research and performance simulations, PDD guides designers in an increasingly complex world -- improving the quality and value of any project.

In all our offices, we follow the same basic principles which we apply to different types of spaces and projects. In our projects, we consider the impact of energy, water, waste and materials. When necessary, we use computational design to aid in the generation of ideas and building performance simulation tools to test them. Among the building performance simulations that we use in our practice are energy modeling, life cycle cost (LCA), daylight and glare analysis software, air flow and thermal comfort tools.

PDD is a process-driven approach integrated into our design process. Projects in our practice typically move very quickly, driven by the developer and market forces, making it challenging to implement sustainable design strategies in projects. The activities in the process can be organized as a set of strategies described in the figure on the following page. The vertical columns indicate the phases: Conceptual Design (CnD), Schematic Design (SD), Design Development (DD), Construction Documents (CD), Construction Administration (CA) and Operation and Maintenance (O&M). The horizontal bands identify four areas that must be developed during the design process: site, envelope, light and energy along with a 5th horizontal band for optional building certification. Rectangles in the intersection of these two describe strategies and processes that can be implemented in each area to improve building performance. These can take many forms and combine different analogue and digital tools. It is thus possible to delve deeper into each of these “boxes” or combinations of boxes and develop very detailed workflows that include tools and activities.

DESIGN PROCESS WITH STRATEGIES

	CnD	SD	DD + CD	CA + O&M
ENERGY	Sustainability Concepts & Systems	Life Cycle Cost Analysis	Life Cycle Cost Analysis	Verify Performance as Specified
	Eco-Charrette	Renewable Energy	Life Cycle Cost Analysis	Post Occupancy Evaluation
	Preliminary HVAC Design	Passive Heating & Cooling Active Solar Systems	Energy Model	Final Energy Model
	Climate Responsive Design Guidelines	Preliminary Energy Model	Final Energy Model	Energy Audits
	Preliminary Building Performance Analysis	HVAC	Renewable Energy	HVAC
LIGHT	Daylight	Daylight Lum & Illum	Daylight	Adjustments to Maintain Sustainability Requirements
	Electrical Light System	Electrical Light System	Final Energy Model	Energy Audits
			Integrated Envelope Design	
ENVELOPE	Climate Analysis	Indoor Air Velocity	Shading	Final Enegy Model
	Facade Isolation Study & Shading	Facade Isolation Study & Shading	Final Enegy Model	Adjustments to Maintain Sustainability Requirements
	Envelope Assembly	Envelope Assembly	CFD	Integrated Envelope Design
SITE	Solar & Wind Massing	Site Isolation Analysis		Adjustments to Maintain Sustainability Requirements
	Outdoor Comfort			
	Orientation			
	Site Isolation Analysis			
	Building Site & Microclimate			
CERTIFICATION	Goals	Goal Assessment	Credit Documentation	Design Credit Submission
	Integrated Design		Design Credit Submission	Credit Documentation

CERTIFICATIONS

CRTKL offers sustainability certification services internationally utilizing virtually all existing certification systems. Sustainable building rating and certification systems utilize an integrated design process to generate projects that are environmentally responsible and resource efficient throughout a building's life-cycle: from schematics to design, construction, operation, maintenance, renovation and demolition.

Some systems are single attribute, meaning they focus solely on energy, recycling or water, while others are multi-attribute addressing carbon, toxicity and overall environmental performance. The approach, certification type and philosophy method may differ across these the systems, but a common attribute of projects certified within these frameworks is an intention to reduce the overall impact of the built environment on human health and the natural environment.

Sustainable building rating systems exist to address every project type from single commercial buildings to entire neighborhoods and are available for new construction -- which include focusing on decisions made in the planning and design process and decisions made through construction, as well as for existing buildings, which encompass operations and maintenance throughout the lifecycle of the building.Sustainable building rating and certification systems are proven marketing and educational tools for owners, designers and construction teams as they navigate the process of delivering high performance regenerative buildings while at the same time incentivizing clients, owners, designers and contractors to utilize sustainable design and construction practices.

Our Certifications

LEED is the most widely recognized building certification system used across the globe. Our LEED certified projects span 5 continents and range in size from small tenant improvement projects to large master plans.

CRTKL offers sustainability certification services internationally for new and existing buildings and communities of all types.

As a firm, we seek to utilize sustainable building rating and certification systems as proven marketing and educational tools for owners, designers and construction teams as they navigate the process of delivering high performance regenerative buildings while at the same time incentivizing clients, owners, designers, and contractors to utilize sustainable design and construction practices.

CRTKL has expertise executing the most well known sustainable building rating systems such as LEED, BREEAM, WELL, Fitwel, BOMA 360, GRESB, Estidama, CASBEE, BEAM, as well as emerging systems such as LOTUS, Green Ship, BERDE, Green Building Index and Green Mark. Remaining on the cutting edge of existing and new certification systems enables CRTKL to provide clients the most comprehensive range of options and insights for their projects anywhere in the world. CRTKL always has several projects under certification process and ahs more than 150 certified buildings in thirteen countries.

153 PROJECTS

13 COUNTRIES

36 CERTIFIED

63 GOLD

42 SILVER

12 PLATINUM

LEED

The LEED Rating System is a voluntary, consensus driven, internationally recognized green building certification system providing third-party verification that a building or community was designed and built using strategies aimed at improving performance across metrics such as energy savings, water efficiency, CO2 emissions reduction, improved indoor environmental quality, and resource stewardship. Developed by the U.S. Green Building Council (USGBC), LEED provides building owners and operators a concise framework for identifying and implementing practical and measurable green building design, construction, operations and maintenance solutions. CRTKL has completed 159 LEED projects to date globally.

WELL

The WELL Building Standard is a performance-based system for measuring, certifying and monitoring features of the built environment that impact human health and wellbeing, through air, water, nourishment, light, fitness, comfort, and mind. WELL is grounded in a body of medical research that explores the connection between buildings and the health and wellness of its occupants. WELL integrates performance thresholds after the design/ prescriptive green building work has been completed. The business case is made for lower health insurance premiums, less absenteeism, higher productivity and more.

SUSTAINABILITY CERTIFICATION FACTS

- Certified spaces garner higher rents than non-certified spaces.
- Tax exemptions, permit expediting, and associated incentives are often available for high performance or certified buildings
- Many municipalities are now requiring sustainable building practices, meaning that certified projects are not only future-proofing environmentally by design, but also better prepared to prevent obsolescence as regulations grow more stringent.
- Certified buildings generate transparency and enforce methodical documentation, providing a comprehensive and informative package for building owners and occupants upon completion
- Many multinational and local companies now require sustainability certifications for each of their locations

02

OUR **PROCESS**

We have the most innovative, creative and forward-thinking approaches at different scales.

INTEGRATED ADVANCED PRACTICE

Buildings in the United States account for about 40 percent of our nation's carbon dioxide emissions. Most of these emissions come from the combustion of fossil fuels to provide heating, cooling and lighting and to run electrical equipment and appliances. The manufacture of building materials and products, and the increased emissions from the transportation generated by urban sprawl, also contribute a significant amount of greenhouse gas (GHG) emissions every year. As designers we have an ethical responsibility to design healthy environments with reduced operating costs and environmental impact, promoting biodiversity and supporting the communities around them.

As a worldwide design consultancy, CRTKL wants to reverse this trend through our extensive work in the built environment. Our goal is to provide smarter solutions that have a positive impact on our environment. By implementing a process of Performance Driven Design℠ (PDD) that is backed by data and rigorous research, our designs are not preconceived notions, but rather a synthesis of complex programs and challenges that respond equally to climate, context, and culture resulting in intelligent, yet beautiful, solutions that create greater impact for our communities and our clients.

We reduce emissions from operation through an integrated approach that considers envelope strategies such as shading, window to wall ratio, glazing types, insulation, mechanical systems for heating and cooling, hot water, electrical lighting and plug loads. We use computational design tools to aid in the generation of ideas and building performance simulation tools to test them. Among the building performance simulations, typical in our practice are energy modeling, solar analysis, thermal comfort, Life Cycle Cost (LCA), daylight and glare analysis software, computer fluid dynamics and thermal comfort tools.

Our designs strive to achieve minimum environmental impact. In our projects we consider factors such as energy, carbon, water, waste, materials and indoor environmental quality. From the very beginning of a project, before we draw anything, we assemble a diverse team of designers, climate experts, data analysts and computational design specialists who begin this process with a thorough understanding of a climate and context. By understanding how we can maximize things like views, shading and daylighting we are able to use data to drive building form, orientation, size and placement of materials in order to increase the benefits to building occupants while reducing overall energy consumption through passive strategies. The incorporation of computational design allows us to quickly iterate and evaluate multiple solutions testing scenarios that balance performance and aesthetics.

Exploration of sustainable design through the lens of data science and computational design expands our understanding of the possible and validates our performance requirements. Through our digital tools and processes, we create a pipeline and feedback loop persistently nudging and improving the design solution across all our established metrics. While our computational design teams build tools to align geometric forms with performance criteria, our analytics teams develop insights from the predictive data to inform the development of the design for the projects at hand as well as all the projects we produce looking forward.

CRTKL's process includes a digital fluid ecosystem of tools that deliver higher value. The platform provides standardized tools and methods to develop workflows that require minimum user effort to capture data in the background, with little to no user intervention. The process starts at concept design and allows for data-centric methods to be applied to Computational and Performance Driven Designs. The data can be exchanged in the later stages of the process with our key partners on a project including the Owners and General Contractors. By conceiving design standards as fundamentally rooted in information management, we immediately see the project's longevity and cyclical nature. Our sphere of influence evolves from Design and Documentation, to Data Analytics and Building Solutions.

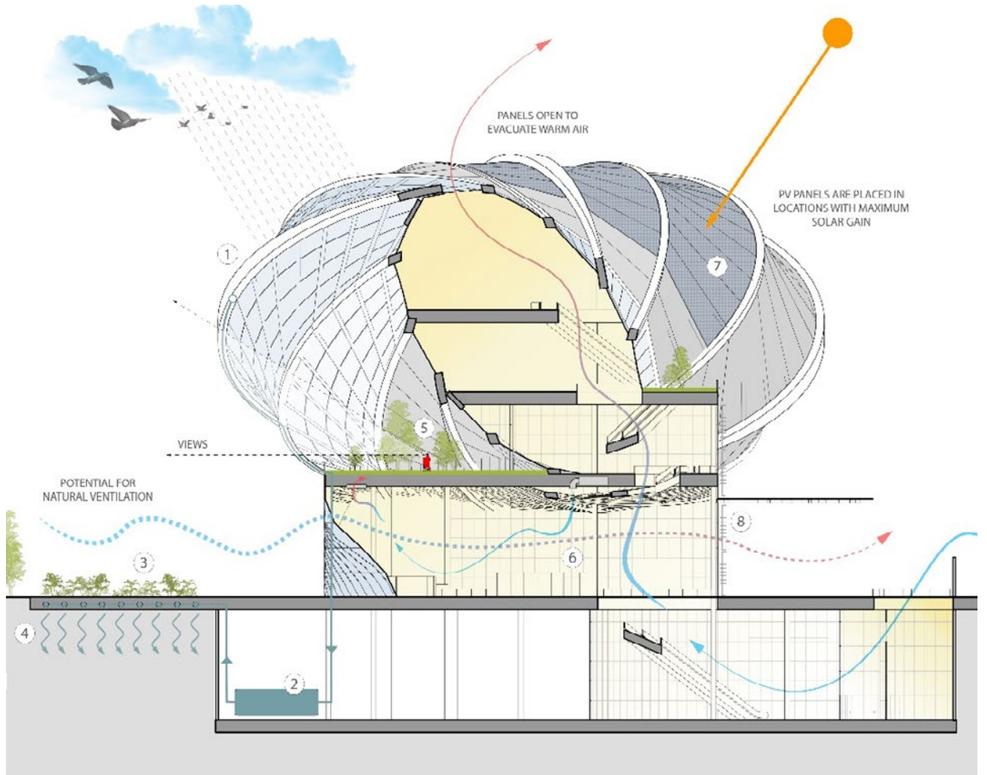
In the end, our solutions are an integral balance of form, high-performance and beauty that contribute to making the world a petter place for generations to come.

DIGITAL TECHNOLOGIES IN PERFORMANCE DRIVEN DESIGN

The design process is multi-dimensional and iterative, simultaneously reconciling different requirements, approaches and drivers. In the Digital Age, these aspects of architectural design are not only expressed through drawings and documents, but more importantly through digital modeling. This includes designing fully in three dimensions, assigning attribute data and information to the elements of the building, and testing the designs against performance benchmarks, whether they be environmental, operational, or financial. Rittel proposed the existence of an alternating generation of and reduction cycle, which repeats itself continuously, improving the design quality in each cycle.

Performance Driven Design[SM] is not simply a set of tools, but also a set of processes. As such, the barrier to entry for these technologies and processes must be kept low during early design exploration. La Roche and Liggett proposed the creation of Very Simple Design Tools (VSD Tools) to be easy and simple to use so that more designers could use them affecting more buildings.

Performance Driven Design[SM] embodies these iterative principles and is critical in the pursuit of superior design through a feedback loop of thesis, experiment, and validation. While simulation reflects anticipated outcomes through digital modeling, the future of PDD will include Digital Twin monitoring and feedback. This loop of data and insight will ultimately not only improve the actual performance of the built environment, but will inform future design benchmarking through quantified outcomes. These types of performance monitoring and simulation is a part of the continuous improvement criteria necessary in the design process, but in operating the physical outcome. In order to get there, determination of the critical performance criteria, disciplined capture of the data points, and consideration of the insights are all enabled through Digital Technology and Processes. These considerations should be implemented as early as possible and should be rigorously maintained throughout the entire design process, allowing the insights drive decision making.



SHANDONG
Science & Technology Museum

DIGITAL TECHNOLOGIES IN PRACTICE

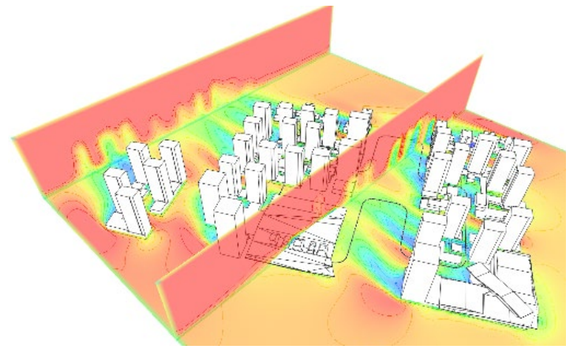
We use simulation tools to test our ideas. We propose ideas, but we also test them with state-of-the-art tools to ensure their feasibility. Among the building performance simulations that are typical in our practice are energy modeling, Life Cycle Analysis (LCA) studies, daylight and glare studies, wind studies and outdoor microclimate studies. We will use appropriate simulation tools as we test and fit the guidelines and later as we work on specific problems.

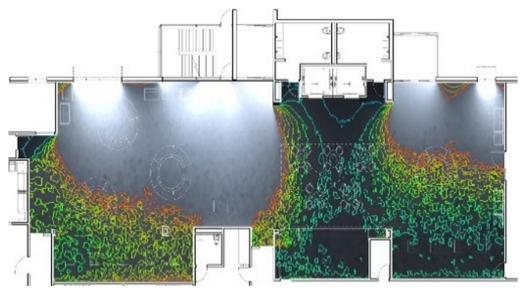
Typically when we describe simulations, we refer to them as simulations for design performance and simulations for code compliance. Simulations for design performance are done to quantify several parameters – some of which might not be required by code. In addition to energy, simulation modelling includes the measurement of many other variables which also provide useful information and facilitate design decisions.

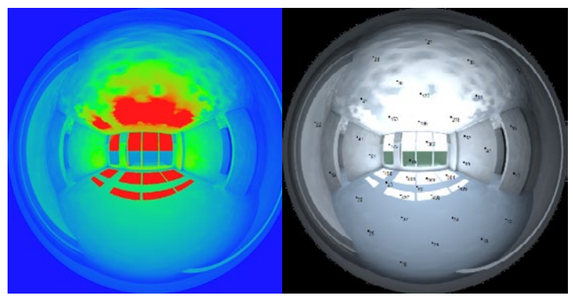
Some of the most common in our practice are insolation analysis on building and ground surfaces, illuminance and luminance levels in interior spaces, airflow in outdoor spaces and energy consumption. Results of these simulations affect glazing to wall ratios, window design, shading systems, etc. The goal of simulation for design performance is to enhance the design by integrating performance attributes in the design.

Modeling for code compliance is typically done for energy consumption and, due to the complicated nature of our projects, in our practice is usually done by consultants. It compares the calculated energy use of the designed building with a reference baseline building to demonstrate that it complies with minimum performance criteria.

We like to initiate simulations as soon as possible in the design process. Feedback is less useful when simulations occur late in the process. However, we believe that it is never too late and it is always possible to implement design strategies that will improve project performance. Clear and visual communication of the results is also crucial to provide adequate understanding to the rest of the project team and the client. Finally, simulations must be useful. Analysis for the sake of analysis should not be done – there must be a possibility to respond to the analysis results and some time for processing. Simulations should only be done if they will inform design decisions or if they are needed to demonstrate compliance.

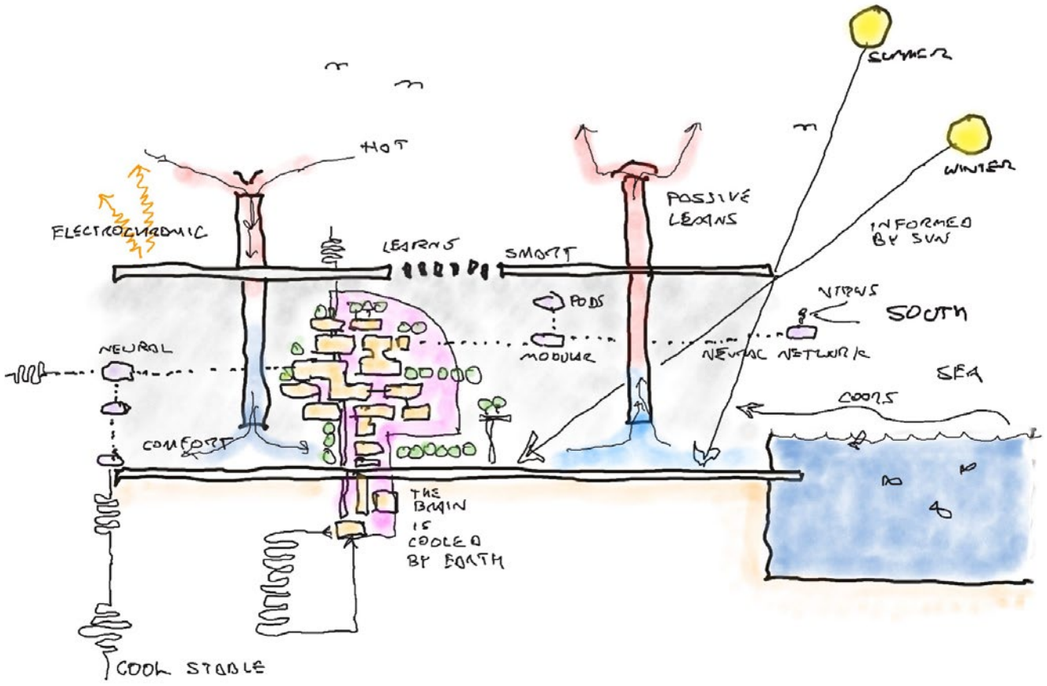


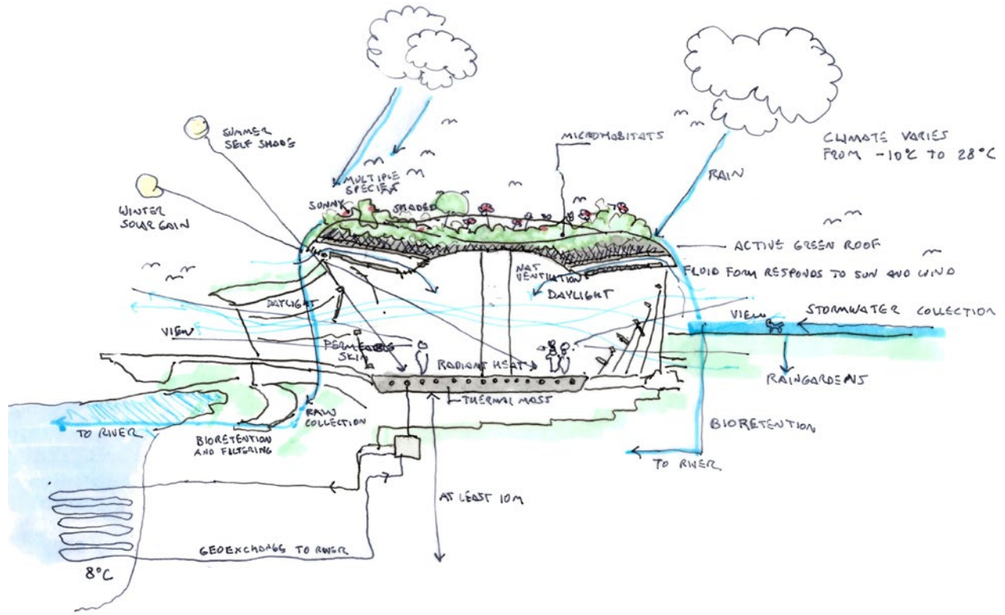




DESIGN DRIVEN

First and foremost, sustainability is about design. Sustainability at CRTKL is integrated in the design process. Analog and digital tools are used as needed to generate ideas and then to evaluate them. Everything from hand sketches to sophisticated state-of-the-art building simulation software is used during this process.





SIMPLE IS BEAUTIFUL

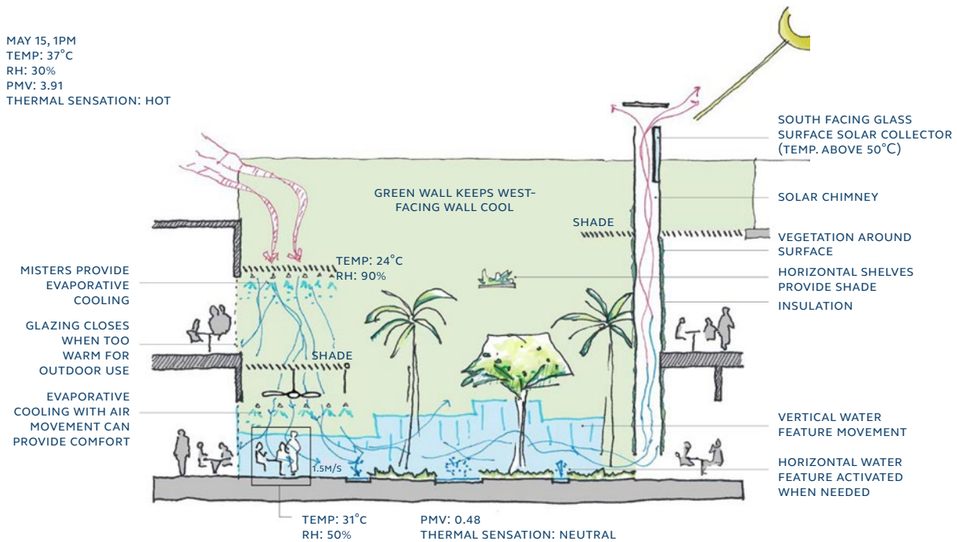
Sustainability does not have to be complicated to work

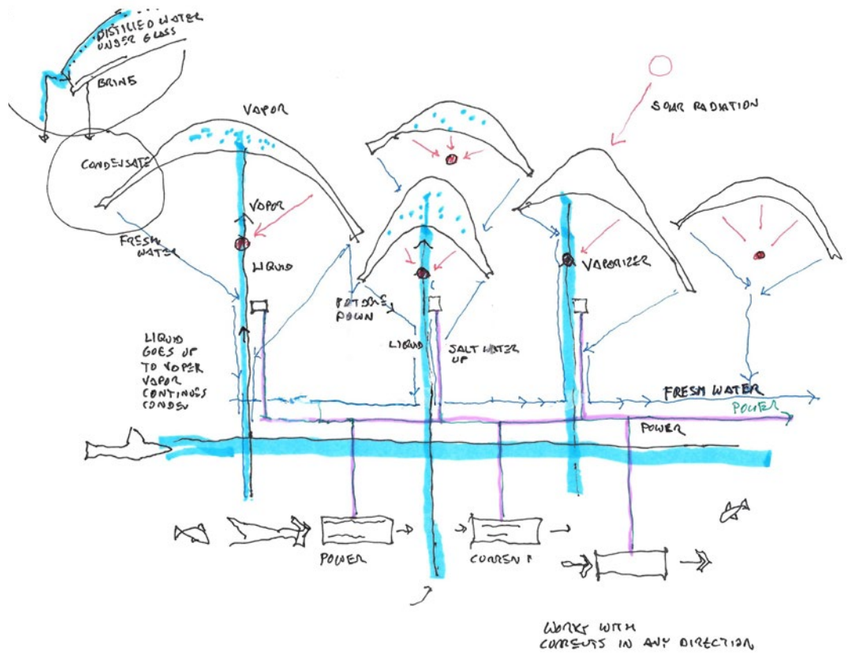
Sustainability does not have to be complicated. We seek simple solutions that achieve maximum benefits. Simple is usually less expensive, easier to operate and maintain and more beautiful. We try to help generate forms that follow performance – such as in the Kaunas Concert Center for a competition in Lithuania. We always move towards simplicity rather than complexity. Simple systems will inform performance and aesthetics and be refined by local climate and culture.

PASSIVE IS POWERFUL

Climate responsive strategies connect buildings with the environment

Understanding climate and proposing strategies that respond to it connects buildings with the environment. We always prefer to implement passive strategies first. High performance mechanical systems and renewable energy complement the passive systems. In the exterior spaces of many of our middle eastern projects. The Mall of Saudi and in the courtyards of a mall in Dubai or Kuwait (confidential projects), shade, air movement, evaporative cooling, thermal mass and green surfaces significantly increase outdoor comfort for much of the year. Our unique knowledge in this field helps us develop appropriate climate responsive guidelines for different climates.





BUILDING PHYSICS SHOULD INFORM DESIGN

We should go beyond checklists

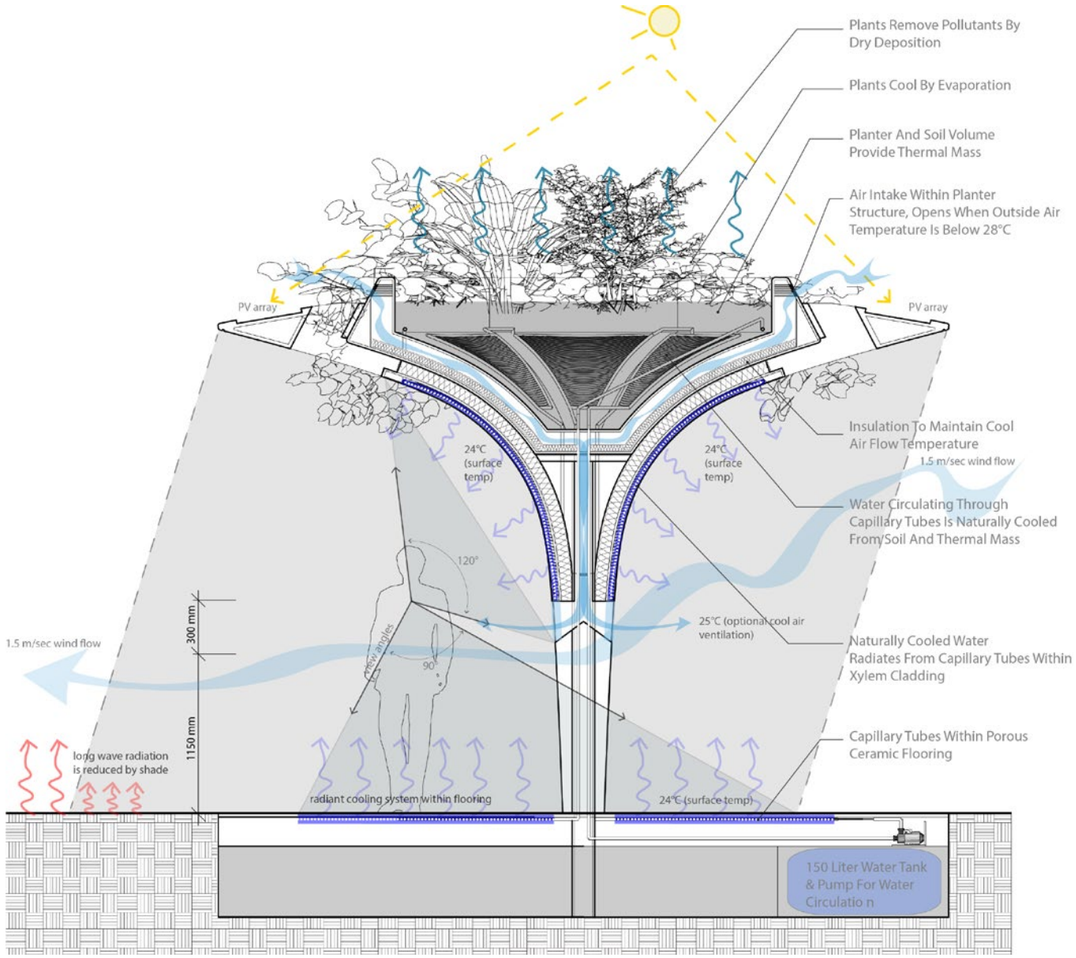
If we understand the rules, we can transform design. Checklists provide easy ways to reduce our environmental impact, however we must innovate and go beyond checklists if we want to effect change. Understanding principles is the most effective way to innovate. We cannot innovate by following checklists. This is the sort of thinking that we implemented in Cnidaria Halitus – our award-winning proposal for the Land Art Generator Biennale in 2016. In our proposal, we looked at the one hundred-year-old technology of solar water heating and reinvented it as art in the Santa Monica coast in California. These learnings are implemented in buildings in which we strive for fundamental instead of superficial change.

RESEARCH-DRIVEN

We advance knowledge to design better projects

We push boundaries to design better projects. Examples include green roofs that have increased period performance by combining radiant systems and thermal mass with active cooling. These advanced research strategies are also implemented in the Xylem to improve cooling performance combining shade, with air movement and radiant cooling using the green roof as an integral part of the system as a natural air conditioner. These research-driven strategies improve performance while adding minimum complexity to the project. We expect to directly implement research results to our work providing better tuned guidelines.

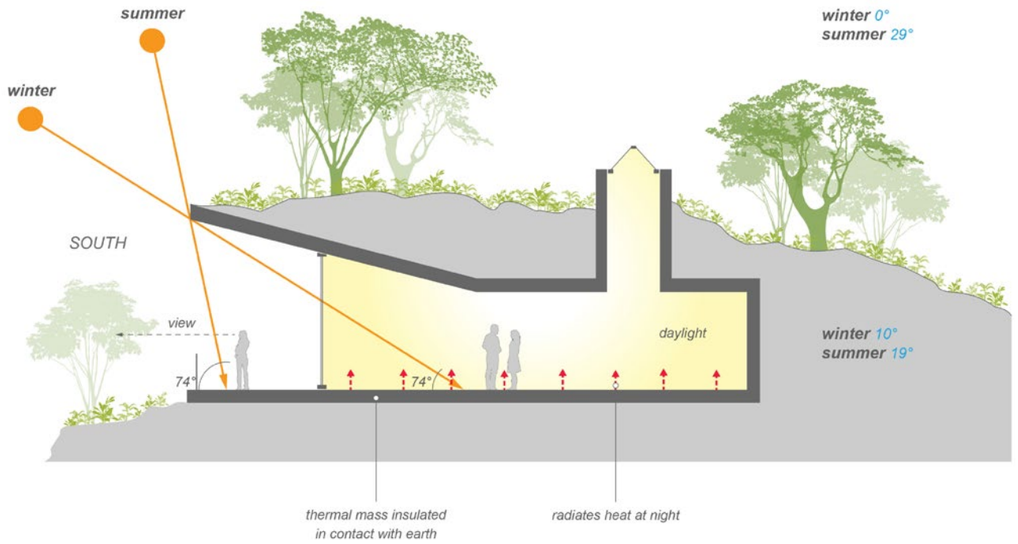
The Xylem improves outdoor thermal comfort by implementing a vegetated roof and water circulation for radiant cooling in addition to shading and natural ventilation. One of the unique elements of the Xylem pad is a planter pad at the top with the presence of a large thermal capacity in a green roof. The green roofs concepts were further developed based on previous green roof research so that they could be used for cooling. The Xylem improves outdoor thermal comfort by implementing four outdoor cooling strategies: a large canopy for shading -- promoting natural ventilation, a vegetated roof for thermal mass and water circulation for radiant cooling. The form of the Xylem maximizes shade by its large diameter at the top while its curvature and slender stem provides for air flow at the bottom.



THERMAL COMFORT STRATEGIES

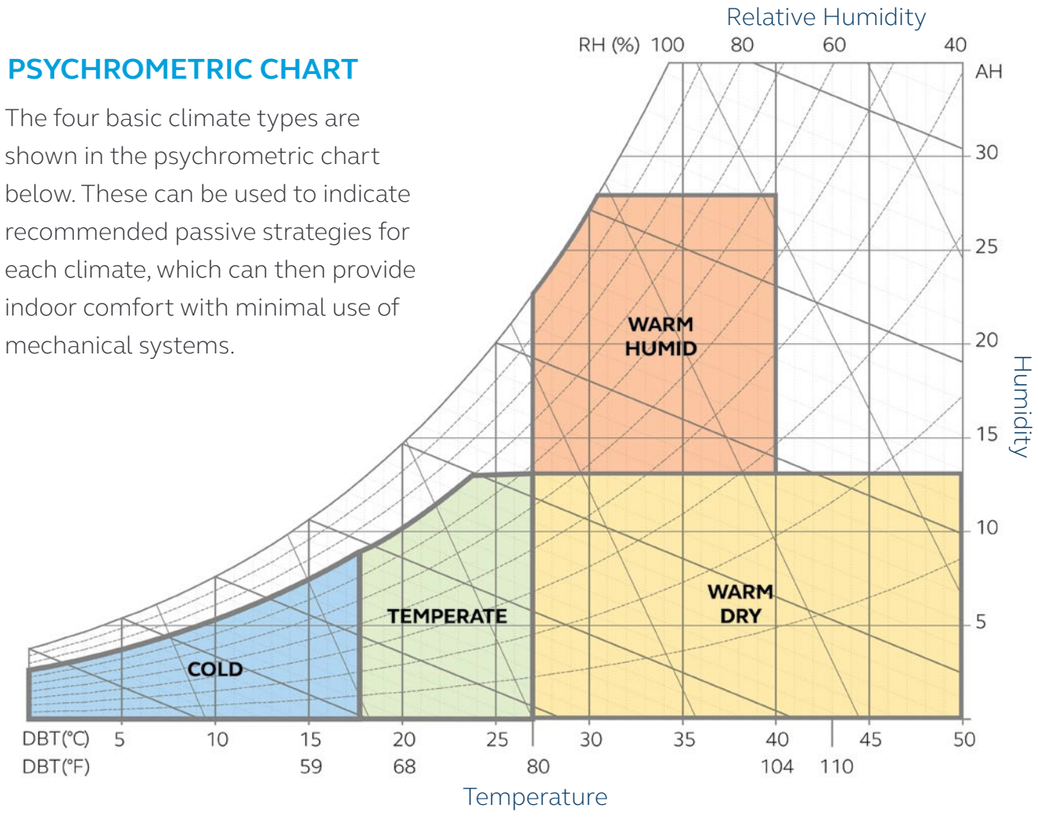
SITE AND CLIMATE DRIVEN

Sustainability is informed by site, climate, culture and people. It is more than a technical problem. Our design decisions are based on a comprehensive study of the climate and cultural values, which then inform and enrich design decisions that include form and introduce local materials when possible.



PSYCHROMETRIC CHART

The four basic climate types are shown in the psychrometric chart below. These can be used to indicate recommended passive strategies for each climate, which can then provide indoor comfort with minimal use of mechanical systems.

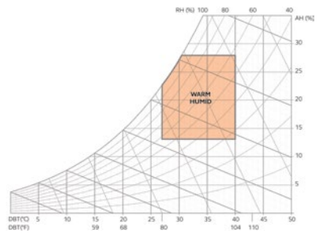


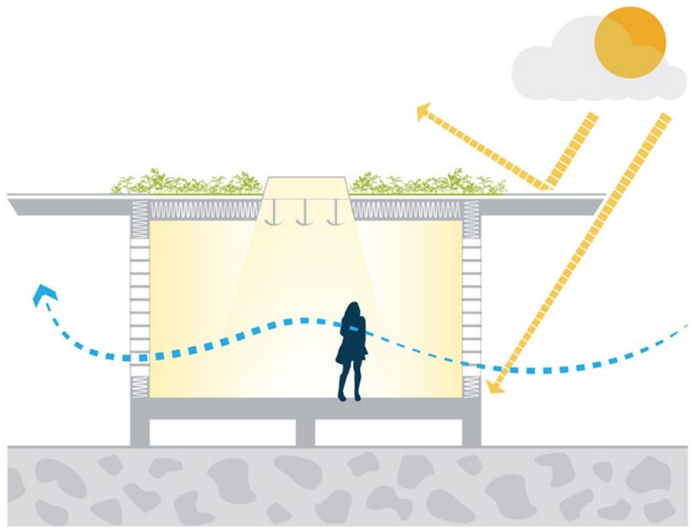
The Xylem
JAKARTA, INDONESIA

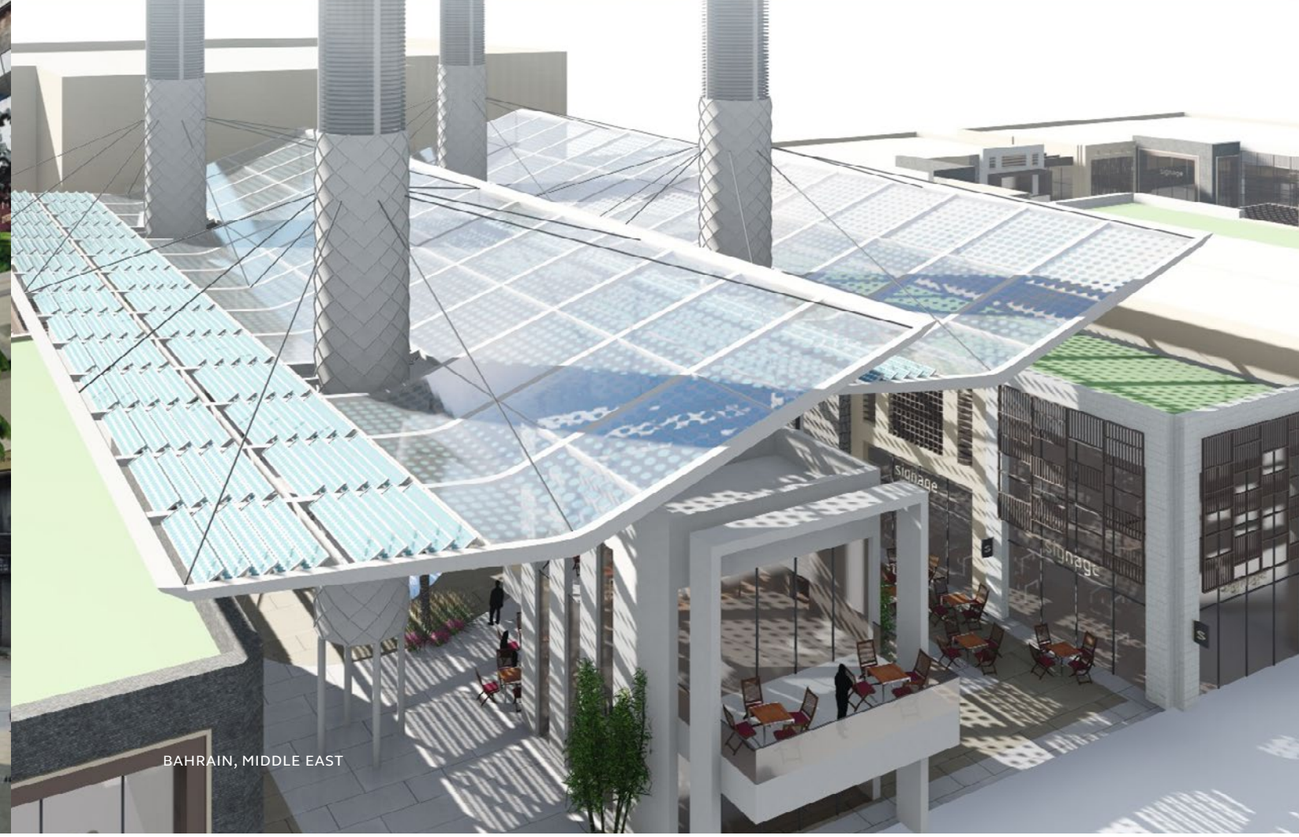
Warm Humid Climate

Strategies

shade
cross ventilation
lightweight construction
reflective outer surfaces
green roofs
daylight





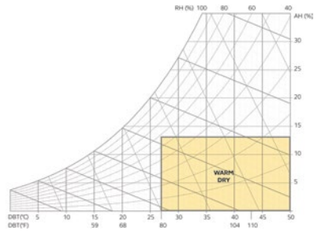


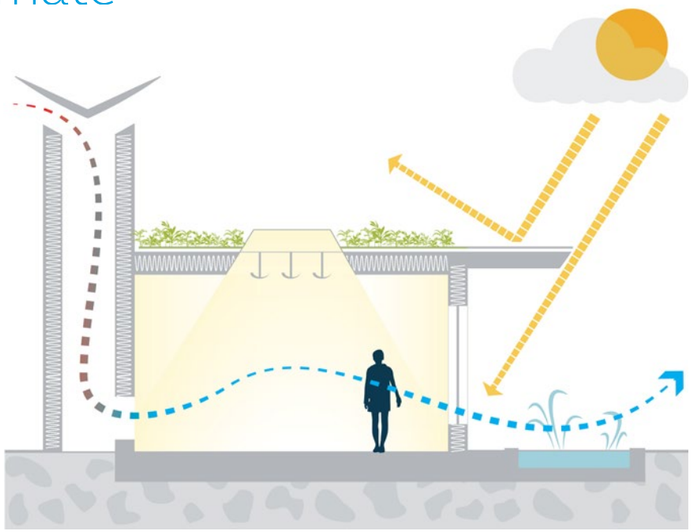
BAHRAIN, MIDDLE EAST

Warm Dry Climate

Strategies

shade
evaporative cooling
reflective outer surfaces
night ventilation
green roofs
daylight





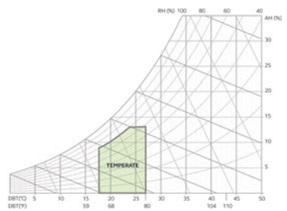
Future Ark
GUIYANG, CHINA

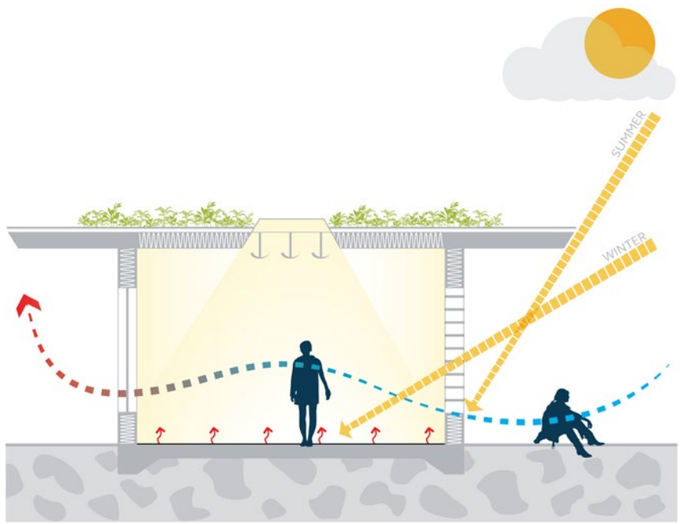
Agriculture Expo Center
HARBIN, CHINA

Temperate Climate

Strategies

shade
passive cooling
cross ventilation
passive heating
thermal mass
green roofs
daylight

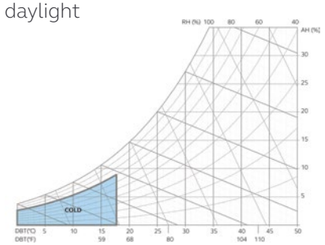


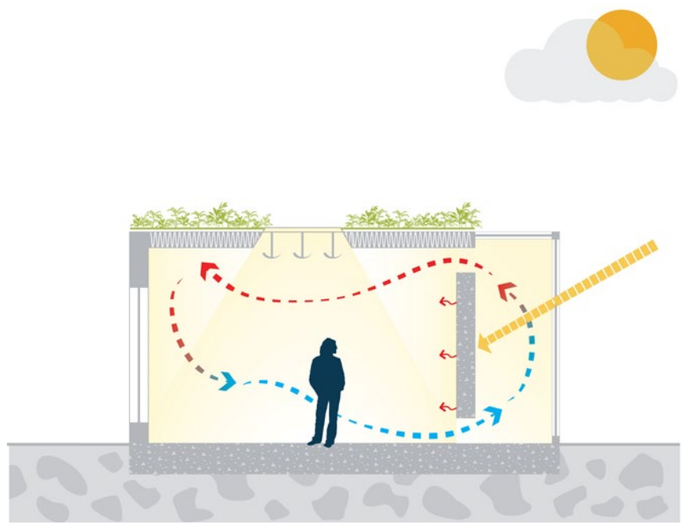


Cold Climate

Strategies

maximize solar gain
passive heating
insulation
high performance windows
thermal storage wall
green roofs
daylight



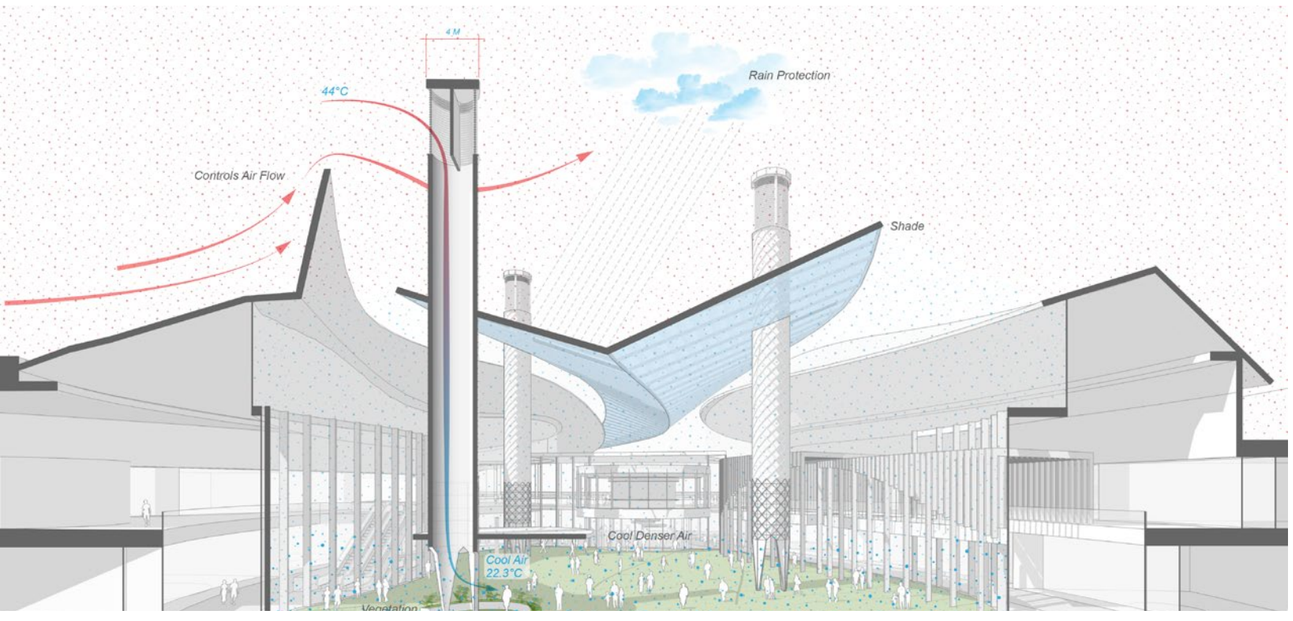


DESIGN FOR COMFORT IN EXTREME CLIMATES

We create livable spaces in extreme climates

In this courtyard for a confidential project in Kuwait, the air is cooled evaporatively at the courtyard level, while the warm desert air is kept above and shade is provided to reduce solar gains. An oasis is created and cool pits (the opposite of fire pits) provide comfort cooling elements while also design features around which visitors will gravitate.

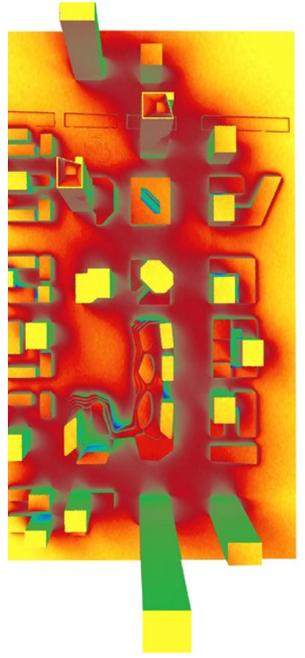
Our experience ensures that we will design comfortable outdoor spaces that can be used for much of the year in any climate in the world – enhancing connectivity and use and increasing productivity and occupant satisfaction.



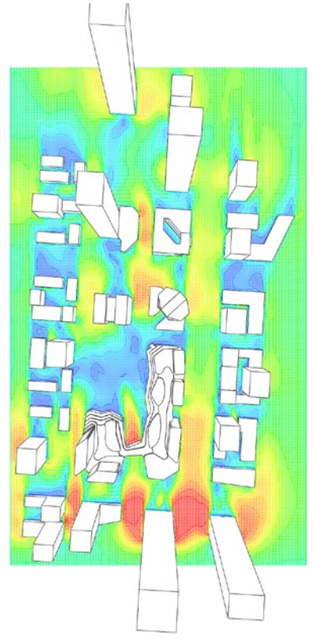
Nanjing Jiangbei
NANJING, CHINA

NANJING JIANGBEI New Town Competition

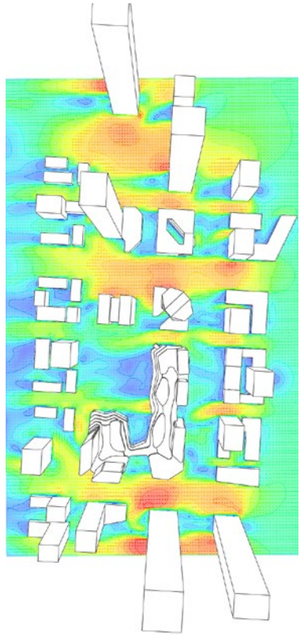
Our microclimate work uses wind and solar studies to develop a proposal improves comfort in outdoor spaces in Nanjing's climate using sculptural urban elements that will provide shade and provide comfort ventilation in the summer.



NANJING: APRIL - OCTOBER GROUND



NANJING: WIND - SUMMER



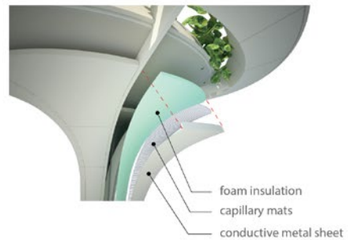
NANJING: WIND - WINTER

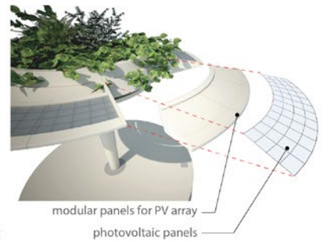
NATURE INSPIRED DESIGN - BIOMIMICRY

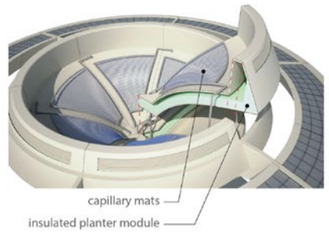
We learn from nature and implement in the built environment

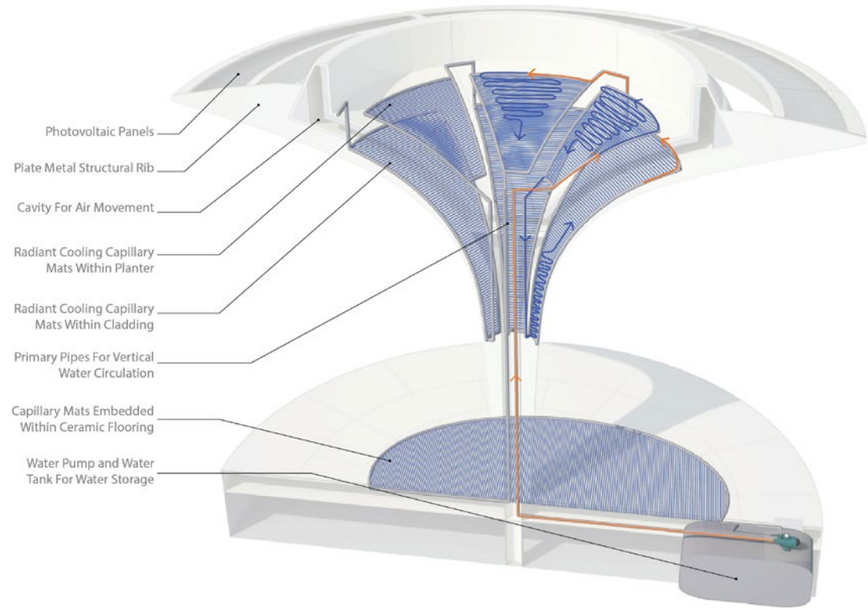
We learn from nature and implement the lessons into buildings. The Xylem uses principles from nature to increase cooling effect. Our goal is to learn from the natural environments surrounding our projects – integrating our buildings with the surrounding ecology.

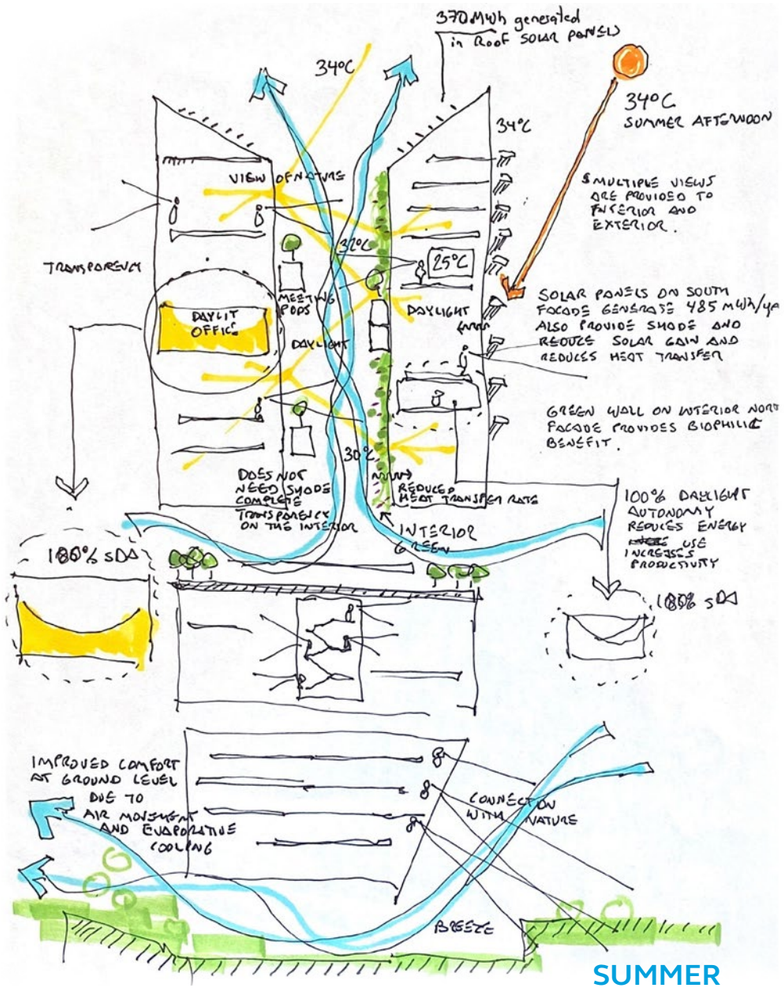
The components and assemblies of the Xylem pods are based on performance and aesthetic qualities, as well as a consideration of the currently available technologies in manufacturing and fabrication. The form has been designed to capture air flow from above and push it to the occupant's level while also providing shade. Liquid-filled tubes embedded in the soil of the planting material are cooled to a lower temperature than the air temperature; the water in these tubes then cools panels at the occupant level and in the ground around the center of the pod – cooling the person above the ground or close to the panels by radiation. An air space between the earth and the panels also helps to insulate the earth while providing an opportunity to provide cool air at the lower level. Photovoltaic panels integrated in the Xylem at the top provide electricity to the pumps that circulate the water. The original design proposes water flowing through capillary mats, however it is possible to substitute the mats with small tubes – and, in fact, it is also possible to substitute many of the components with other locally available materials as long as the energy flows are kept as proposed.









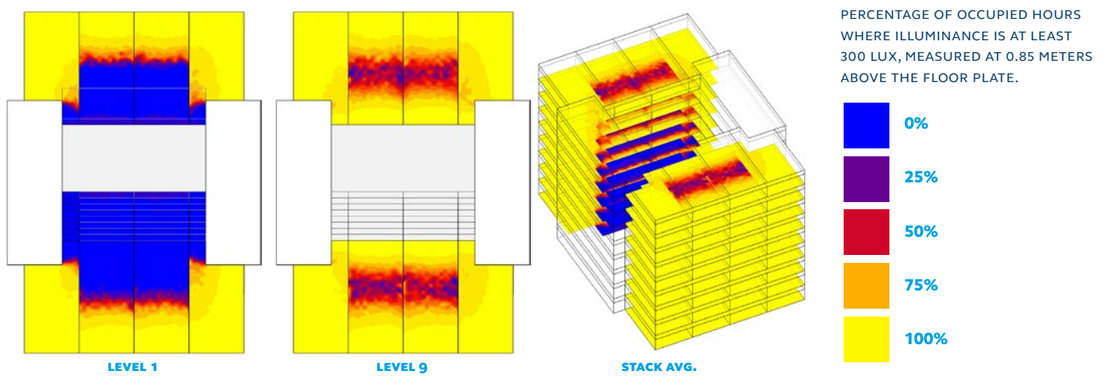


SUMMER

DAYLIGHT IS A GOOD THING

Daylight saves energy, but more importantly it increases visitor and occupant satisfaction in all types of spaces. Research results have validated the importance of daylight in all environments -- including production and office spaces. Our guidelines will help provide spaces with optimal daylight and minimum glare, including the tools and methods to quantify optimum daylight levels.

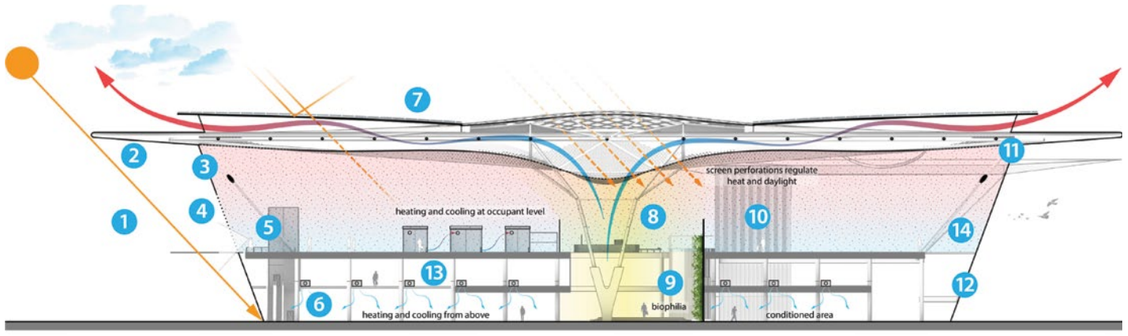
NCI Tower
SHENZHEN, CHINA



REDUCING OUR IMPACT ON CLIMATE CHANGE

Our work maximizes impact on climate change by reducing GHG emissions through improved operation of the buildings and by reducing the embodied energy in the construction of these buildings. This is the case at Terminal 2 in the Guadalajara Airport – which is being designed to be Net Zero Energy.

SUSTAINABLE STRATEGIES



1 SOLAR RESPONSIVE

2 SHADE

3 HIDE PERFORMANCE GLAZING

4 GLARE CONTROL

5 VIEWS

6 WATER EFFICIENT APPLIANCES AND FIXTURES

7 RENEWABLE ENERGY

8 FILTERED DAYLIGHT

9 GREEN WALLS

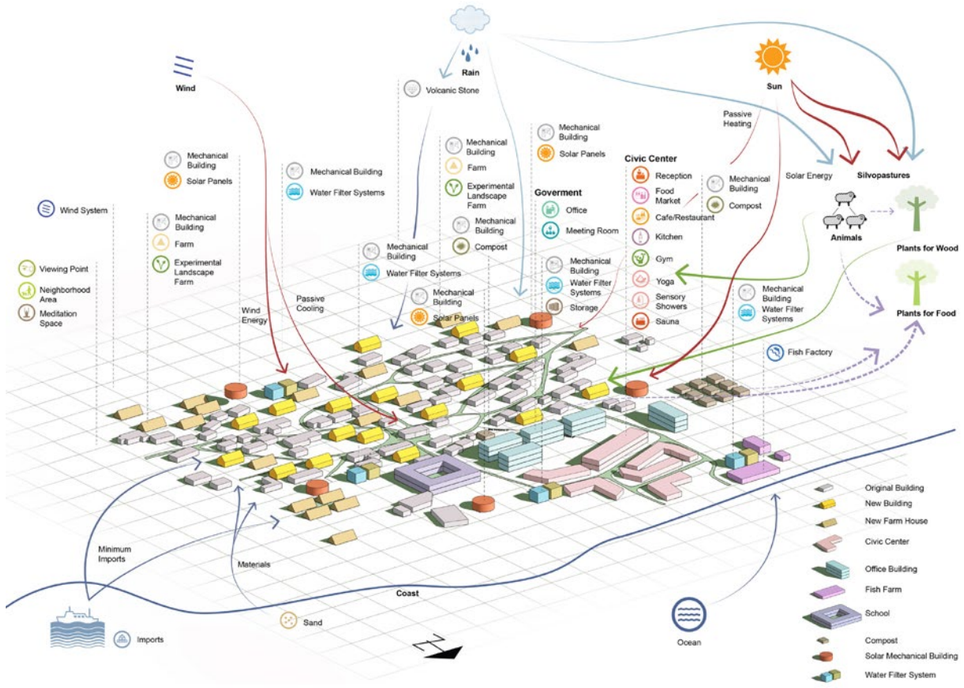
10 HEALTHY MATERIALS

11 HIGH PERFORMANCE ENVELOPES

12 NATURAL VENTILATION

13 EFFICIENT MECHANICAL SYSTEMS

14 CONNECTION TO OUTDOORS



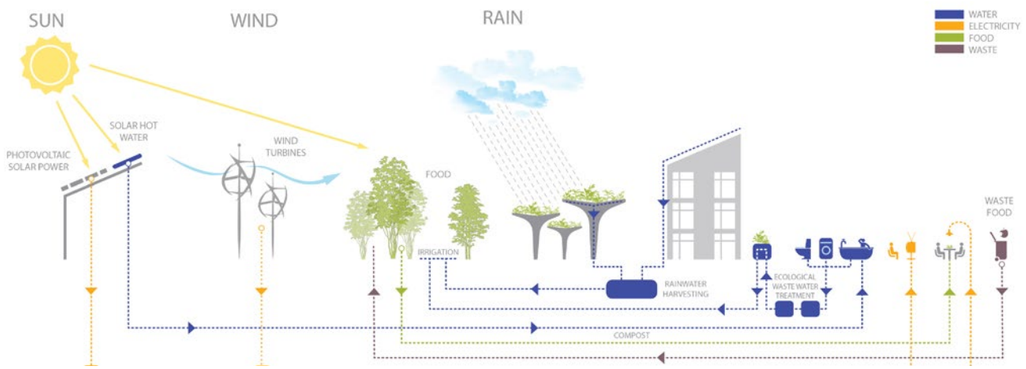
DESIGNING FOR ADAPTATION, MITIGATION AND RESILIENCE

In addition to designing buildings that adapt and mitigate climate change, in response to the increasing frequency of extreme weather events, we are designing even more resilient buildings that can “learn” from their environments and sustain life -- even in the face of disaster. The image above is from our submission for the RIBA competition for the remote island of Tristan da Cunha. Our goal was to improve the life of island dwellers by improving buildings and modes of production with local materials and minimum input from outside the island.

PROMOTING REGENERATIVE AND RESTORATIVE DESIGN

We try to implement a Regenerative Design-based approach to the guidelines that will provide a framework to design landscapes, buildings, cities and systems through effective integration with nature's processes. These systems include energy, water, food, manufacturing and waste.

Current green building assessment methods typically emphasize how buildings should mitigate global and local resource depletion and environmental degradation. We will emphasize how we can improve the environment through a systems-approach strategy that establishes positive links with its context. Maintaining balanced ecological systems will be an important consideration of the guidelines. The principles of biomimicry can be used to inform and inspire solutions tailored to local conditions.



Mall of Saudi
RIYADH, SAUDI ARABIA

WELLNESS: INDOOR AND OUTDOOR

We design healthy indoor and active year-round outdoor spaces that increase occupant satisfaction and wellbeing, and inspire and enrich social vibrancy and promote inclusivity. Daylight studies and microclimate studies ensure performance levels are achieved as designed, contributing to the creation of inspiring and innovative workspaces.

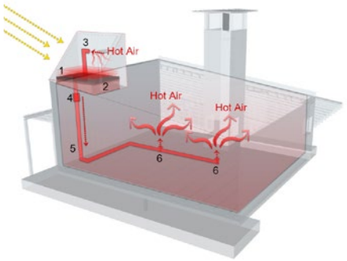
ENGAGING WITH THE COMMUNITY

We are committed to capturing the needs of the local community and identifying existing stakeholder and cultural resources that may support our clients objectives. Many of our studios, especially the Planning and Urban Design team, have extensive experience and work closely with the client and communities to devise an outreach strategy that seamlessly ties into the overall project approach.

These images show the Cerro Azul community center near the city of Tecate at the Northern end of Baja California, just south of the US-Mexico border. The center provides skills training workshops for adults, daycare facilities, meeting spaces for the community and volunteer housing. The project was designed by Cal Poly Pomona students with the California based non-profit Corazon and built by many Corazon volunteers, students and CRTKL staff who traveled to Mexico regularly to support the community.

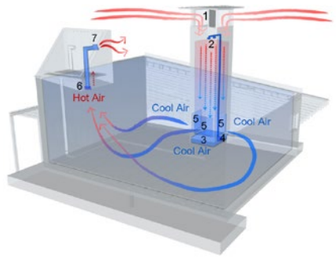
SOLAR ATTIC
Heating In Winter

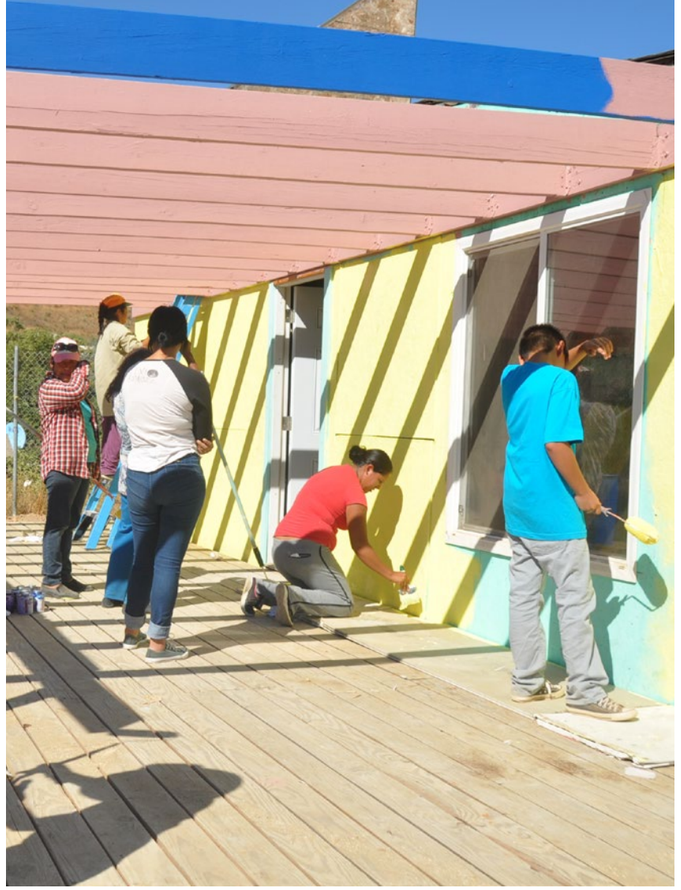
1 THERMAL MASS (CLAY BRICK)
2 INSULATION
3 INTAKE
4 DUCT FAN
5 6' DUCT PIPE
6 HEAT DIFFUSER



COOL TOWER
Cooling in summer

1 WIND SCOOP
2 SHOWER HEAD
3 WATER TANK
4 WATER PUMP
5 VENTILATION WINDOW
6 6' DUCT FAN
7 OUTLET





Cerro Azul
TECATE, MEXICO

Guadalajara Airport
MEXICO

CASE STUDIES

The following pages include examples of how we have been applying these in 2020

PDD can be adapted to the unique circumstances of any project while supporting the needs of all our teams and clients.

Merlata Bloom Milano
ITALY

Merlata Bloom Milano

Milan, Italy

Merlata Bloom Milano is an innovative and unprecedented project with numerous facets that are ready to welcome and satisfy a wide-ranging public of residents, students, workers, researchers and visitors. This smart location combines technology and sustainability, daily life and retail, entertainment and services as well as fulfilling Ceetrus' mission to be a Global Urban Player at the service of citizens with a vision of the future that goes far beyond the confines of traditional retail real estate.

Merlata Bloom Milano is a living space where even shopping becomes an exclusive experience. It combines the use of the most advanced technological and digital tools with the desire to have a positive impact on the territory, promoting biodiversity and responsible consumption. It features for example an innovative Urban Farm on the roof of one of the main structures and follows the best standards of modern urban planning, in term of use of materials and energy sources.

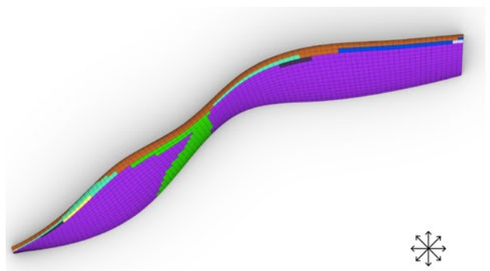
Merlata Bloom Milano will become a unique retail and leisure destination for Milan. The design seeks to blend the complex and the surrounding public park together and reinforce its connection with the Expo Area. The project also includes a 20,000 m^2 urban farm on the roof that will become a new amenity for the city of Milan and is part of our low carbon building strategy.

We looked at performance through the lens of the following categories: Daylight and Visibility, Energy, Cost and Constructibility and Structure. Each of these in turn had a set of measurable performance metrics that we could use to compare options against one another. In some cases, these were proxy metrics that were meant to be indicative rather than literal. This gave the design team a way of comparing designs across the same set of criteria. It also enabled us to weigh the different metrics enabling the team to give a weighted priority to each.

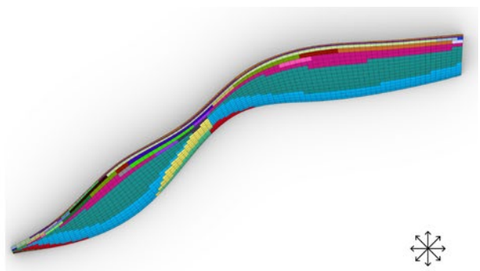
Energy was broken down into (1) maximizing solar radiation incident on the spaces during winter, (2) minimizing solar radiation incident on the space during summer, (3) minimizing the overall peak solar radiation incident on the enclosure and, (4) maximizing the percentage of enclosure surface/panels that were PV suitable.

Daylight & Visibility was defined as maximizing the percentage of enclosure panels requiring low frit/ louvre protection (in this case defined as panels receiving less than 400 kWh during the summer period). We complemented this metric with a ray-casting method to simulate sky visibility from uniformly sampled points inside the occupied space.

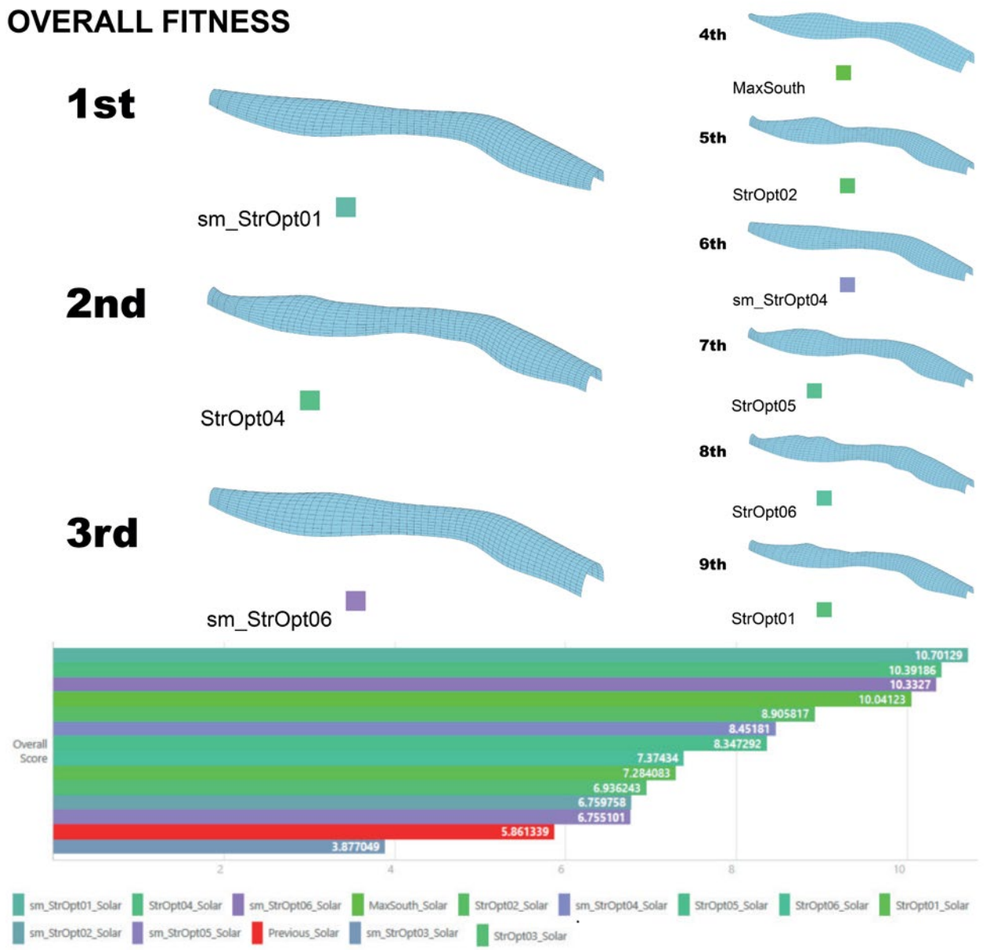
Cost & Constructability was defined as (1) minimizing the surface area of the enclosure and (2) maximizing the percentage of planar surfaces.



Panels colored by cardinal direction ranges: N/NE, NE/E, E/SE, SE/E, S/SW, SW/W, W/NW, NW/N (8 possible zones)

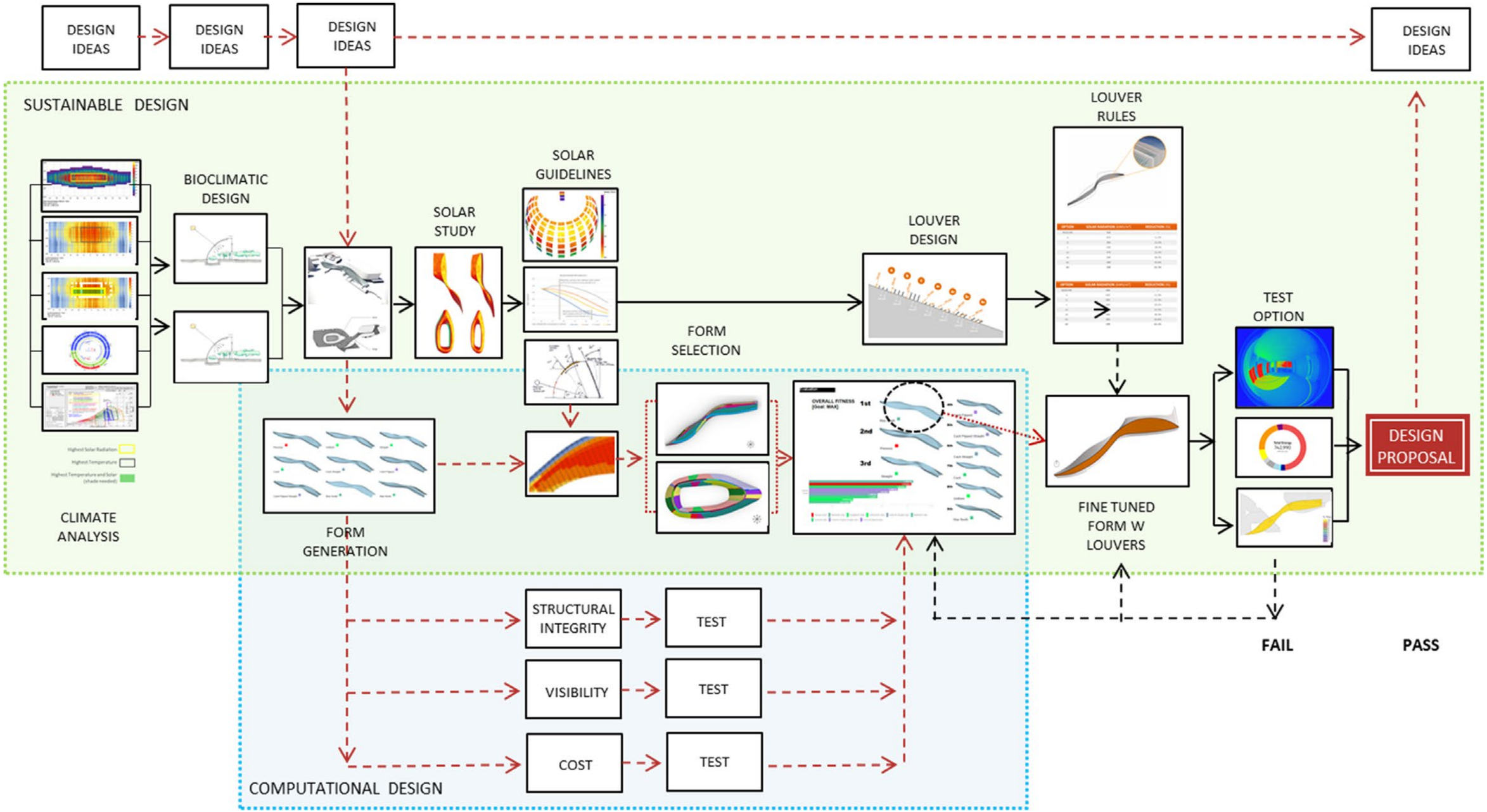


Panels colored by cardinal direction and 15 degree tilt increment ranges between 0 and 90 degrees (48 possible zones)



Lastly, we included a Structure metric which had to do with minimizing the lateral forces carried by the enclosure's members interfacing with the underlying structure. By using this approach, we had a way to discuss design options through an additional lens helping us validate our intuitions and question our predictions.

INTEGRATED DESIGN PROCESS



Mall of Saudi
RIYADH, SAUDI ARABIA

Mall of Saudi

Riyadh, Saudi Arabia

The Mall of Saudi is a project that is deeply rooted in and inspired by its context. It embraces the light, pattern, materiality and rich history of the city to become a modern reflection of the dynamic culture of Riyadh. Named for a natural fertility provided by its location at the junction of Wadis Hanifah and Al-Batha, Riyadh's name means "gardens." Abundant palm groves and farms transformed Riyadh into a lush desert oasis.

Gardens are artful masterpieces that express nature, culture and art through a journey between humans and their surrounding environment. These expressions ignite joy, inspire growth and spark curiosity among all who experience them. Gardens engage all the senses and provide both spiritual and physical refreshment.

The concept for Mall of Saudi is to transport visitors through a series of conceptual garden experiences that cultivate the center of life in Riyadh. Visitors can choose a garden that suits them best, or spend time visiting all of them, all the while marveling at this one-of-a-kind destination.

Each garden retreat includes varying levels of art, culture and nature that help frame an unforgettable experience and provide more than was expected. These expressions of art, culture and nature ignite joy, inspire growth and spark curiosity among all who experience them.

Daylight in Transition Spaces

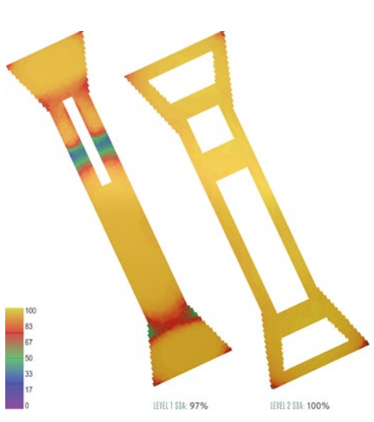
We completed daylight and glare studies for all transitional spaces in the Mall of Saudi. The goal was to maximize the spatial daylight autonomy while minimizing glare probability throughout the mall.

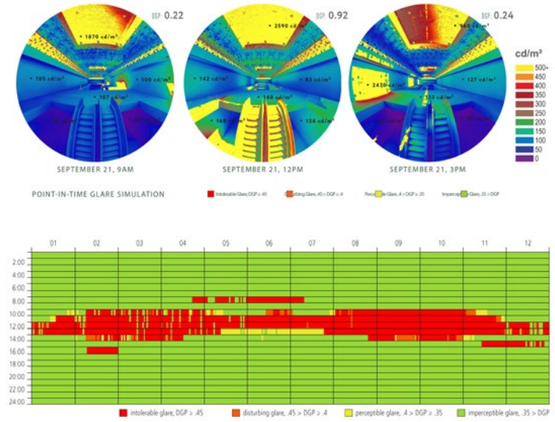
We recommended skylight and clerestory glass performance values depending on their size and type, and their impact on the spaces below them. For instance, a skylight with a VLT of 0.30 and a clerestory with a VLT of 0.40 were assumed for daylight studies on the Arabic Court. The percentage of the space that receives at least 300 lux for at least 50% of the annual occupied hours is 97% for level 1 and 100% for level 2. This is an excellent daylit space achieved by a good distribution of the skylights.

When the sun was halfway in its annual path in the sky (September 21 at 9am, 12pm, and 3 pm), we conducted detailed point-in-time glare studies. This type of simulation is useful to detect problematic times and areas where glare issues occur and helps inform the design team of areas that need more solar protection.

An annual daylight glare probability study helps us visualize glare probability throughout the year. The x-axis corresponds to different days of the year, the y-axis corresponds to time of day and the different colors represent hours with intolerable, disturbing, perceptible and imperceptible glare. In this case, the chart shows potential for glare from 10am to 2pm during the mild period and from 10am to 1pm during the warmer months for visitors looking towards the south.

DAYLIGHT ANALYSIS





Improving Outdoor Microclimate and Extending Thermal Comfort

It is important to implement strategies that will increase thermal comfort. These strategies will affect heat exchange between the building, the environment and the occupant with little or no energy use.

Using climate data and building simulation software, we determined and tested our strategies. The strategies implemented are shade (which will reduce radiant gains to the occupants and building surfaces), air movement to improve evaporative cooling at the skin level; water features to promote evaporative cooling; and green surfaces to reduce solar gains in surfaces exposed to the sun.

The image above shows comfort calculations and how the comfort calculations show how the user would feel during May using different outdoor mitigation strategies. The results demonstrate that implementing shade, air movement and evaporative cooling will make the outdoor space more comfortable.

North Hills Innovation District
RALEIGH, NC, USA

North Hills Innovation District (NHID)

Raleigh, North Carolina, USA

Planned around an existing heavily wooded creek and greenway, the district includes luxury apartments, a unique “maker” space, a food hall and event space and multiple new office buildings.

The natural topography of the Big Branch ecosystem that provides the spine for North Hills Innovation District–provides both challenges and opportunities in sustainability.

A pedestrian walkway offers a continuous esplanade of hardscape, seating, informal gathering spaces, outdoor dining and bridges that bring residents, guests and office workers a chance to engage with nature. Elevated terraces provide views over the walkway and into nature, blurring the distinction between public and private, business and pleasure.

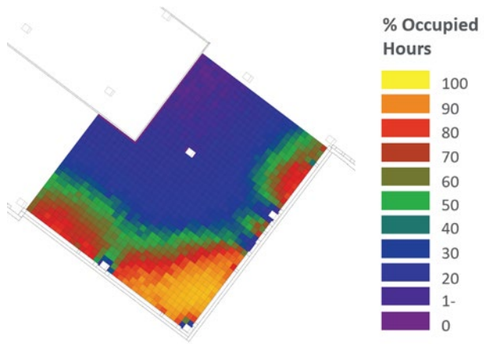
North Hills Innovation District recognizes the way we live and work now. Gone are the days of commuting to an isolated corporate campus environment only to work in isolation. NHID integrates innovation and community with nature.

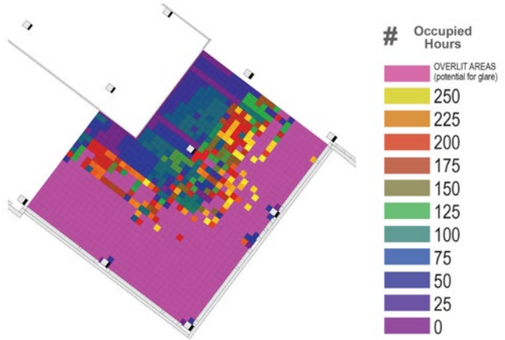
We performed daylight daylight and solar radiation studies to optimize an envelope that would allow for maximum daylight with the solar protection necessary to avoid glare and solar heat gain.

Daylight analyses provide an assessment of luminance levels the office space is likely to get from daylight on an annual basis. We then evaluated and compared Spatial Daylight Autonomy (SDA) and Annual Sunlight Exposure (ASE) studies of four facade options that integrated horizontal louvers.

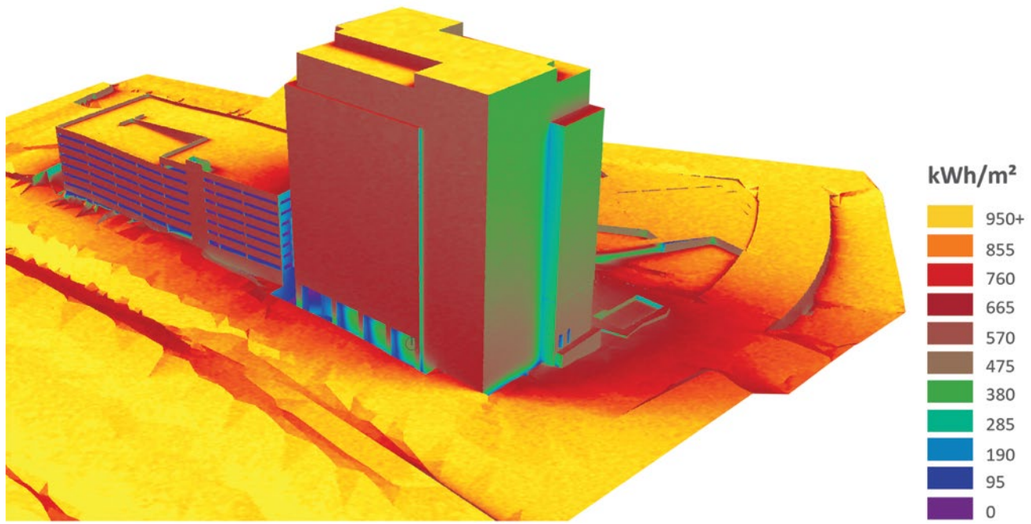
A solar radiation study during the warmest time of the year (Mid-April to end of September) was also performed on the southwest and southeast windows to visualize the effectiveness of the shading devices. We selected the facade design option that reduced glare probability and incident solar radiation on the southern facades the most.

DAYLIGHT





SOLAR



Block 4 Busan

Busan, South Korea

On this project, CRTKL collaborated with a local Korean architect, Sangji, to redevelop the exterior envelope of three prominent residential towers located in Busanjin-Gu, Busan, adjacent to Citizen's Park- a well-known landmark for the city. The planning for the towers had already been established and approved. Our scope was to focus on performance analysis and re-design of the exterior facades for: 3 residential towers, podium, main entry gateway and public facades of auxiliary facilities.

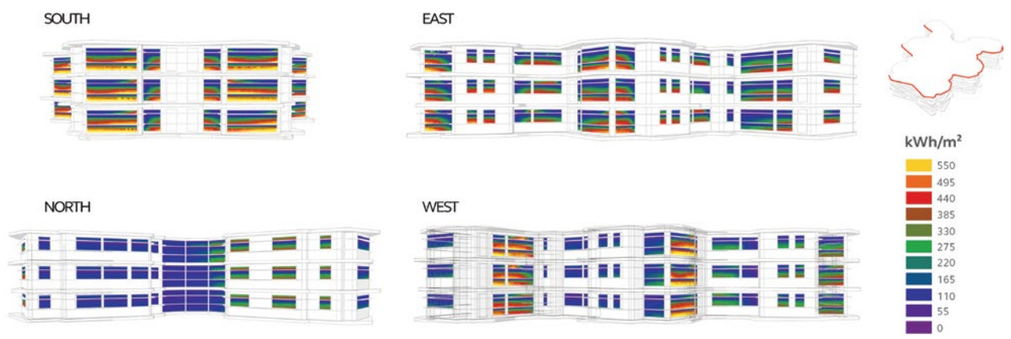
We started the process with an initial charette that included members of our PDD and Computational Design teams. Our goal was to develop three distinct high-performance schemes that responded to the local climate and context of Citizen's Park. From these three options, the client would ultimately narrow it down to a single option to be further developed in Schematic Design. After our initial presentation, Sangji helped us narrow it down to two schemes, but then the Union of collective landowners liked both options so much that they had to put it to a vote of 800+ members in order to decide which scheme would ultimately be developed further.

The resulting design option that was selected used a combination of biophilia principles and performance-driven design for the distinct facades of the towers-- simultaneously creating a connection to the adjacent park and a sustainable response to the environment.

Inspired by traditional Korean residential design, the towers seek to create visual harmony between the architecture and nature around them. The undulating floor plates create a natural rhythm as they mediate between the low-lying landscape of Citizen's Park and the verticality of the Hwaji mountain to the north. Maximizing floor to ceiling glass in the living areas provides residents a visual connection to nature with expansive views to the Park. The glass is shaded by the integrated projecting floor slabs and intermediate louvers-- which have been optimized based on their solar orientation and relationship to glass, providing a high-performance modern facade.

Block 4 Busan
BUSAN, SOUTH KOREA

We performed solar radiation studies were performed during the summer and winter seasons. Our studies focus on windows since solar gain through windows has the most impact on the interior. During the summer months, less solar radiation through the windows is preferable, while higher solar radiation is better in the winter since it provides free heating.

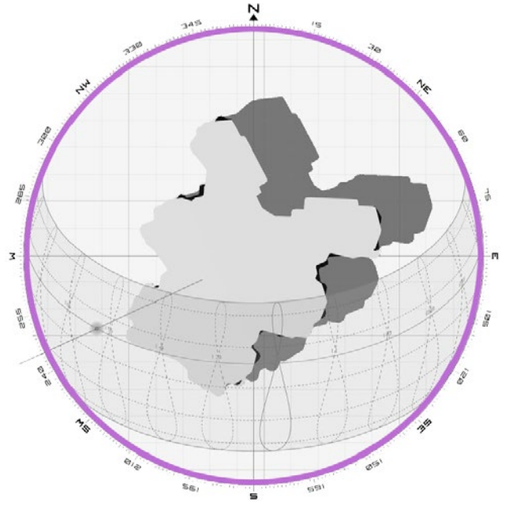


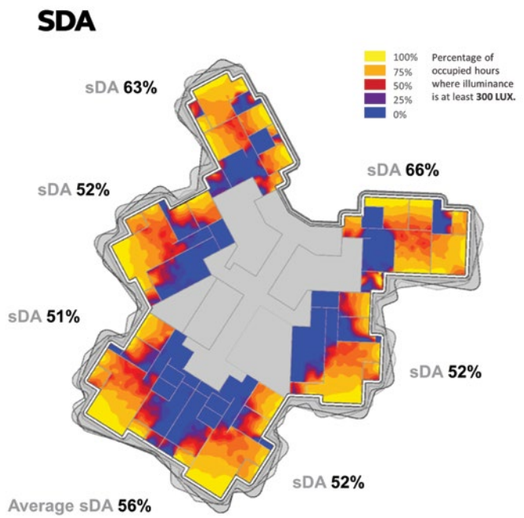
Summer Solar Studies

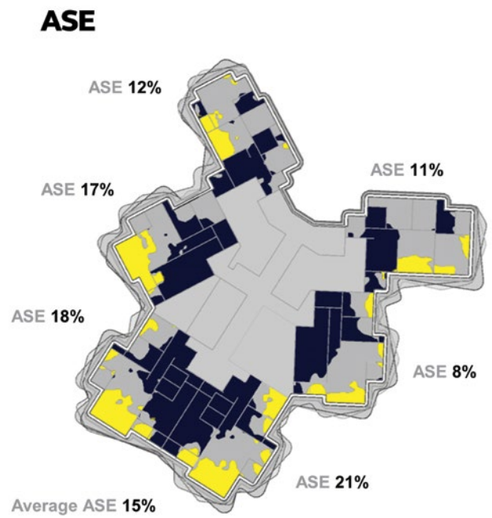
Solar and daylight studies demonstrate that the overhangs are providing adequate solar protection in the summer while allowing ample solar gain in the winter. They also provide daylight all year.

Facades with maximum solar radiation in the winter are southfacing and produce the most comfortable interior spaces during the winter months.

Annual Sunlight Exposure (ASE) study shows direct gain on southern facades, which are mostly during the winter with lower altitude sun and are comfortable to the occupants.







888 S Hope Street
LOS ANGELES, CA

888 S. Hope Street

Los Angeles, California

Overlooking Grand Hope Park, this 568,800 SF, 525 unit Multi-Family Residential luxury facility includes a private 30,000 SF park and pool experience, a terraced lounge on the 34th Floor, loft-like apartments with floor-to-ceiling windows offering panoramic skyline and park views, an outdoor cinema, outdoor pool, dog park, fitness center and yoga studio.

With an emphasis on sustainability, we accomplished the following measures: a 42% water use reduction over baseline in indoor fixtures, 69% reduction of potable water use for irrigation, light colored roofing used to minimize heat island effect, low-emitting materials used for all adhesives and sealants, paints and coatings, flooring systems and composite wood and agrifiber products inside the building envelope.

Four Seasons
LOS ANGELES, CA

Four Seasons Private Residences

Los Angeles, California

The Four Seasons Private Residences is a luxury residential project located in Los Angeles, CA. The project provides fifty nine luxury units in a twelve-story Tower. The design ensures that the residential tower takes full advantage of the area's climate and impeccable views by offering private balconies with outdoor kitchens and roof top gardens. The project attained reductions in indoor water use of 20%, irrigation use by 50% and building energy use by 14%. The project is targeting LEED Silver.

03

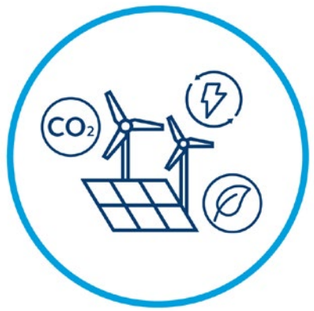
BUSINESS OPERATIONS

REDUCTION OF CARBON EMISSIONS

In 2020, we set a goal to be Climate Neutral for our own business operations by the end of 2021 in order to contribute to the Paris Agreement's goal of keeping climate change below 1.5 degrees C. We have already met this goal, and have achieved climate neutrality for our 2020 global business operations.

We believe in the importance of transparency when it comes to our carbon calculations, and follow GHG Protocol to track our emissions. GHG Protocol was developed by the World Resources Institute and the World Business Council for Sustainable Development, and is the world's most widely used greenhouse gas accounting standard. In 2020 we included both the mandatory Scope 1 and Scope 2 emissions (direct emissions and electricity) in our operational carbon footprint as well as several categories of Scope 3 emissions that are voluntary to report - business travel, commuting, and paper consumption. Our 2020 emissions prior to neutralization measures were 2,044 metric tons CO_2e.

We define Climate Neutrality as "the state where human activities result in no net effect on the climate system" per the CDP's Science-Based Targets initiative, which requires both net-zero emissions and an avoidance of bio-geophysical changes that negatively impact climate. We have achieved this through a combination of mitigation strategies to reduce our emissions and nature-based neutralization measures that offset our emissions, restore forested land, and preserve habitat. We also follow the CDP's mitigation hierarchy – we prioritize mitigation over neutralization and pledge to continue to reduce our carbon consumption prior to offsets by at least 10% each year, using our 2019 emissions as a baseline.



CLIMATE NEUTRAL SINCE

2020

BUSINESS TRAVEL
761,496 kg CO2e

ELECTRICITY
777,683 kg CO2e

EMPLOYEE COMMUTING
284,983 kg CO2e

PAPER
219, 539 kg CO2e

DIRECT EMISSIONS
0 kg CO2e

TOTAL
2,043, 701 kg
(2,043.7 tonnes)
CO2e

EQUAL TO
444 cars
driven for a year

IT WOULD TAKE
222 acres of forest to sequester that much carbon for a year

We achieved this goal through several strategies:

- Office Lighting upgrades to increase energy efficiency
- Work from Anywhere - expand opportunities for flexible working locations to reduce our commuting carbon footprint
- Break room, copy room, and conference rooms designed to facilitate composting and recycling over trash to landfill
- Compostable paper products and kitchen supplies

We are committed to continuing to refine our carbon footprint tracking and to adding more scope 3 categories as well as to implementing additional mitigation strategies.

- Additional scope 3 categories we will be adding to our carbon footprint calculations include catering and data usage
- Starting on Earth Day 2021 we are holding our first Climate Action Challenge, during which all CRTKL employees are invited to submit their ideas for ways we can further reduce our operational carbon footprint. Our goal is to generate 100 ideas in 100 hours. We are awarding prizes for the best ideas and we have committed to implementing the top strategies submitted.

CORPORATE SOCIAL RESPONSIBILITY

We strive to implement policies, programs and practices which enrich our culture and promote diversity, equity and inclusivity while enhancing community stewardship at every level - from local to global.

Just Label

CRTKL has received the Just Label for our US region; this is the first step towards achieveing Just Label for our global operations. As the largest firm with the label so far, CRTKL's process to proactively evaluate the firm's policies and practice sets in motion an ambitious vision with real tools for organizational and systemic change.

In the process of achieving our first JUST Label for the US region, we reviewed internal diversity, engagement, equity, health programs and benefits. We also evaluated how the business interacts with the communities around us: how we show up, who we bring to inform our work, where we direct our financial investments and how we measure the social and environmental impacts of our projects.

The JUST Label brings social equity priorities to the forefront. Internalizing them as part HR, financial and procurement practices enhances our pathways to measure success as an organization. The JUST Label connects the dots across the many ongoing efforts to measure what matters.

Diverse and Inclusive Industry, now and future

An inclusive industry goes beyond diverse representation as a snapshot in time. CRTKL believes in creating inroads at every age, as well as encouraging the profession itself to evolve. We recognize the inherent value in a diverse workforce and an inclusive work environment. This influences how CRTKL volunteers, recruits, hires and cultivates growth. A few examples of these efforts include:

- An internal Women in Leadership network to advance gender equity in the field (WIL)
- Active participation in ACE mentor programs and additional youth outreach platforms
- Recruiting teams take part in HBCU's 20×20 interview program
- Patron members of NOMA's President's Circle (National Organization of Minority Architects)

Transparency, Voice and Agency

CRTKL strives to empower employees at all levels to set the tone for an inclusive internal community. We invest in cultivating reciprocal communication across levels of seniority, creating pathways for people to participate and organize on their own behalf. We believe a diverse, inclusive and equitable firm evolves by facilitating both informal connections and a supportive structure.

Cultivating Awareness and Connection

Firmwide education and training build awareness and shared language on unconscious bias, microaggressions and bystander intervention - encouraging employees to better understand each other, gain perspective to appreciate their differences and recognize the impacts that individual behavior has on collective culture. This complements the work of genuinely connecting and building trust and confidence with one another. Round-table discussion series and internal working groups create space for people to engage with broader and complex industry issues. It lets different voices step in and helps level the playing field for our employees to build, explore, grow and contribute.

Directing Influence

CRTKL considers participants beyond direct clients and project boundaries. We are keenly aware that who is at the table determines how issues are addressed. Looking at projects and industry issues in their larger social, economic and environmental context, our outreach considers who has power to effect change through their scope or role, who is affected by decisions and systems and who can offer insights about parts of the built environment ecosystem that we might not typically see.

CoLab workshops, research microgrants, impact studies and our internal Social Action Committee give employees room to explore and advance ideas through implementation. Just as crucially, they invite community partners and external stakeholders to be agents in our organizational process and strategic direction.

Each initiative has different objectives and focus areas with overarching goals to bring in new views, co-create solutions and proactively connect between different groups and ideas that don't otherwise cross paths. This allows us to advance a well-rounded agenda toward the tomorrow we believe in. CRTKL employees are encouraged to be bold, use our platform and advance the standing of others.

We are also analyzing how the firm channels its financial commitments – from who we select as our vendors and consultants for more equitable purchasing, to how we give back through charitable donations and volunteering.

Governance and Systemic Change

CRTKL has introduced several new policies as a result of the JUST label process, to ensure that the inner workings of our organization are transparent and consistent. They help hold us accountable to the stances we take.

The JUST Label shows our work in context and builds a more cohesive narrative of the different pieces of the puzzle that form CRTKL's mission and values. These practices improve how CRTKL continually evolves and remains adaptive and responsive to employee and community needs. Social equity is always a work in progress toward a more sustainable, inclusive, diverse and equitable future.

04

THOUGHT **LEADERSHIP**

We believe that a design practice must be informed by research. Our practice values research and consider it a vital part of how we design an develop projects. We also partner with organizations that are equipped to do research.

CONFERENCE PRESENTATIONS

PUBLISHED PAPERS/ JOURNAL ARTICLES

PRESENTATIONS/ SEMINARS

Published Papers / Journal Articles

We publish and share our research in peer-reviewed international technical and scientific journals and conference proceedings.

Presentations

Even though the pandemic eliminated face to face conferences in 2020 we continued with speaking engagements and were still able to present our work virtually in events such as CARBON POSITIVE RESET! 1.5°C GLOBAL TEACH-IN with Architecture 2030, several ULI Meetings, the Passive Low Energy Architecture Conference PLEA in La Coruna Spain, the Windsor 2020 Resilient Comfort conference in the UK, the University of Concepcion in Chile, The DFC Leadership Summit on the Future of Environmental Responsibility, the Knowledge Series Sponsored by US AID and MAITREE in India and the IIDA retail forum.. We also published in the journal Energy and Buildings and the BDC network as well as and on our own blog “You Are Here.” We have presented on resiliency, building performance, green roofs, passive cooling systems, designing for disassembly, big data, green retail, the evolution of green building, aesthetics and sustainability, material health and others.

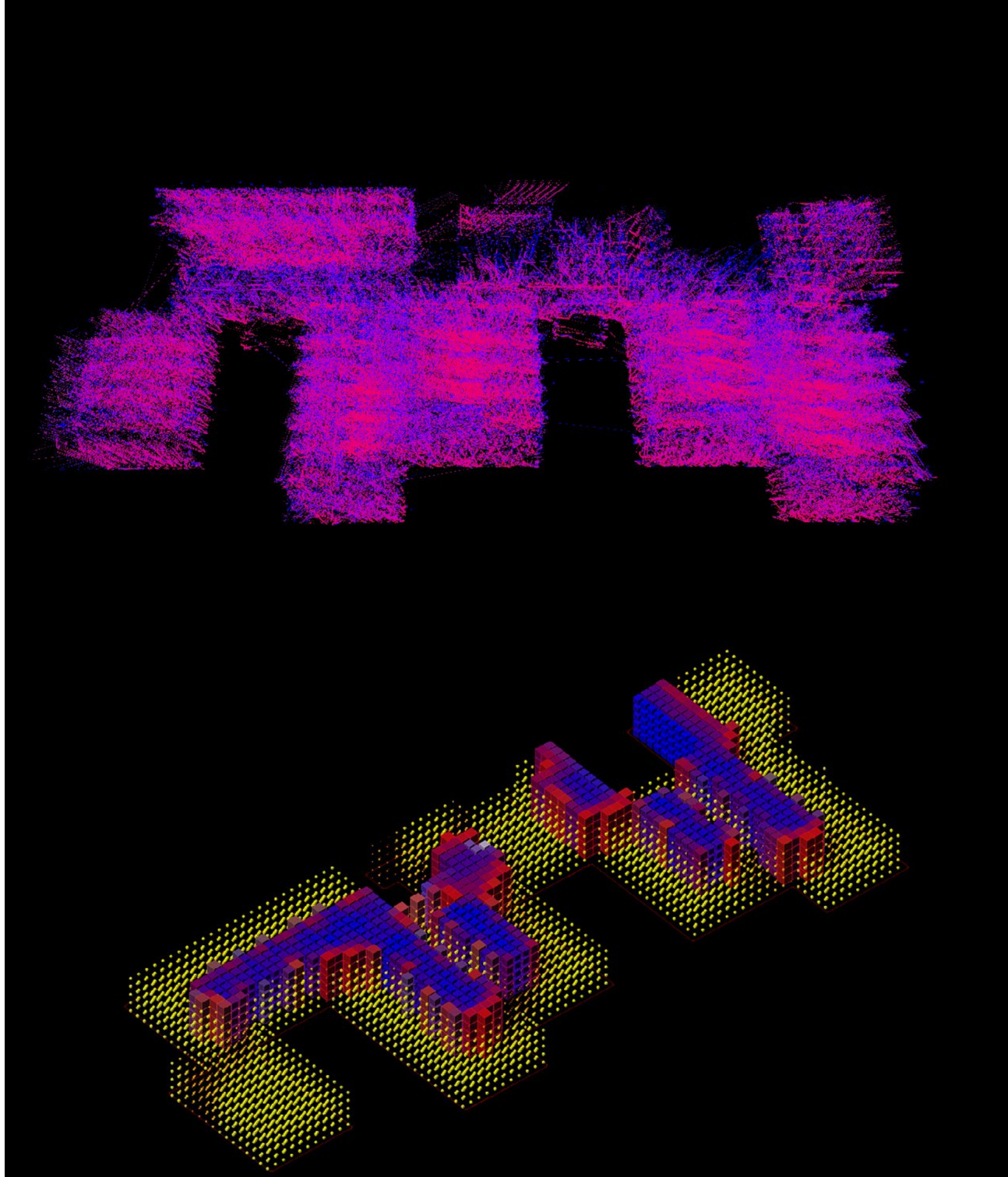
ALTERNATIVE REPRESENTATIONS OF DAYLIGHT

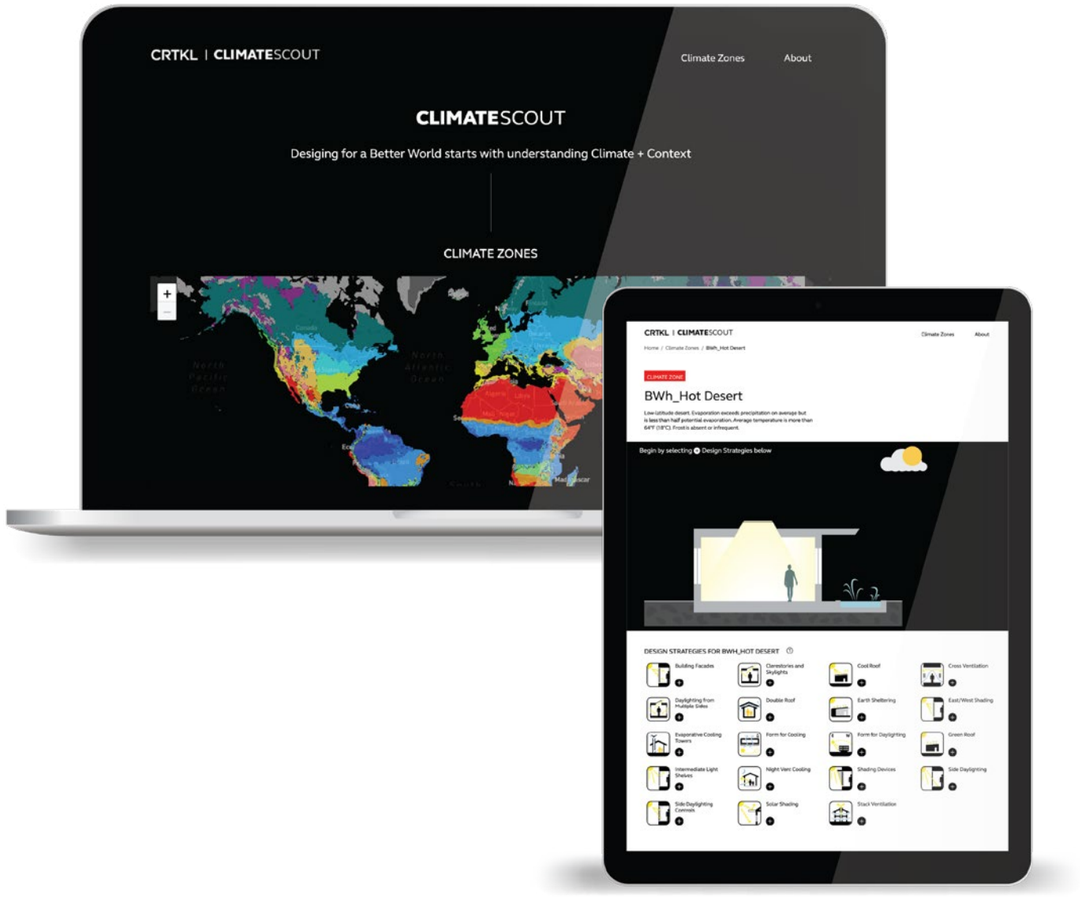
We use building simulation tools to evaluate the environmental performance of our ideas. We propose ideas, but we also test them with state-of-the-art tools to ensure their feasibility. Data is a fundamental part of the building simulation process and it is not always easy to understand this data. As designers we are always looking for ways to better represent information in a clear and simple way including the three dimensional quality of space when possible.

The computational design team proposed a creative and immersive means of communicating the visualization of daylight availability within a building to augment traditional 2d analysis deliverables. The team built a custom ray-casting application in Unity3d to help visualize what the space might look like through this analysis lens. To visualize this, the three-dimensional space inside the building was divided into a 3d grid of cells or voxels. The next step was to sample 'light' (vector) emitting points uniformly across the window locations and building an algorithm which allowed to control the rays that would be emitted by using the sun angles of a specified analysis period. The algorithm also allowed to control how many light reflections or 'bounces' would be considered.

After running the simulation, the application was able to detect the collisions between the light rays and each cell/voxel making up the 3d space of the building. Rather than using strict collisions a 'closest point' threshold of 2 meters was set and each ray was weighed according to intensity- simulated by linearly reducing the intensity of each ray after every bounce.

This model and the animation produced by the app was used as a presentation tool to complement other more rigorous methods of calculating available daylight. This application is the first step in exploring alternative methods of representing daylight.





CLIMATESCOUT

Understanding climate and developing an appropriate architectural response is one of the first steps in any architectural design process. We have developed a web-based climate application that helps users design buildings that respond to site by providing climate specific design advice at the building scale. To achieve this, it uses the Köppen-Geiger climate classification and building scale design strategies from Architecture 2030's Palette. The Köppen-Geiger climate classification system empirically maps biome distributions around the world organizing regions by similar vegetation characteristics. The first version of this classification was developed in the late 19th century and it is still widely used today for applications that must consider different climates, such as ecological modeling or climate change impact assessments.

The 2030 Palette provides a free online platform that provides a database of sustainable design principles, strategies, tools, and resources for designers. It puts the principles and actions behind carbon neutral and resilient built environments at the fingertips of designers, planners, builders, and policymakers.

For CLIMATESCOUT we have selected the 27 building scale strategies from the 2030 palette and have compared them with the 30 climate subtypes to determine their applicability for each of the Köppen-Geiger climates. By doing this the user can only select and combine appropriate strategies for that climate. As the user selects these curated strategies, they appear in real time overlaid in a diagram in the same page, providing an immediate visual connection between climate and building response. Most climate analysis tools are effective in visualizing climate data and quantifying the effect of some strategies on thermal comfort, but they do not provide a visual image of these strategies integrated in an architectural response. CLIMATESCOUT does this, providing a more integrated and coherent vision of the strategies working together. Future versions could provide some quantification of the impact of selected strategies on thermal comfort.

Through a combination of data and images, CLIMATESCOUT connects climate with architecture to help users create more sustainable buildings.

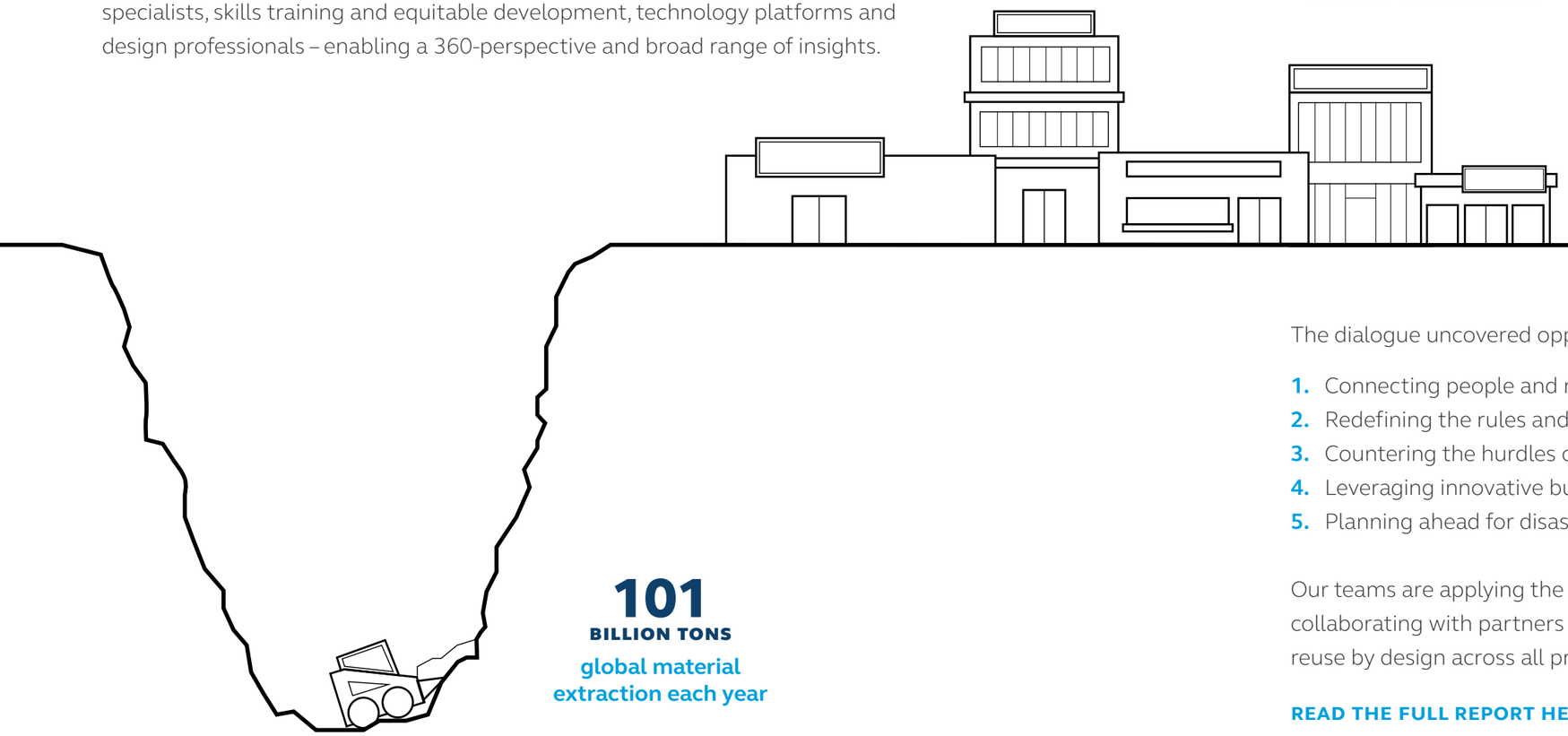
COLAB

The CRTKL CoLab is a flexible platform for problem-solving, strategizing, innovating or co-designing solutions within a short time-frame. It's an opportunity to explore complex issues and develop stronger relationships with industry partners.

CRTKL's first virtual CoLab connected a diverse group of experts to discuss reducing waste in retail architecture. Construction and demolition debris from buildings represents over 100 million tons each year, and more than 60% ends up in landfill. Since processes are not yet established to recapture building products intact, valuable resources are going to waste, especially in spaces with shorter life spans like pop-up shops.

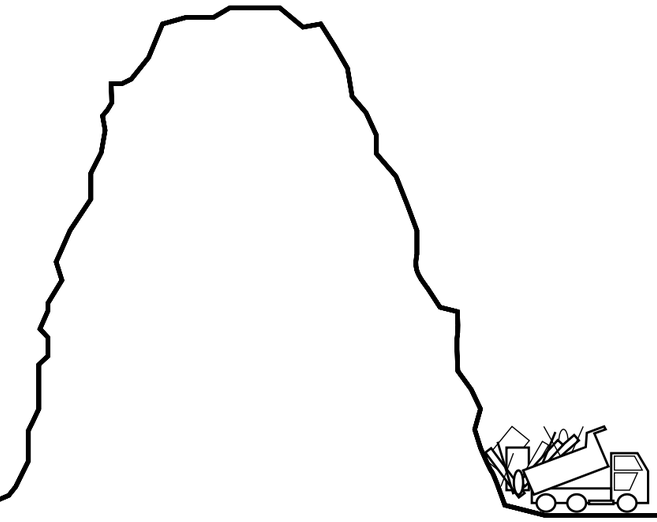
Participants included retailers, policymakers, contractors, materials management specialists, skills training and equitable development, technology platforms and design professionals – enabling a 360-perspective and broad range of insights.

4.5
YEARS
average lease lengths
for mall retail tenants



101
BILLION TONS
global material
extraction each year

2.2
BILLION TONS
estimated annual
solid waste by 2025



The dialogue uncovered opportunities for action across key themes:

1. Connecting people and networks for collective knowledge and power
2. Redefining the rules and agreements that shape practices downstream
3. Countering the hurdles of cost and time through partnership and demand
4. Leveraging innovative business models to fill supply chain gaps
5. Planning ahead for disassembly in projects and process

Our teams are applying the findings to both existing spaces and future design – collaborating with partners to advance deconstruction strategies, responsible sourcing and reuse by design across all practice areas.

READ THE FULL REPORT HERE

05 GIVING BACK

We believe in connecting with our local communities and giving back. Our staff is involved in different events and competitions that help our local or global communities.

Given the history and breadth of our practice, we have developed long-standing relationships with many minority- or women-owned businesses as well as small-business-designated organizations. We are happy to comply with any preferred team inclusions and regularly do so on our many public, institutional or academic assignments.

CRTKL expects all employees to conduct themselves as global citizens. One way we do this is by supporting the more organic and grass roots efforts of our employees. A few initiatives worth mentioning in 2020:

ACE Mentoring
A&D Museum
AIA Retrospect
Angel Tree Program
Angeles Forest Trail Repair
A Place to Go
Architecture in the Schools
Artists V. Architects
Autism Speaks
Bark + Build
Beach Cleaning
Burnham Prize
CRTKL Toy Drives
CANstruction
Casey Trees Volunteer
Catholic University Charrettes
Chicago Architecture Center
Children's Educational Charity
Corazon
Cosmo Couture
CRE8
Cycle for Survival
DCBIA Community Improvement
DesignCosmo Couture
Design Mix
Downtown Mission
Dubai Cares: Rebuild the School
Education Stipend
Fabric
Factor-H
F*Cancer
Festival of the Trees
FIU Mentor Program
Form Follows Fitness 5K
Fridays for Future
Furniture 4 Kids
Give a Dog a Bone
Habitat for Humanity
Herman Miller Cat House
IIDA Lavish
Invest Southwest
JDRF Real Estate Games
JDRF Sheraton Gingerbread Village
Latinos in Architecture
Lighthouse for the Blind
Little Free Libraries
Make a Wish
Medical Foster Care Program
NAIOP Community
Enhancement
Open Source Architecture
Park(ing) Day
Pathways to Equity
Preservation Chicago
Race for Hope
Rebuilding Together
ReFortify
Sandcastle Competition
for Heal the Bay Foundation
Spark Week
St. Agnes Gala
Swap Don't Shop
The Sameness Project
United Way
University Tours of the
Dallas Office
We Care
Women of Tomorrow
Wreath Laying at ANC
YMCA Stair Climb
ZeroLandfill

A bit more detail regarding just a few of these partnerships.

ACE Mentoring: Our LA and Seattle offices are both active in the ACE mentoring program, organizing and conducting activities for high school students to teach them about architecture, engineering, and construction. This year our LA office worked with St. Mary's Academy all-girls school in Inglewood, CA to create a public pavilion near the LA coliseum. We, along with representatives from other AEC firms, have been guiding the students through programming, architectural design, interior design, MEP and structural coordination of their pavilion.

Angel Tree Program: Annually, CRTKL sponsors multiple children in the community whose families are struggling financially to provide gifts for the holidays. As humans, it is our duty to be kind and understand that a small gesture can go a long way.

CANstruction: An annual event throughout the United States focused at raising awareness about hunger. Multiple CRTKL teams compete in different cities to create massive sculptures using cans of food. CRTKL donates design time, administrative support and participation in local food banks.

Corazon: Corazon is a non-profit organization that builds housing in Mexico. Our LA office worked with them to develop a center in Tecate for the Cerro Azul community.

Cosmo Couture: Every year CRTKL participates in one of IIDA's fundraising events where Architects and Interior Designers partner with a manufacturing firm using only that firm's products to create a garment reflecting a theme. A portion of the proceeds are donated to a beneficiary announced that year.

Cycle for Survival: Every year CRTKL fields teams from multiple offices to participate in this charitable event to help beat rare cancers.

Education Stipend: Every full-time employee is given a $2,000 stipend (per annum) to put toward a class or coursework on a job-related subject.

Factor-H: In collaboration with Cal Poly Pomona, our LA office worked with Factor-H to design a center for people with Huntington's disease in South America.

Invest Southwest: is a City of Chicago initiative to encourage urban revitalization in neighborhoods that have historically been victims of disinvestment. CRTKL has been invited to lead a multi-disciplinary team to write the RFP for a design scheme to redevelop a site on 79th Street, on the South Side of Chicago.

JDRF Real Estate Games: CRTKL is an annual sponsor and participant in this sport-related fundraiser for juvenile diabetes research.

JDRF Sheraton Gingerbread Village: CRTKL is an annual participant in the Gingerbread Village fundraiser for JDRF, held at the Grand Sheraton in Seattle. A Seattle tradition for 27 years; architects throughout the city donate their time and design skills to build elaborate gingerbread houses in partnership with the chefs of the Sheraton.

Preservation Chicago: Since 2019, CRTKL has established an ongoing collaboration with Preservation Chicago. We apply our design skills to envision what could become of historic, abandoned buildings, focusing on under-served communities across the Chicagoland area.

Spark Week: An annual week-long event where each CRTKL office develops a program of study, outreach and action to spark ideas and solutions to the challenges

United Way: CRTKL is a corporate sponsor for United Way, providing sweat equity for the campaign as well as a sizable donation on top of employee contributions.

VOLUNTEERING: HIP HOP ARCHITECTURE

(CRTKL – grassroots fundraised $1500)

The Hip Hop Architecture Camp® positions Hip Hop culture as a catalyst to introduce underrepresented youth to architecture, urban planning and design.

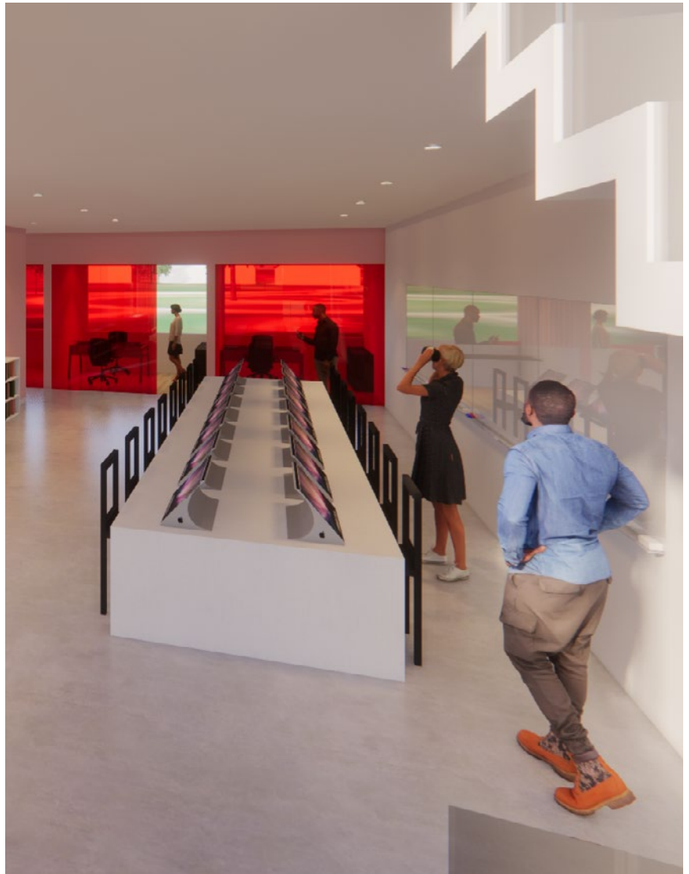
In 2020, the program went virtual. The Hip Hop Architecture Camp® hosted a one-week intensive experience designed to introduce young learners to architecture, urban planning, creative place making and economic development through the lens of hip hop culture. Throughout camp, there were a number of design challenges where campers are paired with design industry professionals, community activists and hip hop artists to create unique visions for their communities through the physical and digital models, a Hip Hop Architecture track and music video.

CRTKL's Seattle office fund-raised last summer to support this singular program and sponsored a winter intern to follow on the week-long virtual summer camp. Top selected participants had the opportunity to continue developing their designs in paid winter internships hosted through design firms.

CRTKL hosted our seventh-grade intern, Coleman Simmons, during his winter break. There, he had designed a Black Lives Matter community resource center for school-age children and young adults.

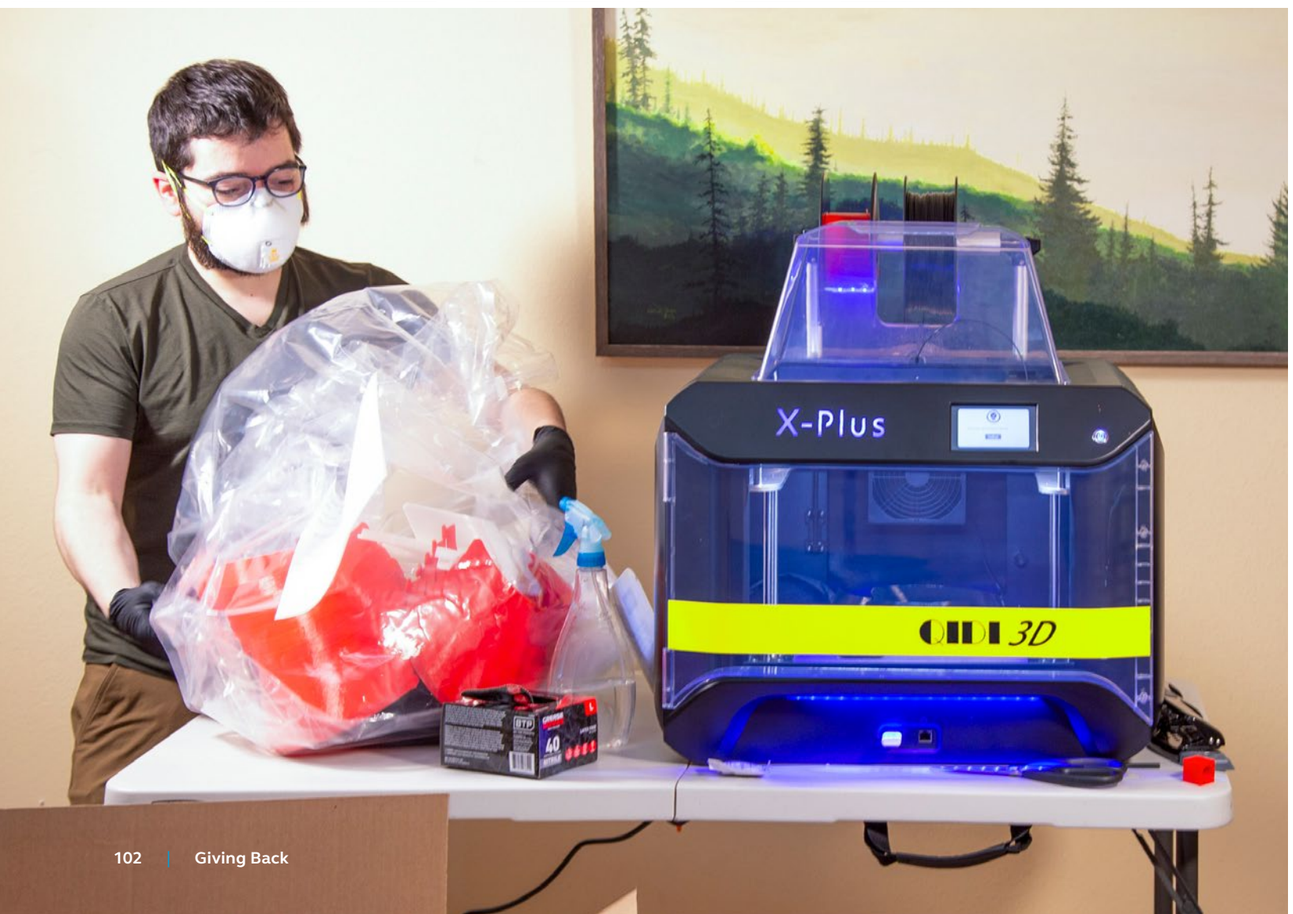
CRTKL designers collaborated with our intern, to further communicate his design vision and engage him in the process of bringing the project from TinkerCAD concept model and material board to immersive renderings and animations.

The team participated in the final virtual showcase where all of the interns and host firms shared their bold and thoughtful creations.



"Although I have worked on other community efforts during my tenure at CRTKL, Hip Hop Architecture Camp uniquely outreaches to under-represented youth potentially making a difference in their career aspirations. Through the winter internship program, we were able to inform and influence future practitioners of architecture by sharing the advanced digital tools and visualization abilities at our fingertips, while directly advancing their own vision on the projects they thoughtfully developed during the summer."

Orlando Orozco



COVID MASKS

All over the world, essential healthcare workers are facing face mask and PPE shortages as they combat the COVID-19 pandemic. In many of our offices, we have access to 3D printers for assistance in design, modeling and planning—which gave us an idea. We can repurpose our existing technology to do what we do best: design with people in mind. Read on to learn how our designers are came together around the world to alleviate face mask and PPE shortages for our most vulnerable workforce.

In Chicago, volunteers distributed shields and masks to Lurie Children's Hospital.

In Dallas, our team distributed their shields and masks to OneEQ.

In Los Angeles, the team donated their first batch of printed face shields to Huntington Hospital. After this first donation, they continued their printing efforts while reassessing local needs for their following donations.

In Mexico City, the team printed shields and evaluated the most critical and at-risk local healthcare employees to distribute too.

In Miami, the office donated their hand-sewn masks to Baptist Health.

In Seattle, volunteers have delivered hundreds of printed face shields and fabric face masks to One Medical, Harborview Respiratory Department, UW Cardiology center and Harrison Medical Center – St. Anthony Hospital with plans to continue.

In Washington, DC,the team produced PPE for Washington Adventist Healthcare and MedStar Health employees. Our New York City office also joined in the effort for these locations with hand-sewn masks.

At CRTKL, our goal has always been to design with a brighter, healthier world in mind – and we are lucky to work with the talented people who are willing to take us there, no matter the circumstance.

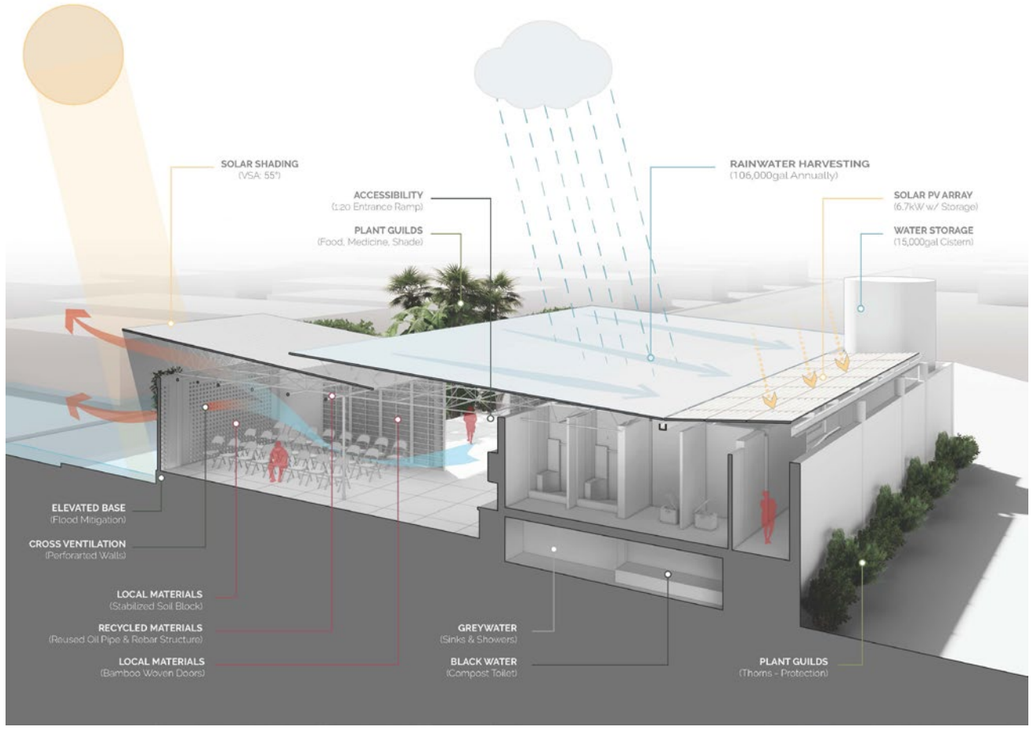
DESIGN FOR SOCIAL RESPONSIBILITY

Casa Dignidad: A Community Center For Barranquitas

At CRTKL, we believe that we can use or knowledge an architectural experience to help others. An interdisciplinary team of Cal Poly Pomona students led by Pablo La Roche through a course at the Lyle Center for Regenerative Studies in the spring of 2020 proposed design ideas for community center for people with Huntington's disease in Venezuela.

Huntington's disease is a genetic, progressive and fatal neurodegenerative disease. It affects people with a worldwide prevalence of 0.5-1 per 10,000 people. The disease is caused by mutations in a single gene, called Huntingtin, and the penetrance of the mutation is 100%. Huntington's disease does not discriminate based on ethnicity or gender, and most people with Huntington's do not receive any treatment. Their families must take care of them, and in many cases, it is the children that are taking care of their parents who cannot work and provide for their families. People with the disease are either hidden in their homes or wander around town aimlessly until they are so sick that they are simply left to die. Factor-H is a nonprofit agency based in Los Angeles that helps people in communities that have Huntington's disease in South America by addressing the medical and social issues and raising awareness, mobilizing communities, and providing infrastructure to help these communities grow with dignity and hope.

The students Jake Chevrier, Allie Park, Clement Tsang and Nyree Vertanessian worked closely with Factor-H's team and proposed ideas that will continue to be developed by a local architect with support from Factor-H, Cal Poly Pomona students and CRTKL staff. The project construction will be funded by Factor-H.



The community center is being designed for net zero energy with very low water consumption and composting toilets. It is adapted to the very hot and humid climate of Barranquitas in western Venezuela, with a floating roof and few enclosures that allow the breeze to move through it. Vegetation will provide shade and the building opens towards internal courtyards that will allow much needed recreation and urban farming. These will be used by children and adults and become a focal point for people with Huntington's disease, a social space where patients and kids mingle. The Center will provide social integration with the community and offer care for families, by providing medical, educational, and recreational activities for the community.

06

OUR **PARTNERSHIPS**

Collaboration and dialogue with our peers is essential to advance the performance of the built environment. We all need to do our part in the generation and sharing of knowledge.

We are members or sponsors of several organizations such as:

1. CBE Berkeley. Industry Partners (Industry Advisory Board)
2. USGBC. Silver Member
3. Carbon Leadership Forum University of Washington
4. BuildingGreen. Sustainable Design Leaders Peer Network

In order to maximize our impact, we:

1. Signed onto the AIA 2030 Commitment.
2. Account for climate action in our next strategic plan.
3. Advocate and design for building reuse.
4. Include embodied carbon as a key factor when selecting materials.
5. Support carbon education within our firm, academia, and professional networks.

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