



TAKING INTEGRATED, PRODUCTIZED CONSTRUCTION FROM THEORY TO PRACTICE

An Introduction of the NetZERO
Building Platform.



INTRODUCTION

Sustainability. Resilience. Construction efficiency. Solving the current and future problems in the AEC sector depends on integration and collaboration. Building information modeling, particularly when used at higher levels, enables disparate project teams to work together more effectively.

Collaborative project delivery methods like design-build and integrated project delivery are growing increasingly common. And construction firms are forming more strategic partnerships to solve the complex challenges around building sustainability and safety. Vertical integration, where individual firms take ownership of multiple phases of the process, is also becoming more common.

The construction supply chain is evolving, creating a bevy of new options for building owners to choose from as they embark on new projects.

According to McKinsey, the construction ecosystem is moving towards greater consolidation, where construction processes are more integrated and product-based, instead of being fragmented and project-based.¹

Driving this change is the adoption of manufacturing approaches that reduce risk and optimize labor. Prefabrication in particular is expected to feature more prominently, since it maximizes labor efficiency, cuts costs, and improves schedule certainty. Here's why integrated construction solutions are the ideal solutions to solving big sustainability challenges.

WHY COMMERCIAL CONSTRUCTION IS CHANGING

New innovations – ranging from IoT sensors to high efficiency mechanical equipment to renewables – empower building owners and operators with the tools to optimize energy performance and improve the occupant experience. Maximizing the potential of these innovations adds complexity to the entire building lifecycle, starting with design. Performing energy modeling and lifecycle carbon assessments requires data that is sometimes difficult to quantify.

That can lead to deviations between the model and the actual performance of the building. To minimize those deviations as much as possible, these assessments must be performed earlier, more frequently, and with greater input from the owner and other project stakeholders.

Once construction begins, it's important to monitor progress to ensure that

sustainable solutions are actually being considered and implemented. It's also important to improve the sustainability of the construction process itself.

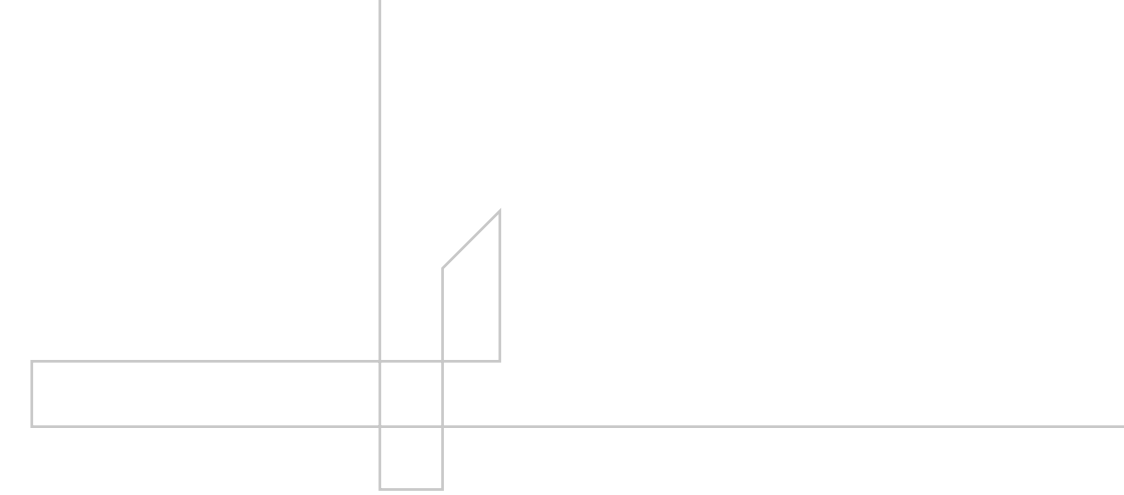


UP TO
20% OF CONSTRUCTION
MATERIALS GO
UNUSED.²

**BETWEEN NOW AND 2050, ½ OF EMISSIONS
GENERATED BY NEW CONSTRUCTION WILL
BE EMITTED BEFORE THE BUILDING IS IN USE.³**

Traditionally, high-performing buildings are constructed with an inexpensive structural system, and other components, such as the MEP systems and materials, are expected to do the heavy lifting of driving sustainability. This is reflective of the ineffectiveness of the sequential, project-based approach to construction. It's difficult to understand the costs of each component, and as the project unfolds, sustainable measures often have to be cut back due to costs.

These issues diminish the potential sustainability of the finished product and they undermine the project team's ability to address the rework and waste involved in construction.



STREAMLINE COMPLEXITY WITH INTEGRATED CONSTRUCTION PRODUCTS

These sustainability hurdles are common in ambitious green commercial building projects.

That's why forward-thinking AEC firms are responding with more industrialized solutions that offer building owners greater assurance of project quality, costs and timing. Industrialized construction solutions incorporate manufacturing techniques to deliver more reliable, consistent outcomes.

They incorporate automation, mechanization, and process efficiencies to mass produce building components and make customization more affordable.

Industrialized products come in the form of prefabricated single- and multi-trade assemblies, as well as modular components. While these methods have existed for decades, the need for greater

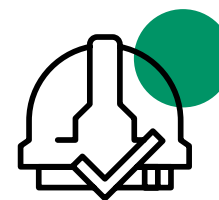
predictability in construction is driving higher levels of adoption.

And newer innovations, like IoT sensors and big data analytics are used to monitor fabrication processes and continually identify efficiencies.

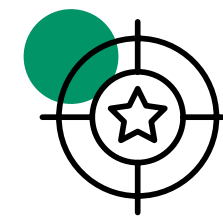
THE BENEFITS OF INDUSTRIALIZED SOLUTIONS



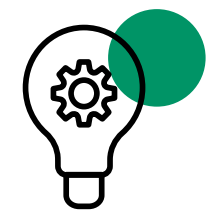
**OPTIMIZE
LABOR UTILIZATION**



**IMPROVE
WORKER SAFETY**

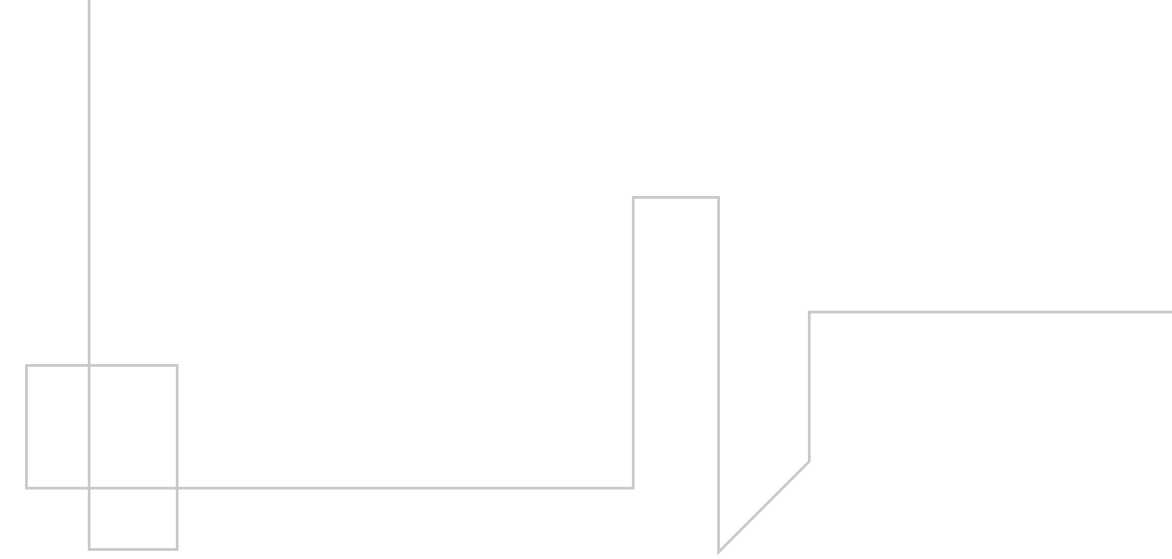


**BETTER, MORE
PREDICTABLE QUALITY**



**INNOVATE
MORE EFFECTIVELY**

STREAMLINE COMPLEXITY WITH INTEGRATED CONSTRUCTION PRODUCTS



These standardized solutions simplify decision-making for designers and owners. Instead of having to conceive every sustainable aspect of the project from the ground-up, they can choose from a menu of options that are proven to work. And integrated solutions enable them to realize the benefits of industrialized construction at scale because every element of a building impacts the performance of another. That's why the shift to vertical integration on the business side of construction will make industrialization even more effective.

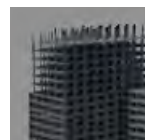
Being able to select a multi-trade prefabricated solution from a single provider can greatly reduce risk for project owners, since the time-savings and cost reductions are applied to multiple aspects of the project, instead of one. Real estate players that optimize prefabrication for scale can see more

than 20% in construction cost savings.⁴ And designers and engineers can spend less time concerned with how to make the varying building elements work with one another, since the prefabrication partner has already figured out which components are compatible and how to make them most effective.

There is a common misconception that prefabrication limits design flexibility. On the contrary, it can actually free up designers to focus more on aesthetics and the occupant experience, since sustainable elements can be baked into the product. That sustainability extends to the construction process, since manufacturing components in a controlled environment allows for more efficient energy consumption and less onsite waste. And the waste generated in the factory setting can be processed for recycling more easily.

STREAMLINE COMPLEXITY WITH INTEGRATED CONSTRUCTION PRODUCTS

The concepts discussed thus far in this eBook aren't just theory. Clark Pacific has spent decades perfecting the processes and materials needed to produce high-performing building components with prefabrication. Our NetZERO Building Platform is a complete prefabricated structural and mechanical system with an optional facade that drives even higher levels of sustainability.



1. STRUCTURE

PREFABRICATED BUILDING FRAME

Offsite fabricated structural components are optimized to reduce global warming potential of the building frame.



2. MECHANICAL

THERMALLY ACTIVE FLOOR SYSTEM

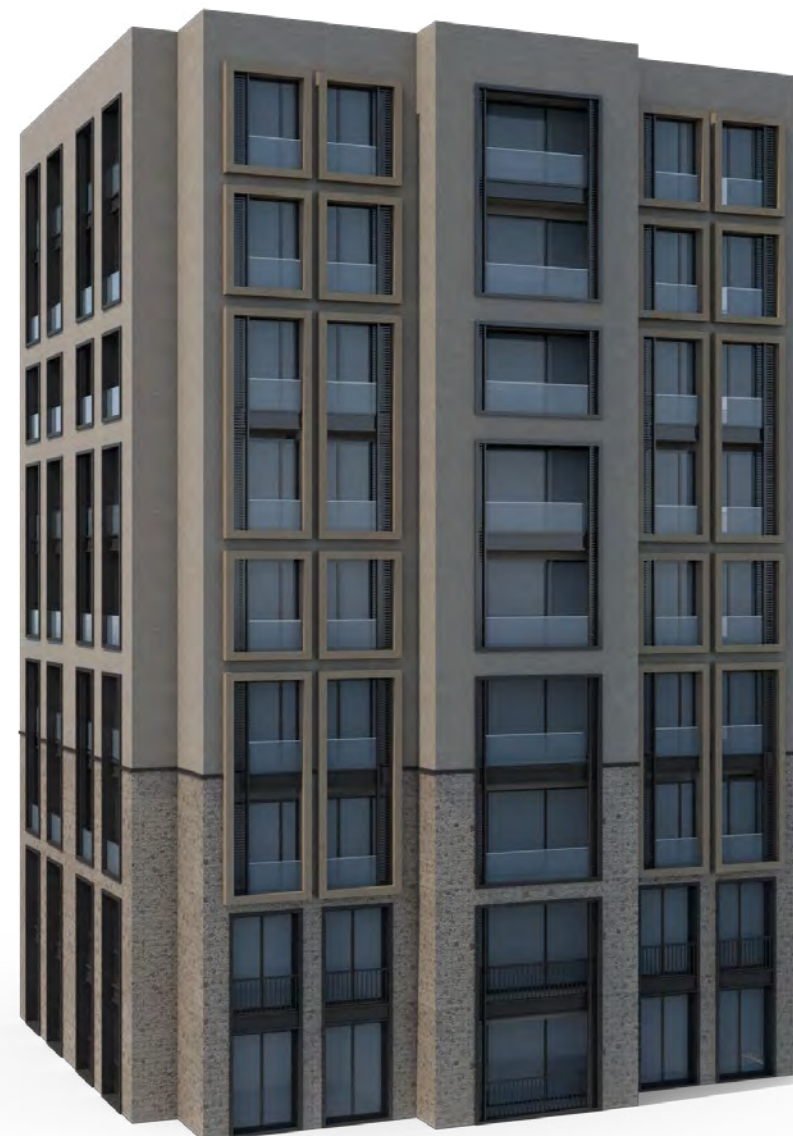
Prefabricated radiant floor system leverages the perfect balance of thermal mass, energy efficiency, and program flexibility into a cost-effective and healthy building solution.



3. FACADE

INFINITE FACADE (OR SYSTEM OF CHOICE)

High efficient, thermally isolated building facade system enables high efficiency comfort solutions.



The system is ideal for green office buildings, higher education facilities, and municipal buildings. It includes a building frame optimized with a proprietary concrete mix and an integrated thermally active radiant floor system to address the most pressing challenges facing building owners today.

- **SUSTAINABILITY** – Reduce carbon by 40%, over the life of the building and cuts energy consumption of the mechanical system by 50%.⁵
- **DESIGN FLEXIBILITY** – The structure and mechanical systems are optimized for design flexibility
- **CONSTRUCTION EFFICIENCY** – Offsite manufacturing is 20-30% faster than traditional approaches.
- **OCCUPANT HEALTH AND WELLNESS** – Control of thermal comfort and the use of a 100% dedicated outside air system increases occupant satisfaction by 50%.⁶
- **FUTURE ADAPTABILITY** – The integrated mechanical system and independent thermal zones make future renovations easy.

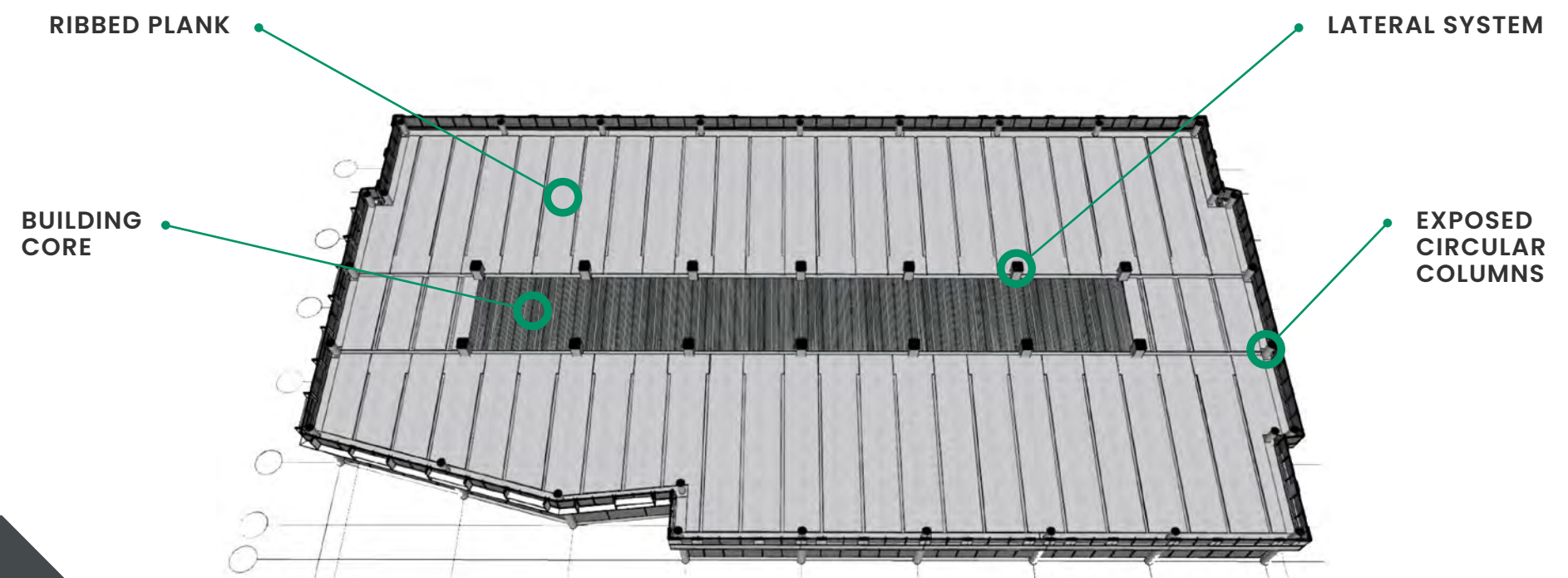
THE STRUCTURAL SYSTEM

The NetZERO Building Platform frame comes as a kit of parts:

- **Long span rib floor plank that spans up to 55 feet.**
- **Prefabricated beams are designed support the floor system spanning between columns.**
- **Round perimeter columns provide full structural support.**
- **Lateral elements can be tailored to the programming are commonly located in the core.**
- **A hollow core deck that's highly flexible for the incorporation of bathrooms, mechanical closets, etc.**

To reduce the floor height, notches are built close to the core so that the mechanical system can be tucked into the structure. This is one area where the benefits of integration really shine through. Coordinating the execution of this type of approach can be challenging.

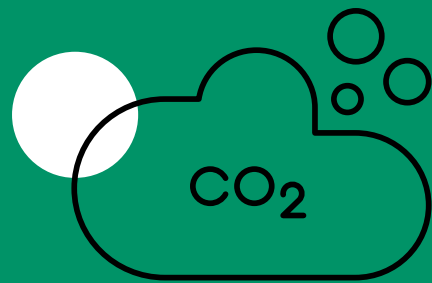
But because the mechanical system is incorporated in the structure by design, potential conflicts are addressed up front, and the output is a more reliable, cost-effective structure. Cantilevers and building steps can be incorporated into the system, making it highly flexible for designers.



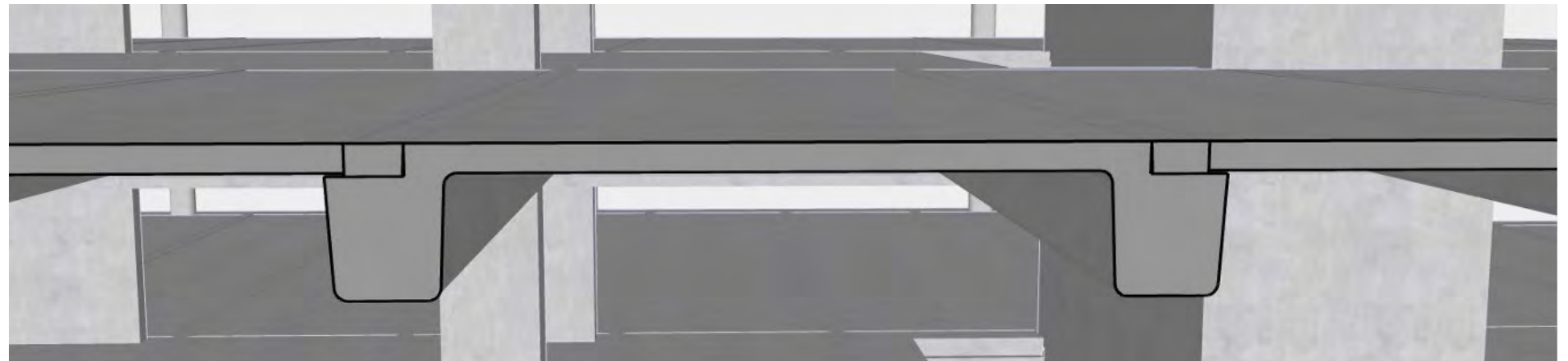
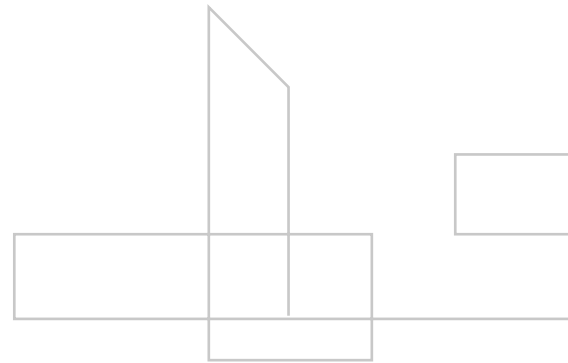
The figure below demonstrates the standard configuration, but the building components are limited only by the imagination of the design team.

WHY THE STRUCTURE IS MORE SUSTAINABLE

The system features a precast frame that uses 25% less concrete volume when compared to cast-in-place construction methods. And our concrete mix replaces up to 70% of the Portland cement, the leading carbon emitter in concrete construction.



ALL OF THE ABOVE GRADE CONCRETE IN THE NETZERO BUILDING PLATFORM HAS LESS EMBODIED CARBON THAN THE LIGHTWEIGHT CONCRETE TOPPING SLAB USED IN STEEL BUILDINGS.⁷



Optimizing the use of concrete enables us to drastically reduce the embodied carbon associated with the project without sacrificing the integrity of the structure.

To achieve that 25% reduction in concrete volume, the design of the structure resembles that of a cast-in-place (CIP) system, but with some notable differences.

Our system features concrete ribs that are 24 inches deep and 18 inches wide. Beams are located at 10 feet on center. This configuration allows the slab to be mild reinforced and only 4.5 inches thick. With a CIP frame, the slab is typically eight or nine inches thick with post-tensioning. The NetZERO approach offers the flexibility that is common in steel structural systems, but in a way that is more cost effective and sustainable.

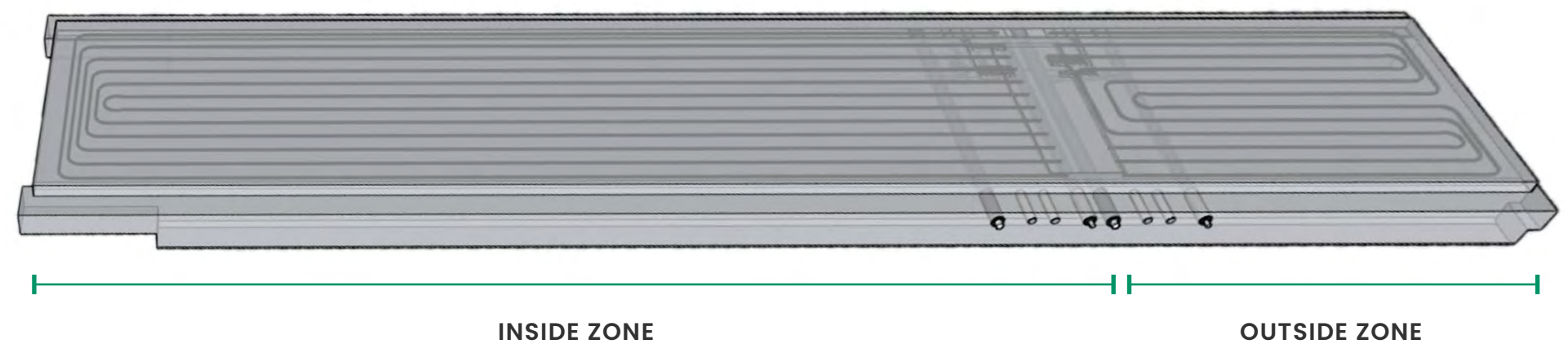
THE MECHANICAL SYSTEM

The radiant mechanical system delivers heating and cooling consistently throughout the structure:

- **Tubing is embedded throughout most of the structural floor to heat and cool the building at lower water temperature differentials.**
- **Embedded tubing enables substantial thermal storage capacity.**
- **Hydronic piping and control valves are tucked up close to the soffit, minimizing the projection of piping.**

Each structural panel contains two zones that allow for independent control of the building's edge and interior. PEX-a piping's design life is well over 100 years in this application giving an owner confidence that they will have worry free operation over the life of the building. Each panel contains self-learning zonal controls that allow the panel to accommodate changes in program or HVAC zone requirements. In this system, the building mass can be charged throughout any 8-hour period of the day.

Like a battery, the building slabs can then be used to ensure comfort throughout the day, requiring smaller cooling capacity. This reduces the energy load required by the building. And with radiant systems, if you're heating one section of the building at the same time as cooling another, the system is able to take heat out of the cooling zone and move it into the heating zone making one of those functions essentially free. Over the course of the year in the San Francisco Bay Area, heating and cooling occur at the same time 35% of the time.



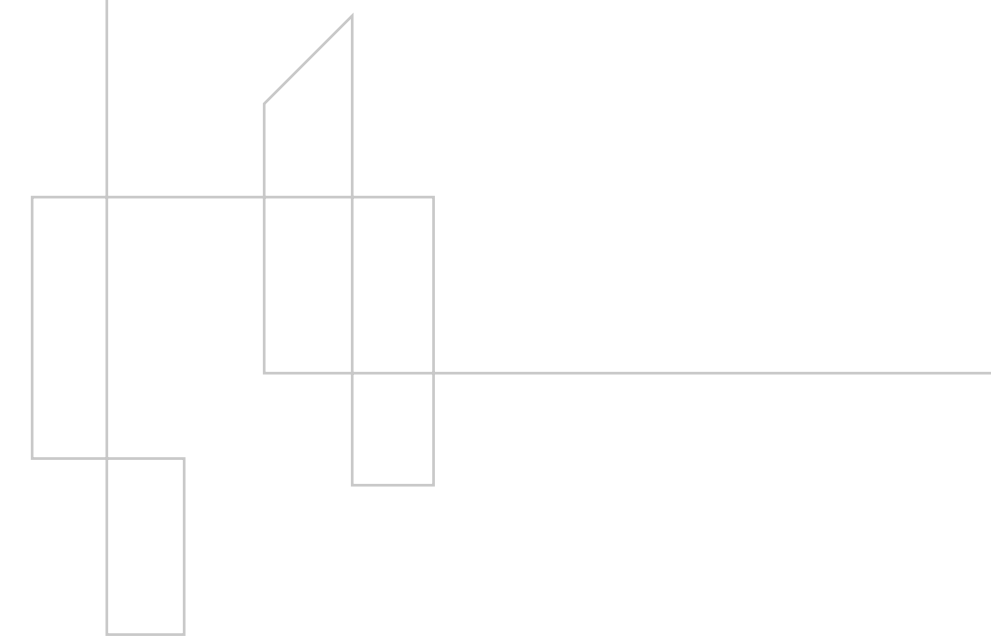
THE MECHANICAL SYSTEM

Since the slabs can work all day, heating and cooling doesn't require extreme temperatures, further improving the energy efficiency of the system.

These intelligent operations rely on the use of control sequences created by the Center for the Built Environment at UC Berkeley. Altogether the system cuts the size of the all-electric air sourced heat pump in half, reduces the number of VAV boxes by one-third, and can allow for an air handler one-fourth of the size that is typically required.

In addition to providing consistent thermal comfort, the NetZERO Building Platform also supports occupant wellness. The system supplies 100% outside air to the interior space. Fresher air is associated with higher levels of cognitive function and productivity among employees.⁸

And, compared to recirculated air systems, outside air leads to a 33% reduction in allergy symptoms and 50% less asthma symptoms.⁹



**ULTIMATELY,
THE INTEGRATED
RADIANT SYSTEM
MAKES HEATING
AND COOLING 50%
MORE EFFICIENT
THAN A HIGH
PERFORMANCE
VARIABLE
REFRIGERANT
FLOW SYSTEM.¹⁰**

THE PAYOFF OF INTEGRATED MECHANICAL AND STRUCTURAL SYSTEMS

Some owners and designers hesitate to pursue radiant systems because of the additional design and engineering considerations they require.

The NetZERO Building Platform is embedded with the practices and techniques that are already proven to work. With the structural and mechanical systems combined and optimized out of the box, more time can be devoted to the function of the building, and not resolving conflicts.

Integration also supports more effective operations. With finely-tuned systems that are built to work together out of the box, facility managers will encounter fewer surprises. And they can achieve higher levels of occupant comfort since the system is meant to provide the same level of heating/cooling and fresh air throughout the entire building, in smaller zones.

MAXIMIZE THE NETZERO BUILDING PLATFORM WITH A HIGH-PERFORMING FACADE

NetZERO Building Platform can work with rain screen and curtain wall systems, as well as Clark Pacific's Infinite Facade product.

The Infinite Facade combines up to seven building systems into a single solution, further streamlining construction and boosting building sustainability.

[Learn more about Infinite Facade](#)

1. RADIANT TUBING

Multi-zone radiant tubing is incorporated into the prefabricated floor planks.

2. CEILING FAN

Ceiling fans can be used to increase the heat and cool air coming off the slabs and allow occupants to better customize the temperature to their individual needs.

3. ACOUSTIC CEILING TREATMENT

Acoustical clouds absorb sounds without encumbering air flow.

4. EXPOSED CEILING

Exposed ceilings allow fresh air to flow freely into the space.

5. SUN SHADES

To ensure the radiant system can meet all of the building's heating and cooling needs, solar shading is optimized for daylight control and visual comfort.

6. MINIMIZED DUCTWORK

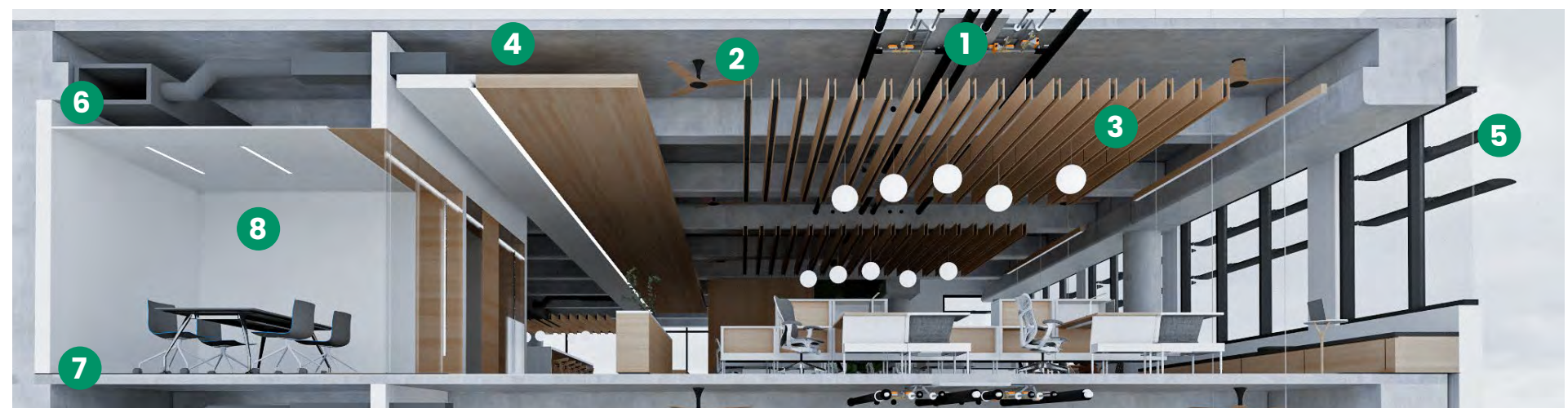
1/4 size of traditional and notched into ribs.

7. THIN CARPET TILE

Thin carpet tiles allow for the radiant system to heat and cool air while providing floor comfort.

8. DEMAND CONTROL AIR

Conference rooms supplied on demand for premium comfort.



WHAT YOU CAN ACHIEVE WITH THE NETZERO BUILDING PLATFORM

The NetZERO Building Platform supports sustainability goals by reducing carbon emissions throughout the building lifecycle. And it empowers you to address the sustainability challenges of the future.

GRID FLEXIBILITY

The thermal storage allows you to balance energy loads throughout the day and optimize grid services. As grid interactive efficient buildings come into focus as a way to achieve decarbonization and zero net energy goals, the NetZERO Building Platform positions you on the path to achieving those milestones now, instead of 2030.

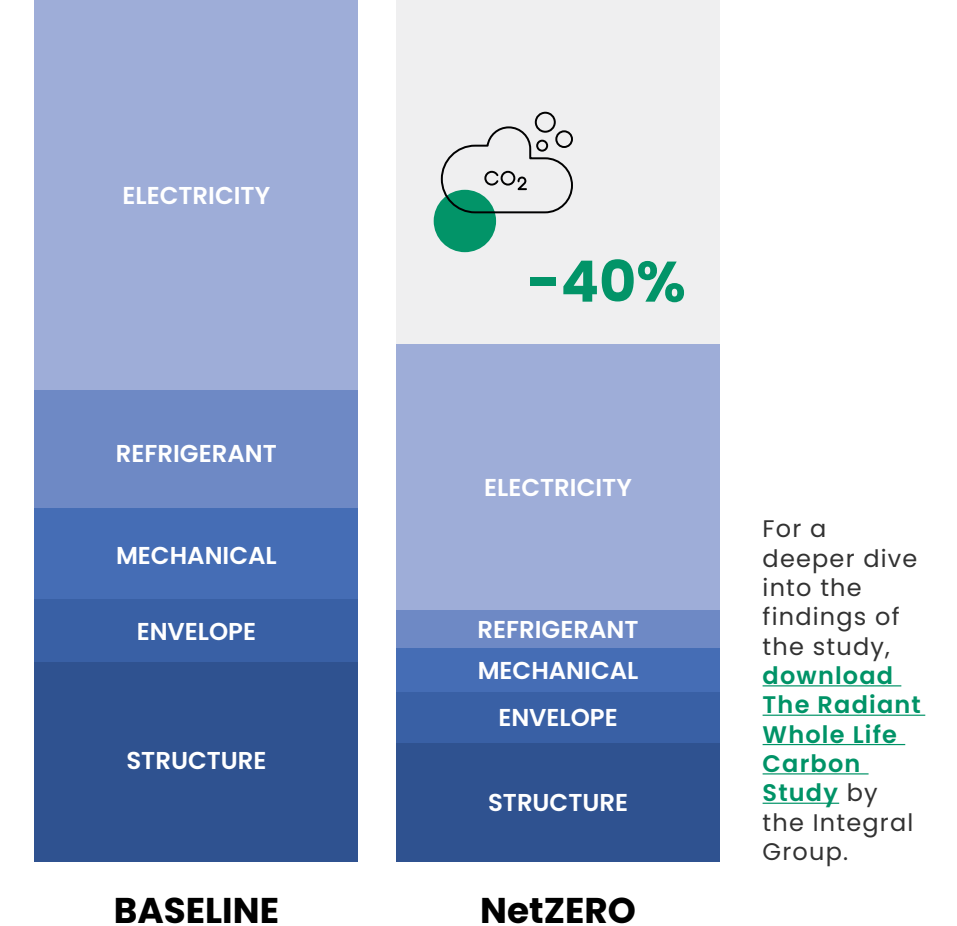
MASSIVE ENERGY SAVINGS

The NetZERO Building Platform was independently studied by the Integral Group. The study found that the whole life

carbon emissions of the platform were 40% less than a typical all-electric building. In addition to the embodied carbon reductions embedded in the design and fabrication of the structural and mechanical systems, the system requires less energy for operations.

Other findings from the report:

- **The fan coils for variable refrigerant flow (VRF) systems alone have 3x more embodied carbon than the NetZERO Building Platform's entire mechanical system.**
- **The system's HVAC use has less than 1/2 the total carbon impact of a steel structure with a VRF system.**
- **Refrigerant leakage for a steel structure with a VRF system has a larger carbon impact than the entire lifetime of the NetZERO Building Platform.**



SUSTAINABILITY AT LOWER COSTS

Typically, incorporating a radiant system out in the field comes at a premium. But with the NetZERO Building Platform, two systems are fabricated with the efficiency of prefabrication. And that translates to lower costs. Its hydronic heat pumps are 50% smaller than those of a VRF system with dedicated outside air. The straight, prefabricated piping is 70% the typical length of VRF systems. And the structural notch for straight mains doesn't require any returns.

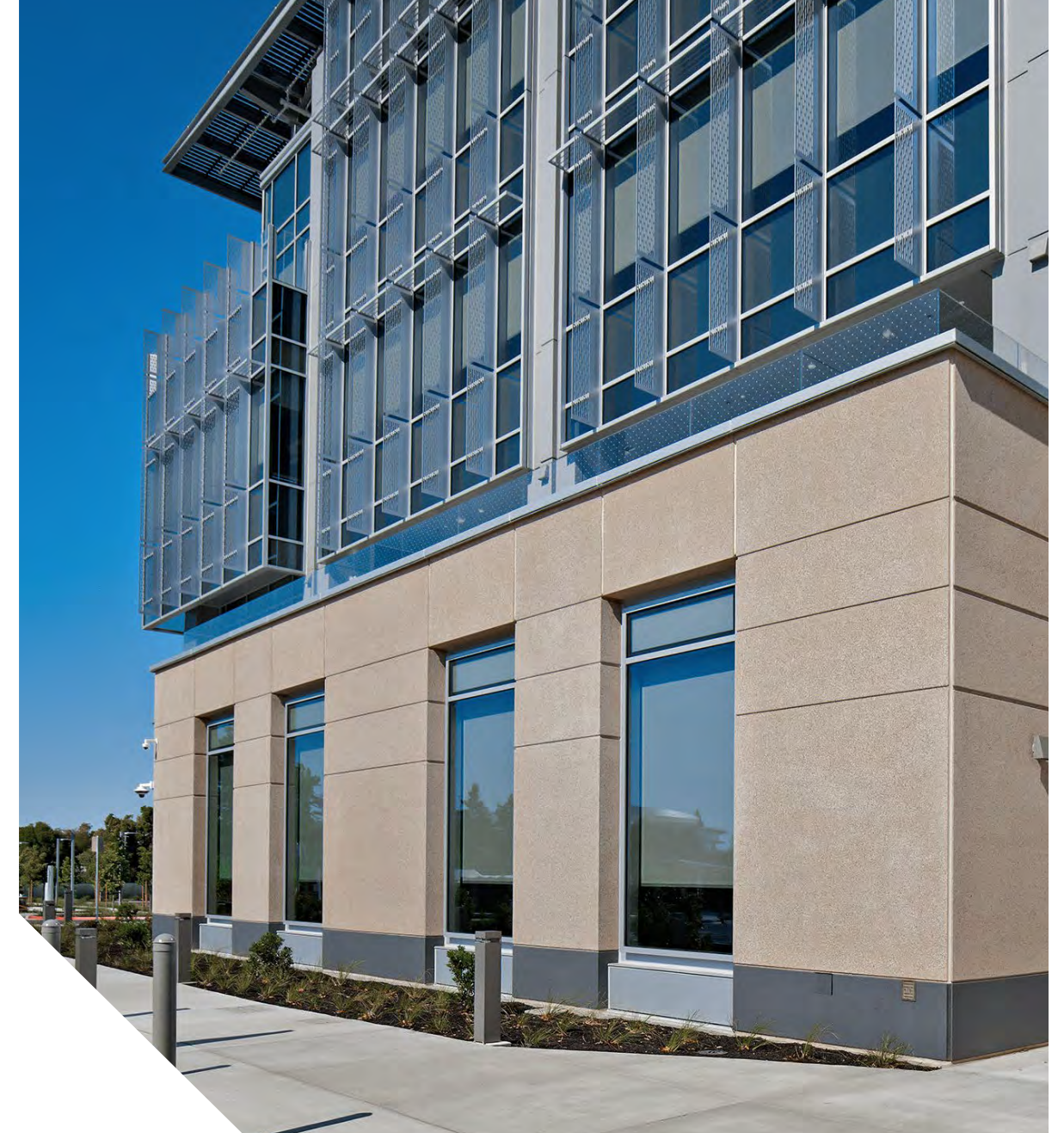
To learn more about the benefits of the NetZERO Building Platform, [watch the NetZERO Building Platform Tour](#) on demand.

SIMPLIFY COMPLEX PROBLEMS WITH PRODUCTIZATION AND INTEGRATION

Productized, integrated construction solutions may be new, but they aren't anything to be afraid of. In fact, systems like the NetZERO Building Platform reduce uncertainty because potential conflicts and surprises are addressed by the provider. And productized solutions don't have to come at the expense of design flexibility and aesthetic appeal. In fact, with many of the typical design and engineering hurdles worked out, designers can focus on bringing their creative vision to life.

CHART THE PATH TO 2030 AND BEYOND WITH CLARK PACIFIC

For decades, Clark Pacific has been a leading manufacturer of prefabricated building systems. We are transforming design and construction by delivering high-quality, cost-effective buildings with less risk. Clark Pacific paves the way for prefabrication as a smarter, safer and more efficient way to bring great designs to life. We collaborate with construction owners and design-build teams to develop and deliver prefabricated building systems for commercial and institutional projects of any size and complexity.



To learn how our experts can help you navigate the future of construction, contact us.

1-800-350-0306 • info@clarkpacific.com

Sources

1. [https://www.mckinsey.com/-/media/McKinsey/Industries/Capital Projects and Infrastructure/Our Insights/The next normal in construction/The-next-normal-in-construction.pdf](https://www.mckinsey.com/-/media/McKinsey/Industries/Capital%20Projects%20and%20Infrastructure/Our%20Insights/The%20next%20normal%20in%20construction/The-next-normal-in-construction.pdf)
2. https://www.researchgate.net/publication/335999140_Achieving_sustainability_through_reducing_construction_waste_during_the_design_process_A_value_management_perspective
3. https://www.worldgbc.org/sites/default/files/WorldGBC_Bringing_Embodied_Carbon_Upfront.pdf
4. [https://www.mckinsey.com/-/media/mckinsey/business functions/operations/our insights/modular construction from projects to products new/modular-construction-from-projects-to-products-full-report-new.pdf](https://www.mckinsey.com/-/media/mckinsey/business%20functions/operations/our%20insights/modular%20construction%20from%20projects%20to%20products%20new/modular-construction-from-projects-to-products-full-report-new.pdf)
5. <https://info.clarkpacific.com/resources/integralstudy>
6. <https://escholarship.org/uc/item/3nh8q2bk>
7. <https://info.clarkpacific.com/resources/integralstudy>
8. <https://hbr.org/2017/03/research-stale-office-air-is-making-you-less-productive>
9. <https://ajph.aphapublications.org/doi/abs/10.2105/AJPH.80.10.1193>
10. <https://escholarship.org/uc/item/3nh8q2bk>

