

Integrated Building Design

What is it? – How does it help Newton? - How can it help you?

By Josh Morse – City of Newton Public Buildings Commissioner

Integrated building design is a term that refers to a wholistic approach to the design process through which engineers and architects work together to ensure that every design decision or change is fully accounted and adjusted for.

The City of Newton uses integrated design primary for building energy efficiency, cost control measures, and for embodied carbon reductions.

Integrated Building Design and Energy Efficiency

The design process for large school projects like Countryside, Franklin, and Horace Mann takes several years to complete. The design changes and evolves constantly as part of the natural progression of our collaborative process. For every action there is an equal and opposite reaction. When you decide to add or increase the size of a window, the building envelope becomes less efficient and therefore, needs more heating and cooling to maintain the space temperatures. If you decide to go from double-pane windows to triple-pane windows, the building envelope becomes more efficient, and you need less heating and cooling capacity to maintain the space temperatures.

This is just the first step in integrated design. Let's dig a little deeper with a hypothetical scenario. At the Countryside School, our building will be fully electric for heating and cooling. During the design process, it is determined that we should change the height of the gymnasium by 2 feet to help minimize the massing impact to the neighborhood. We could just leave it at that, but we don't. We bring our HVAC and electrical engineers to the table with the architect to work through the following:

If the gym height is reduced, the surface area of the exterior walls is reduced. This in turn reduces the heating and cooling losses and gains through the walls. It also reduces the volume of the air within the gym that needs to be heated and cooled. This means that the heating and cooling equipment capacity can be reduced. If the heating and cooling equipment capacity is reduced, then the electrical demand that that equipment creates goes down as well. This means that the electrical lines, breakers, and panels can be reduced in size. If the electrical distribution is reduced in size, then the main electrical switchgear can be reduced in size. If the switchgear size is reduced than the size of the electrical service to the building can be reduced, which means the primary electrical conduit and duct banks can be reduced and the electrical transformer from Eversource can be reduced. We're not done yet. If the size of the heating and cooling equipment is reduced, then the weight of that equipment is also reduced. That means that the dunnage of the structural steel can be reduced. If the steel and equipment

weight is reduced, then we might be able to simplify and reduce other elements of our structure and foundation. We're still not done. If the gym height becomes lower, than the lights in the gym will be closer to the playing surface, which means that the light fixtures don't need as much light output. This means the electrical feeding the lights gets smaller, and on and on it goes.

The point here is that we never make design decisions in a vacuum. The design of a building is complex, and every change requires a full analysis to ensure that each and every detail is considered and adjust for.

We use integrated design to improve our building envelope efficiency, reduce the size of our heating and cooling equipment, and improve our overall building performance from an energy standpoint.

Integrated Design and Cost Control Measures

Every project has a budget. Most every project at some point will experience budget pressures. To help control expenses we apply integrated design to ensure that the changes we make realize their full potential cost savings.

Let's say that we were looking to reduce our project costs by \$100K, and part of getting there was the reduce the height of the gym. Integrated design helps ensure we squeeze every bit of savings out of this decision. If the gym height is reduced, the amount of brick on the façade, structural steel and insulation in the walls is reduced, interior block, painting, and finishes are reduced. The heating, cooling, and supporting electrical equipment size and costs are reduced. The list keeps going, but the point is made. To realize the full savings, we make sure that all our engineers and architects are in the same room to ensure that every adjustment is made to the plans and specifications to ensure that the full costs savings are realized.

Integrated Design and Embodied Carbon

There is embodied carbon in every brick, tile, light bulb, and everything else that makes up a building. Each and every component is a different amount of embodied carbon. What you specify and use for each system, finish, or product is a chance to either lower or raise the embodied carbon of your building.

Let's say we decide to reduce the height of the gym to help reduce our embodied carbon. Integrated design helps us make sure we squeeze every bit of embodied carbon out of our building. It important to ensure the engineers and architects are together, and that your goal is clear. If we reduce the height of the gym the walls, roof, structure, foundation, systems, finishes and other equipment can become smaller and leaner, and therefore will contain less embodied carbon. However, you can't manage what you don't measure, so it's important that you identify the embodied carbon of the elements and systems so that you know how much embodied carbon you are reducing. This is very important if you are trying to reach a specific embodied carbon target, as it will allow you to approach the gym height differently. You may determine that to hit your

target, you must reduce the gym height by 2.5 feet, or 1 foot. No matter what your goal is, if you don't have your entire design team there with open minds, you will not achieve your goals.

Integrated Design – How Can it Help You?

Integrated design principles can easily be applied to any residential or commercial project. Whether you want to save money, improve your building energy efficiency, or reduce the embodied carbon footprint; intelligent, thoughtful, and coordinated design development is important. When you're selecting your design professional, ask them about their approach to integrated design. You'll want a progressive, forward-thinking designer and design team at your side.

Not every project is a major renovation or rebuild, but that doesn't mean that integrated design shouldn't be applied. Let's say you decide to take advantage of the incredible utility rebate programs and go all electric with new heat pumps at your house. You will want to start with a home energy assessment. Then take advantage of the incredible programs to help insulate and air-seal your home. Only after doing this, will you want to select an HVAC contractor who will not just grab the heating output of the existing boiler to help size the new heat pumps, or one who will just use an average heating and cooling load based on the size of your home. You will want a contractor who will conduct a thorough analysis of your home, the types and efficiencies of your walls, roof, attic, windows, and doors. You will want a full heating and cooling load calculation for your home to ensure that the new heat pumps are not oversized. This can save you money up front and will certainly save you money in the long run. It will also extend the life of your new heat pumps, as when they are sized correctly, they won't cycle on and off excessively.

If you're interested in working to improve the energy efficiency of your home, replacing the heating and cooling systems, go solar, or electrify your ride, please know that the City of Newton and many of our resident experts are here to help. For more information check out our [climate and sustainability webpage](#), and sign up for a free home energy assessment while you're there. You can also email Liora Silkes, Newton's Energy Coach at lsilkes@newtonma.gov with questions and she can help connect you with tons of resources.