FEATURE

A Life Cycle Assessment: Comparing Fixed and Modular Structures.

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The right thing to do—environmentally speaking—can also be the smart thing to do—operationally and financially. That is the conclusion of a life cycle assessment that compares the environmental impact of two interior buildout options.

The first option consisted of fixed casework combined with architectural walls. Both elements involved the construction of permanent, built-in millwork and steel-stud-and-gypsum-board walls.

Researchers compared the first option against a second that consisted of modular casework and modular walls. Once assembled, these elements have the appearance and performance of permanent construction, but can be rearranged without the waste and mess of demolition.

In contrast to other studies, this research measured the effects of these two approaches on

- Global warming potential
- Primary energy demand
- Waste generation

While total cost of ownership typically considers purchase cost along with the ongoing cost of operations and utilities, this life cycle assessment (LCA) considered something else: the impact on the environment of producing, installing, and reconfiguring or replacing casework. It looked at multiple aspects of the product's impact, from raw materials to manufacturing processes. In addition, it considered the waste generated from manufacturing, construction, and demolition.

The assessment also took into account the impact to the environment on an ongoing basis. What impact does casework have over time, and how might renovations and reconfigurations affect waste and energy consumption?

Data for the assessment was gathered from a number of sources. The model for the LCA calculations is a hospital organization in South Western Ontario, Canada. This hospital is undergoing a significant construction project, combining two facilities under one roof for a total of five floors of new construction and five floors of renovation to the existing facility. Like a growing number of healthcare organizations, this hospital counts environmental responsibility among its core values having realized that a sustainable approach also impacts financial results.

To demonstrate this, the hospital wanted an objective accounting of the environmental impact of its purchasing decisions and ongoing operations related to casework.

An independent research firm was engaged to conduct the LCA. The firm's researchers used installation measurements for the modular casework and walls based on existing energy records and product specifications. Fixed casework statistics were compiled from a database on materials. These statistics included costs of materials and construction and installation energy requirements.

The researchers then created the LCA model with a proprietary software system, which assesses the cradle-to-grave environmental life cycle impact.

Facility Layout and Scope for the Life Cycle Assessment

The blueprints, specifications, and interior construction figures for the hospital became the basis for the buildout scenarios. These included:

- 246 Exam rooms
- 77 Interview rooms
- 46 Nurse reception
- 38 Nurses' stations
- 1 Pharmacy
- 1 Laboratory
- 6,117 linear feet of walls

Rates of change were measured using three different scenarios: conservative, mid-point, and observed. Casework and walls have a high replacement rate in healthcare facilities, so three scenarios were developed to determine additional materials required and

waste generated during remodeling and replacement. The scenarios include a range of replacement rates over a 12yr time span, from slower change rates to more rapid replacement rates.

Observed change rates are based on client experiences and field research. These change rates were reinforced by factors such as an increase in healthcare process improvement initiatives that impact the physical space. The conservative change rates were based on the minimal amount of change a hospital would make. Not all healthcare facilities change things as often as our observed rates suggest, particularly facilities built with fixed millwork and conventional walls.

All three scenarios were used to measure material replacement, global warming potential, energy consumption, and waste generation over a 12yr span.

Comparing the Impact of Fixed and Modular Structures on the Environment

Researchers analyzed key areas of modular and fixed structures. Each area relates to the effect of these structures on the environment.

1. Influence on climate change using global warming potential (GWP) as an indicator, using measurements of greenhouse gas emissions.
2. Energy use using primary energy demand (PED) as an indicator.
3. Waste using construction/manufacturing waste (C/MW) generation as an indicator.

Finding #1—Impact Is Similar At The Outset, Then Diverges

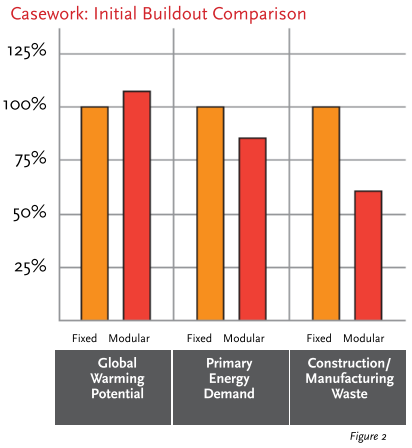

Figure 2

At initial buildout, environmental impacts are similar for both modular and fixed casework. Yet over their entire life cycle, modular casework and walls contribute less to climate change, primary energy consumption, and waste generation when compared to the impact of fixed casework and architectural walls. (Figure 2)

The initial installation of modular casework generated slightly more GWP than fixed millwork. This is due to the material makeup of modular products, primarily higher levels of plastic and steel than fixed casework, which uses more wood. Within the first year, however, fixed casework surpasses modular casework in its GWP impact.

Approximately 205,000 kg of CO_2 equivalents are emitted from modular casework at initial buildout. Just slightly less than 200,000 kg of CO_2 emissions are emitted from fixed casework. Contrast that initial comparison at 12yrs: CO_2 emissions from modular casework have remained fairly static and are measured at approximately 220,000 kg of CO_2 equivalents; fixed casework is measured at approximately 540,000 kg of CO_2 equivalents, two-and-a-half times its initial measurement.

Primary energy demand represents the amount of energy consumed to produce the materials and manufacture them in their final form. The PED, for example, considers the energy associated with wood, from growing trees to processing the wood. PED measures both fossil and renewable primary energy.

Modular casework always consumes less primary energy, from the initial buildout through year 12 and for all replacement scenarios.

Waste generation measurements considered construction and manufacturing phases as well as remodeling of the hospital. This assessment shows the advantage of modular casework over fixed: since modular casework is 95% reusable, remodel waste is negligible. On the other hand, 100% of fixed casework must be replaced.

In the conservative scenario, remodel waste of modular casework is approximately 5,000 kg. By comparison, remodeling fixed casework results in nearly 90,000 kg sent to the landfill. Construction/manufacturing waste is significantly different between fixed and modular casework. The conservative scenario measures approximately 6,000 kg of modular casework waste versus approximately 19,500 kg of fixed casework waste.

Finding #2—Product Replacement Yields Dramatically Different Results

Consideration of product replacement yields dramatically different results when comparing modular to fixed casework. Modular casework is reusable, keeping product replacement low and landfill waste to a minimum.

Because modular casework is reusable, approximately 5% of new product is required during replacement. The same is not true for fixed casework: 100% must be replaced, and 100% of the discarded product becomes landfill waste. Material replacement is a significant factor in the life cycle assessment of the two approaches in this study.

Walls: Initial Buildout Comparison

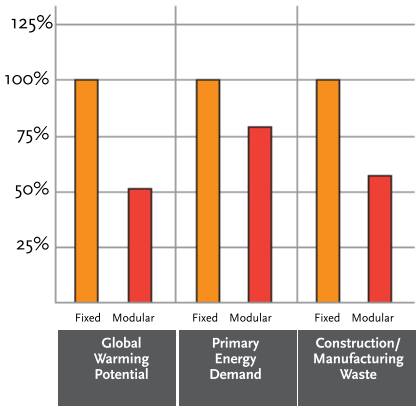

Figure 8

By contrast, modular casework is highly reusable. Over a 12yr period, modular casework will use up to 151% fewer materials than fixed casework.

Finding #3—Fixed Walls Have A Greater Environmental Impact

Both modular and architectural walls had the largest overall environmental impact on the hospital buildout in this study.

However, modular walls have less impact in all environmental categories compared to the steelframe-and-gypsum-board walls. Modular walls account for significant reductions in waste and significant increases in change without product replacement. The construction downtime in renovating spaces with architectural walls is considerable. (Figure 8)

Walls: Construction/Manufacturing Waste

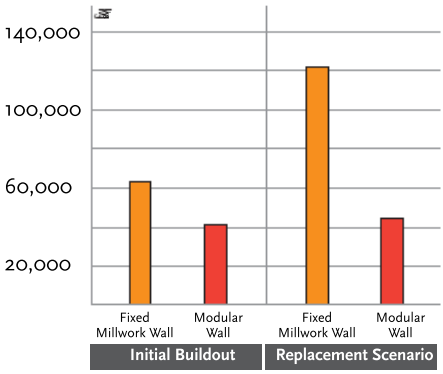

Figure 11

The differences between the two wall approaches increase when replacement scenarios are considered. In all cases, the impact of modular walls from initial buildout through replacement is negligible. Fixed walls present a different picture. Environmental impact nearly doubles from initial buildout to replacement for global warming potential, primary energy demand, and construction/manufacturing waste. (Figure 11)

Conclusion—Modular Casework And Modular Walls Reduce Impact

Regardless of a hospital's rate of change, modular casework and modular walls will always yield better results when compared to fixed casework and architectural walls. Modular casework and walls supports a hospital's need/desire to change, whether due to expansion, renovation, or process improvement/ Lean initiatives.

Modular casework and walls support change in another way: Reuse of products positively affects the bottom line of a hospital organization. Fixed casework and architectural walls essentially mean that a construction or renovation project is a start-over.

In fact, within the first year of occupying the new facility, the Ontario hospital is reconfiguring modular casework and modular walls to more closely align the physical environment with new work processes. No waste generated, minimal additional purchases required, minimal downtime: the right way—and the smart way—to operate a complex and environmentally responsible hospital. For a copy of the full research report, please visit *www.hermanmiller.com/Research/Research-Summaries.* ghc