

The Monadnock Bungalow is the perfect addition to the Carlotta residence, balancing sustainability, affordability, accessibility, and responsiveness to the homeowners' needs. Implicit in the design brief is the client's clear desire for simplicity. This design implements a combination of traditional and modern techniques to provide a harmonious living environment.

The ADU design is deeply rooted in sustainability, employing the use of local and recycled materials as well as natural materials and indoor plants for better indoor air quality. Additional sustainability features can be noted in almost every element of the ADU design.

Structure:

A key passive design feature is a Trombe wall, which is a south facing wall with a high thermal mass. During daytime in winter it absorbs the heat from the sun and dissipates the heat in the evening, thereby warming the ADU inside. The Trombe wall serves as the only load bearing wall, supporting both the ADU roof and the solar mudroom.

Building Envelope:

- **Roof:** The roof comprises a metal structure (Quonset type) which serves as the north wall and supports a green roof. The valleys of the Quonset roof can be filled with natural insulation (e.g. bagged straw) to augment the insulating property of the green roof that will go on top of the metal roof. This design optimizes ease, speed, and cost of construction. The underside of the roof is clad with recycled wood siding. The roof design provides excellent insulation (R-40) and water treatment for rainwater harvesting.
- **Walls:** Cordwood exterior walls offer excellent (R-20) insulation, preventing heat loss. It is sustainable, locally available (could potentially be harvested from the site), and aesthetically pleasing. The interior bathroom wall is a variation on cordwood using glass bottles with mortar. This wall is waterproof, aesthetically pleasing, and, again, made of recycled materials. The design recommends that the remaining interior walls use beadboard or recycled wood siding instead of drywall.
- **Windows:** The south-facing windows lining a Solar Mudroom provide light without rendering the ADU vulnerable to the changing external temperatures. Minimal openings in the remainder of the structure also ensure sustainable and affordable temperature control year-round. Being the coldest side, the north wall has no windows. Since the intent is to use recycled windows with storm shutters (good, insulated windows are expensive), one window each has been provided on the east and the west sides to bring light into the bedroom and the bathroom.

- **Floor:** The floor is insulated with locally sourced stone on top and could potentially have hydronic heating depending on the homeowners' budget.
- **Solar Mudroom:** The Solar Mud-room incorporates a greenhouse element made from salvaged glazed door and window panels.
 - It acts as an extra porch space prior to entering the house.
 - It passively heats the house in winter and cools the interior space in summer.
 - It incorporates optional solar panels as a supplemental power source.
 - It features a biocell for greywater treatment and recycling and year-round garden access.

Finishes

No additional finishes are required, since the ADU is designed to have the 'natural' look and feel

Mechanical systems

Heat pumps have become more efficient and affordable. A 12000 btu heat pump should be more than adequate, given that the conditioned space in the ADU is only around 485 square feet. Passive design strategies such as the Trombe wall, solar mudroom and well insulated building envelope shall serve as additional heat. A wood stove can be considered as a supplemental/emergency heat source.

Electrical systems:

A new 100amp panel will be required as the main power supply. There is an option to incorporate south-facing solar panels as a supplemental power source.

Plumbing systems:

Water Supply – it could be a challenge for the existing well to serve as the main water supply to the ADU. Therefore, a rainwater harvesting system is proposed in the form of a deep-water pond (deeper than the frost line in the area). Rainwater is collected in the pond, filtered and treated (UV or Reverse Osmosis etc.) and pumped back to the ADU. Research will need to be done to find out if the ordinances allow treated rainwater as a primary water source.

Sanitary system – It could be a challenge for the ADU to be connected to the existing septic system if it does not have additional capacity. The design proposes the use of a composting toilet instead of a flushing toilet (which can use as much as 27% of total water consumption of a household) as well as greywater recycling to substantially reduce the load on the septic system. The biocell in the solar mudroom serves to treat the greywater.

Location Considerations:

The ADU is located in an area on the property with maximum sun exposure and capitalizes on this natural resource with the creation of a solar mud room. Its proximity to the main house ensures accessibility and convenient caregiving while maintaining privacy and unobstructed views. Despite its compact footprint, the open floor plan and ample light create a spacious feel. The design also minimizes strain on the septic system by incorporating alternative systems and positioning the structure near existing utilities to overcome this challenge. While the ADU's sleek modernity lends it elegance and excitement, the use of natural and on-site materials pays homage to the homeowners' existing property, blending the new structure seamlessly into its surroundings.

Cost consideration:

The conditioned space in the ADU is only 485 square feet and very well insulated, keeping the cost of infrastructure down. Material and labor have both been considered in the design concept. Most of the proposed materials are locally sourced, some possibly available on site (e.g. cordwood). Some other materials are available at salvage yards, which can lower the cost substantially. In terms of labor, the proposed ADU has quite a few DIY (Do It Yourself) components that can have significant cost savings if the owners are handy.

Current construction costs in New Hampshire for a project such as this are \$150 - \$200 per square foot. With the proposed design, the number should be \$100 per square foot. Given that the total area of the ADU is 792 sq.ft. including the Solar Mudroom, a rough order of magnitude cost estimate for the ADU is \$60,000 - \$80,000. This will not include the solar panels, furniture or any extensive site work.

In conclusion, this ADU design integrates sustainable practices, cost-effective solutions, and thoughtful site planning to meet the homeowners' needs for a simple, functional, beautiful and environmentally friendly living space.