deck insulation, and the slab perimeter and footings include R-10 c.i. As the building has no mechanical heating or cooling system, natural ventilation, thermal mass, and passive solar gains are used for space conditioning. In the winter months, the low sun penetrates deep into the building to provide warmth and light. In the summer, overhangs and awnings control solar gain. Operable windows with low-e glazing allow natural ventilation and help to reduce heat gain. Backup heating for the coldest winter mornings is supplied by wood stoves. These systems also flush the building with cool night air and then store the coolness in the thermal mass for later use.

All noncritical loads are manually turned off at night. An operators' manual was provided to the Real Goods Solar Living Center staff to teach them how to properly tune the building for optimal comfort and efficiency.

Additional Features

The center's energy-production system, connected to the electric grid, generates 14 kW of PV power and 1 KW of wind power, more than enough to power the site. Extra energy is sold to the local energy company.

The following how-to tips were implemented in this project: QA1, QA3, QA16, EN2, EN6, EN11, EN19, EN24, EN25, EN26, DL1, DL2, DL3, DL7, DL9, EL1, EL5, EL7, EL15, EL19, EL26, PL1, PL2, and EX1.

REAL GOODS SOLAR LIVING CENTER	
Processes for Achieving Energy Savings	**Description of Project Elements**
Envelope	
Opaque Envelope Components	R-50 c.i. above-deck insulation (14 in. cellulose, aluminum radiant barrier, vent air space). R-65 insulated cavity (straw bale). R-10 c.i. under and along entire 3 ft perimeter slab floor and vertical along footings; center of slab is earth coupled; 600 ton mass in 5000 ft^2.
Vertical Glazing (Envelope)	U-factor 0.72, 26% window-wall ratio (passive winter heating).
Window Design for Thermal Conditions	0.68 SHGC, clerestory and low windows opened and closed by staff as part of the natural ventilation system. All glazing faces south except for clerestory, which faces east.
Window Design for Daylight	Overhangs on all glazing, fixed and operable.
Lighting	
Daylighting	East clerestories, white curved ceiling, full height south curtain wall, interior and exterior light shelves. Interior is insulated and operable to cover upper curtain wall. Continuous dimming controls based on interior photocells.
Electric Lighting Design	0.6 W/ft^2 pendant-type, T-8 fluorescent fixtures.
HVAC	
Equipment	No mechanical HVAC, wood stoves for backup heating.
Ventilation	Natural ventilation through staff-operated clerestory windows and open front and back doors.
Service Water Heating	
SWH	35 gal passive solar hot water heater for the restrooms and service sinks.
Additional Savings	
Plug Loads	All noncritical loads manually turned off at night. All wires in conduit and twisted to mitigate EMFs.
Exterior Lighting	CFL, manual control on all night; total of 130 W.
Other	10 kW of PV on trackers plus 4 kW of building-integrated PV, 1 kW demonstration wind turbine, free-standing. Battery backup for eight hours without sun or wind.
Water	Grey water recycling for irrigation.

CLIMATE ZONE 4—NUSTA SPA

WASHINGTON, DC

Nusta Spa is a full-service day spa located in downtown Washington, DC, which is in climate zone 4. This 4,600 ft^2 building retrofit project called for new electrical, mechanical, and fire protection systems. Nusta Spa is the first spa to be accepted into the USGBC's Leadership in Energy and Environmental Design for Commercial Interiors (LEED-CI) pilot program and is LEED-CI Gold certified.

The Nusta Spa space was completely disconnected from the existing base building constant-volume system and equipped with a new 20 ton air-cooled chiller and associated horizontal fan-coil units (FCUs) with electric heat. This increased the available

Figure 4-9. Nusta Spa main entrance.

(a) **(b)** **(c)**

Figure 4-10. (a) Natural lighting with occupancy sensors, (b) a recycled water fountain, and (c) lighting design of 1.3 W/ft^2.