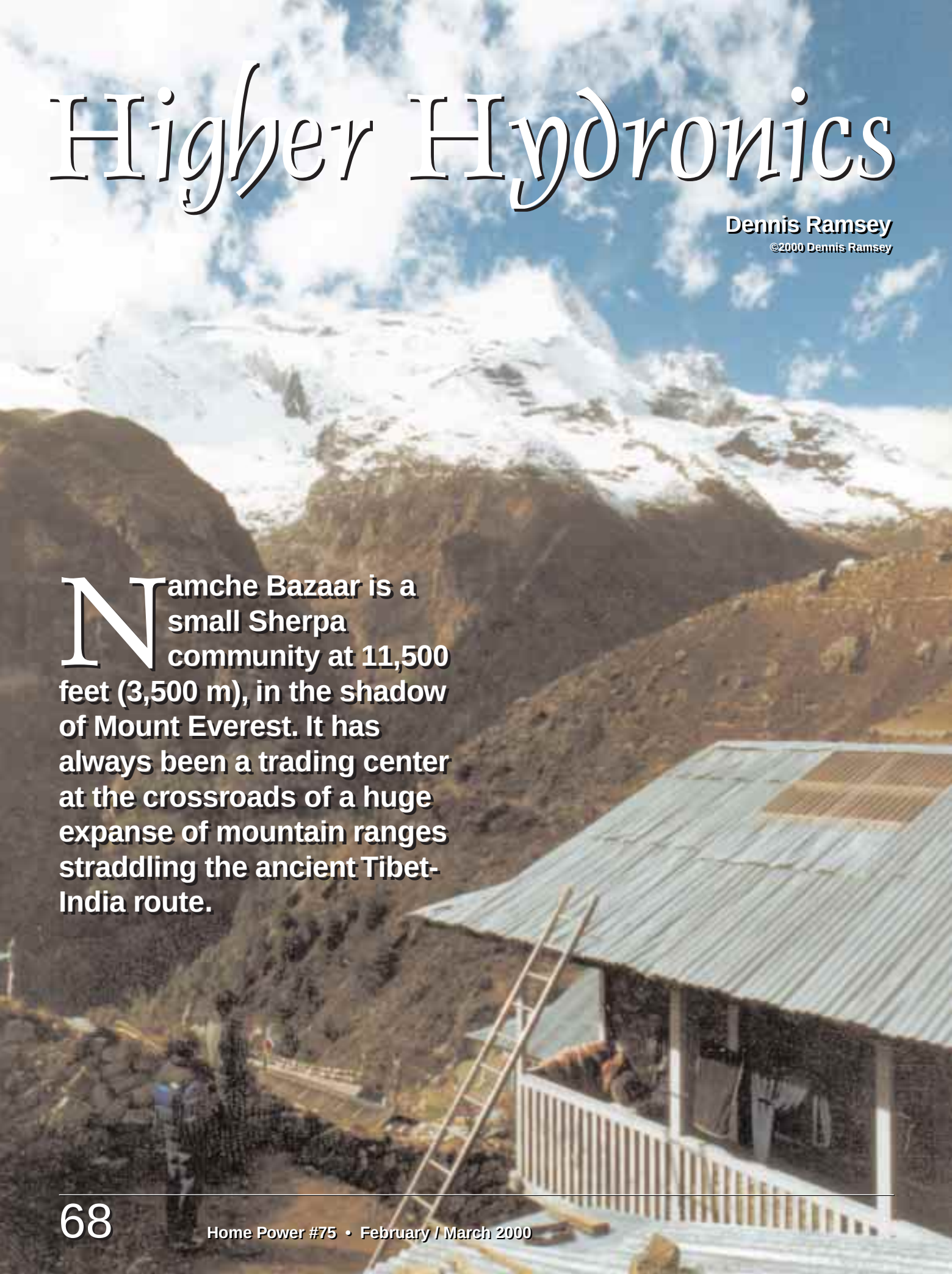
Higher Hydronics

Dennis Ramsey



Namche Bazaar is a small Sherpa community at 11,500 feet (3,500 m), in the shadow of Mount Everest. It has always been a trading center at the crossroads of a huge expanse of mountain ranges straddling the ancient Tibet-India route.

Porters on the long road to Namche.

Nowadays, Namche reaps enormous profits from the mountaineering and tourism industries of Nepal. Besides the usual trekkers' lodges, Namche sports two European bakeries, a cybercafe, several pubs and pool halls, a disco and cinema, and pizza parlors complete with real pizza ovens which were helicoptered in.

Namche Dental Clinic

In 1994, a bit before these modernizations, Namche got a dental clinic. An unusual group from the UK called the Everest Marathon, which does a high altitude marathon around Everest every other year, decided they would sponsor a dental clinic in this crossroads community. They partnered with the American Himalayan Foundation, and established the Namche Dental Clinic.

Two young adults from the community were sent abroad for two years of training in Canada, and a large building was constructed of stone and timbers. Dental chairs and a range of modern equipment were brought in from the U.S. This clinic now provides services such as fillings, extractions, and cleanings, as well as tooth brushing and flossing lessons to villagers from all over the region. Namche was the perfect choice of location, since it is the main market center in the highlands, and many people travel to town for the Saturday market. Saturday is the clinic's busiest day.

Cold Dentists

The only thing the clinic lacked was relief from the bitter winter cold. It's so cold, in fact, that the clinic is closed for the month of January each year, since no one would brave the weather to visit the clinic anyway. But during November and February, it's cold enough that the dentists have trouble with their manual dexterity.

The Everest Marathon decided to put some effort into upgrading several features of the clinic, to improve the solar absorption in general, and to install some form of heating system. The funding for this project was provided by the Everest Marathon and the Jean-Pierre Michaud Fund of Geneva, Switzerland. The Marathon paid all equipment and in-country expenses, while the Michaud Fund provided renumeration for the labor.

Diana Penny Sherpa, who is the head of the Everest Marathon, contacted me in Kathmandu about two years ago to talk about the possibilities. We decided that the first thing to do was vault and skylight the space from ceiling to roof, and double-pane the windows. This changed the ambience entirely, by allowing in much more sunlight and warmth. We also talked about solar hydronic heating of the inside operating rooms. A few months later, I was able to visit Namche to do a survey of the clinic's situation.

Dedication

I flew into Shyangboche, an hour above Namche

A Saturday market crowd at the crossroads of the Himalayas. Some travel from as far as Tibet to trade here.

The Namche Bazaar dental clinic, overlooking town. New skylights add natural light and solar gain.

Bazaar, in a small four passenger Pilatus Porter. Four Japanese tourists sat in the back, and I was in the co-pilot seat. The weather was so dismal and dangerous that we nearly got lost. We only made it after the pilot ducked under a cloud bank so he could see up the thin valley to the tiny airstrip. Sadly, this veteran pilot, Ang Gyalzen Sherpa, died two hours later trying to repeat the flight with a load of cargo. He was from the village of Thame, just near Namche. I dedicate this project to him.

Solar Gain

When I saw the clinic, I realized that they had made great strides in the last year. They moved the operating rooms from the cold and damp downstairs to the beautifully vaulted and varnished upstairs. It changed their requirements for supplemental heat entirely. I decided against a solar-based heating system for several reasons.

The much-improved solar gain of the building due to vaulting and double-paning was already sufficient to provide adequate heat except during the coldest or rainiest winter weather. And during such weather, a solar-based system would provide nothing. Since Namche has a very good electrical supply from the Austrian-sponsored 600 KW hydro-electric turbines nearby at Thami, there was another option.

Hydro-Powered Hydronics

I chose to use the available hydroelectricity to run a hydronic system that would provide a high efficiency heat transfer. (Falling water is driven through the hydrologic cycle by the energy of the sun, so hydroelectricity is renewable—a secondary form of solar energy.)

Hydronics basically means heating a fluid and then pumping it to the areas where it is needed. The fluid dumps its heat into the rooms via radiators. The traditional method of heating in this region is to place embers from the hearth into a metal brazier, which is then put into a specific room. The clinic needed a moderate amount of radiant heat in all of its rooms, which could be based on the renewable energy of hydro. It would be controlled by thermostat, so that they only used enough energy to keep the operating rooms at about 68°F (20°C) in winter. And it had to be automatic, maintenance-free, and user-friendly.

The dental team: Mingma, Doka, and Tek (in the chair). Warm rooms make the fingers work better.

I designed a hydronic circulating system that uses a standard 220 volt, 1,500 watt water heater element and a Taco circulating pump. It moves 9 liters (2.4 gal) of antifreeze through 80 feet (24 m) of 3/4 inch (19 mm) copper tubing which is flush-mounted to the baseboards of every room. The copper tubing is soldered into four 4

foot (1.2 m) baseboard radiators so that the hot antifreeze moves through the building in a continuous loop.

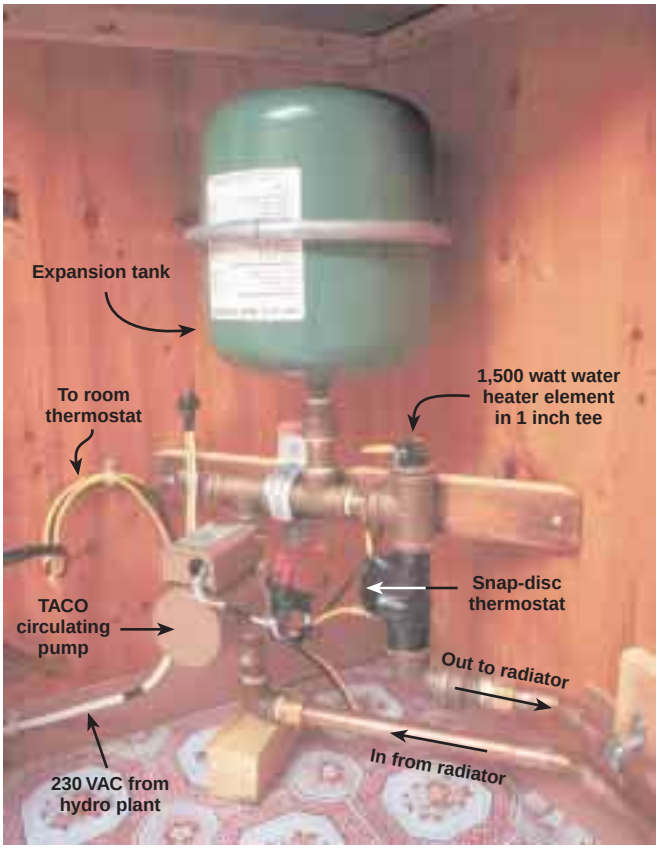
Antifreeze was necessary because the clinic closes during the month of January, when it is bitterly cold. Since the heating system would not be used during this time, plain water would freeze and burst the pipes.

Thermostatic Control

There are two thermostats. One is mounted on the wall of the main operating room, and controls the ambient temperature in the building. The other is a snap-disc, wrapped with fiberglass insulation on the outside of the brass T-junction that holds the heating element. A snap-disc is a small diaphragm thermostat which is intended to be surface mounted at a heat source. In this instance it is used at the heating element to prevent burn-out, and to keep the antifreeze from ever boiling.

Besides being noisy, boiling would wreck a closed system with a small expansion tank by creating high pressure. Although the 2 gallon (7.6 l) expansion tank is intended to absorb the increase in both pressure and volume of the fluid as it becomes hot, there is a limit to its ability to do this. Even a small stress leak would be ruinous.

The hydronic system sends hot water to baseboard radiators throughout the clinic.



A Sherpa carpender builds the corner cabinet to house the hydronic system. System parts are in the foreground.

This small hydronic system is intended to pump a moderate amount of heat around the building, and to do so continuously. The thermostats ensure that the system cycles on and off until the building reaches temperature, and then holds it there. Any solar gain through the skylight during the day augments the total heat requirement.

There must be a relative balance between the size of the building (800 square feet (75 m^2) in this case), and the minimum wattage needed to bring the building to a reasonable ambient temperature. The 1,500 watt heating element was chosen so that the current draw-down would not interfere with the operation of the dental equipment and lighting, while also being adequate to maintain the building at a very comfortable level once the ambient temperature is reached.

I assembled this small system from standard brass pipe fittings from a local hardware store in Oregon. I also shipped the 80 feet (24 m) of Type M 3/4 inch (19 mm) copper tubing and assorted couplings. Three porters walked for eight days to deliver this equipment to the clinic. Air freight is rather expensive in this part of the world.

Installation

I was able to return to the clinic in June of 1999 to begin the work. The installation was a bit tricky since the copper tubing had to be sweat-soldered in place. The

Author Dennis Ramsey with plumbing in progress.

tiniest leak would have caused me to take much of the tubing apart, and wouldn't be seen until the system was filled with antifreeze. I took meticulous care with my soldering, and was relieved to get it right the first time.

We had a Sherpa carpenter with us for a day who made a corner cabinet to enclose the pump/heater. I varnished it the next day to blend with the paneling.

After six days of work, I was able to fill the system with antifreeze, burp out the air, and let the heater operate for a few hours. The slow and gentle heat rising from the radiators warms the whole upstairs of the clinic.

Hydronic System Costs

Item	*Cost (US$)*
Motor transport	486.00
Assorted tools and supplies	243.75
TACO pump	183.39
Porterage	150.00
Four hydronic radiators (4 foot; 1.2 m)	142.18
Food and lodging	130.00
Copper tubing	82.95
Thermostats	76.83
Brass pipe fittings	70.00
2 gallon (7.6 l) expansion tank	38.90
Heating elements	30.00
Total	$1,634.00

Welcome Warmth

I spoke with Mingma, one of the dentists at the clinic, by phone from Kathmandu in mid-November, 1999. The clinic also has its own phone now. He informed me that they had been using the system for about three weeks, and that the building is very comfortable. The dentists can now work without fighting the cold in their shoulders and arms, and the patients who walk for miles through the cold to reach the clinic are relieved of their pains by resting in the only fully heated building in Namche Bazaar.

I feel confident that the system will last quite a few years. All of the components are rated for this use, all of the tubing is protected from strain and abuse, and the heating element is thermostatically protected from burn-out. I also provided a kit of spare parts such as replacement heating elements (with wrench), a spare cartridge insert for the Taco pump, and spare snap-disc thermostats.

The loop containing the heater and pump is designed so that the heating element can be changed with the system full of antifreeze, so there is no spillage. Should the pump need maintenance, the cartridge can be changed with minimal loss of fluid. The loop is refilled through the nipple under the expansion tank.

High Hydronics

The Namche Dental Clinic at 11,500 feet (3,500 m) is probably not the world's highest dental clinic, since both Lima, Peru and Lhasa, Tibet are at higher elevations, and they certainly must have dental clinics. But this may be the world's highest hydronic heating system, or at least the highest one in a dental clinic.

Cheers from Nepal!

Access

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