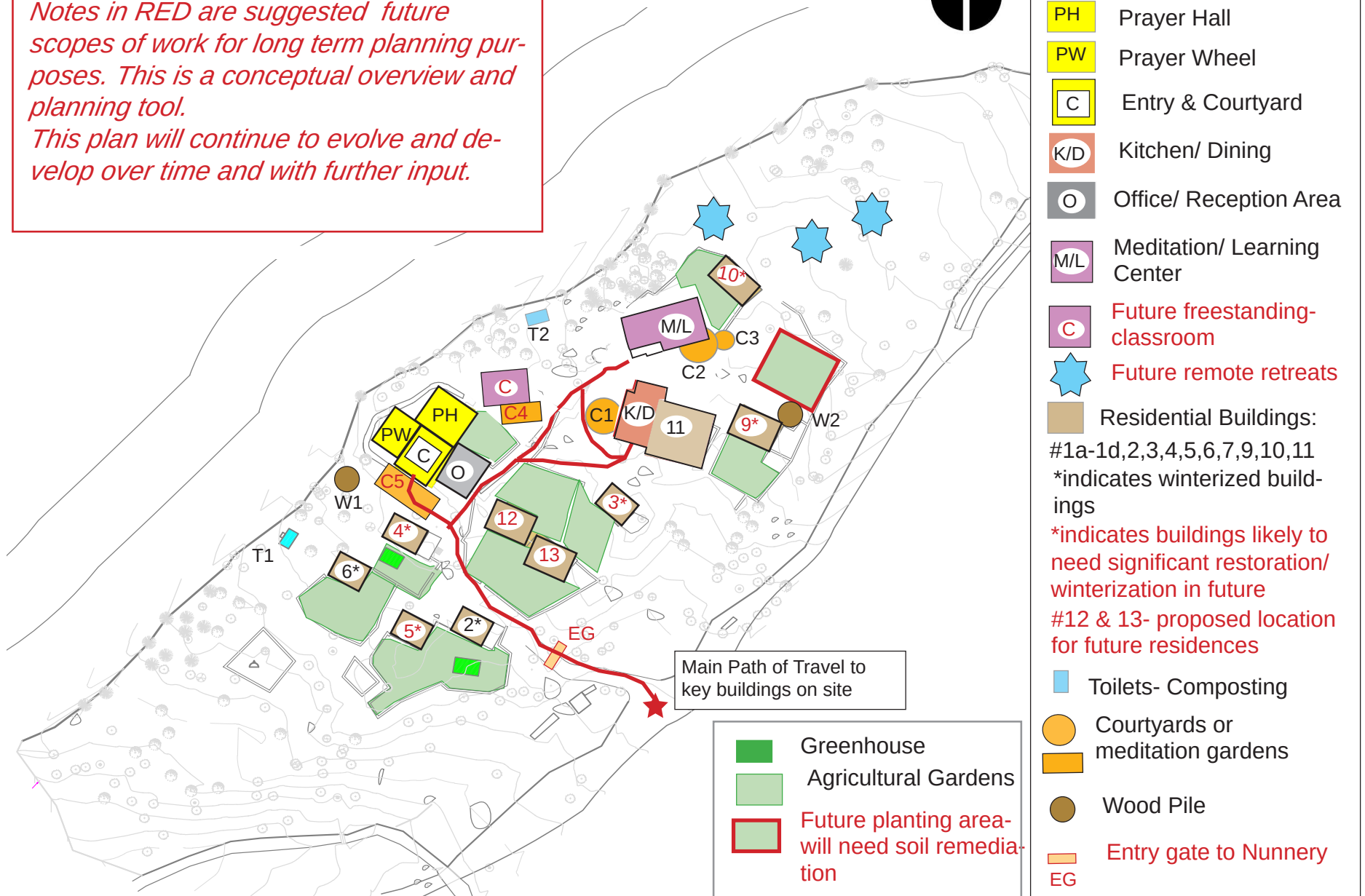


# PROJECT PHASING- MASTER PLAN

*Notes in RED are suggested future scopes of work for long term planning purposes. This is a conceptual overview and planning tool.*

*This plan will continue to evolve and develop over time and with further input.*



# MASTER PLAN- PLANNING AND CIRCULATION



Overall, the proposed project phasing and master plan reflect the intent to continue Deboche's organically evolved landscape.

Communal activities have been placed along a main circulation path anchored by the Prayer Hall on one end and the Meditation/ Educational Center on the other.

Residential and agricultural uses are located on the outer edges of the main communal core to the nunnery.

Main Path of Travel to key buildings within site by nuns

Main Path of Travel into site and key buildings by daytime visitors from the EBC trail.

## SITE KEY

- RESIDENTIAL BUILDING'
- GARDEN/ AGRICULTURAL
- PRAYER HALL / PRAYER WHEEL-
- EDUCATIONAL / MEDITATION
- SEMI-PUBLIC/ ACTIVE AREA
- COURTYARDS/ GARDENS
- REMOTE LONG TERM RETREAT

# BUILDING CONSTRUCTION - LOCAL METHODS ASSESSMENT

typical new construction consists of a stone foundation with ~18" thick stone walls (typically an inner and outer layer) built within concrete or wood vertical support members. Larger or more upscale structures also include concrete lintels. Other options include mud or cementitious plaster on interior & exterior, or sometimes between the two layers of stone. Wooden joist systems with corrugated metal roofs are the norm



Traditional structures in the Khumbu consist of stone walls with a mud plaster and simple wood framing; additions include plywood interiors and metal roofs.



Showcase projects such as the Khumbu Climbing School have integrated modern takes on traditional construction techniques with the goal of better thermal and seismic performance

## DEBOCHE GOALS

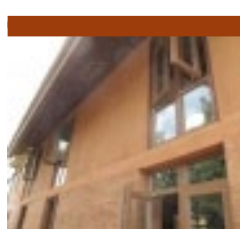
- Regionally appropriate
- Resource efficient
- Modern adaptations for improved thermal and seismic performance
- Meet programming needs of users



Traditional examples of rammed earth construction can be found in the Mustang region of Nepal



Modern practitioners of rammed earth construction can still be found in the Mustang region



Local NGOs like Abari are working on modern adaptations of regionally appropriate construction using rammed earth and bamboo.

# DESIGN & CONSTRUCTION OVERVIEW:

## Building Design Strategies Supporting Energy Efficiency:

- Rectangular overall building plans with long axis on east-west direction maximizes passive solar gain.
- Combined uses: Multiple uses are grouped within buildings to share energy and material resources
- Larger glazed openings facing South, South-West, South-East directions. Small openings facing North.
- Thick walls to achieve high thermal mass combined with high performance insulation.
- Vestibules at entries to protect interior from wind, snow and heat loss.
- Storage rooms, stairs, restrooms and built-in cabinets are typically located on the North side of buildings.
- Triple occupancy rooms are located on north side of the Phase II building.
- Sunrooms/ sundecks at south facing residential rooms to maximize passive solar gain. These areas to be equipped with operable windows and/or movable translucent corrugated panels to create a warm, protected and ventilated semi-outdoor space for private meditation during the daytime. During sun hours, the sunlight entering the spaces will be converted into heat when it touches the stone exterior wall and flooring material (TBD).

## Building Codes:

- The AWB team used the “**Mandatory Rules of Thumb**” from the **Nepalese National Building Code** as general design guidance during the concept development phase. Further code review and structural engineering to occur during the next phases of design development and construction documentation.

## Seismic Design & Safety Strategies:

- The nunnery is located in an area of considerable seismic activity. The Deboche structures will be designed to resist seismic loads and ensure life safety in the event of an earthquake.

## Building Materials Proposed for Deboche:

- Exterior walls\*: Load-bearing stone masonry in cement mortar.
- Lower level floor: raised wood frame
- Upper level floor: wood frame
- Roof framing: wood timbers or alternate truss system
- Roofing: corrugated metal
- Interior finishes:
  - Floors: veneer plywood or wood planking.
  - Restrooms to have water resistant finishes.
  - Ceilings: veneer plywood or exposed structure/ decking
  - Walls: veneer plywood
- High performance building insulation to be installed in:
  - All exterior walls
  - Under deck of lower floor
  - Above ceiling at upper floor
- Windows: High performance/ double insulated. Provide operable windows in living quarters, restrooms, kitchen, dining areas and classroom and any other spaces needing ventilation control.
- Acoustical insulation is suggested in these locations:
  - Nun's rooms
  - Classroom walls

\* NOTE: The design team is reviewing alternative construction systems with high thermal insulation values. One of the systems currently being investigated is a SIP system (Structural Insulated Panels).



# EXISTING RESOURCE USAGE

## Electricity:

- Nuns receive fairly reliable electricity from the microhydro power plant at Tengboche for limited interior and exterior lighting at the prayer hall.

## Cooking/ Heating:

- Large cast iron wood burning stove in kitchen.
- Small gas stove in the kitchen provides auxiliary hot water heating or cooking.
- Hot water heating is also supplemented by a solar collector oven located near Building 1.
- Warm water system captures heat from the main stove for hand and dish washing at the kitchen sink.
- Small cast iron wood burning stoves used for heating and winter cooking in residential living quarters.

## Waste

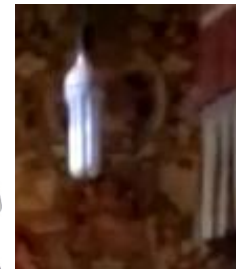
- The nuns have a limited waste footprint
- Consumer waste is burned or buried on site
- Human waste is handled through 2 outdoor composting toilets
- Effluent from the kitchen is piped out to edge of property



Main woodpile for wood burning stoves



Creative exterior light cover made from a plastic container



Interior light in Prayer Hall



Solar collector oven outside of kitchen area



Gas stove in kitchen



Kitchen stove with water warming system in background (blue tank)



Stove in nuns' residence.

# SUSTAINABLE STRATEGIES: RECOMMENDATIONS

## Thermal Insulation

- Pursue aggressive thermal insulation levels for all new buildings, especially the nun's living quarters.

## Efficient Cooking & Heating Stoves

- Research high efficiency kitchen and residential stoves that re-capture and distribute heat
- Research new stove technology for alternative fuel sources other than wood.
- Relocate outdoor solar collector oven near new kitchen with good southern exposure and access. Consider adding a second unit if needed.
- Replicate water warming system in new kitchen

## Solar Hot Water Heaters

- Install solar hot water systems for showering and other hot water needs.

## Photo Voltaic Panels

- Augment electricity service from the microhydro power plant at Tengboche by installing a small battery backup photovoltaic system (150-300w) for provide backup lighting

## Water Supply

- Install elevated water reservoir tanks at new buildings.
- Plan for a cistern & collection system for rainwater harvesting from the roofs of new buildings

## Human Waste

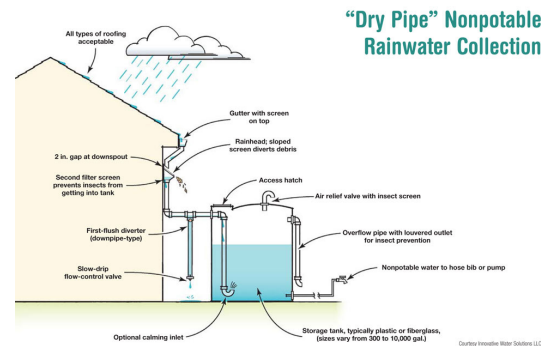
- Composting toilets are currently planned for the new buildings. Further research is required to confirm final system, building requirements & operational support.
- Continue to maintain outdoor composting toilets for resident and guest usage. Add additional units as needed to support future needs.
- The team will be tracking the progress of the Everest bio-gas project to determine if there are applications that can be used at Deboche in the future.



Maximize southern facing roof space for solar generation



Solar water heaters are one of the highest heat producers and energy savers. The system to the right is one of many installations seen throughout the Khumbu.



Introduce on-site water collection and storage systems





# SUSTAINABLE STRATEGIES

## Thermal insulation is a key priority in high altitude buildings.

- Heating in the winter period requires large amounts of fuel in addition to the large amounts of fuel needed for cooking.
- **The most sustainable and durable solution is to add insulation.**
- **Once a building is insulated, the fuel consumption for heating is reduced for the lifetime of the building.**
- Insulation also makes buildings more comfortable and will reduce internal air pollution

*The information below is from the working papers of:*

*Sjoerd Nienhuys Renewable Energy Advisor [www.nienhuys.info](http://www.nienhuys.info)*

The following formula for the recommended minimum average building insulation value is based on the altitude at which the building is located. Although these values are much higher than the current insulation values of existing buildings, they are substantially lower than the official minimum thermal insulation values applicable under similar climate conditions in Europe.

<i>Values are related to the Himalayan range of mountains</i>		
Minimum Winter Temperature in Degrees Celsius	Approximate Altitude Above Sea Level	Recommended Minimum Rc in m <sup>2</sup> .K/W With 5 Sun Hours per Day
< -30° C	3000 m (10,000 ft)	Rc = 3.5

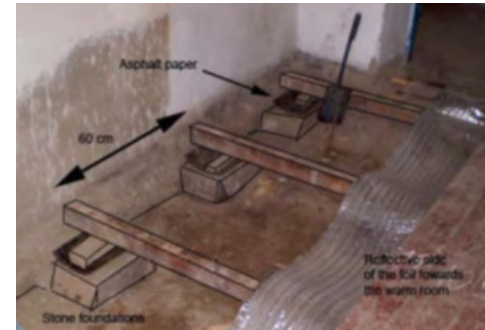
When for example the existing insulation value of a construction is RC = 0.5 m <sup>2</sup> .K/W, the following insulation materials can be applied to improve the overall insulation value of the construction. <b>Minimum Winter Temperature in Degrees Celsius</b> < -30° C	<b>Approximate Altitude Above Sea Level</b> 3000 m (10,000 ft)	<b>Thickness of Insulation Type EPS, Glass or Sheep Wool</b> R <sub>m</sub> =25 m <sup>2</sup> .K/W 14 cm	<b>Insulation of the Materials in the Left Columns</b> Rc in m <sup>2</sup> .K/W Rc = 3.5	<b>Total new Insulation Value of Construction</b> Rc in m <sup>2</sup> .K/W 5 Sun Hours Rc = 4.0
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## INSULATION:



The low weight and high insulation value of the **low density EPS**, combined with very little absorbing of moisture, makes it a durable insulation material, highly suitable for earthquake zones.

*Each 4 cm (1.5 inch) thickness has an insulation value of RC = 1.0 m  
As a comparison: A 50 cm thick stone wall has an insulation value of only RC=0.5*



An **elevated floor** provides additional thermal insulation because of the airspace below. Construction of an elevated, ventilated floor on cemented supports.



### Windows/ Doors:

The insulation value of a door or window is often only one quarter of the wall insulation. These openings require extra attention in insulation

**Double insulated operable windows** at lodge in Phortse. Windows were manufactured in India.



**Reflective insulation materials** will greatly improve the thermal insulation values of roofs and walls. Breathable Reflective Foils are currently available in the market, allowing moisture (and oxygen or CO<sub>2</sub>) to pass or exchange but still work as reflective foils and increase the thermal insulation value. These foils are also called "perforated breathable foils" and "perforated radiant barrier foils". Brand names are: Sisalation® facing foil, Ecofoil, Armafoil, EcoGUARD, Thermabar and Atticbar.

# SUSTAINABLE STRATEGIES

## RECOVERING HEAT GENERATED FROM STOVES

### Heat Exchangers:

Most stove heat disappears through the chimney. When a room is insulated, the stove/heat exchanger will produce 25% more heat for the same amount of fire-wood than a regular stove without a heat exchanger.



This heat exchanger model has an additional cover to retain the heat for baking. The insulating cover can be removed and the unit continues to function as a heat exchanger.



Heat exchanger in a small residential stove.



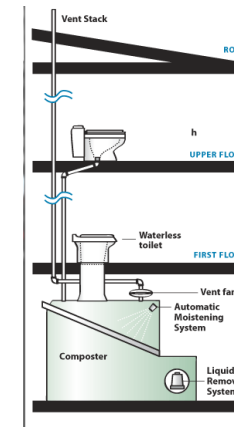
### Water Warming Facility

The water warming facility is connected to the space-heating stove. This warm water can be used for dish washing, body washing, cooking or laundry

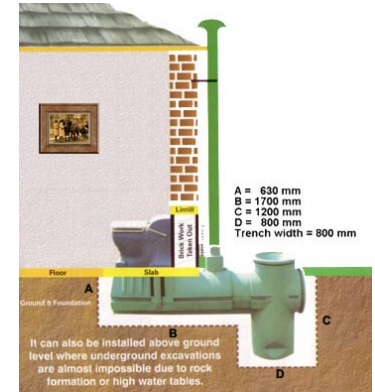
An existing water warming system is in place in the Deboche kitchen. System should be replicated in the new nuns' residence.

## HUMAN WASTE MANAGEMENT

The team is researching the building & operational requirements of various composting systems. The benefit of **composting toilets** is that unlike the poured-flush toilets (typical in Khumbu trekking lodges), they do not freeze during winter nor require large amounts of water.



Clivus Multrum -A composting toilet currently planned to be installed at the Khumbu Climbing Center project.



Ecosan waterless toilet

**Bio-gas** systems recycle animal and human waste into methane gas that is used as cooking fuel in homes. The bio-gas system includes a composting toilet, an animal waste intake, a very large underground tank to which the two sources of waste are connected, and a piping system and gas burning stove to which the fuel generated in the tank is sent.



# NUNNERY DESIGN PRECEDENTS-

## Khari Gompa Nunnery, Thamo, Khumbu Valley

- Khari Gompa is an excellent precedent to look to for design, program, construction methods, materials, and renewable energy considerations.
- Just slightly larger than Deboche Nunnery and located in the same region, the nunnery accommodates 35 nuns.
- In process of rebuilding structures which were in serious disrepair
- Expanding capacity to serve local population and provide much improved facilities for nuns

### New Construction:

- Prayer Hall finished construction, 2011
- Rebuilding nuns' private quarters to include toilet and bathing facility with solar hot water, 2013-2015
- Some labor has been done by volunteers and nuns
- Using traditional building materials of stone and timber

*\* Team members from the Deboche Project and Architects Without Borders visited the nunnery in 2014.*



Reconstructed Prayer Hall



Newly constructed nuns' living quarters



Newly constructed nuns' living quarters

# NUNNERY DESIGN PRECEDENTS-

## Nagi Gumpa, Kathmandu Valley

- In the Shirapuri Wildlife Preserve, site is 12 acres in area
- Associated with the Ka-Nying Shedrub Ling Monastery
- Many nuns come from poor Tibetan refugee families
- There is a high demand for entrance to the convent
- More Tibetan and Nepalese women arrive each year seeking access to an education and a vocation

## Site Facilities:

- 100+ nuns between 9-90 years old
- Original buildings constructed in 1962
- Cluster of one-room quarters for nuns
- Isolated dwellings on site for 3-year meditation retreat
- Under constant effort to upgrade aging facilities

## Study Program:

- Offers liturgical training and strenuous religious education, not historically available to nuns for study
- 40 nuns residing at Nagi Gumpa have successfully completed their 3-year meditation retreat
- Students study in the prayer hall, courtyard spaces, or within surrounding buildings

## New construction:

- Facilities need expansion and renovation to provide living quarters, dining halls, classrooms, medical clinics and retreat facilities.
- Old rooms razed to build three-story cement building with 45 rooms. Each room will have a large window with a panoramic view overlooking Kathmandu Valley.





# NUNNERY DESIGN PRECEDENTS-

## Tsoknyi Gechack Nunnery, Chobar

- Tsoknyi Gechack Ling is the only nunnery practicing the Tsoknyi tradition outside of Tibet. The nunnery in Chobar opened in 2010 with about 32 nuns- and is now home to over 150 nuns.
- The nunnery is in the midst of significant growth. The overall master plan includes 6 new buildings. The primary school and dormitory is complete. A nun's shedra and residence is under construction, along with a 3-year retreat building. Other projects in the pipeline include a new kitchen and dining hall, an International Retreat Center, and a large shrine hall. Fund raising is ongoing for these projects.

### Study Program:

- At the primary school, the girls receive a basic education, which includes general topics of study and language. Many of the young nuns come from villages in the mountains where there is limited access to education.
- Once they complete primary education, and if they decide to continue with a traditional Buddhist education, they will then move to the shedra to live and study.

*\* A representative of Architects Without Borders visited the nunnery in 2014 and toured the newly constructed primary school and dormitories.*

*The architecture firm for the nunnery generously shared floor plans with Architects Without Borders - to help us learn how the nun's living and educational spaces were programmed..*



New Dormitory and Primary School



Shared sleeping rooms for younger students- 10 per room



Smaller classrooms for primary students



# AWB PROJECT SUMMARY

## WORK DONE TO DATE BY AWB ON THE DEBOCHE PROJECT

### MAY-JULY 2013:

- Supported the development of the community survey to collect and gain an understanding of the community and its long term vision and purpose
- Supported the development of the Site Survey scope of work.

### NOVEMBER 2013:

- Project manager selected. AWB team formed with 12 design professionals.
- Two members of AWB visited Deboche while trekking in Nepal. Met with the Deboche nuns and a monk from Tengboche. Created a photo documentation of the site & structures.

### DECEMBER 2013 - JANUARY 2014:

#### Research Phase:

- Historical Research
- Buddhist Nunnery Research
- Khumbu Vernacular Design
- Alternative Energy Sources
- Applicable Code and Political Jurisdictions
- Construction Methods/Materials
- Site Assessment
- Interviews

### FEBRUARY 2014:

- Half-day design charrette
- 3D modeling of the site / topography studies

### MARCH 2014:

- Preliminary Master Plan & Schematic Design

### APRIL 2014:

- Deboche Site visit by AWB Project Manager. Met with Deboche nuns to review early programing and concept schemes.
- Met with the Mt. Everest Foundation team and contractor to review project scope and proposed locations of new buildings.
- Toured new projects at the Khari Gumpa Nunnery in Thamo and the Tsyoni Gechak Nunnery in Chobar.
- Met with contractors & developers in the Khumbu area to learn about local projects and materials.
- Visited the Khumbu Climbing Center construction site in Phortse

### JUNE- NOVEMBER 2014:

- Met with the Tibetan Nuns Fund Director to learn about their nunnery projects in India
- Revised & refined concept designs to reflect input from nuns and trip learnings.
- Developed conceptual design package in support of grant proposals and fund raising.



### AWB TEAM:

Laura Rose (Project Manager)

Adrine Arakelian

Andrea Fitch

Corey Fitch

Chrissie Seillie

Ginger Daniel

Julie Campbell

Justine Markowski

Katerina Prochaska

Maciej Jan Cichy

Vernon Abelson

Yelena Romanoff

