

# Earthbag building in Nepal

*How natural building techniques can help to rebuild after disaster*

In 2015, Nepal experienced two extreme earthquakes, one in April measuring 7.8 on the Richter Scale, which killed over 8,800 people and injured more than 21,000, and then an aftershock in May measuring 7.2. In both cases villages, towns and cities were affected, leaving nearly 3.5 million people homeless.

Nepal had been in the top three of our travel list for over ten years but other opportunities always arose so we had never made it there. In light of the earthquakes we decided this was the year we should visit, figuring the last thing Nepal needed was people not visiting or helping out where possible. Tourism is a huge part of the Nepalese economy and natural disasters play a large part in its decline.

BY MARK CLAYTON

### Helping to rebuild

The plan was a six week trip; two weeks doing a trek to Everest Base Camp, two weeks volunteering and two weeks as contingency. In the lead up to our trip, Karina attended a fund raising event in Adelaide where she met people who led us to Karma Flights, a charity set up under the Cloudbase Foundation and local paragliders in the city of Pokhara. The charity has been operating for several years and generally focuses on education projects delivering teachers and support to villages.

In contacting them after the fundraiser, we found out they were already assisting in the rebuilding of Nepal and were looking to build their first demonstration building in Pokhara using earthbag techniques. From initial conversation it sounded as if this project would be completed by the time we arrived, but we kept in touch as we felt there would be other projects they were involved in that would interest us.

### Sausage bags

We arrived in Pokhara in early December and after negotiating some accommodation, we headed out to meet Prem, the local guy behind the Karma



# Rebuilding Nepal

Flights team. Arriving on site I could see the initial footings were in place but that was about it. I also spotted that the 'sausage bags' for earth building had recently arrived. Introducing ourselves to Prem, we found that the project was taking a little longer than planned and that currently there was no project leader driving the project.

I immediately saw this as the project for us. I had gained experience working with earthbag on a superadobe project a few years prior in Adelaide so was, to some extent, familiar with the building method. The next day I arrived on site about 9am to meet John, the only volunteer at that point. John and I spent the day organising the site, working out what needed to be done, what materials were required, and setting a plan for the coming weeks.

Earthbag construction is reasonably new in Nepal, although it is getting more attention due to the simplicity of the building techniques, economical build cost and, more importantly, the fact buildings can be designed to withstand earthquakes, therefore future proofing the building.

## Volunteers

Attracting volunteers turned out to be easier than I thought, which was fantastic! As we started building the walls and visible progress was made on site, we attracted the attention of passers by. Their intrigue to ask what we were doing led to our consistent greeting of 'Have you come to volunteer and help us build?' as we, not so subtly, handed them a shovel. This technique proved very successful and by day seven we had a committed team of 10 regular volunteers and usually two or three more ad hoc.

## Typical day

Each day I would arrive on site at 8am to see where we were and work out the plan for the day. The volunteers would arrive about 9am and we would have a quick toolbox meeting about the day ahead. Lunch was included and consisted of dal baht, a local dish that is eaten by

almost everybody in Nepal at least once a day; it tasted slightly different each day and there was always loads of it. After lunch we would be back into the build until about 2.30pm. At this point we would start finishing up our current tasks, tidy up the site and the tools and prepare the wire for the following morning.

Most days we left site about 3pm, when we would head to a supermarket down the road to purchase the cheapest beer in town; this exercise helped build the team's morale and commitment, but it also allowed us to convince passers by, or other people anyone in the team knew, to come along the next day and volunteer. It became an excellent recruitment strategy.

One volunteer had an interest in making short films and documentaries, so each morning he would set up *GoPro* cameras around the site, on tools and peoples heads. Once we had enough footage, we held a short film presentation at the local Movie Garden, which gained a few more volunteers. I have since heard this footage is being used to develop a series of short documentaries about how to build earthbag buildings. This will be available to everyone at no cost to promote this technique in Nepal and across the world.

## Building takes shape

With a team this size the build gained momentum rapidly and we were completing two courses a day. We employed four locals to assist with the material mixing and at the same time showed them the techniques needed to build using earthbag. We employed local electricians to complete the wiring that involved running two circuits, one for mains and another smaller one for running batteries and solar when the power is down, which currently happens on a daily basis in Nepal.

Local carpenters made the three window frames and the door frame and their workmanship was amazing, all done using hand tools. My highlight was watching the local roofers make the bamboo roof trusses. Armed only with a knife, they managed to cut and tie eight

trusses all with the same dimensions and created an incredibly strong product, done in one day and ready as we needed them.

## Simple design

The building is a simple rectangular design measuring four by eight metres. The wall height is 2.4m and consists of 15 courses of earthbag, equalling 360 linear metres of bag work above ground. The roof is a standard Asian hip and gable design, made from bamboo and metal cladding. Where we could, we used material from the site; extra material of sand and gravel was sourced from a local supplier who sourced it from local riverbeds.

In general, the mix used was six of sand, six of gravel, three of local clay and one of cement. The cement content did vary for the footings and the top two courses, which created a ring beam to some extent. The mix can be modified depending on location of a build and size and consistency of product available. The material mix to go in the bags that we used in this case was deliberately a reasonably dry mix; it would hold together when compressed in your hand and thrown into the air, but no wetter. This made it easier to work with but would still set overnight, holding the barbed wire between the courses.

## How the courses work

The basic structure is that three layers of 'sausage' bag work are laid below ground level and the first two courses above ground are double courses, forming a buttress support at the base of the building. As the wall courses are built up, a double coil of barbed wire is laid between each row. Where possible, we chose to run long lengths, around corners and on multiple walls to aid with the strength of the building.

It is important to make sure the bags are filled well and evenly; this not only assists the building going up reasonably level, it also reduces the amount of tamping required to level and compact the bags once they are laid.

# Rebuilding Nepal



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1. Starting the earthbag walls.
2. Doors and windows inserted as walls grow.
3. Volunteers develop great teamwork.
4. Skillful local craftsmen at work.
5. Bamboo frame for the roof.
6. Roofing sheets go up to weatherproof the building and rendering underway.
7. The happy group of volunteers!
8. Render protects and weatherproofs walls.

# Rebuilding Nepal

Doors and windows were inserted and secured to surrounding bag work using L-shaped brackets made from metal. These brackets were attached into the bags and the timber framework with a spacing of two courses for the windows and three for the doors. We also chose to reinforce the bags that butted up to windows and doors by hammering in reinforcing (reo) bars about 40cm long to tie them vertically. The top two rows of bag work are secured also with reo pins all round, these were again 40cm long and numbered twenty in total.

Roof trusses were tied down using reo bar anchored through the wall about six courses down and then tied off using wire. This was done to the inside only but could easily be done on the outside as well if the building was located in a high wind area. Local roofers were engaged to complete the wire tying of the roof and to install the metal roof; at the same time, grass matting was installed directly under the roof cladding to reduce heat transfer into the building.

It was amazing watching these craftsmen at work using the most basic materials; I was very impressed in not only the quality of the work but the pride they took in making sure the job was completed to a high standard.

## Render

The final important step is to render the building. The rendering needs to be done within a few weeks of building otherwise the UV rays from sunlight will start to deteriorate the polythene bags. Rendering is also very important to keep the building waterproof and creating a protective layer over the bag work.

Rendering is done by first filling the hollow gaps created by the shape of the earthbags. Once this had been done, we pinned chicken wire to the bag work, which was done in one long piece from the ground outside the building, over the top of the wall to the ground on the inside.

At least three coats of render are required, made from a mix of available product such as earth, sand, dung, limestone and cement. The floor is to be

an earthen floor. When we left the project, the floor wasn't completed but we had used up any leftover material as a base, which was compacted as a subfloor. Not only did this mean inside wasn't muddy, it also cleared the site.

## Swapping skills

Teaching the skills found its own pace and as new volunteers arrived on site, they would buddy up with an existing volunteer. We made sure that all tasks were undertaken by all volunteers. The main reason for this is that many volunteers would be going onto other projects in Nepal and being able to understand a whole build will enable passing of valuable information to others, thereby delivering better buildings in rural Nepal.

It was great working with local Nepalese and seeing their interest and enthusiasm for what we were doing. The intrigue and observations definitely travelled in both directions. They are masters at mixing, fixing and creatively making whatever is needed from the resources available. If you had a team of them working on a project consistently for two weeks, future earthbag builds could be left in their hands.

## Technique is spreading

There are ongoing presentations in Nepal with Builders without Borders and Dr Owen Geiger promoting earthbag construction. As projects are completed and people learn the techniques, I see this becoming a more mainstream method of building, especially in the villages where access to other building materials can be difficult and expensive.

This project was funded by donations from family and friends raised by Karina, Karma Flights, Cloudbase Foundation and Sustainability House. Karma Flights have plans to build two schools in the coming 18 months. Karina and I have been approached by volunteers we worked with on this project, who have set up a foundation based in France to project lead a school rebuild later this year in collaboration with Mission Muskaan in the village of Sindulpachok in Nepal. So we may be returning to this amazing country sooner than we thought. ♦

*As the Business Development Manager for Sustainability House, Mark Clayton is focused on building strong working relationships with clients. He has been an owner builder himself; his project was featured in TOB 190 Aug/Sept 2015.*



## Links & resources

### ◆ Sustainability House

Sustainability House is a nationally recognised provider of energy efficiency assessments and ecologically sustainable design (ESD) services for commercial and residential buildings.

1300 308 525, [www.suho.com.au](http://www.suho.com.au)

### ◆ Karma Flights

A team of professional paragliding pilots who provide charity tandem flights throughout the world to make a difference in the communities where they fly.

[www.karmaflights.org](http://www.karmaflights.org)

### ◆ Cloudbase Foundation

Works to equip free flight pilots with best practices, support, and training, to accomplish their altruistic goals through singular events and long-term projects.

[www.thecloudbasefoundation.org](http://www.thecloudbasefoundation.org)

### ◆ Mission Muskaan

Aims to defend the rights of children in Nepal and around the world.

[www.missionmuskaan.org](http://www.missionmuskaan.org)

### ◆ Good Earth Nepal

Building houses and schools in Nepal using earthbag technology, and teaching others to do the same.

[www.goodearthnepal.org](http://www.goodearthnepal.org)

### ◆ Rebuild Nepal

Designs for temporary shelters.

[www.onestopportal.org/rebuild-nepal](http://www.onestopportal.org/rebuild-nepal)

### ◆ Earthbag building

Dr Owen Geiger and Kelly Hart bring the concept of earthbag building to the broadest possible audience.

[www.earthbagbuilding.com](http://www.earthbagbuilding.com)

[www.naturalbuildingblog.com](http://www.naturalbuildingblog.com)