Imperial College

BUILDING BRIDGES 2006

Expedition Report

NORTHERN MALAWI

Aim

To build a footbridge across the North Rukuru River near Uledi.

An expedition to construct a suspended bridge across the North Rukuru River on the north western edge of the Nyika National Park, near Uledi in Northern Malawi.

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www.imperial.ac.uk/expeditions

Editor

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PICTURES

Front Cover Main: Mixing the concrete in front of the tower on the western river bank.
Rear Cover: Workers collecting gravel from the river bed, downstream of the construction site.
Background: A stock pile of gravel on site waiting to be used to make concrete.

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Above & insert – Workers carrying their tools down to the river at the start of another day.
Right – One of the older workers carries rocks across the river.

Contents

Below & insert – Mixing a batch of concrete in the foreground while Andras inspects the work done.
Bottom right – Passing bricks across the river using a human chain.

SUMMARY

By Naomi Bessey & Daniel Carrivick

OUTCOME

After several set backs at the start of the expedition, this determined five person expedition team worked tirelessly to construct a suspended foot bridge across the North Rukuru River near Uledi in Malawi. Despite cautious estimates, the bridge span turned out to be greater than anticipated, which forced major design changes and added logistical complications. Nevertheless, an original conservative schedule along with working dawn till dusk seven days a week meant the bridge superstructure was completed within time and on budget. Unfortunately, due to the delivery of steel cable being fraught with delays, the bridge was unable to be finished. A return in the summer of 2007 is planned to complete the project.

EXPEDITION SUMMARY

The team were forced to stay in Lilongwe longer than planned as they waited for their luggage, which had gone astray on their outbound flight. Then when travelling north, the team's progress was halted by a drunk man who ran out in front of their truck. The team assisted where they could but sadly the casualty died that night from his injuries. The police were informed and formalities dealt with before the team could continue.

Members of the team met and discussed plans with senior officials from the National Park headquarters, and with Tommy Mhango the Nyika Parks director. These meetings confirmed full government support for the bridge, which was emphasised as vital in order for Uledi to become a fully functional and effective anti-poaching scout camp during the rainy season. Some park staff had initial reservations over the community sharing ownership of the bridge. However while there, team members persuaded them this was in their best interest in terms of looking after and maintaining the bridge. Senior officials agreed, and now the community will have joint ownership status of the bridge with the government.

The team went out with a very flexible design centred on a suspended type footbridge with masonry towers, concrete anchorage and a span of up to 30m which, based on information available, was very conservative. However initial surveys revealed only one possible site for the bridge, with a span of 37m and flood debris a metre higher than previously thought. Thus major design adaptations were necessary in order to make construction possible.

The community displayed an obvious enthusiasm for the bridge; this being motivated significantly by the prospect of paid work. All communication with the villagers was done through the four elected chiefs of constituent areas, via the National Parks chief resident scout at Uledi Camp. Impromptu progress meetings, which were attended by the chiefs, park staff and the team, were held on site when issues arose. A total of forty-five workers were employed at local rates clocking up some 4800 man-hours between them. Feedback from those employed was generally good though the work was harder than many had anticipated. This resulted in a 25% pay rise to keep them happy. Several workers suffered from minor aches, strains, cuts and bruises, with injured feet being the most common. The team ensured all were attended to, though other than the cleaning of wounds, most of the first aid was carried out more for psychological benefit than by necessity.

Materials were sourced locally where possible and hence the majority of the workforce was employed to extract and carry rocks, gravel and sand up or down river to the site. Only ten people were needed at any one time for the actual excavation and construction work. Mzuzu was the nearest town where cement and steel could be bought, which involved a three day round trip. Three journeys were made due to the volume and weight of cement required and the load capacity of our truck. Bricks were purchased locally however a track had to be cleared before they could be reached. Seven truck loads of bricks were required to move more than 6000 bricks which were used for the towers. All supplies brought in by truck had to be manhandled from the road end at Uledi Camp down to the site and across the river as necessary.

Two 4.4m high mixed masonry-reinforced concrete towers, with 1m deep foundations were built together with two anchor blocks each made from $6m^3$ of bulk fill reinforced cement concrete. The free span between the two towers is 36.7m, with a total superstructure span of some 60m while the height of the towers allows for 1.6m freeboard above highest known flood levels. Also fabricated were the 0.7m wide timber-decking units, made from termite resistant blue-gum wood. These are easily replaceable due to their simple design, and since wood was supplied from the National Parks saw mill at Chelinda.

With the concreting complete, it was left to cure and a four day round trip was embarked upon to Lilongwe to collect the steel cables. However the consignment was still stuck in Europe somewhere as all freight had been removed from the plane to make room for urgently required school exam papers. With nothing more to do, the team cleared the site, making sure everything was safe and secure, ready for the teams return in a year's time to finish the bridge.

Below & insert – Many hands help to lift the heavy rebar cage into the anchor pit.
Right – A worker passes Andras a large boulder while constructing the anchor block.

INTRODUCTION

By Naomi Bessey & Daniel Carrivick

The aim of the 2006 Imperial College Bridge Building Expedition to Malawi was to build a foot bridge across the North Rukuru river. The need for a bridge was outlined by Biosearch Expeditions who visited the area in 2004. They discovered that during the rainy season the North Rukuru rises so much it is not possible for people to safely cross the river. This means that for many months of the year National Park staff can't get into the park to patrol against poachers. A bridge would enable them to do this and would give local villagers access the park all year to collect firewood, as well as visit communities situated on the other side of the river just outside the park. A bridge would also allow scientific staff, who document and assess animal and plant species, access to the park during different seasons of the year thus enabling them to build up a more complete picture. The expedition team planned to build a suitable bridge which involved the local community, used locally sourced materials, would not be sabotaged by poachers and had a lifespan of fifteen years.

This report gives an account of the expedition and details various other aspects including finance, health, equipment and food. It is hoped the report will be of use as a source of information for people planning similar expeditions or visits to the same area, as well as a document where those interested can discover more about our expedition.

Below & insert – Rafael cooling off by washing his face down by the river.

EXPEDITION MEMBERS

Compiled by Daniel Carrivick

Daniel Carrivick

26 years old

EXPEDITION ROLE

Dan co-led this expedition with Naomi. Both prior to and during the expedition, Dan looked after the finances by processing claims and recording all income and expenditure. On the expedition he was responsible for all monetary issues including keeping track of people employed and ensuring they were paid accordingly. While on site Dan often found himself in the role of managing the workforce which totalled some 45 labourers. He planned and purchased all the food required for the expedition. It was his responsibility to ensure there was enough, both in terms of quantity and variety to last the duration of the time spent on site. Dan liaised with the airport authorities when our shipment failed to arrive and negotiated with customs to have the shipment cleared in advance. He made sure all the applicable rules and regulations were adhered to regarding our waste disposal and workers health and safety amongst other things.

ACADEMIC STATUS

- 2002-to date - PhD student in Structural Geology, Imperial College London.
- 1998-2002 - MSci Geological Sciences, Imperial College London.

EXPEDITION EXPERIENCE

- 2005 – Led an expedition from Imperial College to the Shar Kangsum mountain range in Tibet. First ascents of at least two 6000m peaks and new route on a 6600m peak.
- 2005 – Wilderness Medical Training 2-day course successfully completed (Royal Geographical Society).
- 2004 – Led a team of four students who ski-traversed over 550km, unsupported, across Greenland's icecap in 29 days collecting a multitude of hydrological, meteorological and physiological data on the way as part of the Imperial College Trans Greenland 2004 Expedition.
- 2003 - Co-led an Arctic training expedition to cross pressure ridges on the west coast of Greenland.
- 2002 - Field assistant for exploration into the small scale reservoir properties of trangressive sandstone bodies bisected by marine ravinement surfaces in New Mexico's canyon lands.
- 2002 - Member of the Imperial College Apolobamba 2002 Expedition. Ascent of three peaks up to 5700m, two of which were previously unclimbed. Ascent of Illimani (6462m) in the Cordillera Real.
- 2001 - Equipment Officer for the Imperial College Tagne 2001 Expedition. First ascent of two previously unclimbed 6000m peaks.
- 2001 - Wilderness Expedition First Aid two-day course successfully completed.
- 2000 - Six week geological mapping and wild camping in remote area on the Isle of Skye

OTHER INTERESTS & ACHIEVEMENTS

- 2006 Southern England Quest Adventure Race Series champion. Finished 5th in both the 2004 & 2005 British adventure ACE race two day series (male solo category).
- Annual summer alpine mountaineering trips to the French and Swiss Alps since 1997, including summiting Mont Blanc (4808m) at the age of 18. Led novice groups up to AD grade on mixed terrain.
- Competent skier, learnt in 1993 and skied annually since 1998 in North America, Europe & Scandinavia.
- Keen participant in other outdoor activities including mountain biking, canoeing, rock and ice climbing, scrambling and caving. Regular competitor in marathons, with a sub-three hour personal best.

Naomi Bessey

22 years old

EXPEDITION ROLE

Naomi co-ordinated a large part of the expedition, particularly the pre-expedition liaison. This involved ensuring that both government authorities in Lilongwe and the Scout team at Nyika National Park were fully briefed about the expedition prior to arrival. Naomi also organised the truck hire for the duration of the expedition, ensuring that the team would be met at the airport, and sorted out other logistics such as accommodation for the first few days in the capital. Once in Malawi Naomi co-ordinated the movements of the team and, together with Dan and Andras, liaised with park officials. She often took a dominant role in meetings with the park and local chiefs, but all major decisions were taken in consultation with the team. Naomi administered most of the first aid on the trip. While Dan macro-managed the workforce, Naomi managed the Imperial team for maximum output; she also ensured that the construction teams were working efficiently. Naomi, along with Dan, had final say on any logistical decisions; this included the decision to return and complete the bridge the following year.

ACADEMIC STATUS

- 2006-to date - PGCE in Secondary School Science, Institute of Education, University of London.
- 2002-2006 - MSci Physics, Imperial College London.

EXPEDITION EXPERIENCE

- 2005 – Arranged guides, transport and border crossings from Nepal as the logistics officer for Imperial College Shar Kangsum Expedition to Tibet. First ascents and new routes on three 6000m peaks.
- 2005 – Wilderness Medical Training 2-day course successfully completed (Royal Geographical Society).

Above & insert – How many engineers does it take to blow up a football?

- 2004 - Thirty day tour of Scandinavia, including three weeks wild camping and exploring Lofoten Islands above the Arctic Circle.
- 2004 - One month trip to central and northern Sudan. Experienced extreme desert conditions and worked with Sudanese doctors surveying houses for sanitary, schooling and medical needs in refugee camps outside Khartoum. Taught English classes in a community centre in the capital.
- 2003 - Five week sailing Expedition from England to St Petersburg in 30ft yacht, position of first mate / acting captain. North sea crossing and Baltic traverse. Planning, logistics and navigation in varied weather conditions; multiple practical tasks to keep boat afloat, often in situations of extreme stress.
- 2002 - Four week sailing trip through Holland and Germany, crossing into the Baltic Sea. Demanding storm experiences in 21ft river yacht.

OTHER INTERESTS & ACHIEVEMENTS

- Enjoys being in remote areas and the mountains - keen walker and mountaineer in all weathers.
- Likes travelling abroad, visiting places off the beaten track and reading.
- Has made a pledge to try every water-sport going (kite-surfing next!)

András Szollár

21 years old

EXPEDITION ROLE

As design co-ordinator and chief site engineer Andras was responsible for all technical parts related to the design and construction of the footbridge. This included leading the three months of research and design efforts with a few students while in the UK. During this time he consulted professional engineers and staff from Imperial College Civil Engineering Department for advice. On site Andras made significant amendments to the design following the initial survey which he led, supported by Dan's geological knowledge. During the construction Andras provided the technical know-how to the construction processes; basic geotechnics and earthworks, assembling reinforcements and reinforced concrete casting, which was aided by Dan and Naomi's dry-wall and brick laying skills. Andras focussed on particular construction processes, guiding technical work and ensuring quality of workmanship, while other team members took on the responsibility of managing the workers.

ACADEMIC STATUS

- 2004-to date - MEng Civil & Environmental Engineering, Imperial College London.

EXPEDITION EXPERIENCE

- 2005 – Imperial College El Salvador Reconstruction and Development Project team member. Site Engineer and Health & Safety Coordinator during 6 weeks voluntary work in a rural community.
- 2005 - Two weeks individual backpacking in the Central Americas. Ascent of volcanoes in Guatemala and Honduras including Volcan Acatenango (3976m). Jungle trekking and camping alone in Honduras.
- 2005 – Completed additional 2 day 'Outdoors' first aid course, including new CPR protocols.
- 2004/06 – Qualified St John Ambulance member. Attended many duties & treated numerous casualties.
- 2005 – Prepared a manual of 'First Aid for Rural Areas' to be used by Engineers Without Borders – Imperial Branch for use on expeditions and rural projects.
- 1999/05 – Co-organizer of nomad, environmentalist camps, including construction of facilities in rural areas, logistics for a NGO and teaching Navigation, First Aid and Survival skills to youth groups.
- 2004 – Leader of a 6 day winter expedition to Yosemite National Park.
- 2002/04 – Wilderness Leader Trainee and then team leader for several 3-4 day trips in the Rocky Mountains in New Mexico which included search and rescue training, snowshoeing, cross-country skiing, winter bivouacking, rock climbing and mountaineering up 4000m peaks. Trained as an American Red Cross Emergency Responder with Medical gasses and CPR for professionals and NOLS Wilderness First Responder.
- 2003 – Chimborazo, Ecuador (hiked up to 5000m).
- 2003 – Co-Leader of 7 day expedition to the Grand Canyon, including logistics and all preparations.
- 2001 – Gained 'Leader for Hill Walking' certificate after 11 week training, including navigation, logistics, first aid, etc; Environmentalists' Association, Hungary.

OTHER INTERESTS & ACHIEVEMENTS

- Active committee member of Engineers Without Borders, Imperial College division, since 2004.
- Competent off piste skier having skied regularly in the Italian and French Alps, Slovakia & Austria.
- Enjoys a range of outdoor activities including scrambling, rock climbing and mountain biking.

Martin Threakall

25 years old

EXPEDITION ROLE

Martin has strong previous experience of both expeditions and construction projects in developing countries. He was a team member on the first El Salvador expedition from Imperial College in 2002, and went on to lead a ten-strong team in this 6 week construction project in 2004. He also wrote his final year project on Project Management and Construction Methods for building bridges in developing countries. Martin had experience of working in design offices and construction sites in the UK which was used in the initial design phase, where he fed in to specific workshops. His knowledge and experience was also put to good use whilst in Malawi where he worked with Andras in developing the design and the construction

Below & insert – Rafael sitting in the shade on a tree sticking out over the river.

methods to suit the actual situation and to overcome difficulties brought on by the site or lack of particular materials in country. Martin also used his previous fundraising experience to target potential sponsors and to apply for further donations.

EMPLOYMENT & ACADEMIC HISTORY

- 2005 – to date – Deloitte Graduate, London
- 2001-2005 – MEng Civil Engineering, Imperial College London

EXPEDITION EXPERIENCE

- 2005 – Led 2 other trekkers around the Torres Del Paine W-circuit in winter, in Southern most Chile.
- 2004 - Successfully scaled Volcan Acatenango (3976m) in Guatemala.
- 2004 - Led the El Salvador Expedition, taking a team of 8 other students and an engineer to El Salvador to work on reconstruction of seismically resistant houses for 6 weeks. This included raising funds of over £17,000 and managing the construction project whilst living in the rural community.
- 2002 - Took part in the first El Salvador Expedition, helping to develop and teach affordable seismically resistant building techniques to people whose homes were destroyed in the 2001 earthquakes.
- 2001 - Successfully summited Huayni Potosi (6088m) in Bolivia. Also completed the Inca Trail in Peru and a 5 day rafting expedition on the Apurimac River, including running class 5 rapids.
- 2000 - Completed a 16 day trek through the Zanskar Valley in India as part of a 20 strong team. This included 3 passes above 5000m. Responsibilities included leading the team on some trek days and organising logistics whilst in Delhi.

OTHER INTERESTS & ACHIEVEMENTS

- Completed the Trailwalkers Challenge, a 100km trek across the South Downs, in 2006, in less than 24 hours despite having to evacuate one person due to extreme heat. Raised over £3000 for Oxfam.
- Awarded the Imperial College Outstanding Achievement Award at Commemoration Day 2005.
- Set-up and led the Imperial SIFE Team in 2005, a student social enterprise team. Projects worked with children and parents to improve their financial literacy, income and prospects.
- Worked in the 2004 "constructionarium" team to construct a scaled-down version of a tube station. Personally in charge of the installation of an in situ retaining wall, plus significant involvement in the ground works, and pre-fabrication and installation of reinforced concrete slabs.
- Qualified as a Fitness Trainer with Premier Training International in 2004.
- Represented Imperial College in the Temple Challenge Cup at the Henley Royal Regatta in 2002 & 03.
- Eight months of design work and working on site during a gap year in 2000-01. Designs were based around a wide variety of materials while working on site involved site investigations to determine nature of foundations, supervision of on site processes such as concrete pours and checking the installation of items I designed such as feature sky light frames.

Rafael Holt

22 years old

EXPEDITION ROLE

Rafael was very happy to be asked to join this expedition when an engineer had to pull out due to time commitments. He had never done anything like this before. What interested him was the remoteness of the location together with the nature of the work involved and the opportunity to travel to a new country. Not being an engineer, Rafael provided his enthusiasm and his hands for the construction work that the bridge entailed, as well as for the planning involved, both in the UK and Malawi. His main responsibility was to build and maintain the expedition's website prior to the expedition and after it.

ACADEMIC STATUS

- 2002 – 2006 – MSci Chemistry, Imperial College London

EXPEDITION EXPERIENCE

- 2002 to 2006 - Summer tours to the French and Swiss Alps. Activities undertaken include AD Alpine mountaineering at 4000m, French grade 6a rock climbing and white water grade 4 canoeing.
- 2005 – Completed a self-supported four day trek to the Choquequirao ruins (3000m), a recently unearthed Inca city across two valleys. Flat distances of 33km each way coupled with altitude gains of up to 1500m in one day mad this very physically demanding.
- 2002 - Five month course of "Outdoor Pursuits and Survival" was undertaken at the Gymnastik og Idraetshoejskolen ved Viborg in Viborg, Denmark. As well as orienteering and mountain biking several multi-day trips were completed including sea-kayaking around the islands of northern Jutland, Canadian canoeing on lakes in central Jutland and cross-country skiing near Trondheim, Norway.
- 2000 - Outdoor survival and environmental awareness course in the XI region in Chile, near Lake General Carrera. The course included the building of cabins using naturally available materials.
- 1999 to 2001 - Multiple treks of 2 - 5 days in relatively remote areas of the Peruvian Andes up to altitudes of 5,000 metres. Physically and mentally demanding as maps are of poor scale and quality.

OTHER INTERESTS & ACHIEVEMENTS

- Squash player since the age of 14, represented Imperial College in the BUSA and ULU leagues, 2003 – 2006. Squash Club treasurer in 2005 – 2006.
- Webmaster for Imperial College Union Outdoor Club for 2005 – 2006, for which full colours were awarded by the Union.
- Keen surfer, having surfed in Peru since age 9.

Below & insert – Andras doing a few calculations while waiting in the back of the truck. Naomi and Rafael reading books in the background.

ENGINEERING REPORT

By Andras Szollar & Martin Threakall

Summary

This expedition completed the construction of both towers and anchors. The bridge was unable to be completed due to delays with the shipment of steel cable.

Mission Statement

To work with the local natives to build a permanent footbridge across the North Rukuru River near Uledi and in doing so provide the community with construction skills, techniques and tools which they will be able to use and pass on long after bridge is complete.

Background

The need for a foot bridge across the North Rukuru River was brought to our attention by Quincy Connell who is involved with Biosearch Expeditions. Biosearch is an organisation which runs annual expeditions to the Nyika Plateau to study the flora and fauna in the region, often making new scientific discoveries and uncovering rare species native to the plateau. Quincy Connell is an experienced expedition leader who works closely with Biosearch and has on several occasions led their expeditions.

In the summer of 2004 the Biosearch team went particularly far North during their studies of the Nyika National Park, to Uledi, where they had to cross the North Rukuru River in order to get into the Park. Wading backwards and forwards, ferrying all their loads was no easy task. By living, working and talking with members of the community and with the National Park Scouts stationed in Uledi, Quincy soon discovered that the community is cut in two during the rainy season when the river rises several metres, making it totally un-crossable. In addition to this park staff are unable to get into the park to patrol against poaching. Quincy put forward the proposal of building a foot bridge to see what the community and National Park thought of the idea. It was well received and the project gained momentum from there on.

Quincy briefly investigated and took photos of the possible site for the foot bridge. Then when back in the UK he found an example of an existing foot bridge which seemed a suitable sort of design. All that was missing was a team to put these plans into action and actually build the bridge. Realising he didn't have the time, human resources or knowledge to build the bridge himself Quincy looked elsewhere for people who might be interested in such a project. Quincy got in touch with Bob Schroter, a friend of his who was chairman of Imperial College Exploration Committee, to see if any students from the University would be interested in building the footbridge. Bob dutifully passed on the information to Daniel Carrivick, the chairman of Imperial College Union Exploration Society at the time. Dan asked among the student population to see if anyone was interested in such a project and after several of his friends expressed an interest he decided to put his weight behind the project to give it strength. The team then recruited more engineers and helpers to overcome both the logistical and the engineering aspects of the challenge.

Aim

The main aim of this expedition was to build a footbridge across the North Rukuru River on the north western edge of the Nyika National Park, near Uledi in Northern Malawi. Secondary to this the team also wanted to find out more about Uledi, the Nyika National Park, and the surrounding area, and identify if there was a need for any further projects within the region.

Design Process

SITE INFORMATION

Most of the information about the site that we had prior to the expedition was given to us by Quincy and is detailed below. He had previously identified a possible site for the bridge when he visited Uledi with Biosearch Expeditions in 2004. Some of this information came from meetings with him, some from communicating via email and the rest was deduced from photos of the site which Quincy had taken. The following is what we knew or had been told before we visited the site.

- The river to be bridged was called the North Rukuru River.
- The site was adjacent to the community of Uledi and a small National Park manned post. Uledi was situated at the foot of the north west side of the Nyika plateau, about 1000m above sea level.
- The river channel at the proposed site was 4-5m deep, 15-20m wide, with ~30-50° slopes on both sides valley.
- Upstream and downstream the river bends in a series of meanders where it cuts its way through steeper 'gorges'.
- The bedrock of the area was mainly sandstone however some mudstones and recent deposits are also present.
- The rainy season lasts from December to April and causes the river to flood annually. Most areas near the river are part of the floodplains. The community and the areas around the bends of the river are on somewhat higher grounds. Actual flood levels were not known and will have to be established on site, by looking for evidence of flooding and by asking the local community.
- The lowest point of bridge may have to be above the ground level of the channel banks due to flooding and overspill.

Below & insert - Andras plots up the site measurements to create a cross sectional profile across the river.

- Designing a bridge with a span of 25m would be more than adequate for the task.
- There was no restriction on the distance and positioning of anchors since the flood plain areas on either side of the channel are flat and expansive.
- The bridge was for pedestrian use only i.e. the bridge was not for use by carts or animals.
- The nearest source of electricity was one and a half days drive away.
- Local resources available consisted of termite resistant timber from blue gum trees available from Chelinda in the centre of the National Park. Sand, gravel and rocks might all be available to collect locally.
- The nearest commercial town and source of other construction materials was two days drive away.

Quincy even had a design in mind, based on a picture he had been given of a Scottish footbridge. This bridge consisted of wooden decking units placed on chains which were suspended from thick wooden upright posts on each bank. More thick wooden posts had been piled into the ground at an angle to form anchors around which the chain passed before being secured back on itself. The design was very attractive for its simplicity. The materials were not specialised, construction methods were not technical and thus the cost was relatively low. This coupled with the fact the bridge had a surprisingly large span (15m) and did not have a large amount of sag (approx. 1m) meant it seemed to be ideal for the task in hand. However the engineers had their doubts about up scaling the design. These centred on the use of the chains and the fact their strength is largely unknown. Also metal chains were not readily available in Malawi and wooden uprights were no good as a main part of the bridge as these would just be burnt by poachers unless they were protected. Hence the team started to look elsewhere for ideas.

PRELIMINARY DESIGN

The design process was governed not just by the site specifications but also by the following guiding principles which were adhered to as much as possible.

- To use locally or at least nationally produced materials where possible to support the local economy.
- The design and construction methods should be simple for ease of application and future maintenance. The majority of the bridge should be replaceable by the locals from local materials.
- Locals should be involved from the beginning and most of the work should be done by them, under supervision, to ensure a sense of ownership and boost belief in their own capabilities as well as to learn useful technical knowledge which they will be able to share and apply after the expedition has left.

A group of engineering students were formed and different types of footbridges were thoroughly researched after initial load estimates and brainstorming. Taking into consideration our preliminary information and the guiding principles the group identified two main types of footbridge as being appropriate. These came from the Department for International Development's Footbridge Manual and I.T. Transport's Footpath and Track field guide. A summary of these are outlined below.

- **Steel truss** footbridge without piers, suitable for spans of 10-20m and possibly 25m. Components would have to be constructed in competent workshop, transported to site and parts bolted together on site. However, no local knowledge/resources were expected to be available nearby Uledi for the welding which would be required.
- **Cable stayed** suspended or suspension type bridge. Does not need supports and is suitable for spans over 20m. Cables and joint components have to be sourced. More advanced technical knowledge is required for design and construction however structure can be raised by manual labour. Based on Malawian construction material prices, this option is also cheaper, hence altogether preferred to a steel truss bridge.

Further research thus focused on different types of suspended/suspension footbridges. A Swiss guide for building footbridges in developing countries, and in particular Nepal, called Bridges for Prosperity was found. This guide was the source of our initial design ideas and calculations which were derived from the Helvetas design.

The design team had several meetings with professional engineers from Buro Happold, Expedition Engineering and WhitbyBird, and with staff from Imperial College, in order to justify decisions made so far and ensure the applicability and constructability of the final design. These meetings revealed that significant adjustments had to be made to the Helvetas design, due mainly to our very different site conditions and available resources – the materials available in Malawi are significantly different to those readily available in Nepal. The following changes were made accordingly:

- The anchorages on both sides were doubled from $3m^3$ buried dead man RCC (Reinforced Cement Concrete) anchor into $6m^3$ full depth RCC anchor blocks due to presumed high pore water pressures experienced during flooding. In order to minimise the associated increase in the amount of cement needed, the anchors were further modified to become 40% bulk rock-filled RCC blocks.
- The connection of the cables was modified for simplicity, and turnbuckles were added on one side to allow for small adjustments after construction.
- The general dimensions of the towers and their foundations was kept the same, however their material was altered from pure masonry (mortared walls and dry fit inside) to mortared double layer brick sides with rock & gravel fill inside. An RCC slab was added to the top of each level to strengthen the tower and prevent sagging by distributing the load more evenly across the whole surface. This also protects the finer elements of the fill from being washed out by rain.
- A 1m wide decking was chosen and changed from a very complicated steel design to a simplistic and easy to replace timber design built up from 2m units, with "safety slotted" crossbeams, which can be replaced one by one.

All the materials for this design could be sourced from within Malawi apart from the structural parts, such as steel cables and turnbuckles. Time was spent researching where these could be purchased from and how to transport them to Malawi. Two different approaches were identified. One was to purchase the structural parts from South Africa and have them transported to Malawi and the

Above & insert – First view of the site through very long grass.

other was to obtain the parts from the UK and have them air freighted to Malawi. Purchasing the parts in the UK was not an option due to the high cost of shipping them over compared with the relative cheapness of purchase and delivery from South Africa. The disadvantage of buying from South Africa was that the strength and quality of the parts was dubious at best. Hence we set about writing to steel cable manufacturing firms in the UK asking if they would consider supporting us. MacAlloy got back to us expressing an interest and after discussing our needs with them they got in touch with their Italian sister company called Tensoteci who kindly agreed to supply us with the steel cable we required.

SITE SURVEYS & FIELD TESTS

On arrival at the site an initial walk was taken through the area to gather general information about the river and its catchments' characteristics. The location of tributaries proved critical along with bends and meanders in the river. The lower part of river was not a suitable site as it opened out onto the flood plain and was thus too wide. Far upstream the river was not so wide, however this was not suitable as a significant tributary, which would also need to be bridged, joined the main river in between. This large tributary raised concerns about possible washout problems downstream from it as evidence of scouring was present downstream in the opposite river bank. The bends in the river were to be avoided due to erosion of the river cliffs and unfavourable bank conditions. Also there was a significant height differential between the river cliffs on the outside of the bend and the point bars on the inside of the bend. Thus the only possible location for a bridge was between the large tributary which joined the river upstream and the first downstream ninety degree bend. A cross-sectional profile of what we thought was the best site in this location was taken and trial pits were dug. However analysis of the underlying geology shown in the river bank coupled with the position of existing trees meant the final chosen site was 50m upstream of this. Another cross sectional profile was undertaken of the river at this new site. This showed the chosen site had disadvantages in that the river was a little bit wider and its banks were a fraction lower than the original site. Nevertheless these were outweighed by the better geotechnical conditions of the upstream site i.e. bedrock nearer the surface and less undercutting of river bank. The site surveys and profiles were undertaken using the most simplest of methods as our survey equipment was in one of the delayed bags which had not yet arrived. String, a 5m tape-measure and a spirit level was all we had to use and these were bought in Mzuzu.

DESIGN MODIFICATIONS

The surveys revealed that even our most cautious estimates, which were based on the information we'd been given prior to the expedition were an underestimate. Comparison of the real site with the presumed site gave much worse conditions. The span was wider, flood levels were higher, the river banks were in a poor condition and there were problems with the proximity and impact of the tributaries. Thus major modifications had to be made to original design in order for the bridge to fit the site.

The most significant problem to solve was how to accommodate the increase in the span of the bridge. A span of 36.5m was now required but the cables ordered only covered spans up to a 30m. Thus the cable was not long enough to simply use the same design with a larger span. The possibility of saving a few metres of cable length by making changes to the design was investigated. This could not be achieved by shifting the anchors and towers closer to the river as this could have provoked slope failure of the embankments or failure of the soil in front of the anchorages. The distance between the anchors and the towers could only be decreased by a small amount due to sloping ground conditions and this in itself was not enough. Exclusion of the originally planned turnbuckles was an absolute must in order to reduce the length of cable required. This also simplified the construction, decreased vandalism possibilities and decreased the possible failure modes of the bridge however more changes were needed to further reduce the cable length needed.

Many nights were spent on meticulous and very conservative calculations to determine whether it was feasible to build the bridge or not under the real site conditions, with materials procured for the anticipated conditions. The final idea was to modify the connection of the cables. So rather cut the main cable in two and have two separate cables on either side of the bridge, the new idea used just one cable which would be looped through the front of the anchor block before returning on the other side of the bridge. This avoided the need to cut the main cable and meant there were only two ends of the cable which needed fastening with bulldog grips as opposed to four. These modifications were finally sufficient for a bridge to be safely constructed using the 130m long cables ordered. Other changes made to the design were as follows:

- The dimensions of the anchor on the west side had to be rotated by 90° as sandstone strata was expected to be reached and excavation after 2m-depth would be near impossible.
- The towers had to be raised by 1m on both sides to accommodate for the increased sagging of the cables due to the longer span of the bridge and to cope with higher flood levels. This meant the addition of two extra levels, each of which was $12m^3$. The implementation of this design change meant we required almost an extra week's worth of labour.
- The increased span did not only mean problems with the length of the cables, but also increased the possible loads on these. In order to avoid exceeding the original design loads of the cables, the width of the decking was decreased from 100cm to 70cm.
- The addition of simple embankment protection works in order to further increase the life span and safety of the bridge during flooding.

The final reinforcement calculations were done on site in accordance to the new design and orders for the size, shape and amount were sent to Mzuzu.

Owing to the remoteness of the community and the time taken to collect materials from Mzuzu it was necessary to order the reinforcement in advance with limited information. This was in part due to the fact

Above & insert – Andras in the river conducting a site survey.

that as work progressed so new information about the site was gained. Hence a lot of engineering thought and consideration was required throughout the project to ensure the design was possible from a construction perspective, and that the design remained sound with the materials we had available to us. In certain situations it was necessary to re-redesign some aspects of the bridge numerous times as the site conditions, the materials we had, and the quality of the materials we could order became apparent. In some situations these modifications were enforced by the fact that the materials we had to use weren't quite what we wanted, thus the design was amended so we could use what we had. An example of this was when we ordered the timber. The saw mill managed to get our quantities muddled up so we ended up with more thick planks than we needed and not enough thin planks. A redesign of the decking modules was therefore necessary so the timber we had could be used to fit the task. The result was instead of the top layer of planks being placed laterally across each module they were rotated ninety degrees and placed longitudinally. This change in orientation of the top layer of timber was done in such a way that another layer of decking could be added on top, perpendicular to this, as and when is needed.

Methods

The construction of the bridge was carried out solely with the use of manual labour and hand techniques. Nothing but the simplest of hand tools could be used owing to the remote geographical location of the bridge, its lack of transport links and the absence of heavy engineering equipment available in Malawi. All operations had to be carried out by hand. For example it was financially unrealistic and almost logistically impossible to transport a simple concrete mixer to the site so the concrete was mixed by hand. This constraint had a significant impact on both the design of the bridge, and the construction plan and timelines developed for the project. In this section the nature of the main construction methods used will be explained together with the reasoning for using these methods.

The construction of the bridge can be represented by five main phases; site preparation and excavation, building of towers, building of anchorages, manufacture of decking, and finally the assembly of the cables. During each of these phases a variety of different activities were carried out, and these are detailed below. They subdivided into the following sections; site selection and preparation, material collection and transportation, construction of the towers, anchorage construction; decking assembly and installing the cables. The final section looks at the methods used in the overall management of the site.

SITE SELECTION - PREPARATION & EXCAVATION

Upon our arrival in Uledi, apart from meeting representatives from the community and the National Park, the first tasks were to view the river and the potential sites from an engineers' perspective. This allowed different potential sites to be assessed and compared against one another, and for these points to be weighed up against the needs of the community and the National Park. A spirit level, tape measure and string was used to produce a cross section of the prime sites, and test pits were dug on either side of the river to assess soil conditions and bedrock depth. Visual signs, such as flood debris caught in vegetation beside the river and flood deposits on the slopes either side of the river were also analysed to assess the height and extent of the flooding. Anecdotal evidence was also collected from community members to gain a good picture of the extent of the river in the flood season.

Once a site was chosen, it was cleared using pangas and scythes, and the soil and geology was studied in depth. This resulted in the final position of construction being chosen slightly further upstream, where the underlying geology was deemed to be more stable and the bank conditions were more favourable. Both banks of the river at the new site were cleared from vegetation which included tall grass and bushes. One type of plant contained 'Buffalo Beans'. These were highly itchy and caused such severe irritation that the individual affected was unable to continue working until the barely visible hair-like spines had been removed from that persons skin – best done by thorough washing and soaking in the river. Additional spaces were also cleared for the storage of construction materials on site. Approach paths to both construction sites were cleared. These were set out downstream from construction sites in order to minimise any unnecessary erosion of bank upstream. Steps were cut into steep banks or slopes to provide easy access. These had to be re-cut, sometimes daily, as a large amount of water dripped from the material being carried making the steps slippery and prone to erosion by their continuous use.

The site was marked out using string and stakes once each site had been appropriately cleared. This was done by simple methods that the locals could learn, like using a 3-4-5 triangle of string for creating right angles. The final position of the centre of each tower and anchor were re-measured and compared to the design based on the initial cross-sectional profile. A mark was put on the main post on the west side of the river and this was used as ground level. The level of all other marks and posts on site were determined compared to this base mark using a clear hose pipe filled with water as a level to obtain a vertical control across the whole site. The stakes were checked regularly and had to be replaced as the structure of the towers came out of the ground. Sometimes stakes were replaced by ones in different places as and when this proved more practical for construction.

Excavation then started simultaneously on both sides by four 2-man teams; two people in each of the anchor pits and two on each of the tower's foundations. All material dug was removed and carried out by hand. The river bank on the west side of the river consisted of a hard clay soil some 50cm thick, underneath which lay a sandy subsurface with minor amounts of clay. Centimetre bedded sandstone bedrock was encountered at about 90cm below ground level in the tower's foundation and at 1m in the anchor pit. This was welcome from an engineering view and justified previous geological approximations about the structure of the embankment, and design decisions made according to these. Most of this sandstone was friable and therefore easily removed but some parts were cemented and hence difficult to excavate. A large rock protruded into the pit and this had to be removed with significant difficulty so that the reinforcement cage would fit in. Cutting vertical sides and ensuring the pits were of the correct dimensions was very arduous because of the tough clay and sandstone.

Below & insert – Andras marks out the site by banging in wooden stakes, cut from the local bush.

On the east side of the river the soil was largely semi-unconsolidated sandy flood deposits which were relatively easy to remove. Some penetration testing was done on the bottom of the tower foundation pit, to determine whether compacting the soil would add strength to it, particularly in the saturated state, which it is likely to experience during the flood season. It was decided that compacting the soil would be beneficial, and a hand compactor was used to carry out this task over the bottom of the foundation pit. The anchor pit on this south side was 3m deep. In order to provide some degree of safety, and also to facilitate an easier infill, steps were cut in the back face of this pit. This made entry and exit of the pit quicker and safer, and also made the back face more stable. The front face was protected with some corrugated tin shuttering, propped off the steps in the back wall by using trunks from cleared trees. Everyone on site was told to stay away from the edges of this deep pit, and the excavated material was moved some distance away from the edges to ensure it did not increase the likelihood of these walls collapsing. The community members were surprised at our insistence on these safety measures, as they regularly dig pits in this soil to this depth or deeper for latrines. This point gave us some confidence in the soil's strength, but we felt the safety measures were none-the-less important as they added a greater degree of safety and transferred a more responsible health and safety approach across to the community.

MATERIALS - COLLECTION & TRANSPORTATION

The majority of the bridge structure was constructed from a few simple constituent materials: boulders, bricks, aggregate, sand, cement, reinforcing bars and timber. Reinforcement and cement was brought from Mzuzu in the truck which was a good ten hour drive from Uledi. A round trip therefore took three days; one day to get to Mzuzu, one day to purchase goods and a third to return to Uledi. Timber was cut from the Blue Gum reserves of the National Park as it was the only termite resistant wood in the area. This was also brought to Uledi by road from the park headquarters in Chelinda which was a five hour drive one-way. Bricks were bought from the community and collected from various sites around the village of Uledi using the truck. This required some clearing and patching in of the paths to make them suitable for vehicular access. The brick stacks had been covered by a thin layer of mud to protect them from the elements so this had to be removed before the bricks could be collected. Despite this mud covering the bricks showed signs of weathering and weakness which meant they had to handled and transported carefully. All these materials brought in by truck were stored in the National Park buildings in Uledi and then carried by hand from there to the site as required.

The remainder of the raw materials were collected from the river bed in the area local to the bridge site. These were sorted and washed as necessary. Boulders were carried by hand, and to provide blocks and chips for building the lower portion of the towers' external walls, some boulders were broken at their source, using club hammers and chisels, and then carried over to the site. Aggregate was hand selected from the river bed, and some time was put in to explaining to the workers what size and type of stones were appropriate and which were not. This included the importance of discarding algae-covered rocks. A test sieve was made in the hope this would standardise the process and allow consistent high quality aggregate to be collected, but it simply was not quick enough to suit the timeframes we were working to. Sand was shovelled directly from the river bed. Care was taken to ensure a decent sand quality was collected i.e. sand with no dark organic matter in it. Both sand and aggregate were collected from designated sites. These had been previously tested by simple methods and were found to contain the best quality material. Maize sacks were used to carry the aggregate and sand to the site by hand. Considerable care was taken to ensure correct proportions of the work force were allocated to the various materials, and that they were taken to the right side of the river. Typically materials were delivered on a "just in time" basis, so mismanaging this supply chain could have caused significant delays to the construction and throw the two sides of the bridge out of sync with one another. The immediate use of materials had the positive effect of helping to motivate workers in the supply chain.

TOWER CONSTRUCTION - BRICK LAYING & INFILL

Once the tower foundation pits had been dug work began on constructing the towers. The foundations were constructed flush against the pit wall. Hammered rocks held together with mortar were used for the walls. The space between the walls was filled with large boulders from the river which were packed in with sand and stones. This fill was laid and packed as tightly as possible, to give it the best possible chance of spreading the load and transferring the weight to the ground below.

The broken boulders were laid by two community members, who showed some skill, enthusiasm and diligence towards this task. Laying the broken pieces within the foundation was relatively easy. These broken boulder walls were constructed to just above the highest flood level - a height of about 50cm above the height of the surrounding ground - as it was felt if bricks were used at this lower level they would quickly weather and the tower could be weakened. In this portion of the tower it was extremely difficult to lay the irregular rocks consistently. Bricks were used above this level for the tower walls and this increased the speed of the construction considerably as, whilst not wholly regular or standardised, the bricks were at least roughly square and of similar size to one another. Double and in places triple layer brick walls were built to give the tower's walls extra strength, and these too were held together with mortar. The towers were built in one metre high tiers, which were filled with boulders and sand. This sand was compacted by hand before the whole tier was topped off with a 50mm thick mesh-reinforced concrete slab. The concrete mix used for these slabs was one batch of cement to 1.7 batches of sand and 3.5 batches of gravel. These RCC slabs provided strength to the towers at each level and additional reinforcement was placed vertically from foundations up to the top level to protect against any sideways forces which may be imposed on the bridge, for example if something were to get stuck under the bridge. Two handrail columns formed the top level of each tower. These were constructed from single layer brick walls filled with concrete. RCC saddles were put on top to spread the weight of the cable.

A ratio of one cement to three sand was used in the mortar mix to lay the broken boulders and bricks. This is quite concrete heavy, but was selected as a result of the inferior quality of some of the cement used. The mortar was mixed by the barrow load continuously whilst the laying was

Below & insert – Andras undertakes a settling test in order to determine how much silt and clay is in the sand.

going on, to provide a continuous flow and allow a continuous work rate on the laying. Once laid this mortar was regularly splashed with water to improve curing and to help it develop as much strength as possible. This was particularly important given the extreme sun and heat it was exposed to, especially on the west side of the river where there was very little shade.

ANCHORAGE - MIXING & POURING REINFORCED CONCRETE

The anchorage pits were dug at the same time as the foundations for the tower. They took longer to dig because although not as large as the tower foundations the anchor pits had to go deeper. On the west side, where the anchor pit was 2m deep and 3m wide, hard rock was encountered below 1.5m. Penetrating below this depth was hard work and pick axes were used to break the rock up. On the east side of the river the anchor pit was 3m deep and 2m wide. The sandy subsurface was a lot more unconsolidated and as the pit got deeper, temporary shuttering was installed against the face to protect those in the pit from potential collapse of the pit wall. Being unconsolidated the sand was easily dug out however below a depth of 2m it was difficult for those shovelling to eject material from the pit because the sides were so high. Also the pit was pretty small and there was really only room for one person to work in the bottom of the pit at a time. The pit was enlarged backwards and cut to form a couple of large steps which led down to the bottom of the pit. This gave the workers more room, provided a safe method of accessing the bottom of the pit and helped in the removal of material from the bottom of the pit.

Once the anchor pits were dug, work concentrated on the construction of the towers until all but the top level of the towers was complete. Then one whole day was designated to the pouring of each anchorage. This was done non-stop to avoid cold joints forming and ensure decent bonding between the various pours. All the concrete was mixed on site by hand and a mix of one batch of cement to two batches of sand and four of gravel. Mixing the amount of concrete required for a three by two metre anchor block by hand was in itself a full days' (ten hour) operation. Thus all the necessary preparations were made in the days leading up to the pouring of an anchorage. The team had some experience of mixing by hand and therefore knew the appropriate size of mix and the proportion of materials required for the anchorage to achieve a good balance of practicality and quality. The whole workforce worked hard to stockpile enough sand and gravel for the concrete, and rocks for adding bulk to the anchorage thus reducing the amount of concrete required. Also the reinforcement bar was bent and assembled to form cages and the pipes for the cable connections were shaped and inserted. Owing to tight timelines, the last mix for one of the anchors was completed and poured by torchlight, which was sub-optimal but still achieved a reasonably decent result.

Where mixing was taking place, a rough screed mixing plate was formed to try and maintain a decent mix with as little dirt or vegetation in it as possible. The constituent parts were added by full wheel barrow loads and dry mixed with spades and hoes. Water was added by the bucket and mixed in continuously, though it did take numerous buckets before the mix was anywhere near workable. Once the concrete was well mixed it was put into buckets and poured where required.

The slabs which went on top of each tier of the towers could be made in one mix however larger elements, such as the anchors, required numerous mixes involving as many as ten batches. These flat slabs were tamped to provide as good a finish as possible, and where necessary were patched with a mortar mix afterwards to cover any exposed rebar or segregated aggregate. Each pour for the anchorage was poked to release any trapped air. All concrete was continuously doused with water to help it cure and develop as much strength as possible.

Reinforcement was ordered to shape. This minimised the amount of cutting and bending required on site. The mesh for the flat slabs was cut on site using a metal saw, and the vertical reinforcement for the towers was bent, not without difficulty, on site which only served to confirm that having the rest bent in the shop was a good idea. The shaped reinforcement for the anchor cages simply had to be tied together. This was done by twisting thin metal wire around the bars where they crossed to hold them in place. Attaching the piece of railway track was done in a similar way, though some amendments to the construction of the cages were needed to a) insert the railway track into the cage and b) get the railway track to stay in the right position within the cage given its heavy weight. Stones and boulders were used as well as concrete to infill the anchor cages. These were passed carefully to Andras who stood inside each cage and placed them on top of the concrete before the next batch of concrete was placed on top.

DECKING ASSEMBLY

The decking modules were constructed in advance, and they were designed so that they can be manually placed onto the cable. They will be fixed into position, whilst remaining easy to replace as this becomes necessary due to wear and tear, damage, insect attack etc. A production line process was set up to construct the identical modules. This worked very well and led to a rapid construction of all the modules. The timbers were cut to length and the modules assembled at the National Park buildings in Uledi, before being carried down to the site one by one.

Earthworks were carried out around each of the towers. This involved the back fill of each tower which both protected the towers and provided an approach ramp up towards the decking level. Two stairways were also constructed from timber and these will be placed at either end of the bridge to provide access from the top of the earth ramp to the decking level. Further building up of earth in front of the anchorages will be required once cables are in place, to provide greater force to resist motion of the anchorages.

ASSEMBLING THE CABLES

The cables could not be installed as they were delayed in transit and thus did not make it to the site before we had to leave to return home. However, with all the major construction work complete, it shouldn't take too long to install the cables and decking, thus finishing the bridge.

The site was cleared and made safe when it became apparent the cable would not arrive in time. This involved the filling in of the pits which provided access to the anchorage. These

Below & insert – Andras mixes a test batch of concrete while Naomi pours some water in.

will need to be unearthed again before the cables can be put in place. Temporary structures which aided the construction of the towers were removed from the site and all rubbish was burnt or buried as appropriate. Steel mesh was removed from the unfinished bank protection work so it would not be removed by individuals or swept away by floods. This was locked away in the National Parks building to safeguard against loss or theft along with the decking modules, approach stairways, unused bridge parts, a few specialised tools and pieces of maintenance equipment.

Instructions were left regarding the maintenance which needed to be carried out on the structures throughout the year and key members of the community took responsibility of these minor activities. These included appropriate curing methods for the concrete and the protection of exposed steel parts against corrosion. The necessary materials were left with individuals so they could complete their tasks.

SITE MANAGEMENT

The management of the site was a key aspect of the project for the expedition team. The considerable amount of manual work which needed to be done in a short amount of time meant that a sizeable workforce had to be employed on a daily basis, and kept under a reasonably tight rein to ensure deadlines were met *(see appendix D)*. Progress was reviewed regularly to ensure the workforce was suitably distributed and no task was progressing slowly and thus hindering another, and equally ensuring that no task was overmanned. It was also necessary to keep a close eye on how individual tasks were progressing as despite English being one of the national languages of Malawi, it is not widely spoken in rural areas, so sometimes instructions and directions were not entirely understood. If the workforce were left un-supervised then confusion would soon reign as they all had different ideas on what they should be doing, and when they knew what they should be doing one or two would bunk off.

The team made a conscious effort to get involved in the work from a practical perspective so as not to be seen purely as supervisors, but as individuals helping work to progress in a directly practical way. This increased community morale and helped the team build strong relationships with community members. There was a fine balance to strike between getting involved in the practical work and maintaining a smoothly functioning site, and this often proved to be one of the more difficult aspects of the work. This problem was exasperated by the large area from which material was collected, which made keeping track of the workers extremely difficult and time consuming.

The team reviewed progress thoroughly on a daily basis, to check where the project was compared to the milestones set out. During this the tasks required for the following day were confirmed and the number of community members needed for these agreed upon. The workforce numbers were gradually increased throughout the construction to suit the needs of both the time plan and the budget. It was tempting to employ a lot of extra workers when the day's tasks weren't completed. However this was not done as these extra workers would have only been laid off again at the end of the following day. This obviously was not good for workforce relationships especially if these individuals were needed again in the future. Thus extra people were only hired when we knew we could give them work in the longer term.

The efficiency of operations was analysed daily and recommendations made on how to improve situations which clearly weren't working or which were taking too long. An example of this was the movement of bricks from the park buildings to the site. Initially five or six workers were allocated the task of carrying the bricks by hand. However the group was too small. They worked without their friends so they weren't happy and they were despondent at the size of their task. Thus they worked slowly and inefficiently as they were unable to see progress being made. They also got tired quickly as they had to climb a steep incline each time to collect more bricks. This situation was remedied by getting everyone to form a human chain where bricks were passed from one person to the next. This worked well after getting over the initial organisation and implementation problems which were largely associated with difficulties in communication. The difference in atmosphere was amazing. Our workers enjoyed the work much more as they worked with their friends and there was a real team spirit. The bricks got moved quickly and efficiently and the workers didn't get as tired as they didn't have to walk backwards and forwards all the time. The speed of work could even be controlled by one of us at the start of the chain if need be. There were a few disputes among the work force when some of them got carried away and started throwing bricks, rather than passing them, from one person to the next. This resulted in many broken bricks as some workers couldn't catch and a few workers sustained minor cuts to hands and feet as the bricks were sharp. Hence in the interest of safety and to keep the peace we insisted the bricks be passed from person to person. From then on efficiency was maintained by changing the tasks workers did throughout the day. Giving a worker the task of transporting material for a whole day just didn't work as they soon tired. Hence this was intermixed with tasks which required less effort such as forming a chain to pass bags of sand from the river up the bank to the site. Efficiency was also improved by getting workers to transport loads just a short distance at a time rather than getting them to carry material all the way from source to site in one go. Typically a supply chain was implemented where each team of workers moved material a short distance to where the next team was ferrying material. This worked well as the teams felt obliged to keep up with one another so they didn't let the chain down. Materials were deposited in specific areas on either side of the river for the construction of the tower and anchorage. Measures such as marking out the areas for the separate materials and clearing these areas of vegetation to maintain good quality material piles were put in to practice.

Another aspect of site management which the team focused on was looking after the tools and materials, ensuring they were cared for and returned to the huts each lunchtime and evening. The team received substantial help with this from Clever, one of the National Park Scouts. What made this discipline particularly important was the time and difficulty involved in procuring new tools or materials, should some be lost or damaged. The team were also careful to ensure that the right good quality tools were bought in sufficient quantities at the beginning of the project.

Above & insert – Smoothing off the top of the stone wall with cement, ready to start laying bricks.

Results & Future Work

The construction of the towers including the high strength RCC saddles for cables on both sides of river were finished. About half of the required earth works had been carried out. These were to provide access ramps and to backfill the area surrounding the towers. A stepped ladder for each tower has also been made to provide access to the decking level. The anchorages on both sides of river are complete and decking units have been constructed to cover entire span and more so there are replacement sections ready made should one become damaged. However there is still a bit of work which will need to be carried out by an expedition in the future.

The main thing left to do is to install the cables. These include the walkway, handrail and suspender cables which all need to be put in place and fastened. The methods to achieve this involve working at height and therefore require specialist safety equipment, such as harnesses and appropriately set up rope systems which are not locally available. There is also a necessity for additional embankment protection works as the towers had to be positioned closer to the river banks than initially envisaged due to the length of cable available and the increased span of the river. The need for bank protection should ideally be re-evaluated and appropriate measures be taken before installation of cable systems takes place. Once the cables are fully installed the decking can be placed onto them. This will also require specialist equipment and will be increasingly hazardous as the construction involves lifting and moving heavy decking units at height. Finally access ramps on both sides need to be finished and stepped ladders fixed in place. Walkways connecting the decking and the access ladders also have to be constructed.

Before leaving for the final time the community will be briefed about the safe usage of the bridge and the necessary limitations implications of these limitations. Additional training will be given to responsible bodies, enabling them to monitor the structure, carry out simple maintenance measures and recognise signs of possible failure.

Discussion

SITE INFORMATION & DESIGN

The site information the team had prior to arriving on site in Uledi, which all the preliminary plans and designs had been based on, was found to be significantly different from the actual case. This resulted in a much more challenging problem for the team to overcome than had been expected. Major design changes were required. Turnbuckles were removed from the design, anchor blocks and connections were totally redesigned, the towers were made higher and the walkway narrowed to name but a few. The team were successful in utilising all possible efficiencies to get as much as possible from the pre-ordered cable which became the limiting factor in the changes made to design while in Malawi.

METHODS

The community members who worked with the team had limited knowledge or understanding of a lot of concepts, and little construction experience. The assumed knowledge base was significantly different to the actual knowledge base as a result of significantly different cultural, educational and experience backgrounds. As a result the team had to teach and demonstrate a lot of techniques, and even the most basic processes became slow and difficult. Time constraints meant in some situations education of the community members had to take second place to getting the job done. However this is not unsurprising as it is unrealistic to expect every community member to learn from every job they are carrying out over the course of the project, especially as so much of the time was spent collecting materials.

MATERIALS

The speed of construction was often limited by the sourcing of the materials. Where possible it is worth using all spare resources to stock pile these materials whilst other parts of the construction are taking place, to ensure all the materials are available and ready when they are needed. The non-delivery of the cables did have some benefits as it gave time for additional protective ground works to be carried out. This also meant sufficient time was allowed for the full curing of the RCC anchorages. Completing the bridge next year will give further time for protective works to be carried out on the banks, and also an opportunity to review any erosion that has occurred over the year and carry out work to suit. Whilst there is the obvious disadvantage that the community must last another year without the bridge, it will in the end result in a better solution for the long term.

FINAL THOUGHT

Where site details are not 100% known, it is not possible to build too much safety margin and flexibility in to the design. Be prepared to amend the design and construction methods to suit site conditions and available resources.

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Above & insert – Laying a concrete slab on top of the first level of one of the towers.
Right – A worker brakes up the large round boulders into angular blocks for the walls of the towers.

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Above & insert – One of many flat tyres. Wellington, our driver, loosens the nuts.

ADMINISTRATION & LOGISTICS

By Daniel Carrivick

Training & Preparations

WILDERNESS LIVING

Most members of the team knew each other through Imperial College Union Outdoor Club where a general level of fitness was maintained by regularly undertaking various mountain activities together. Through these trips the team had all gained a basic knowledge of camping and surviving outside in harsh environments. All team members had prior expedition experience and had worked together on extended mountaineering trips. Skills were refreshed and developed in the build up to this expedition both on general mountaineering trips and by attending more specific courses. Four of the team attended a long training session held by Biosearch Expeditions over the May bank holiday weekend. The three days spent together gave a realistic taste of what living conditions would be like in the wild in Malawi as well as covering basic skills such as orienteering, first aid and health and safety issues.

FIRST AID

All expedition members had basic first aid knowledge and skills prior to the expedition. Andras, being a qualified St John Ambulance member, had a wealth of first aid knowledge and experience. Naomi, who was already a qualified outdoor activity first aider, underwent further wilderness medical training by attending the two-day Far From Help 1 Course organised by the Royal Geographical Society on the 11-12th March 2006. Dan attended the same course to renew his wilderness expedition first aid qualification which had lapsed after being gained more than three years previously. The team also attended a short refresher course given at the Biosearch training weekend where key skills were practiced.

CONSTRUCTION

No specific construction training was undertaken before the expedition. Andras and Martin both had previous construction experience and they passed their knowledge and skills onto the rest of the team and the workforce throughout the expedition. Andras spent three weeks before the expedition on a work placement at Expedition Engineering Ltd. This involved the design of steel structures as well as using reinforced concrete both of which were of most relevant to the expedition. He also received additional support on the team's initial design for the bridge. The work experience, training and support Andras received from Expedition Engineering Ltd. was invaluable in Malawi, as the sophisticated alterations which were essential called for the entire design to be rethought.

VISITING OTHER FOOTBRIDGES

Members of the team visited Scotland at Easter to find the footbridge in the photo shown to them by Quincy as a potential design model. The footbridge crossed the mouth of Allt a' Chaoil Reidhe just as the river enters Lock Pattack on the NNE side of Ben Alder (Grid Reference NN 5380 7860). The bridge was situated some seven miles from the nearest public road and the weather was very unsettled so bikes were used to reach the bridge from the A889 at Dalwhinnie. The footbridge did not look that old but it was already beginning to a look a little bit worse for wear. A notice was stapled to one of the posts; its ink had started to run but the message could still be made out. It read "Danger. Unstable Bridge. Cross at your own risk". This did not inspire confidence and it was with some trepidation that the bridge was first crossed. Normally it wouldn't have mattered but the river was high, the wind was gusting and the persistent rain was turning to sleet. It was not a day to be falling in a river in the middle of nowhere, with no shelter or spare clothing. The wooden decking was slippery and the bridge was not very rigid and therefore offered little support. Two chains acted as hand rails and the walkway sank significantly underfoot with each step as the weight of a person caused the chains to tension. This sinking of the walkway as you put your full weight on your foot did not happen smoothly either as the chains got caught and snagged in the wooden uprights. This caused the decking to suddenly jolt and lurch as the chain was released. When a person stood in the middle of the bridge the decking unit lay in the flowing water and vegetation caught in the chains underneath the bridge were testament to this being a regular problem. Being able to test the bridge immediately highlighted the strengths and weaknesses of the design. Many photos were taken showing the detail of the construction methods and materials used, and these were analysed with the rest of the design team on return to London.

Permission & Permits

NATIONAL PARK ENTRY PERMIT

Nyika National Park has an entry fee payable per person per day spent inside the park just like all the other parks and reserves in Malawi. However the team was able to get this charge waived given one of the main reasons for building the bridge was for the parks benefit. Permission to enter the National Parks free of charge can only be granted by the Department of National Parks and Wildlife in Lilongwe. The team therefore sought permission by visiting the National Parks headquarters while gathering supplies in Lilongwe at the start of the expedition. Mr Ramosh M. Jiah (Deputy Director of Education & Extension) wrote us an official letter outlining who we were and what we were doing. This letter was sufficient for repeated free entry and exit at the National Park gates and it was also accepted for entry and VIP treatment at the Vwasa nature reserve.

MALAWIAN VISA

British passport holders do not need a visa to enter Malawi however Andras, as a Hungarian national, did need one. He had some difficulty getting a visa from the Malawian governments diplomatic offices in

Below & insert – The local currency. Malawian Kwacha notes and coins.

London, and a lot of persistence on his part was required. On arrival, all members of the party were given a 30 day visa. Those staying longer than 30 days had to get extensions. The process involved one member of our team presenting all our passports to the local government offices in Mzuzu which turned out to be straightforward and free. This can also be done in other major towns in Malawi such as Blantyre and Lilongwe.

ETHIOPIAN VISA

Two members of the team had stopovers in Addis Ababa on their way back to London. The cost of their flight included a night in hotel and a bus journey to and from it. However both as UK citizens required transit visas. These were obtained from the Ethiopian embassy in London prior to expedition. However Ethiopian transit visas are only valid for 30 days after the date of purchase. Thus getting them was a last minute thing so they would still be valid for the return journey.

Fund Raising

EXPEDITION COSTS

The fundraising was split in two parts, the first of which focused on raising money for the expedition while the second concentrated on securing funds to cover the cost of the bridge. Trust funds and charitable organisations were targeted to help meet with the expedition costs and an expedition fact sheet and generic letter were written to them. Information about these organisations together with their contact details were found on the Royal Geographical Society's website. A spreadsheet of application details, including deadline and contact address, was drawn up. This, along with additional research into each grant awarding body, was used to tailor letters to meet each organizations requirement. Applications were written in two main bursts, with all team members working together to complete their allocated tasks. Each application sent included a personal letter, an expedition fact sheet, the expedition proposal, and any official forms. A total of £6500 was raised from three different organisations. Each team member made a personal contribution of £500 towards the expedition which added another £2500 to this to give a total income expedition income of £9000.

CONSTRUCTION COSTS

Malawi is a very poor country and the National Parks, which are run by the government, are no exception. The people in charge of Nyika National Park had initially agreed to provide the materials for the bridge free of charge; however it soon became apparent that the park had no money and therefore could only provide materials which were found naturally in the park i.e. timber. Obviously timber alone was not sufficient especially if the bridge was to be safe from the threat of being burnt by poachers. Thus funds needed to be raised for tools and materials to construct the bridge.

Information about trust funds, charities and companies relevant to the engineering nature of the expedition were primarily gathered from within Imperial College Civil Engineering Department. A project portfolio detailing the expedition was put together and sent out along with a covering letter which had been tailored to address the needs of each organisation. All in all about fifty applications were sent out and where replies were not forthcoming they were followed up by emails and phone calls a few weeks later. A total of £4000 was raised for construction costs, from five different companies and one charitable organisation.

EXPERIENCES

Start fund raising as soon as possible. It is never too early to start applying to trust funds and grant awarding bodies. The deadline for applying to at least one trust fund was missed as they had their deadline at the end of January and our fundraising didn't get underway until mid February. The principal of "if you don't ask, you won't get" was followed. Hence the letters written didn't just ask for financial assistance, they also asked for sponsorship, product discount or technical knowledge as applicable. Only specific types of companies were approached and these were selected based on previous experience. The fundraising was targeted at small to medium UK based companies – very small and they can't afford to help while large companies are looking for more than an expedition such as this one could offer in return. Businesses also prefer to support local initiatives rather than foreign ones. Letters are far better than sending emails as in most instances letters were replied to while emails didn't get through, were blocked or ignored. Our biggest success was getting a consortium of different companies to help with and check over the design of the bridge. Regular meetings were held with engineers from these companies to discuss all aspects of the design and construction process.

Finances

EXPEDITION ACCOUNT

Financial arrangements were made by Imperial College Exploration Board's Honorary Treasurer with Imperial College Finance Division to manage the expedition accounts. In practice, Imperial College acted as the expedition's banker. All income was paid into the expedition bank account held within Imperial College and all expenses claimed back through Imperial College. The expedition's financial position was continuously monitored by Imperial College Exploration Board and all transactions passed before the Board's Honorary Treasurer.

OPERATIONS

Most pre-expedition expenses were paid personally by expedition members, by cheque or card and reclaimed later from our expedition account. Payment for the truck hire was paid by electronic transfer to an English bank account held by Land and Lake Safaris through whom we were

Below & insert – Wellington, the teams driver, looks at the engine to see why the truck won't start after going to collect a load of bricks.

hiring the vehicle. We would have normally been extremely cautious about paying in full such a large sum of money in advance when our only correspondence had been via email. However the company had been highly recommended to us by organisers of other UK expeditions in Malawi who had used them in the past and continued to do so. This together with the fact the money wasn't being paid into a foreign bank account eased any reservations we may have had.

Payment for the transportation and delivery of steel cables from the manufacturers in Italy to Lilongwe in Malawi was made by electronic transfer to a Dutch shipping company. The transfer of money was requested by the expedition team on 19th July 2006 and marked as urgent. However, for whatever reason, the Dutch shipping company say they did not receive the money until 4th August 2006. This meant our goods were not shipped on the 2nd August as planned. This delay together with other factors meant we were not able to complete construction of the bridge.

SUMMARY

Contributions received totalled £13,000; which includes £2500 from the five expedition team members' £500 personal contributions. A total of £7000 came from various different trust funds, with £5K raised internally, i.e. from University grant awarding bodies, and £2K raised from external sources. The remaining £3500 was donated by numerous engineering companies who we contacted with regards to supporting the construction side of the expedition.

Expenditure to date totals £12,976.09. Just under half of this, £6,126.99, was spent on travel with our flights and the hire of the three tonne truck accounting for 85% of this expense. The other 15% of travel expenses was mainly spent on diesel and other costs associated with the running and maintenance of the truck. £3701.94 was spent on construction with the major costs being the purchase of cement, steel and rebar, and the shipment of the steel cables. The amount spent on labour was not that much accounting for just 10% of the total construction costs. Out of the remaining £3147.16, 26% was spent on subsistence, 21% on equipment, 30% on first aid and training and 23% on miscellaneous items *(see appendix E)*. Tensoteci supported us by donating a large amount of what otherwise would have been very costly material. This helped us keep our construction costs down. Also to minimise our expenses we borrowed lots of equipment from our University, namely camping, cooking and communication equipment from recreational clubs within our universities union, site safety equipment from the Geology department and instruments from the Civil Engineering department.

The balance at the 1st January 2007 shows the expedition account was in credit to the tune of £23.91. This will go a little way to cover costs associated with printing, binding and distributing this report as well as to subsidise the travel costs associated with presentations we have lined up in the forthcoming months.

Insurance

POLICY

Each expedition member was insured with AIG Lifeline Plus group personal accident and travel insurance. The policy is fully comprehensive and includes £5 million personal liability and unlimited emergency medical expenses which covers air-ambulance fees and repatriation. It also covers lost personal property, stolen cash up to £1000, travel disruption and costs associated with being hijacked, kidnapped or ransomed. The insurance also entitles holders to travel assistance and benefits while travelling in the form of pre-trip planning advice, concierge services, document protection and security advice though these were not used by the team. The cost of such a policy is not known as Imperial College arranged this insurance for the expedition members free of charge.

EXPERIENCES

No dealings with the insurance provider were experienced. The team were held up by the delay of their luggage and mice damaged some of the teams' personal property however no claims were made as it was unlikely either of these instances were covered by the teams policy and even insurers did agree to pay out then the amount of compensation received would have been relatively insignificant. Thus making a claim was advised against as it was unlikely to be worth while.

Travel

By Daniel Carrivick

FLIGHTS

The expedition team flew with Ethiopian Airlines from Heathrow to Lilongwe, via Addis Ababa International airport where a connecting flight was caught. The flight into Addis Ababa was some forty odd minutes late which did not leave much free time for transferring onto the flight to Lilongwe. It wasn't so tight that we had to rush to catch our connection neither was there time for sitting down and waiting, it was simply a case of getting off one plane and going straight through to the gate to catch our connection. We arrived in Lilongwe on time only to find our baggage, all nine bags, had not made the connection in Addis Ababa. The luggage was reported as missing and the necessary paperwork was filled out. The assistant told us our bags would be put on the next flight which was on Monday and that we should return then to collect them. This was something of a set back as the plan was to leave Lilongwe on Sunday and travel to Mzuzu. As it turned out only six of our nine bags arrived on Monday's flight. After some discussion the team decided that Martin would wait in Lilongwe until Wednesday in case the bags came in on the next flight while the rest of us would proceed to Mzuzu. It was too late to go to Mzuzu on Monday afternoon, after everything was sorted out so our departure was delayed until early on Tuesday. The remaining three bags turned up on Wednesday's flight and on Thursday Martin took a local bus to Mzuzu where he waited until our truck returned a few days later to collect him as well as some supplies.

Above & insert – Martin enjoying the local cuisine. Nsima (maize flour), relish and a bit of chicken.

When preparing for the expedition there was a lot of confusion over our weight allowance with the airlines website saying one thing and our travel agents saying something different. In the end, when we got our tickets our baggage limit was 40kg, which was nice as this was more than the other sources had led us to believe. With such a large weight allowance packing was easy as there was no chance of us going over the weight limit. This meant some foods which could not be bought in Malawi were taken out with us from the UK.

On arrival in Lilongwe the team changed some money at the airport. The exchange rates at the airport were more favourable than in the city so this was worth doing. Our truck had been left at the airport along with Wellington, our driver, who had been hired for the first few days until the team had got used to Lilongwe and driving the truck. The journey from the airport to the city centre took just under half an hour.

TO ULEDI

The expedition hired a 3 ton truck for the whole duration of the expedition, which was paid for by means of an electronic transfer before the team left England. This transport was arranged through Land & Lake Safaris, who are based in Lilongwe. They were recommended to us by Biosearch Expeditions as being very reliable and "on time". A driver had been arranged to show us around for the first three days until we were familiar with both the truck and Lilongwe. However Wellington, our driver, asked if he could continue to drive the truck as without a truck he would be unable to find work so the team employed him on their own terms for the rest of the trip. This worked out quite well as we were a little concerned about what we would do if we had any problems with the truck as our knowledge was limited to say the least. Also Wellington assisted on site and saved us from getting ripped off by local tradesmen by telling us what a good price was, thus he more than earned his wage.

The drive from Lilongwe to Mzuzu along the M1 was on good, fast tarmac roads and took approximately five hours. From Mzuzu the tarmac road continued as far as Rumphi. The M24 was then taken past Bolero and Mwazisi before turning off to the park gate at Thazima. This broad two-lane dirt road was relatively well maintained. It was flat and fast though some parts were rutted giving the effect of a series of violent rumble strips. These caused severe juddering which was only eased by finding a different line on the road or reducing the vehicles speed to a crawl. The road through Nyika National Park was a mountainous single lane dirt track. Its quality varied with some reasonable stretches but there were also some bad sections which required care and skill on the part of the driver. Bog standard cars were seen travelling along this road however they are not suitable as seen by the passengers of these vehicles who were forced to get out and push or walk alongside their vehicle. Once at the Kaperekezi Gate the M9 turned into a two-lane dirt road, which was taken through Nthalire as far as the turn off to Uledi. This was undulating in places and not as good as the M24 but it seemed fast compared to the road in Nyika. The road from the M9 to Uledi was not travelled along that often and the closer you get to Uledi the more potholed and overgrown the road becomes. Park staff were concerned the truck, having a long wheel base and low clearance, would not be able to reach Uledi as the road was very bad. However thanks to some excellent driving by Wellington we were able to get the truck to the village.

GETTING AROUND LILONGWE

While in Lilongwe we used the three tonne truck we had hired to get around the city. Using such a big vehicle did not pose any real problems, not even with parking. Someone had to stay with the truck whenever we stopped to guard the contents in the back of the truck as there was no way of securing them. The roads were often quite busy and in some places it was quicker to walk however with large loads this was not possible most of the time. On occasions we did walk in and around various parts of Lilongwe however care had to be taken to avoid dangerous areas of the city. One such area was the bridge across the river between Area 2 and Area 3 which is a notorious place for muggings to take place. For similar reasons walking around the city after dark is just not done. A taxi was used on one occasion to get round the city and the fee was arranged in advance by our truck driver to ensure we were given a fair price.

Food

ULEDI

The food eaten while staying in Uledi was generally very good. We were not limited by the amount or the weight of the food that could be taken as there was plenty of room in our three tonne truck for whatever food we wanted. We were however limited by the length of time foods kept. Getting fresh supplies was not too much of a problem as these were brought back every time the truck went to Mzuzu to collect building materials. All cooking was done over an open fire rather than on stoves, which gave us much more freedom when it came to cooking things. Breakfast typically alternated between porridge and cornflakes. Lunch often consisted of sandwiches made from sliced bread and filled with things like cheese, mayo, eggs, tuna and tomatoes. When there was no fresh bread or fillings, chapattis were made and eaten with tinned meats and vegetables. The team made there own bread on one or two occasions. The main evening meals were based around staples, typically potatoes, rice or pasta to which vegetables were added. Tomatoes, onions, carrots, aubergine and other local green leaved vegetables were the main fresh vegetables used and when these ran out they were replaced with tins of tomatoes, other tinned vegetables and tinned beans. Meat was not eaten very often. The only fresh meat eaten was one chicken which the team purchased locally. All other meat was tinned. Tuna was often added to pasta sauces given the lack of unprocessed meat, for a bit of variation. Soya mince was also used a few times though some meat eaters preferred to go without rather than use this substitute. Eggs and bananas were purchased on occasions from locals in Uledi. Simple puddings such as blancmange, jelly, whip or custard were regularly eaten after main meals to help with hydration and keep energy levels up. Pizzas and cakes were also made every now and then. They would have eaten them more frequently if they didn't require so much effort to make.

Below & insert – Andras uses the village pump to fill a bucket of water from the communal well.

TRANSPORTATION

Most foods were bought in Lilongwe however a handful of foods, which couldn't be purchased in Malawi, were taken out from the UK. These foods including things like tomato puree, blancmange, instant custard, herbs, spices and powdered sauce mixes. The weight of this food was not that much and so there was no problem taking it out on the plane with us. Similarly we did not have any issues with getting this food through customs and into Malawi. All food was transported from Lilongwe to the site in cardboard boxes in the back of our three tonne truck. The bouncing around, coupled with people sitting and standing on things, took its toll on some foods. A few containers broke as a result, most notably a three litre plastic bottle of hot peri-peri sauce. Other casualties included tomatoes which had often been reduced to a pulp by the time Uledi was reached. Eggs were placed in a box filled with saw dust which was held on the lap and this worked very well though did require a lot of attention.

LOCAL

The bulk of the expedition food was purchased at the beginning of the expedition from Shoprite in Lilongwe. This included tinned foods such as beans, corned beef and tuna, packets of soups and sauces, dried foods like rice and pasta, bottles of oil and sauces, boxed goods like cornflakes and porridge, and raw ingredients such as flour, sugar and milk powder. Large bags of potatoes and onions were also bought and these kept for the duration of the expedition. Most items did not cost any less when buying in bulk so the smallest sized packets were bought for convenience. This meant if one packet split the loss of food was minimised and that measuring out amounts of foods was much easier e.g. estimating 500g of rice is a lot easier from a 1kg bag than from a 10kg bag. Shoprite had a good range of own-brand products which are more expensive than equivalent products in English supermarkets but were on the whole cheaper than other Malawian supermarkets. However the other supermarkets such as the PTC supermarket across the road from Shoprite are worth visiting as they often have special offers which undercut the Shoprite prices. The cheapest prices for western foods worked out at £1.80 for 1kg of porridge oats, £3.80 for 1kg of cornflakes, 96p for 1ltr of oil, 76p for a 150g tin of tuna or a tin of tomatoes, £7.50 for a large sack of onions or potatoes, 60p for 500g of pasta, 33p for 1kg sugar, 73p for 200g of milk powder and 57p for a tin of baked beans. The quality of this food was generally good with the pasta being better and less starchy than in most developing countries, however the tinned meats left a little bit to be desired.

There are also a number of supermarkets in Mzuzu from which most foods can be purchased. None of these supermarkets are as large as Shoprite in Lilongwe or offer the same sort of range. Some of the more obscure foods may not be available in Mzuzu e.g. porridge oats. Fresh fruit and vegetables were often purchased from markets in small towns such as Rumphi and Nthalire. Four tomatoes cost approximately 11p, a large bunch of local vegetable leaves 2p, three small aubergines 13p and four carrots 10p. Bananas were often bought from the roadside at the Kaperekezi Gate for about 2p each and sugar cane was also widely available from the side of the road. Eggs were purchased both locally from inhabitants in Uledi as well as from shops and cost about 5p each. A chicken was also bought from a local for just under £2. This was slaughtered, cooked and eaten.

WATER

Bottled water was used for drinking while in town and on route to and from Uledi. One litre bottles of water cost 70 Kwacha (MWK), equivalent to 27p each depending on where they were bought. Bottled water was readily available both in Lilongwe and Mzuzu as well as in other towns throughout Malawi such as Rumphi and Nikhata Bay. Water for cooking with was obtained from local taps and boiled when stopping off overnight between Mzuzu and Uledi e.g. at Chelinda and Vwasa marsh.

The North Rukuru River was the main source of water at Uledi. Despite the size of the river, the quality of the water was good because the river came down off the Nyika plateau and there were virtually no settlements upstream. Some team members drank straight from the river without treating the water, while others took the precautions of either using iodine drops or boiling the water first. A well situated in Uledi near the school also provided clean water. This was not used regularly as a source of water because the river water was much closer and therefore collecting water from the river was more convenient. Water was collected in plastic buckets which had lids to keep the dust, amongst other things, out.

EATING OUT

While in Lilongwe the team either ate out at restaurants or got takeaways close to where they were staying. The choice of places to eat out at was not that great with the dishes offered by most places being orientated around fast-foods. Shoprite, the biggest supermarket in Lilongwe (Area 4), had an in store takeaway counter which sold hot meals ready to eat. The beef stews were of high quality and very meaty by Malawian standards. They were priced by their weight which made eating these takeaways a little more expensive than eating elsewhere. A separate fast food place situated next to the entrance of Shoprite was the Malawian equivalent of KFC. The food was reasonable in price and quality though queues were often long as it was popular with locals. Nandos was situated adjacent to Shoprite and served the traditional peri-peri chicken and chips that the restaurant chain is famous for all over the world. Chicken portions were small and not as meaty as in the UK, as was typical of chicken portions throughout Malawi. Other places eaten at included a fast food place adjacent to a seven-eleven supermarket which was situated next to a garage on the Kamuzu Procession Rd about 1km NW of Shoprite on the outskirts of Lilongwe. The meals were cheap, portion sizes good and the quality of meat was good, however the best thing was their speed of service. Midway between Seven-eleven and Shoprite on the SW side of the Kamuzu Procession Rd was Chick 'O' Rellos which served reasonable burgers and chicken pieces at typical prices.

Complete meals with drinks typically cost around £1.50 per person. Fast food places used frequently by locals were the cheapest with meals working out at about £1.20 per person while dishes at more upmarket restaurants, such as Nandos cost approximately £1.80 per person. The cleanliness of the restaurants visited was reasonable and there were no problems with poorly cleaned cutlery and crockery being used.

Above & insert – Naomi and Andras pour concrete to make sand compacters, outside the National Park buildings in which the team stayed while in Uledi.

In Mzuzu, the team ate at the Mzoozoozoo hostel where they also stayed. The bar menu was not that extensive but the variety offered would meet most western people's needs and included decent dishes not found elsewhere such as steak, meatballs, omelette and sausages. Portions were large and the quality was excellent. There was sometimes a bit of a wait for food if other people had also ordered but there was something reassuring about knowing that your food was being cooked freshly for you. The most expensive meal was a mixed grill which cost £2.50 with the cheapest meals costing half this amount.

The team sampled the local traditional cuisine at Lucy's Restaurant in Nthalire. The meal, which is typically eaten with your hands, consisted of a lot of nsima, a bit of relish and a small piece of chicken with not much meat on it. Nsima is the local staple of boiled maize flour while the relish consisted of boiled vegetable leaves and some tomatoes. Everyone found the nsima very filling and not everyone could finish it as it was a bit bland on its own. Although the dish wasn't that amazing it has to be sampled at least once as it makes you appreciate your other expedition food more and at 50p per person it is dirt cheap too.

Accommodation

ULEDI

While in Uledi and on site, the team stayed in one of the empty National Park buildings. The National Park had three buildings in Uledi all set around a central dirt courtyard. Each building was split into two separate apartments, each with three rooms. The National Park scouts permanently stationed in Uledi lived in the building opposite our across the court yard. The buildings were made of bricks with corrugated roofs and concrete floors on which people slept. Some of the doors and windows were broken or missing altogether. The sleeping bags and mats taken did not do much to soften against the hard floor which was fairly uncomfortable. Two rooms were used for sleeping in, another for keeping our food and personal supplies in and a fourth for construction tools and materials. Mice lived in some of the rooms and despite our best efforts they succeeded in eating some food and equipment. Mice ate their way through a rucksack and a first aid kit (which was in the rucksack) to get at some sugar-coated Ibuprofen. The mice also went for our araldite which left a sticky mess everywhere. Birds got in under the roof and flew around some rooms. Two toilet sheds were permanently situated at the back of one of the buildings and these contained concrete floored long drops which the team used. Cooking was done over an open fire in the courtyard and wood for this was collected from the surrounding area, usually with the help of locals due to the dangers of going into the bush alone. The team would have happily camped on site and was able to do so however despite perhaps being more comfortable, camping would have been less practical and less secure.

TOWNS & CITIES

In Lilongwe the team stayed at the Korea Garden Lodge which has three main types of rooms that suit most peoples needs; bronze, silver and gold. The bronze rooms, which the team stayed in, were pretty basic but still had the luxury of mosquito nets and fans. The toilets and showers were shared amongst all those staying in the bronze rooms and were of reasonable standard. Perhaps the best thing about staying there was that you got to use the same facilities as those in the silver and gold rooms. These facilities included a restaurant, bar, internet and a pool which unfortunately was being cleaned when we were there. Bronze rooms were the cheapest rooms available and cost the equivalent of £10.45 per night for one person. All five of us were able to fit into two rooms for which the total came to £31.50 per night. These prices included a buffet-style breakfast which was nice at first but after a few days became nothing special.

When there were no bronze rooms available at the Korea Garden Lodge the team stayed at the Crescent Guest House, just up the road from the Lodge. Large spacious en-suite bedrooms in self-catering apartments were the standard and seemed fairly grand and luxurious compared to the bronze rooms at the Korea Garden Lodge. The kitchen was well equipped and the lounge was comfortable with a working TV. Prices were negotiable. Rooms for the five of us in an apartment to ourselves ended up costing £34.40 for the night. Both the Korea Garden Lodge and the Crescent Guest House had enclosed court yards where vehicles could be left safely.

In Mzuzu the team stayed in a small friendly hostel called Mzoozoozoo. The accommodation was in wooden bunkhouses and all beds had mosquito nets. The facilities were a bit primitive but they were adequate for what we wanted and at less than £2 per person per night for a bed who could argue. Camping is also permitted within the grounds of Mzoozoozoo and costs just under £1 per person per night. The hostel is within walking distance of the town centre and has an enclosed yard where it is safe to park vehicles and leave tents. The food is good and cheap, and the bar on-site is a hub for the local ex-pat community, as well as a good place to meet other travelers.

CAMPING

The team camped once at Chelinda when travelling between Mzuzu and Uledi, at Vwasa marsh while visiting the nature reserve and at Nkhata Bay when spending time at Lake Malawi. Camp was set up on the green outside the main park office buildings at Chelinda, with the parks permission. An outside tap provided water and there were toilets round the back of one of the buildings which were used. Getting up in the morning was a chilly experience as overnight the temperature drops significantly up on the plateau. Our driver slept inside one of the buildings next to a log fire to keep warm for he only had blankets as opposed to sleeping bags like the rest of us.

Similar arrangements were made for us at Vwasa where camp was also set up on the square in front of the ranger base. A long drop inside a shed was used behind the main building. Cooking was done on the opposite side of the track to where the tents were so as to not attract animals to the camp site. We were assured that although the elephants often walked down the track next to the building they never came onto the square in front of the building where we had pitched our tent. Confidence was not inspired when we heard the news that only the previous week one of the Park Rangers had been seriously injured by an elephant. That night, true to form, the elephants stomped down the track. We

Below & insert – Loading up the truck full of supplies for the five week expedition.

were ordered not to move and to remain silent as the elephants passed a little too close for comfort with just the thin skin of our tent separating us from them. The next morning the Park Ranger who had been watching from the relative safety of the building admitted the elephants had come much closer to the tent than he had imagined.

At Nkhata Bay the team camped at Butterfly Lodge. The site was picturesque and idyllic, set under the trees on the rocky shoreline of the lake. The cost for five persons (two tents) worked out to be £5.75 per night. Wooden huts on stilts were also available to rent for twice the price. Facilities were as you would expect with proper toilets and wash rooms. The lodge had some canoes which were essentially hollowed out logs that residents could try and paddle if they wanted to, when they were not being used for business. The team ate at the neighbouring Mayoka Village and also cooked on the beach using a camp stove (which had been taken on the expedition in case of emergencies).

Communications

PRE EXPEDITION

While planning the expedition most of our communication with various foreign people and organisations was carried out via email. This included communication with the Nyika National Park staff, Land & Lake Safaris who organised our truck hire, the Italian firm who supplied the cables and a Dutch freight company who shipped our cables to Malawi. Using email to communicate with the European firms proved a very fast and efficient way of communicating when doing business. However communications with the freight company were not so quick and easy when problems arose with the shipment being delayed.

Land & Lake Safaris are a travel company based in Lilongwe run by an English man who does things according to an English rather than a Malawian timescale. Thus they were very quick to respond to our initial requests however as the quotes were finalised and tailored to meet our needs so replies took longer to get back to us. This was because Land & Lake Safaris had to wait for third parties to provide the relevant information, and being Malawian, these third parties operated in their own laid back way. Communicating with the Nyika National Park staff on the other hand was a bit more of a slow and laborious process. This was probably due to a combination of factors including the nature of their work taking them away from their office for several days at a time, their poor computing facilities coupled with a little bit of doing things the Malawian way. However given time they did reply to most emails so it was just a case of us having to be patient and wait for answers to our questions.

CONTACTING HOME

The team used email to communicate with people back home during the expedition. There are a number of internet places in Mzuzu and these were utilised every time someone went to pick up supplies from the town. The connection speed was faster in some places than others so it is worth trying a number of different cafes to find the best one. The internet provided an inexpensive means of communication which worked out at approx £3.00 per hour. In Lilongwe we took advantage of the free internet access which was available to people staying at the Korea Garden Lodge. The Lodge had one computer with internet access which could be pre-booked by residents. Being able to access emails proved invaluable, as we were able to easily and cheaply keep in contact with our cable suppliers in Italy and the shipping firm in Amsterdam to check everything was going according to plan and to sort out any last minute problems.

TWO-WAY RADIOS

Two-way radios – the cheap sort, available from most outdoor shops, with 3-5km limited range - were used while on site to aid communication. Sometimes the two-way radios were used to communicate between people supervising different activities, which were out of sight from each other such as construction of the towers and collecting boulders from downstream. However most of the time the radios were used to communicate between the two different sides of the river, which saved an awful lot of traipsing backwards and forwards across the river. Shouting was possible but it wasn't very convenient and it did disrupt the workers. The radios were kept switched off until they were being used to save battery life. This meant before a person talked to someone they had to shout across the river to get someone to switch on the two-way radios. Each radio was taken out to Malawi with fully charged one-cell battery together replacement AA batteries. However the AA batteries were not required as the original battery lasted for the duration of the expedition. A small portable solar charger was also taken so the teams AA batteries could be recharged on site.

FROM ULEDI

The National Park post in Uledi had a solar-powered radio with which they could contact the camp at Chelinda. However the radio only worked every so often as communication links were not maintained on a regular basis. Various parts of the radio were used for other things so all the pieces had to be assembled correctly before any attempt could be made to communicate with Chelinda. Similarly the battery had to be fully charged by the solar panel, which took some time. It was therefore impossible to communicate with Chelinda on an ad hoc basis. Prior planning and repeated attempts were often required which could take as long as a day or two before successful communication was made. From Chelinda, National Park staff could contact the Nyika Park headquarters at Thazima and the National Park headquarters in Lilongwe with much more ease as these all had radios permanently set-up for operation.

Below & insert – Looking out through the broken windscreen of the truck, caused when a man ran out in front of the vehicle.

Clothing & Equipment

Below is general information regarding clothing and equipment. For a complete list with more specific comments see appendix A, B & C.

CLOTHING

Each person on the team took two complete changes of clothes along with some extra items for comfort. One set of clothes was worn on site. Typically this was a pair of trekking trousers and a T-shirt, together with a fleece for the chilly mornings and late evenings. These clothes were old and beginning to fall apart before the expedition began so it really didn't matter how dirty or destroyed they became. When it came to leave Uledi one team members shoes, who had been stitched up once before, were completely worn out with large holes down each side. They had no more use as far as the team member was concerned however a local had other ideas and asked if he could have them saying he would be able to mend them. The local wasn't even concerned as to whether they fitted or not, for him this was a dream come true as any shoes were better than no shoes. A good sunhat was essential as one side of the river had no shade.

The second set of clothes was used when travelling and in the towns and cities. These consisted of trekking trousers a long-sleeved shirt or t-shirt and a wind-proof jacket. The clothes taken were obviously in a better state of repair when they were taken, however new clothes were not taken where possible as these too would took a little bit of a beating with all the dust, wear and tear.

FOOTWEAR

Most of the team members wore old approach shoes on site as they already owned these from their other recreational activities. These were fine for getting around in and the protection offered by ankle boots or steel toe-caps was not really needed. They were also more comfortable and breathable than most workman type boots. Some of the team chose to take their shoes off every time they crossed the river to keep them dry while others kept them on when wading across. Taking them off had the advantage of having dry feet but the inconvenience of having to stop, take them off, cross the river, dry your feet, get the sand off and then put socks and shoes back on. While the main draw back from leaving them on, apart from getting wet feet, was sand often got in causing rubbing. One team member took and used sandals however this is not advisable due to presence of snake, scorpions and other dangerous creatures.

TENTS

The team used Wild Country Sirocco tents which had the benefit of being light enough for us to be able to take one tent between two people but were large enough to sleep three people if need be. This sort of flexibility came into its own when the team was not all together in the same place at the same time. The tents also had wide entrances and porches which completely unzipped. This enabled air to circulate more freely through the tent keeping it cool in the sun. Before leaving the UK the mesh doors were all treated with an insect repellent though what effect this had is not clear. No demanding conditions were experienced, not even strong winds, and no problems were encountered with the tents taken.

Risks

Expedition members faced a range of potential hazards primarily associated with the remoteness of the working environment along with the general nature of the construction activities undertaken. Specific hazards, their consequences and how they were managed is detailed in appendix F. The risks associated with the hazards encountered, for example construction methods and the heat and intensity of the sun etc. were minimised by planning thoroughly and preparing fully for these eventualities. During the expedition risks were continually assessed and monitored, for if one team member was injured and required evacuation, this could jeopardise the whole expedition for everyone else involved. This daily assessment was particularly true for the risks associated with construction activities as these often changed or evolved with time. An example of this was when workers stood still in a chain and passed bricks from one person to the next. After doing this for a bit some workers spaced themselves further apart and started throwing the bricks from one person to the next so they could move the bricks further in one go. This didn't work well with lots of bricks being dropped or broken and their being a very high risk of someone getting injured. Thus the workers were made to go back to passing the bricks from hand to hand by standing within arms reach of the person next to them.

ROADS

One of the biggest dangers in Malawi is travelling by road. Travelling at night in the dark is just not done because it is too dangerous. Tobacco trucks are regularly overloaded and often topple over as a result. Overturned trucks were regularly seen on the side of the road; indeed it was not uncommon to pass several on one journey. In one town a lorry had toppled over causing several other lorries to fall over like a stack of dominoes. Branches are often laid sticking out on the road to warn of dangers ahead such as a broken down vehicle.

Unfortunately the truck hired by the expedition was involved in an accident while the team were travelling to Nyika National Park at the start of the expedition. The team had left Mzuzu shortly after lunch and were travelling through Ekwendeni when a drunk man ran out in front of our truck. Our driver, Wellington, instinctively braked and swerved to try and avoid the man but it was too late. Indeed Wellington did well to keep control of the truck and bring it safely to a stop. People from the market immediately started to gather round and a few tended to the injured man who lay motionless in the middle of the road. Everyone seemed to stop and stand still for a moment. Then there was a sense of urgency and people started shouting. The casualty was picked up and laid in the back of the truck. Lots of other people jumped in too. They told Wellington to drive to the hospital which was less than

Above & insert – Dans fingers show the combined effect of handling bricks and concreting.

500m away on the edge of town. There, the man who was bleeding from his head, went straight in to see a doctor. After some time the news was given that they had stopped the bleeding and the man was going to be taken to Mzuzu hospital in the ambulance as they could do no more for him in Ekwendeni. Wellington then went to the Police station to report the accident. The locals said Wellington wasn't to blame and thanked him for staying and helping out (many drivers driver off after hitting a pedestrian in Malawi). They also said the man was being chased at the time of the accident, and was thought to have been drinking heavily. The Police took a statement from Wellington and looked at the damage to the truck; the windscreen had shattered and the front bumper and panelling was dented. Fortunately an off-duty policeman had seen the accident and was able to verify the version of events. Wellington then drove the police to Mzuzu hospital as they didn't have a vehicle of their own. There they saw the nature of the injuries sustained by the casualty. Wellington had to report back to the Police station the following morning so the team returned to Mzuzu where the night was spent. The following morning brought the sad news that the injured man had died overnight. The police went back to the scene of the accident and after much deliberation said Wellington was free to go. However the Police asked for help on behalf of the locals who had been caring for the deceased because the man had no money and no family in the area. The morning was spent buying a coffin, picking up the body from the hospital mortuary and taking it to the graveyard. Then the truck went back to Mzuzu to be tested to check that it was road safe. These tests involved a series of emergency stops and after about three of these the truck was given the all clear. The team then continued on to Nyika National Park.

WILDLIFE

The two main hazards in Uledi from wildlife were scorpions and snakes. The most common place to see scorpions was close to the campfire. They hid under the rocks around the fire enjoying the warmth. Care was therefore required when moving these rocks and also when lighting the fire as the warmth often drove the scorpions out from under the rocks. The snakes ranged from pink and half a metre in length to greyish blue and over 3m in length. To the locals, all snakes were poisonous. One day Andras was in the bottom of a 3m deep pit, concreting one of the anchors when there was a lot of commotion from his fellow workers, who had all deserted him. He decided he should clamber out and see what all the noise was about. As he did, a large snake flew in to the pit and started thrashing around aggressively. There was no way the snake could get out and it wouldn't do the anchor any good if it stayed there, so the locals beat it to death with long sticks and even then they didn't want to get too close. A small snake was found by a worker when clearing a path up a small overgrown tributary and killed at first site with a hoe. Naomi came across another large snake in the grass next to the path late one evening when returning from the site. After a long tense standoff the snake backed off and Naomi was able to continue.

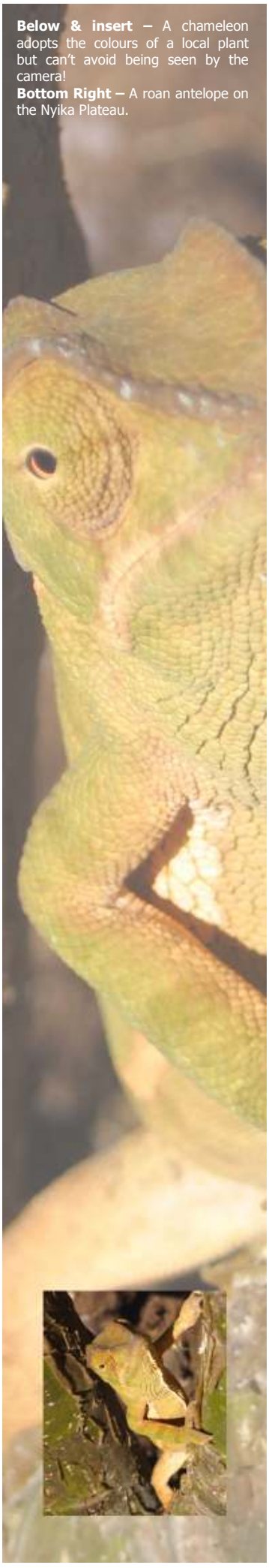
Medical Issues

A large amount of first aid supplies were taken out to Malawi. These included antibiotics, creams, ointments, dressings, instruments, painkillers and other remedies. The supplies were arranged into two first aid kits; one big one that contained everything and remained on site in Uledi and a second smaller first aid kit which stayed in the truck and contained more specific things, for use when travelling backwards and forwards between Uledi and Mzuzu to collect supplies. As well as these group fist aid kits, each person carried their own small personal first aid kit with day-to-day supplies in it. For a complete list of first aid supplies taken see appendix C.

Should the evacuation of a casualty have been necessary then we could have used the radio at Uledi to contact Chelinda and arrange for some sort of help. This was fine in theory but in practice it often took some time to get through because the radio had to be assembled, the battery charged, and someone on the radio at the other end. The nearest telephone was in Nthalile which took a couple of hours to reach in the truck from Uledi. Given the remoteness of Uledi, any evacuation carried out ourselves would probably be better than waiting for help to come. Any injured person would have had to have been transported by road to Chelinda, a five hour drive away over very bad roads, from where they could be flown to medical facilities in either Mzuzu or Lilongwe. The alternative would be to drive all the way to the hospital at Mzuzu from Uledi which would take about ten hours.

Most of the team were already immunised against hepatitis A and B, typhoid, diphtheria, tetanus and polio, though those that required boosters or new vaccinations had them. Team members also received immunisations against rabies as the risk was believed to be significant. All team members used Doxycycline anti-malarial tablets which were taken as prescribed for one week prior to the expedition, during the expedition and for four weeks after the expedition. No serious side effects were experienced although one team member was ill on a few occasions when the tablet was not washed down with plenty of water. There was concern that team members may suffer from photosensitive skin rashes. As a result, suitable clothing was taken so most parts of the body could be covered-up and protected as necessary. These measures did not need to be implemented as no one developed any photosensitive skin rashes.

No medical emergencies were experienced involving team members or people associated with the expedition. The majority of team members did feel under the weather at one time or another, to such a degree where it impacted on the work they could do. Upset stomachs the most common cause of feeling unwell and one person suffered from loose bowel movements. These are thought to have been caused by poor personal hygiene as opposed to in-proper cooking as everyone ate the same food and not everyone was ill at the same time. These illnesses were generally left to sort themselves out under their own devices, with no medicines or drugs given, just plenty of rest. A fair number of the workers employed were treated for minor cuts and grazes mainly to hands and feet. These were predominantly sustained by handling materials such as bricks. Most of these injuries were superficial – the sorts of scrapes that back home you wouldn't think of cleaning or putting a plaster on. Nevertheless they were all cleaned and covered. A few cuts were deeper and in awkward positions such as under the toes. These wounds were redressed every



Below & insert – A chameleon adopts the colours of a local plant but can't avoid being seen by the camera!
Bottom Right – A roan antelope on the Nyika Plateau.

day as necessary. The tips of the fingers of one of the team members were rubbed raw by handling a lot of the bricks which were very rough. The raw skin was burnt away by the cement when laying concrete which reduced the finger tips to bloodied sores. Although painful, these healed quickly and nicely after thorough cleaning though they did limit the use of the affected hand.

The workers soon latched onto the idea that they could have time off work by getting their cuts and grazes seen to. This wasn't particularly helpful as it took key team members off site which meant the rest of the work force could not be effectively supervised. We decided if workers continued to come with small insignificant wounds we would have to restrict treatment times to before or after work, or during lunchtime unless it was a medical emergency. Similarly when other workers cottoned onto the idea that we had medical supplies they wanted whatever they could get. One day ten guys had been mixing concrete all day for one of the anchors and at the end they all came to us for pain killers due to the hard nature of their work. We were very suspicious of their needs and wary of setting precedent. In the end we reluctantly gave each person an Ibuprofen tablet and made it clear that this was to be a one off occurrence.

First aid was always administered on site. Our first aid supplies were kept out of sight of everyone except team members, even those being treated, to reduce the risk of causing unwanted problems. Drugs, dressings and other treatments were never given to people to take off site as then there is the potential for these to be misused or stockpiled and used for alternative purposes. People given pills had to take them there and then in front of us.

There was some concern over workers using the team's drinking cups. This caused some of the teams vessels to be 'donated' for use only on sight by the workers. Possible oral infections among the local population mean that sharing drinking vessels is not recommended. On future expeditions the use of colour coded cups is recommended, with one set of coloured mugs for team members to use (to be kept indoors unless used for cooking), another coloured mug or mugs for the workers on site and a third large mug or jug for pouring water into cement or concrete mixes.

Environmental Impact

One of this expedition's main priorities was to minimise, as much as possible, its environmental impact. This included both the impact of the team and the bridge on the environment. Environmental impacts were assessed prior to the expedition and standard operating procedures implemented to minimise the teams' environmental impact. These were continuously monitored throughout the expedition and where necessary refinements made. We worked sympathetically with the local workers on site by encouraging them to avoid damaging their environment. This ranged from making sure pollutants didn't enter the river to ensuring the size of the site cleared was kept to a minimum and trees were not cut down unnecessarily.

The British Mountaineering Council's (BMC's) guidelines on waste management were followed throughout the expedition. All rubbish was burned on a day-by-day basis on the camp fire. The National Park camp at Uledi had a 1.5m deep pit for other rubbish which would eventually be buried along with two deep toilet pits which had a concrete floor over them and small straw huts over them. The waste pits were set back, high up a river cliff some fifteen odd metres above the river bed, so they were situated well above the nearest flowing water. All non-burnable food packaging was placed in the rubbish pit. The locals often asked for some of these items, as they were able to find a use for them. Such items included things you might expect such as tins and jars, which they don't have because they can't afford those sorts of foods, along with some more obscure things like cement bags. Some waste was also taken back to Mzuzu and Lilongwe, and disposed of there. Toxic waste was minimised by using rechargeable batteries as much as possible and where normal batteries were used, these were brought home to England for proper disposal. At the end of the expedition, the sites on both sides of the river were thoroughly cleared of all rubbish. Such operating procedures minimised any potential visual, chemical and/or physical impacts. No equipment or non food items were dumped at any time during the expedition.

Above & insert – The decking units are cleared from the site and put into storage.
Right – Taking the coffin to the hospital mortuary.

Photography

DIGITAL CAMERAS

All team members took their own digital cameras on the expedition for taking photographs. Martin took just under two hundred photos, each 2304x1728 pixels, using a Pentax Optio S5z camera. Meanwhile Naomi used a Pentax Optio S50 with 5.0 effective megapixels, 3 x optical zoom giving a range of 5.8-17.4mm. A large 1GB memory card meant high resolution photos were taken giving superfinely compressed images with dimensions of 2560x1920 pixels. The Optio S50 used two AA batteries at a time making it light and quite compact. This camera can take video clips, the length of which is limited only by memory space. Some 450 photos and a few video clips were taken using this camera.

Rafael took a Canon Powershot S400 camera with 4.0 effective megapixels, 3 x optical zoom giving a range of 7.4-22.2mm. As well as photos the camera can also take video clips up to three minutes long. The camera is powered by a rechargeable lithium-ion battery which lasted a long time but it couldn't be recharged on site or replaced with rechargeable AA batteries. Because of this, the Powershot S400 is not recommended for expedition use, however if like Rafael it is all you have then it is of course better than nothing.

Dan and Andras both used a Canon PowerShot A85 digital camera with four memory cards between them; three 1GB and a 512MB one. The camera takes four AA batteries at a time which makes it quite large and heavy. Picture quality was reasonable with 4.0 effective mega pixels, 3 x optical zoom and a large screen. The camera was fully automatic, very easy to operate and took up to 3 minute long movie clips. Photos were taken on a high resolution setting giving finely compressed images with dimensions of 2272x1704 pixels. Short movie clips up to 30 seconds long were also taken as well as photos. The highest resolution setting of 640x480 pixels was used which recorded at ten frames per second. The memory cards were filled but after final editing there was some room left on them by the time they were brought back home. Dan brought back over 700 photos and 230 video clips while Andras brought back a further 320 photos and 20 odd movies.

Digital cameras have numerous benefits in that they remove the need to fiddle around changing films in adverse conditions and unwanted photos can instantly be deleted making room for more better photos as and when they are taken. However most digital cameras eat batteries and the Canon PowerShot A85 was no exception. Due to this rechargeable Ni-MH 2300-2500mAh rapid charge compatible AA batteries were taken for use in most cameras. At least two sets of rechargeable batteries were taken for each camera along with a rapid charger, plug and adapter. The batteries were kept charged up while in Lilongwe and on our way to Uledi, with recharging possible whenever staying in Mzuzu. Attempts to recharge the batteries from the truck using the cigarette adapter while travelling did not work very well as the roads were too bumpy – all the dust and bumping around actually broke the charger. Fortunately the team also took a small portable solar panel which recharged AA batteries only. The device took about a day (10-12hrs) to fully charge four AA batteries. This solar panel was used to charge batteries while on site. This was convenient as the charger could be put out in the sun at the start of the day and left to recharge while that days work was being undertaken although an eye had to be kept on the solar panel to ensure no one walked off with it. However in the towns and cities the solar charger was less convenient as there was nowhere safe to leave it out unattended. Having replacement sets of batteries as well meant the camera could always be used and batteries could be recharged at leisure rather than having to do them immediately. The cameras consumption of batteries was reduced by ensuring both the flash and the LCD screen was switched off at all times unless needed. Viewing of photos was primarily reserved for when the batteries could be easily recharged i.e. where there was an electricity supply. Cameras were kept handy at most times, especially while on site when they were kept in pockets or bags which meant all those unexpected and interesting moments were captured in print. Everything worked well and there is nothing extra we would have taken. Given our experiences, we advise against the use of battery chargers with travel adapters while travelling along dirt roads and this method of recharging batteries should not be relied upon.

PURPOSE

Most of the photos taken are for private use by the photographer and for future personal memories. As well as being used here in the report, some of the construction photos have been used by companies and organisations in some of the literature that they produce e.g. Engineers Without Borders UK used a photo from the expedition as the front cover for their Annual Review 05-06 booklet. Photos of workers and other local inhabitants have been printed out and laminated so they can be given to individuals when the team returns to complete the bridge. A selection of the photos have been put together to form a slide show and this formed the basis of the teams post expedition presentations. The movie clips were made into a nine minute video showing different phases of the construction process to date which was also shown during some presentations. Use of any image from this expedition requires prior permission from the photographer. Please direct all enquiries to the editor (see inside cover page for contact information).

CONCLUSION

Written by Daniel Carrivick

1. The Imperial College 2006 Building Bridges expedition made significant advances towards its aims by returning home safely having;

a. Met with local chiefs and National Park staff to clearly identify the need for a bridge.
b. Carried out investigations on different sites and determined the best site for the bridge.
c. Totally re-designed the bridge following new information obtained from the site investigations.
d. Cleared the chosen site from thick vegetation and prepared it so excavations could begin.
e. Collected vast amounts of sand, gravel and rocks from the local area around the site.
f. Constructed both towers and anchor blocks.
g. Cleared and made the site safe ready for the cables to be installed at a later date.
h. Enjoyed the hard work and the experience which has broadened the teams engineering and expedition skills.

2. All the team members worked hard together using knowledge they had gained from previous expeditions to help make this expedition a success. When unforeseen circumstances arose members worked well together to see that they were resolved as quickly and safely as possible. All team members wanted to get their hands dirty and get involved with the construction. This was good for the workers moral as they saw members of the team doing the same things they were being asked to do. However in the interest of efficiency it was often necessary to take a step back and actually adopt more of a management role. This was due to the fact there was a large work force and only a small number of team members on site at any one time.

3. The achievements of this expedition were limited by the delivery of the teams' cables being delayed. These cables were being shipped from Europe to Lilongwe. The cables didn't make it on to the originally intended flight because there was a delay in shipping company receiving our payment. This payment was made by electronic transfer and statements show the money left our account as arranged however for whatever reason our shipping company did not receive the money until some two weeks later. Then when the cables were put on a flight they were only taken off again to make room for an urgent consignment ordered by the Malawian government. Both delays were beyond the teams' control. The cable finally arrived in Lilongwe as the team flew back to England having tried but been unable to change there flight due to no availability and long waiting lists.

4. Despite being unable to complete the bridge, the locals were very pleased the team had done what they had. The expedition employed a large number of very poor people which otherwise would not have been able to find work. This they were very grateful for. The expedition also helped build bridges between the National Park and the Uledi community who were able to lay down their differences and come to a common agreement over the use of the bridge.

Above & insert – Local children insisted on lending a hand by copying what the workers did.
Right upper – Andras and Naomi eating lunch in the shade.
Right lower – The market in Mzuzu.

ACKNOWLEDGEMENTS

Compiled and written by Naomi Bessey & Daniel Carrivick

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INDIVIDUALS – John Anderson, Anthony (from Expedition Engineeering), Philip Carrivick, Steven Carrivick, Wellington Chimtengo (our truck driver), David Chinn, Quincy Connell, Lorraine Craig, David Dalgado, Sergio Dale, Mark Daniels, Andrew Dorward, Felix (a scout stationed at Uledi), Harry Foot, William Z. C. Gondwe, Christopher Green, Jason Hoadley, Gillian Hoyle, Kien Hoang, Ruth Hopgood, Tom Hull, Ramosh M. Jiah (Deputy Director Ministry of Information & Tourism), Susan Johnson, Rod Rhys Jones, Harriet Kirk, Mike Labuschagne, Davood Liaghat, Robert Lloyd, Stuart P. Lungu, Zedi M Nyirenda, Phineas C. Mbota (Assistant Director Ministry of Information & Tourism), Ed McCann, McDonald, Clever Mfune, Lackson Mhango, Tommy Mhango, Sarah Morgan, Leonard Moyo, Ciaran McKeown, Dr. Washington Y Ochieng, Ole (from the Nyika-Vwasa Trust), Peter Overton, Marianne Overton, Dr Mautz E Rainer, Nararya Sastrawinata, Bob Schroter, Jane Simpson, Sophie Smith, Dr Jamie R Standing, Dr Niel Tsang, Nigel Wheatley, Catherine Wilson, Shane Winser, Alastair Muir Wood, Peter Wong, Marie-Odile Zanders, Chiara Zatti.

BRIDGE BUILDERS – Kachindewe Badda, Chenjelani Chilenga, Herrings Chilenga, Patikani Chilenga, Rombani Chilenga, Tyford Chilenga, Nkhuchucha Chilenga, Zakzazka Chilenga, Kesings Kandawa, Hyson Kaonga, Kenford Kaonga, Khwimani Kaonga, Macreen Kaonga, Mavuto Kaonga, Ntchachi Kaonga, Owms Kaonga, Sangwani Kaonga, Tawonga Kaonga, Werani Kaonga, Yato Kaonga, David Mhango, Bonface Mshali, Goodwell Mshali, Kondwani Mshali, Freedom Msongole, Ganizani Msongole, Moses Msongole, Partson Msukwa, Stephan Sichinga, George Sifukwe and all the other workers who were employed and volunteers who helped.

COMPANIES & ORGANISATIONS - BCH Camping, Biosearch Expeditions, Black & Veach, British Mountaineering Council, Buro Happold, Cargo Services Ltd. (Lilongwe Airport), Cotswold Outdoor, Dale Silvio S.R.L., Engineering Without Borders, Ethiopian Airlines, Expedition Advisory Centre, Expedition Engineering, Felix – Imperial College Student Newspaper, Field & Trek, Gordon Foundation, Halcrow, The Happold Trust, ICON Direct, Imperial College Civil & Environmental Engineering Department, Imperial College Exploration Board, Imperial College Finance Division, Imperial College Health Centre, Imperial College Insurance Division, Imperial College Occupational Health Centre, Imperial College Union, Imperial College Union Exploration Society, Imperial College Union Outdoor Club, Interserve, Land & Lake Safaris, LifeVenture, MacAlloy, Malawian Government – Department of National Parks & Wildlife – Ministry of Information & Tourism, Mouchel Parkman, Nyika-Vwasa Trust, Rohan, Royal Geographical Society, Royal School of Mines, SDV Airfreight, Stanfords, Tensoteci, Trailfinders, University of London Convocation Trust, My Visa Advisor, WhitbyBird.

A special mention must go to Imperial College and in particular the Imperial College Exploration Committee for without their support this expedition would never have got off the ground. Firstly we thank the University for having procedures and a recognised body in place to facilitate its students to fulfil their expedition ambitions and dreams. Secondly we thank that body, Imperial College Exploration Committee, for their time, backing, generous financial assistance, dedication, guidance and belief in this expedition.

Finally, we also thank our friends, family and relatives for their understanding and positive encouragement throughout.

Above & insert – Laying rocks for the base of one of the towers.
Right – A team of brick layers finishing off for the day.

Below & insert – Andras using duct tape to seal up the pipe in the cage before the pit is filled with concrete.

APPENDICES

APPENDIX A - Equipment List

By Daniel Carrivick

List of equipment taken to Malawi along with some notes about their usefulness based on our experiences. Quantity of each item is shown in brackets where more than 1.

CAMPING EQUIPMENT

Karrimat / Z-rest (5) – One per person. Z-rests good for keeping moisture away from sleeping bags.
Pole Sleeves (2) – For mending tent pole breakages in the field. Not used.
Rucksack / Duffel Bag (5) – For personal things. Large ones used. Ranged from 60-80Ltr in size.
Sleeping Bag (5) - Used old, heavy and cheap synthetic bags.
Sleeping Bag Liner (5) – Good for keeping sleeping bag relatively clean.
Tents (3) – Wild Country Sirocco tents taken. Sleeps two to three people. Large porch.

COOKING EQUIPMENT

Cooking Pot 1.75ltr & Lid – For emergency use. Cooking pots used on a day-to-day basis were bought in Malawi. Surplus to requirements.
Fuel Bottle – For use with the stove.
Fuel Funnel – Essential for filling fuel bottle.
Maintenance Kit – For cleaning and repairing the stove.
Pan Handle – Kept in stove bag so always knew where it was.
Screw Top Containers 50-200ml (6) – Much better than bags for items used regularly**.** Useful for salt, herbs and spices as well as things like shower gel. Recommend larger ones for sugar and milk powder.
Spoon (5) – Normal large metal spoons taken.
Stove – Primus Himalaya Multifuel stove taken for emergencies. Cooking done over an open fire on a day-to-day basis. Used while camping at Nkhata Bay.
Windshield – To protect the stove from the wind. Not used.

DRINKING EQUIPMENT

Iodine – Good for purifying water without boiling if you can get used to the taste.
Water Bottle 1Ltr (5) – Nalgene bottle or similar plastic bottle. Transparent bottle recommended as it enables bits in water to be seen easily.
Water Carrier (10Ltr) – Ortlieb bag for collecting water with. Buckets used instead. Not required.

CLIMBING EQUIPMENT

Harnesses (2) – Lightweight DMM Alpine harnesses taken for safe travel along cables when installing them.
Prusik Loops (4) – General piece of 6mm cord used to ascend or grip ropes.
Rope 10.5mm 75m – Static multi purpose old caving rope.
Screwgate Karabiners (8) – General purpose. For use in conjunction with slings and prusiks.
Slings (8) – Assorted sizes, for variety of purposes.
Tibloc – Mechanical device which does the same job as prusik loops.

SAFETY & NAVIGATIONAL EQUIPMENT

Altimeter Watch – Not essential, but useful to take if you have one.
Compass (2) – Used to guage general site orientation.
GPS – Took a Garmin Etrex. Used to mark waypoints. Not kept on continually in order to conserve batteries.
Head Torch & Batteries (5) – One per person. Needed most evenings in camp as got dark around 6pm. Still no battery replacements needed for LED torches.
Penknife / Leatherman (5) – One Leatherman in the group is good but they are heavy and everyone doesn't need one. Single blade sharp knives are sufficient for most uses.
Maps (3) – Two road maps and one laminated contoured map. Used more out of interest than necessity.
Whistle (2) – For use in emergencies. Also good for letting workers know when it was lunch time.

HEALTH & SAFETY

First Aid Kit - Personal (5) – Contains none emergency items used on a day-to-day basis. See appendix C for complete contents list.
Lip Salve (5) – Used to stop lips drying and cracking.
Sun Cream (5) – Use minimised by covering up instead.
Sunglasses (5) – Good for fair weather days. High quality lenses essential to block out harmful rays.

WASH KIT

Anti-Bacterial Cleansing Wash – Ideal as no water required to use. Individual hand-wash sachets are useful when travelling for cleaning hands before eating.
Biodegradable Soap (2) – Good for washing both body and hair.
Nail Clippers – Useful, one small pair amongst the group is sufficient.
Toothbrush (5) – Standard.
Toothpaste (2) – Can share a large tube 100ml between two or take a small 50ml tube each. This is plenty.
Trek Towel (5) – Lightweight and good at absorbing moisture. Takes up little room too.

MISCELLANEOUS

Black bags – For rubbish and general use.
Books (5) – Too tired to read most evenings after writing diary. Essential for the travelling though.
Camera, Film & Batteries – Neck strap useful to keep camera handy and safe at the same time.
Duck Tape – Useful for repairs and on site.
Duffle Bag 100ltr (2) – Good for putting food and group equipment in while travelling.
Earplugs – Personal preference. Know who you are sharing a room with and whether they snore.
Frisbee – Not used. Too busy on site. Good as a spare plate though.
Pack of Cards – Essential for passing the time. Played a bit while travelling.
Sewing Kit (2) – Not used. One would probably suffice.

Below & insert – Lunch time. Making sandwiches in the back of the truck in Rumphi.
Right bottom – Andras washing his shirt on the shore of Lake Malawi.

DOCUMENTS

Flight Tickets (5) – Essential for the return.
Money – Sterling changed to Malawian Kwacha in Malawi. Need US dollars to pay the departure tax but everything else can be paid in Kwacha and / or UK pounds.
Insurance (5) – Essential, keep with you.
Passport (5) – Essential, keep it on you at all times.
Visas & Permits – Essential, make sure everyone knows who has them and where they are.

APPENDIX B – Clothing List

By Daniel Carrivick

Each expedition member used old clothing that they already owned rather than buying new clothing especially for the expedition. Hence a range of different types and brands of clothing were worn. Below is a summary clothing list for one person which has been amalgamated from what every one wore together with notes on their usefulness. The quantity is shown in brackets where more than one of each item was taken per person.

Approach Shoes – Worn on site. Quick drying ones which let the water out easily are an advantage. Take old ones as they will get trashed.
Buff – Very versatile piece of clothing, helps to keep you cool and warm, and protects you from the sun.
Down Jacket – Considered taking and could have been worn on the Nyika plateau as it was cold in the mornings, however didn't want it to get singed by embers from the open fire so took lots of jumpers instead.
Fleece Top – Needed in the evenings, when travelling in the back of the truck and during the day when overcast on the plateau.
Gloves (workman) – For wearing on site. Take good care of these otherwise they'll quickly fall apart.
Gloves - Thermal Inner – Not used but useful to take for the cold early morning starts.
Hat, Fleece / Woolly – Again not essential but may be useful if travelling in the back of the truck late one evening.
Sandals – One team member took these and wore them around camp. Not generally recommended though because of snakes, scorpions and other creatures.
Shirt – One long sleeved shirt is good for travelling in, so you have something which will allow you to cover your arms and protect them from the sun.
Shorts – Worn by male members of the team on site and while swimming. In rural areas the inhabitants are not used to seeing womens legs so shorts are not advised to be worn by females.
Socks – Good quality are essential here otherwise your feet will fall apart being in the same shoes day after day. Must be comfortable and functional.
Sun Hat / Cap – Essential. You will need something to cover your neck up with if taking a cap.
Synthetic Insulated Jacket / Soft Shell Jacket – These are both wind proof and warm making them ideal for throwing on when travelling in the back of the truck.
T-shirt (2) – One really old one for wearing on site and another for wearing at other times.
Thermal Top, Long-Sleeved – Could be used instead of a long-sleeved shirt. Has the added benefit of providing extra warmth which would be useful up on the Nyika Plateau.
Trekking Trousers (2) – One really old pair for wearing on site and a second pair for travelling in. Convertibles were taken by some team members which proved useful on site when wading across the river as the bottoms could just be unzipped.
Underwear (2) – The dryflo type are best, quick drying and breathable.
Waterproof Jacket – Taken but not used. Only required if you don't have a good quality wind proof.

APPENDIX C – First Aid Kits

By Daniel Carrivick

List outlining the contents of the first aid kits taken on the expedition along with useful information and personal experiences where applicable. Typical dosages are given where appropriate to put into context the quantities taken. They should not be used as guidelines when administering drugs. Always read carefully and refer to the information leaflet which accompanies all drugs. The information provided below is no substitute for proper training.

ANTI-MICROBIALS – None taken by team members.

Amoxicillin 250mg Capsules (21) – 2 courses, very versatile. Amoxicillin is an antibiotic in the class of drugs called penicillin's. It is used to treat many different types of infections, such as pneumonia, bronchitis, venereal disease (VD), gonorrhoea, and infections of the ears, nose, throat, urinary tract, and skin. Antibiotics work by killing bacteria – they will therefore not work for colds, flu, or other viral infections. Overlaps with Co-Amoxiclav, don't need both, only taken as left over from previous expedition. Dose: One capsule three times daily.
Chloramphenicol Ointment 4g – An antibiotic ointment used to treat bacterial eye infections. Dose: Apply ointment under the lower eyelid four times a day for five days.
Ciprofloxacin 250mg Tablets (28) – Ciprofloxacin is an antibiotic used to treat certain infections caused by bacteria e.g. pneumonia, bronchitis, diarrhoea caused by bacteria, typhoid fever, and bone, joint, skin, prostate, sinus, and urinary tract (bladder) infections. Dose: One tablet twice daily. Treatment for a severe gut infection is 3-7 days and for a chest infection is 7-14 days.
Co-Amoxiclav 250/125mg Tablets (42) – Amoclan. Commonly used for chest, urinary, skin and wound infections. Each tablet contains 250mg Amoxicillin and 125mg Clavulanic acid. Penicillin based antibiotic for treating infections. Dose: One tablet three times a day.
Doxycycline 100mg Tablets (28) – Doxycycline is a tetracycline, a broad-spectrum antibiotic, which is used to treat chest infections, malaria (with a course of quinine sulphate), acne and sometimes travellers diarrhoea. Dose: One tablet twice daily for seven days in the treatment of malaria, with plenty of water. Taken by all team members to prevent malaria. Side effects caused one person to vomit and become nauseous due to not taking with plenty of water.
Flucloxacillin 250mg Capsules (28) – 1 course. Flucloxacillin is a narrow spectrum antibiotic that has specific activity against penicillinase-producing bacteria. It is used to treat certain skin, chest, and soft tissue infections. Given to a local in Uledi who had a bad skin infection. Dose: One capsule four times daily.
Quinine Sulphate 200mg Tablets (28) – 1 course. Used to treat malaria. Taken with Doxycycline. Dose: Three tablets three times a day for three days.

CREAMS AND OINTMENTS – None used on a day-to-day basis.

Caneston Cream 15mg – For fungal skin infections. Apply twice daily.
Daktarin Dual Action Cream 15g – For the treatment of athletes foot. Apply twice daily.
E45 Cream 50g – Treatment for dry skin conditions including dry, itching, flaking, chapped skin and sunburn. Also recommended for eczema, dermatitis and ichthyosis. Apply liberally 2-3 times a day.
Hydrocortisone Cream B.P. 1% 30g – Relief for mild eczema, insect bites & contact dermatitis. Apply sparingly, twice daily for a maximum of 7 days.
Savlon Cream 60g – Antiseptic cream, prevents infection and aids healing. Used to treat minor injuries to workers.

DRESSINGS – Not used much on team members apart from the odd plaster. Tape and plasters, along with a few small dressings were used on local workers who sustained cuts and grazes on site.

Antiseptic Cleansing Wipe (10) – Only a few taken as iodine solution, taken for purifying water, can always be used to clean wounds instead of antiseptic wipes.
Cotton Wool Pads – Soft and absorbent for cleaning skin around wounds.
Crepe Bandage 7.5cm (4) – Useful to have lots as may have to keep replacing dressings.
Dressing, Large & Sterile, No.9 (2) – For covering large wounds.
Eye Dressing No.16 (2) – Dressing for an eye injury.
Fluorets (5) – Flourescein sodium BP 1mg. Sterile ophthalmic strip which makes foreign bodies and scratches on the surface of the eye easier to see.
Gauze Swabs 7.5x7.5cm (5) – Not used, essential for open wounds.
Micropore (1cm x 15m) – More breathable than zinc-oxide tape but doesn't stay on as well.
Melolin Dressing, Non-Adhesive 10x10cm (4) – For cuts, grazes and minor burns. Can be cut to size. Good for blisters if no blister kits available.
Plasters, Assorted (50) – Adhesive dressings. Quantity was fine, variety of sizes were useful.
Steri-strips (6) – 6x75mm. Good for holding closed superficial, gaping wounds.
Triangular Bandage (2) – For immobilising limbs. May need several at a time.
Zinc Oxide Tape 2.5cm x 10m (2) – The wider the better as more likely to stay on longer.

HARDWARE – The expedition was not limited by weight or quantity so a fairly comprehensive first aid kit was taken with quite an assortment of hardware. Supplies were only limited by there cost.

Anaeroid Sphygmomanometer – For taking blood pressure readings.
Dental First Aid Kit – See below for contents information.
Scalpels (2) – For use by a qualified person in countries where levels of medical hygiene are not as high as back home.
Isolaide Resuscitation Aid – Face shield for personal protection during mouth to mouth resuscitation.
Latex Gloves (10) – Non Sterile, medium size. For general hygiene and protection.
Safety Pins (5) – Handy to have a few even though can often make do without them.
Sam Splint (2) – For immobilising limbs.
Scissors, Medical – Tuff cut. Will cut through most materials. Essential to have for emergencies. Leatherman or other substitutes are not suitable.
Sterile Supplies Kit - See below for contents information.
Stethoscope – Economy, for listening to internal sounds such as heart beats and breathing.
Stifnek Select Neck Immobiliser – For immobilising the neck.
Thermometer – Digital one, waterproof with an alarm.
Tweezers – Large pair. Useful to have.

PAINKILLERS – No painkillers were taken on a continuous basis for more than a day. Ibuprofen was taken on occasions by some team members suffering from various pains.

Aspirin 300mg Caplets (16) – For mild to moderate pain and fever. Also an anti-inflammatory and has a blood thinning effect. Dose: 300-900mg every 4-6 hours (Max 4g daily).

Above & insert – The contents of our expedition first aid kit.

Below & insert – Playing football with the local children who loved to show off in front of the camera.
Right bottom – Laying the concrete slab on top of the first level of one of the towers.

Co-Codamol Tablets 30/500mg (90) – For moderate to severe pain. Probably only need half this amount but they came in a box of 100. Dose two tablets three to four times daily (Max 8 tablets in 24 hours).
Ibuprofen 200mg (24) – Anti-inflammatory drug for muscle, joint and period pains. Dose: 400mg every 8 hours with or after food. Supplementary to personal kits.
Paracetamol 500mg Tablets (64) – For mild to moderate pain and fever. Dose: 1g every 6 hours (Max 4g daily).

OTHER MEDICATION – Personal preference together with the local environment dictates what other medication is needed.

Chlorpheniramine Tablets 4mg (30) – Piriton allergy tablets. Antihistamine primarily for hay fever relief. May also relieve insect bites and stings, allergic rashes and itching. Dose: One tablet every 4-6 hours.
Imodium 2mg (18 Capsules) – May prolong gut infections. Only for use when travelling and in harsh environments. Dose: 4mg initially then 2mg after each loose stool (Max 16mg daily).
Prochlorperazine Tablets 5mg BP (42) – Anti-sickness medicine. Dose: 5-10mg every 4-6 hours.
Rehydration Sachets (6) – Each oral rehydration sachet contained 277mg of sodium and 4g of Dextrose, which was added to 200ml of water. Expensive so only a few taken for real emergencies. In less serious situations a rehydration drink can be made with normal sugar and salt.

DENTAL FIRST AID KIT – Not Used.

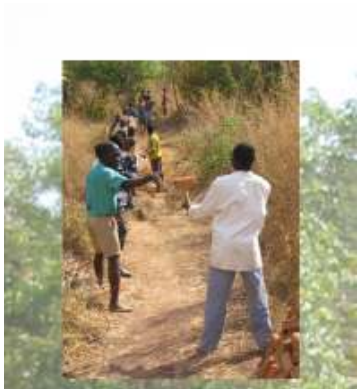
Cement – Temporary cavity filling material.
Clove Oil (10ml) – Temporarily relieves toothache by killing the bacteria eating through your tooth and getting at the nerve. Apply sparingly. Clove oil is very powerful so only a little is needed.
Cotton Rolls – For applying small amounts of clove oil to a tooth.
Guide – Advice and help regarding basic dental care.
Needle & Syringe – To be given to qualified person in countries where levels of medical hygiene are not always of the same standard as they are back home.
Mirror – For seeing behind teeth and inside mouth.
Spatula – For smoothing and removing excess cement.

STERILE KIT – Wilderness sterile kit be given to a qualified doctor or nurse should a member of the team require sudden medical attention on the expedition.

Alcohol Swabs (10) – Sterets pre-injection swab.
Dental Needles (2) – For injecting anaesthetics.
Hypodermic Needles (15) – Three lengths; 0.5x16mm, 0.6x30mm & 0.8x40mm, five of each size.
I.V. Cannula (4) – Venflon drip needles for providing intravenous solutions. Two sizes; 1.0x32mm (54ml/min) and 1.2x45mm (80ml/min).
I.V. Multifusion Set – Intrafix set for giving intravenous solutions. Suitable for pressure or gravity infusion.
Scalpel – Disposable and sterile scalpel.
Syringes (15) – Three sizes; 2ml, 5ml & 10ml, five of each size.

PERSONAL FIRST AID KIT (4) – Each team member carried their own personal first aid kit. The contents of this varied slightly according to each team members personal needs. However the recommended minimum contents were:

Adhesive Plasters (10) – For minor cuts, grazes and to prevent blisters.
Antiseptic Wipes (6) – Used to clean cuts and scrapes sustained from handling materials.
Blister Kit – Sand and gravel in shoes caused abrasion and damage of feet.
Crepe Bandage (1 or 2) – For strapping dressings over wounds and protecting the area around them.
Dressing, Large & Sterile, No.9 – For covering a large wound.
Ibuprofen 200mg (24) – To relieve day-to-day aches and pains.
Latex Gloves (2) – For general hygiene and protection. Worn whenever first aid is being administered.
Melolin Dressing, Adhesive (2) – Good for blisters and thus handy to have in personal kit.
Paracetamol 500mg (12) – For pain relief. Ibuprofen tended to be used in preference.
Triangular Bandage – For immobilising limbs. Also useful as an emergency sun hat.
Safety Pins (6) – Variety of uses, not just for first aid.
Survival Blanket – Heat reflecting emergency blanket 2150x1500mm. Small and compact, folds up to pocket size. Has a multitude of uses. Can be a lifesaver.
Zinc Oxide Tape 25mm x 5m – Used to tape up feet to prevent blisters and to attach small dressings. Wider tape stays on longer, 40-50mm is great if you can find it!



APPENDIX D – Construction Timetable

Written and compiled by Naomi Bessey & Daniel Carrivick

Table D1 details the progress of construction by showing what jobs were done on which days. These jobs were not necessarily carried out over the whole day but they did consume a considerable amount of time and man power on the days shown.

Table D1 Jobs done on a day-by-day basis according to which side of the river the work was done.

Date	Site Survey	Clearing Site	Marking Out	Excavation	Foundation: Wall	Foundation: Infill	Foundation: Slab	Level 1: Wall	Level 1: Infill	Level 1: Slab	Level 2: Wall	Level 2: Infill	Level 2: Slab	Level 3: Wall	Level 3: Infill	Level 3: Slab	Level 4: Wall	Level 4: Infill	Level 4: Hump	Anchor: Rebar	Anchor: Concrete
27-Jul																					
28-Jul																					
29-Jul																					
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20-Aug																					

KEY
West side
East side

Above & insert – Passing the bricks along a human chain to get them from the road to the site.
Right – Andras tests the soil to see how compact it is.

Table D2 shows the number of workers allocated to each job on a daily basis. Where workers did one task in the morning and a different one in the afternoon the number of workers is split in half to represent the number of man-days spent on a specific activity. For example if six people moved bricks in the morning and sand in the afternoon this would appear in the table as a three in the collection and transportation of bricks column and three under the collection and transportation of sand.

Table D2 Distribution of the workforce amongst specific tasks on a day-by-day basis

Date		Collection & Transportation							Construction						Total Workers
		Site Clearing	Excavation	Breaking stones	Sand	Aggregate	Rocks	Bricks	Brick/stone laying	Slabs	Infill	Anchors	Earthworks	Decking	
Fri	28-Jul	2													**2**
Sat	29-Jul	2													**2**
Sun	30-Jul														**0**
Mon	31-Jul		8	2	6										**16**
Tue	1-Aug		8	2	6										**16**
Wed	2-Aug		6	1	3		2	6	2						**20**
Thu	3-Aug		2	4	4		8		2						**20**
Fri	4-Aug			4			17		4						**25**
Sat	5-Aug			4	2		14		4	2					**26**
Sun	6-Aug					3	13		3						**19**
Mon	7-Aug					3	22	8	3						**36**
Tue	8-Aug						26	5	3	2					**36**
Wed	9-Aug			2			28		6						**36**
Thu	10-Aug					2	26		4	2	2				**36**
Fri	11-Aug					2	15	12	5		2				**36**
Sat	12-Aug					4	12	8	6	2					**32**
Sun	13-Aug					4	7		6		2				**19**
Mon	14-Aug					8	10	3	6		2				**29**
Tue	15-Aug				3	14	2		6	2	2				**29**
Wed	16-Aug					22		2	6			10			**40**
Thu	17-Aug				6	18	9	3		2	2				**40**
Fri	18-Aug				4	20				2	2	10			**38**
Sat	19-Aug					8	12	6	6	2	2				**36**
Sun	20-Aug					3		2	7						**12**
Mon	21-Aug												3	4	**7**
Tue	22-Aug												3	4	**7**
Wed	23-Aug	COMMUNITY DAY													**0**

Above & insert – Laying the final level of bricks on top of one of the towers.
Right upper – Creating the shuttering to stop the anchor pit walls collapsing inwards.
Right lower – The sign at the Thazima gate entrance to Nyika National Park.

Below & insert – Workers clear the tree roots while digging the anchor pits.
Bottom right – The site on one side of the river. Mixing concrete for the anchor.

APPENDIX E – Finances

Compiled by Chris Green and Daniel Carrivick

Table E1 shows all the transactions from our expedition accounts up until 1st January 2007. The accounts were managed by Imperial College Finance Division and each transaction was overseen by the Imperial College Exploration Board Honorary Treasurer. Meanwhile Table E2 shows a detailed breakdown of all the expedition's expenditure.

Table E1 Income and expenditure from the expedition account. Income is listed under contributions and expenditure under payments. All figures are in UK pounds (£).

PAYMENTS & RECEIPTS FOR BUILDING BRIDGES, MALAWI 2006 EXPEDITION (ICIS ACCOUNT HQEX.0.867128)

Transaction Date	Description	Amount	
	Personal Contributions		
27-Apr-06	Personal contribution Mr Rafael Holt	500.00	
08-Jun-06	Personal contribution Ms Naomi Bessey	500.00	
08-Jun-06	Personal contribution Mr Dan Carrivick	500.00	
08-Jun-06	Personal contribution Mr Martin Threakall	500.00	
08-Jun-06	Personal contribution Mr Andras Szollar	200.00	
28-Nov-06	Personal contribution Mr Andras Szollar	300.00	
			2,500.00
	Other Contributions		
12-Apr-06	Grant from the Gordon Foundation	1,500.00	
08-May-06	Grant from Interserve Project Services Limited	500.00	
30-May-06	Grant from Mouchel Parkman Services	500.00	
30-May-06	Grant from Black & Veatch Limited	500.00	
01-Jun-06	Grant from The Happold Trust	1,000.00	
03-Jul-06	Grant from Engineers Without Borders	500.00	
03-Jul-06	Grant from the University of London – Dunsheath Expedition Award	2,500.00	
11-Sep-06	Grant from Halcrow Group Limited	1,000.00	
			8,000.00
	Imperial College Exploration Board contribution		2,500.00
	Total Contributions		**13,000.00**
	Payments		
28-Apr-06	Carrivick Mr Daniel Martin - return flights to Lilongwe	3,415.00	
28-Apr-06	Carrivick Mr Daniel Martin - first aid course	258.50	
28-Apr-06	Carrivick Mr Daniel Martin - training weekend/stamps	65.60	
04-May-06	Carrivick Mr Daniel Martin - training weekend	200.00	
06-Jul-06	Land and Lake Safaris - truck hire	1,741.19	
18-Jul-06	Carrivick Mr Daniel Martin - ADVANCE	4,000.00	
28-Jul-06	Dale' Silvio S.R.L. - freight charge	1,324.54	
19-Sep-06	Carrivick Mr Daniel Martin - expedition expenditure in Malawi	1,971.26	
	Total Payments		**12,976.09**
	BALANCE AT 1st Jan 2007		23.91
	Personal Contributions to Balance Accounts		
01-May-07	Carrivick Mr Daniel Martin – report printing and binding	23.91	
			-23.91
	CURRENT BALANCE		**0.000**

NOTE: A breakdown of how the advance was spent has been submitted to Imperial College Finance Division, together with receipts.

Above & insert – Warming up around the fire early one morning at Chelinda, high on the Nyika plateau.

Table E2 Grouped expenditure summary detailing exactly what the money was spent on.

EXPEDITION EXPENDITURE			
Description	Amount	Total	Notes
ACCOMMODATION			
Lodges & Guest Houses	£234.38		*Main cost was in Lilongwe. Mzuzu was much cheaper.*
	Total Accommodation	**£234.38**	
EQUIPMENT			
Specialist Equipment	£334.91		*Tents, solar panel, GPS, insect repellant, stove, rope & repair kit*
Clothing & accessories	£249.82		*Personal clothing and equipment*
Equipment - Malawian	£45.49		*Cooking pots, fuel containers, axes, mugs etc. bought in Malawi*
Maps & Guides	£33.93		*Maps, travel guides, first aid text book*
	Total Equipment	**£664.15**	
HEALTH			
First Aid Training	£258.50		*Wilderness Medical Training course & course book.*
First Aid Supplies	£148.61		*Group medical supplies; drugs and equipment*
Anti-malarials	£147.03		*Doxycycline*
Vaccinations	£90.00		*Rabies*
Personal Supplies	£38.21		*Drugs and bandages e.g. Ibuprofen, Compeed etc.*
	Total Health	**£682.35**	
FOOD			
Supermarket supplies	£394.70		*Majority in Lilongwe with top-ups from Mzuzu / local markets*
Eating Out	£137.90		*Sit-down & takeaway meals while in Lilongwe / Mzuzu*
UK Supplies	£44.24		*Food purchased in the UK and taken out with us.*
	Total Food	**£576.84**	
INSURANCE	**Total Insurance**	**£0.00**	*Covered FOC by Imperial College travel insurance*
TRAINING WEEKEND			
Training	£200.00		*Cost of training weekend with Biosearch Expeditions*
Travel	£66.40		*Train to Nottingham & fuel for car*
	Total Training	**£266.40**	
BRIDGE VISIT			
Accommodation	£61.44		*Contribution towards accommodation costs*
Travel	£186.97		*Contribution towards travel London – Ben Alder in Scotland rtn*
	Total Bridge Visit	**£248.41**	
TRAVEL			
Flights (5)	£3415.00		*London to Lilongwe return with Ethiopian Airways*
Truck hire	£1741.19		*Hire of a 3-tonne pickup for 41 days*
Diesel	£538.23		*Fuel for the 3 tonne truck we hired*
Drivers Pay & Bonus	£110.86		*Special rate as driver unable to get work without his truck*
Truck parts	£102.64		*Spares & repairs e.g. new tyre, battery, terminals, fix punctures etc.*
Airport taxes & parking	£84.57		*Departure Tax (5 x US $30)*
Train / Underground	£73.60		*Travel to and from London airports*
Local transport	£26.68		*Taxi's around Lilongwe and buses between Lilongwe & Mzuzu*
Jeep	£22.94		*Afternoon hire plus fuel in Lilongwe*
Drivers Expenses	£11.28		*Food and accommodation while traveling - often stayed with relatives.*
	Total Travel	**£6,126.99**	
CONSTRUCTION			
Air Freight	£1324.54		*Cost of air freighting the steel cables and parts to Malawi*
Cement	£747.50		*For some 6.5 tonnes of cement (130x50kg bags)*
Steel & Rebar	£541.40		*Mainly for the anchors*
Workers Wages	£345.68		*48 workers, 4790 workman hours*
Tools	£237.81		*Purchased in Malawi and used mainly by the workers*
Specialist Equipment	£189.26		*Purchased in the UK and for use by the expedition team*
Shipment Handling Fee	£81.14		*Handling, clearing & delivering our shipment in Malawi*
Other	£67.01		*Text books, photocopying and stationary*
Timber	£48.92		*Timber for decking from Chelinda*
Misc. Materials	£46.18		*Nails, rope, grease, sacks, timber for supports etc.*
Bonuses	£36.95		*Given to workers - typically 10% of their total earnings*
Bricks	£35.55		*For some 6300 bricks, Poor quality – bought for 1.5MWK per brick*
	Total Construction	**£3,701.94**	
OTHER			
Photography	£89.61		*Card reader, memory cards & rechargeable batteries*
Visas	£69.00		*Malawian visa for Hungarian national & 2 Ethiopian stop-over visas*
Gifts	£55.98		*Presents for helpers i.e. children, the community and our unpaid staff*
Fundraising	£46.13		*Printing & Stationary*
Postage	£43.40		*Sending out leaflets & letters*
Currency Exchange	£35.70		*Commission & cost of withdrawing cash from machines in Malawi*
Photocopying & Printing	£35.50		*For research purposes*
Report	£23.91		*Ink cartridges for printing, binding, postage etc.*
Miscellaneous	£22.91		*International Driving License, International UK telephone calls etc.*
Scouts contribution	£21.02		*Food money for our scout as he hadn't been paid*
Accident	£20.35		*Transport for Police & Ambulance, coffin & burial costs.*
Communications	£20.03		*Phone calls & internet while in Malawi*
Entrance Fees	£15.00		*For Toni Ruttimann bridge building talk*
	Total Other	**£498.54**	
TOTAL EXPENDITURE £13,000.00			

Below & insert – Dan testing the ground stability conditions in the bottom of the anchor pit. The corrugated metal sheeting protects the face and prevents it from collapsing.
Bottom right – A crowd gathers to look at the snake which flew into the anchor pit while workers were concreting.

APPENDIX F – Risk Assessment

Compiled by Naomi Bessey

Table F1 shows the evaluation of risks associated with this expedition. The risks analysed here are only those directly associated with the aims of the expedition and not those generally encountered by travelling, living and sightseeing in Malawi. Compiling this risk assessment helped the team to prepare fully for the expedition not only by minimising the risks but also by making sure everyone knew what actions to take as and when certain hazards arose. Current advice from the foreign and commonwealth office was continually assessed in the run up to the expedition.

Table F1 Risk assessment detailing risks, their consequences and how they were controlled

Hazard and Risk	What are the consequences of the hazard occurring?	How is the risk controlled?	Further action required to control the risk
GENERAL			
Small accidents or incidents involving cuts, sprains, etc.	• Inability to use affected part of body.	• Caution drawn to every operation. • Familiarity with equipment. • First aid techniques.	• Personal daily duties re-allocated. Confined to base camp. • All expedition members will have basic first aid knowledge and experience.
Large injuries or incidents, including severe bleeding, fractures etc.	• Terminate the expedition. • Possible serious and permanent injury if no medical assistance sought.	• Caution drawn to every operation. • Never working alone. • Familiarity with equipment. • First aid techniques.	• Emergency assistance available via contact with liaison officer at base camp. • Insurance will be taken out for all members of the expedition which will cover for rescue and repatriation.
CONSTRUCTION			
Possibility of falling rocks while working under cliffs.	• Possible serious head injuries	• Helmets to be worn at all times by all members of the team when on site.	
Danger of falls of up to 10 metres from river-bed cliffs into shallow water.	• Possible serious injuries or death. • Possibility of drowning.	• No work to be undergone alone, in the dark, or in poor visibility. • Cliff areas to be cordoned off with highly visible barrier to prevent falls.	
Heavy lifting.	• Possible back injury. • Possible foot injury.	• All members of the team to wear suitable boots when on site at all times. • All members of the team to be instructed in the recommended way to practice heavy lifting.	
Danger of losing footing when crossing the river when water levels are high and/or when carrying heavy loads.	• Possibility of being swept downstream. • Slight possibility of drowning if held underwater by heavy load.	• No crossing of river when water levels are high. • Practice safe river crossing techniques on a pre-expedition wilderness survival weekend. • Fixed and tensioned support rope to be in place throughout duration; all crossings to be made on the downstream side of this to avoid tripping/ falling against current. • Support teams to be placed downstream if any hazardous crossing is attempted.	
Dangers associated with cutting, welding or any other skilled labour.	• Danger to eyes from splinters, sparks or small projectiles. • Risk of serious injury by machinery • Burns from heat generated.	• Design and build a bridge where use of skilled labourers is minimised. • Any spectators to be kept at distance when skilled labourers are at work. • Eye protection to be worn by all members of the team within proximity of such tasks.	
Site or personnel being attacked by Poachers while constructing bridge.	• Risk is minimal. Poachers are not known to be confrontational.	• Scout to be assigned by the National Park to look after us for the duration of the expedition.	
TRAVELLING			
Dangers associated with driving in Malawi	• High rates of mortality which are magnified by westerners driving their own vehicle.	• Hire a local driver with good experience of the roads. • Don't travel in the dark and only during the day in good visibility. • Wear seatbelts at all times.	
Dangers associated with car jackings.	• Increased risk of injury upon resisting this procedure.	• Avoid likely places of attack, particularly in Lilongwe. • If car jacking attempted; do not resist. Passively step away from vehicle.	
Travelling alone	• Being attacked, mugged or assaulted.	• Never go anywhere alone, especially in Lilongwe. • Use a taxi or bus to get around. Never walk.	

Additional Notes:

- The risk of contracting fluid-to-fluid contracted diseases will be minimised by wearing gloves when treating open wounds.
- The risk of contracting tropical diseases will be minimised by taking the recommended vaccinations. Water-bourn diseases will be protected against by using iodine solution and by boiling.

Below & insert – Naomi canoeing a traditional log boat at Nkhata bay on Lake Malawi.

ADDRESS LIST

Compiled by Daniel Carrivick

Below is a list of names and addresses we found useful when organising our expedition.

ACCOMMODATION – Lodge in Lilongwe offering a range of rooms to suit most peoples needs. Buffet breakfast included in price and has a swimming pool. Safe - courtyard is enclosed and entrance guarded.

Korea Garden Lodge
P.O. Box 2181, Lilongwe, Malawi
Tel: +265 (0)1 753 467 / +265 (0)1 757 854 Fax: +265 (0)1 756 612 E-mail: info@kglodge.net
www.kglodge.net

AIRLINE COMPANY – Ethiopian Airlines have an office in London which the team found useful.

Ethiopian Airlines
1 Dukes Gate, Acton Lane, London, W4 5DX
Res: +44 (0)20 8987 7000 Admin: +44 (0)20 8987 9086 E-mail: lonam@ethiopianairlines.com
www.ethiopianairlines.com

FLIGHTS – The cheapest available flights to Lilongwe were found at Trailfinders.

Trailfinders
48 Earls Court Road, London, W8 6FT
Bookings: +44 (0)84 5058 5858 Kensington Branch Tel: +44 (0)20 7938 3939 Fax: +44 (0)20 7937 0555
www.trailfinders.com

FREIGHT HANDLING COMPANY – SDV Ltd. are a company who handle air freight at Lilongwe international airport. They looked after our cables while they were cleared through customs.

SDV Ltd
P.O. Box 648, Lilonwe, Malawi
Tel: +265 01-700931 E-mail: sdvkia@malawi.net

HELP & ADVICE – The Expedition Advisory Centre provides information, training and advice to anyone involved in expeditions, field research or outdoor learning.

Expedition Advisory Centre
Royal Geographical Society, 1 Kensington Gore, London, SW7 2AR
Tel: +44 (0)20 7591 3030 Fax: +44 (0)20 7591 3031 E-mail: eac@rgs.org
www.rgs.org/eac

NATIONAL PARKS & WILDLIFE – Malawian governmental body responsible for the National Parks and nature reserves throughout Malawi.

Ministry of Information & Tourism
Dept of National Parks & Wildlife, PO Box 30131, Capital City, Lilongwe 3, Malawi
Tel: +265 (0)1-759831 Fax: +265 (0)1-759832 E-mail: dnpw@malawi.net
www.tourismmalawi.com

MAPS & GUIDES – If Stanford's aren't able to get it then neither will you! They stock the largest range of maps and guides we know of. Maps can be purchased in store or online.

Stanfords
12-14 Long Acre, London, WC2E 9LP
Tel: +44 (0)20 7836 1321 Fax: +44 (0)20 7836 0189 E-mail: sales@stanfords.co.uk
www.stanfords.co.uk

MEDICAL SUPPLIES – Nomad travel & outdoor stores sell a range of travel products. We used there travel pharmacy to source some of our medical supplies.

Nomad
3-4 Wellington Terrace, Turnpike Lane, London, N8 0PX
Tel: +44 (0)20 8889 7014 Mail Order: +44 (0)84 5260 0044 E-mail: turnpike@nomadtravel.co.uk
www.nomadtravel.co.uk

VEHICLE HIRE – Land & Lake Safaris provide fair and reliable vehicle hire. Prices are not necessarily cheaper than anywhere else but they work according to western rather than Malawian timescales.

Land & Lake Safaris Ltd.
Tel: +265 (0)1 757 120 / +265 (0)1 754 303 Fax: +265 (0)1 754 560 E-mail: reservations@landlake.net
www.landlake.net

WILDERNESS FIRST AID – Wilderness medical training provide advanced medicine courses for remote foreign travel ideal for people going on expeditions. A course is run annually, every March by the Royal Geographic Society in London.

Wilderness Medical Training
The Coach House, Thorny Bank, Garth Row, Kendal, Cumbria LA8 9AW
Tel/Fax: +44 (0)15 3982 3183 E-mail: wmt@wildernessmedicaltraining.co.uk
www.wildernessmedicaltraining.co.uk

Above & insert – Andras relaxing on a rock in Lake Malawi in front of the rising sun.
Right – Group photo of the football players and supporters.

BIBLIOGRAPHY

Compiled by Naomi Bessey

BOOKS

Douglas, J. & White, K., 2003. ***Spectrum Guide to Malawi****, Camerapix Publishers International, Nairobi, Kenya.* - This is an extensive and detailed guide to all aspects of life in Malawi. The authors have included coloured maps that are clearer than those in the Lonely Planet guide, but it is less succinct, and the layout is harder to navigate. The guide comes cheap at £12 to UK addresses, and can be ordered over the internet from various sites including Amazon. It is a little bulky for the amount of information it contains due to the quantity of superb photographs.

Swaney, D., Fitzpatrick, M., Greenway, P., Stone, A., & Vaisutis, J., 2003. ***Lonely Planet – Southern Africa****. Lonely Planet Publications Ltd., Australia. (3rd edition).* - An excellent, reasonably up-to-date guide, with 80 of its 776 pages dedicated to Malawi. Exchange rates in kwacha were out of date due to inflation, but prices in dollars were reasonably representative. The 'Places to Stay' section was very useful, but prices were higher than stated at Nkhata bay.

Discontinued. ***Lonely Planet – Malawi****.* This guide is out of print, but if found will be a more efficient guide when only travelling to Malawi.

MAPS

Malawi - *Scale: 1:900,000, Format: Sheet Map (folded), Size: 67x98cm, RRP Price £9.95. Published by ITMB Publishing, Canada. Stanfords Catalogue No. 91672.* – This map was used for navigating through Malawi. It proved accurate and easy to use. The marking schemes are clear. Detailed maps of Lilongwe and Blantyre city centres are included on the map. These are more detailed and therefore useful than those in guidebooks.

Southern Africa - *Scale: 1:4,000,000, Format: Sheet Map (folded), RRP Price £5.99. Published by Insight Travel Maps, London.* – Useful for international road travel, very good for planning routes. This map can be used to navigate between major towns and cities however a more detailed map or guide is needed to get in and out of built up areas.

Southern Africa Road Atlas - *Scale: 1:2,000,000, Format: Book, RRP Price £8.99. Published by Lonely Planet, Australia.* – Better detail than the insight travel. Easier to use and look at while travelling. Not as good for planning as often journeys cover more than one page. (1st edition – Sept 2000).

DISTRIBUTION LIST

As well as being sent to our supporters, copies of this report will be lodged with the following:

Imperial College, London
Royal Geographical Society, London

Please contact the editor to purchase a paper and/or electronic copy of this report.