

Image: Costa Rica, El Salvador, 07/2013



the
el salvador
project

2013



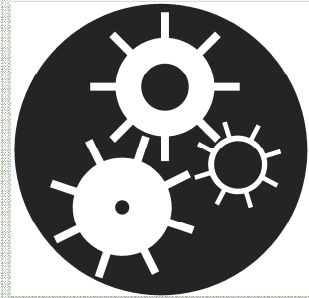
Contents

Introduction.....	3
How We Work.....	4
The 2013 Expedition Team.....	5
Expedition 2013– The Retrofit Project.....	6
2013 Project– Evaluation of Costa Rica.....	8
Part 1: Visual Inspection.....	9
Part 2: Beneficiary Interviews.....	11
2013 Project– Retrofit in San Jose Villanueva.....	13
Project Fundraising.....	16
Budget Report.....	17
Materials Sourcing.....	18
The El Salvador Project Committee.....	19
The Future.....	20
Thank You.....	21
Appendices.....	22
• Appendix A: Technical Drawings.....	23
• Appendix B: Detailed Retrofit Evaluation.....	41
• Appendix C: Detailed Budget Report.....	43

Introduction

Project Aims

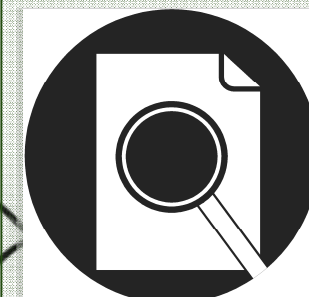
The project this year has been redeveloped with a focus on three key areas: Engineering, Education and Evaluation



Our Engineering aim is to provide poverty stricken communities in El Salvador with efficient and sustainable engineering solutions.



Our Education aim involves working with the local communities during the project in order to facilitate the sharing of engineering knowledge and hands-on skills. This ensures that the development work can be maintained after the team's departure.



Our Evaluation aim is to understand the effectiveness of our engineering solutions, and to make continuous and on-going improvements as necessary. Evaluation of previous projects is crucial for understanding how well our work has actually helped the beneficiaries.

A note on evaluation...

Evaluation is unfortunately not carried out by many well established charities undertaking development work. In addition, it is of the utmost importance to check the integrity of previous projects, particularly if there has since been seismic activity in the area. Using knowledge gained through evaluation, future work can be better designed, and better implemented.

Project History

The El Salvador Project is a charitable volunteer project that provides simple and effective engineering solutions to poor communities in El Salvador who frequently face devastating earthquakes, volcanic eruptions and landslides. The project was first formed in 2001 within the Department of Civil and Environmental Engineering at Imperial College London in response to two devastating earthquakes that killed over 1,000 people and destroyed over 150,000 homes. The first expedition took place in the summer of 2002 and since then has become an established annual undertaking in the student calendar.

Preparation for the annual expedition generally starts in autumn of each year with the team leader recruiting a new team of students for the project which takes place the following summer for approximately 6 weeks. Once a team has been formed, they work together to fund raise throughout the academic year through corporate sponsorship, grant applications and events. During this time, the team leader is also working closely with our partner organizations to develop a project for the summer expedition that is both beneficial and financially viable. Our partner organizations include the UK registered charity Engage for Development, the engineering consultancy ARUP, an NGO in El Salvador called REDES, and Imperial College Union.

This year preparations for the project started a little later, in January 2013, and the expedition consisted of two stages. The first stage (lasting one week) was an evaluation of the project undertaken in 2011, which involved the retrofitting of seismically weak houses to improve their resistance to earthquakes. Once the team had carried out the evaluation and concluded that the retrofit is performing well, the team moved to a new community and retrofitted 9 houses in a village called San Jose Villanueva located approximately 22km south of the capital city San Salvador. This second stage lasted three weeks to give a total expedition length of four weeks. This report outlines the project undertaken in 2013.

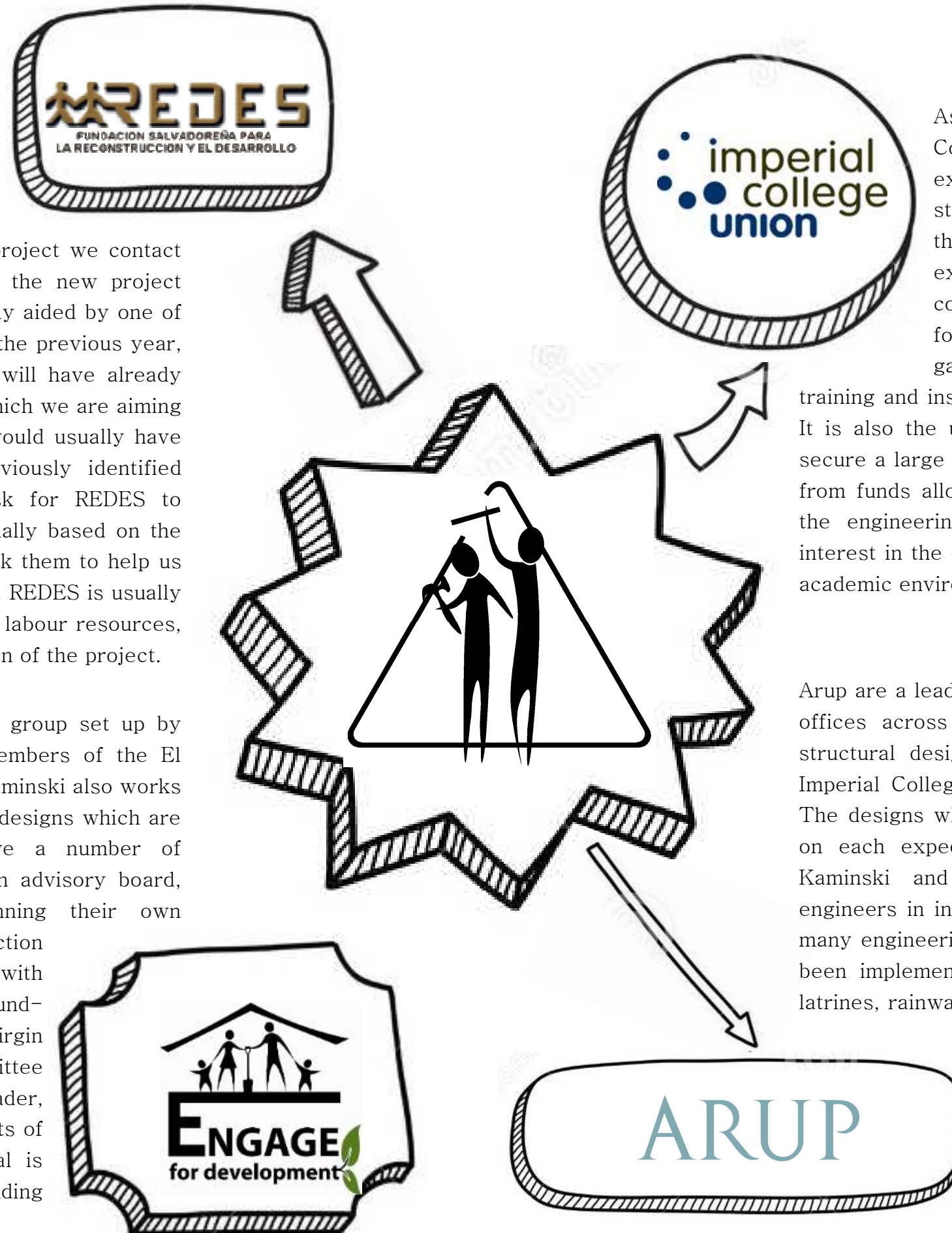


The first ever El Salvador Project (2002)

How We Work

Fundacion REDES are the local NGO that we work with in El Salvador. We have been working with REDES for the entire history of the project and have well established people within the organisation who we are confident to work with. Before the beginning of each project we contact REDES and establish a connection between the new project team each year. The transition phase is usually aided by one of the translators who worked on the project in the previous year, a student of Imperial College whom REDES will have already met. We would propose a project to REDES which we are aiming to complete the following year, the project would usually have been semi-designed already based on previously identified needs, in collaboration with ARUP. We ask for REDES to suggest any refinements to our proposal, usually based on the specific needs of the beneficiaries who we ask them to help us identify. During the team's time in the country, REDES is usually our main source of contacts for materials and labour resources, and act as our general guidance for the duration of the project.

Engage for Development are a small charity group set up by Imperial College alumni and past project members of the El Salvador Project. Their treasurer Sebastian Kaminski also works for Arup, and provides the project with many designs which are implemented in country. The charity have a number of charitable student led projects and act as an advisory board, helping students gain confidence in running their own development initiatives. They serve as a function to the El Salvador Project by providing us with charitable status which helps greatly with fundraising, especially through websites such as Virgin Money Giving. The advise given by the committee is also valuable for each year's project leader, who may not always be experienced in projects of this nature. Every year the project proposal is reviewed and approved by Engage before funding is allowed to go through their accounts.

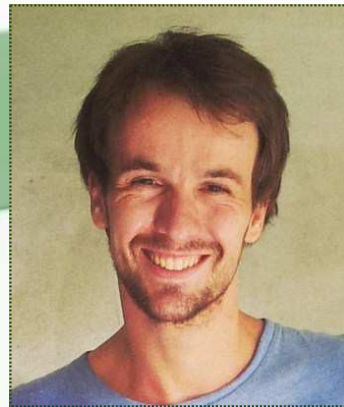


As a project run by students of Imperial College London, there is a society for the expedition which is registered under the student union. The committee members of the society do not necessarily go on expedition themselves but liaise with companies to secure funding, recruit students for fundraising and interface with the union to gain approval for the project and to secure training and insurance for many aspects of the expedition. It is also the union's support that the project is able to secure a large amount of funding from the university, both from funds allocated for student led activities as well as the engineering departments themselves who have an interest in the development of their students outside of an academic environment.

Arup are a leading UK engineering consultancy with global offices across the world. Their main work deals with structural design and they employ many students from Imperial College into their graduate positions each year. The designs which are implemented by the project teams on each expedition are largely designed by Sebastian Kaminski and others who are practicing structural engineers in industry. Employees of ARUP have designed many engineering solutions for the project, which have all been implemented, including sanitation facilities such as latrines, rainwater harvesting systems, retrofit designs for seismic resistance, as well as eco-houses using locally sourced materials, a first for the 2012 project and it is hoped that the design will be able to be implemented across the country in the future, on the grounds of an encouraging evaluation report.

The 2013 Expedition Team

Each year the team are selected primarily from the civil and environmental engineering team leaders before the final team were selected. It was important for each member of the department of Imperial College London, as well as other engineering departments in the team to be able to work well with each other and easily adapt to different situations, with university. Each member was requested to write a short application, describing themselves past experiences and construction knowledge becoming a secondary factor. and the reason for their interest in the project. Every applicant was interviewed by the



Ph.D. Student
Second Year
Water Supply
Systems
Engineering

Robert Wright
Co-Leader



Ph.D. Student
First Year
Non-linear
Structural
Mechanics

Elizabeth Liu
Co-Leader



The El Salvador Project Team 2013
With Hugo our mini-bus driver



Ph.D. Student
(Visiting)
Second Year
Flooding and
Environmental
Engineering

Maria Sunyer Pinya
Spanish Translator



Undergraduate
Second Year

Aeronautical
Engineering

Carlos Poblacion
Spanish Translator



Undergraduate
Second Year

Civil and
Environmental
Engineering

Bradley Pring
Health and Safety



Undergraduate
First Year

Civil and
Environmental
Engineering

Jack Wilkinson
Expedition Treasurer



Undergraduate
First Year

Civil and
Environmental
Engineering

Eric Leung



Undergraduate
Second Year

Chemical
Engineering

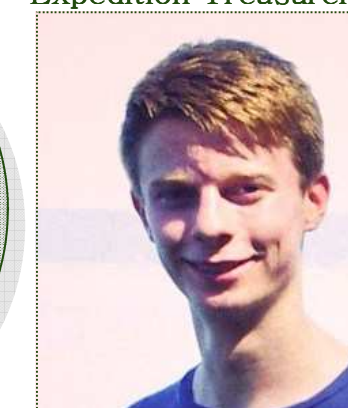
Andy Xu



Undergraduate
Second Year

Civil and
Environmental
Engineering

Sam Simanjuntak



Undergraduate
First Year

Civil and
Environmental
Engineering

Orrin Lancaster
Expedition Treasurer

Expedition 2013–The Retrofit Project

Background

The retrofit project was first proposed for the 2011 project, following the evaluation of a house design implemented across many rural villages and communities in El Salvador. The accommodation was originally designed by the local NGO, REDES called *vara de castilla* houses.

The construction involved a thin steel frame, made from square hollow sections with the walls built from horizontal bamboo rods which were then clad in mortar to finish. The original houses were built by REDES throughout a long period of time, with some also built during collaborating projects over the summer with Imperial College.



Bamboo structure and mortar for vara de castilla houses

After a structural assessment of the structure by the UK engineering consultancy Arup, the houses were deemed to be weak, and fairly unsafe in an area of high seismic activity. Although El Salvador has not suffered any large earthquakes since 2002, the risk is high, and the houses may also be unfit to sustain even low levels of seismic activity. A retrofit which could be implemented quickly and efficiently across multiple houses was essential to ensure the safety of the beneficiaries.

The Design

The retrofit was designed by Arup, and was bespoke to this particular type of structure. The houses were constructed in a very standard manner to the original design, so it was anticipated that implementing the retrofit across many houses at high speed would be plausible. The design aimed to brace all four walls of each room in the structure using large wooden beams, fixed to the wall horizontally at around a 2 metre height. The beams would be drilled and fixed to the walls internally using threaded bolts, which connected to metal plates on the external walls. The corners of the rooms were also fixed with small metal angles, which ensures full effectiveness of the beams. The design would

ensure lateral resistance in the event of an earthquake.

In addition to the retrofit plan, the addition of a porch angle will ensure a rigid connection in addition to the weak spot welds already in place and avoiding collapse in an earthquake. It was also important to ensure the walls of the houses stayed as dry as possible, to prevent water leeching into the bamboo and causing rotting. The bottom 60cm of the houses, on the sides that were exposed to rain, were to be painted with a water resistant paint, and cracks in-filled with a material called cement plastico. The houses were also to be given roof extensions on exposed sides to reduce rain exposure. The technical drawings and plans for the retrofit design can be found in the Appendices.

The El Salvador Project 2011



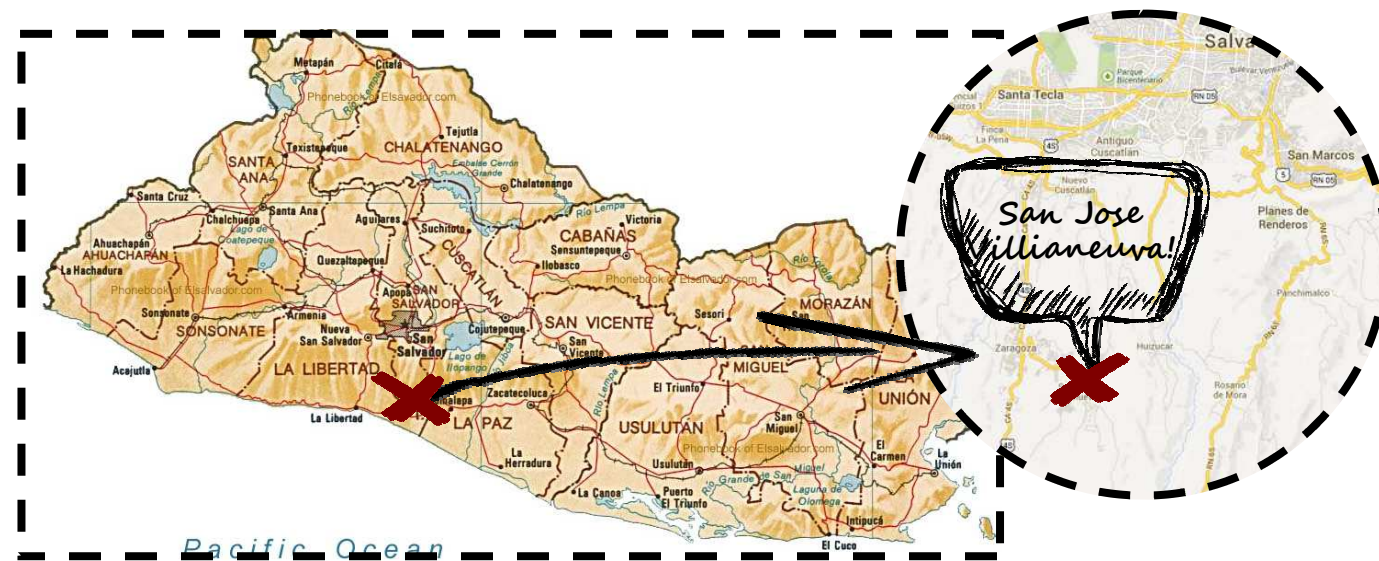
2011 project team with the beneficiaries in Costa Rica, El Salvador

In 2011 a project team from Imperial College London travelled to the village of Costa Rica in El Salvador to implement the first batch of retrofits on the vara de castilla houses. During the six week expedition, the team completed 28 out of the 30 houses in the community, with the remaining two being unoccupied due to extensive damage. The project was completed successfully, with a small leftover budget and within the forecasted timescale. It was decided that subject to evaluation of the design at a later date, the structure could be then used across the remainder of the vara de castilla houses in El Salvador.

The El Salvador Project 2013

The official project brief that was written by the project leaders and agreed with the supporting charity, Engage for Development can be seen opposite. The main purpose of the project was to evaluate the retrofit from the 2011 project in Costa Rica, and following necessary modifications, to implement the same design in another village with vara de castilla houses.

The community to receive aid from Imperial College was identified by the local NGO REDES based on risk of seismic activity, and willingness of the inhabitants. The identified community was a large town, with rural outskirts called San Jose Villanueva, around 45



minutes south of the capital San Salvador. Villanueva is a large town with around 20,000 inhabitants and a fairly developed centre. However the work to be conducted by Imperial College will be on the houses in the more rural outskirts. The El Salvador Project Team of 2008 from Imperial College had previously worked in the town before in 2008, and had helped in the construction of the vara de castilla houses in accordance with REDES' design. These are the houses that the 2013 project team retrofitted this year.

Following the evaluation of the initial retrofit design in Costa Rica, it was decided that the design was fitting to its purpose, with little or no disturbance to the beneficiaries' daily lives. The village had experienced a minor earthquake since the retrofit in 2011 and analysis shows the structures have behaved as expected. However the earthquake was not of a magnitude suitable to assess the structures further, but it was deemed satisfactory for the same design to be carried out in San Jose Villanueva for the 2013 project team. A detailed report of the evaluation process, as well as how the retrofit was carried out this year can be found later on in this report.

Proposed El Salvador Reconstruction and Development Project Brief 2013

Background

Between 2002 and 2005 REDES and a partner NGO constructed 225 low cost vara de castilla houses for poor communities across El Salvador. They consisted of a lightly reinforced concrete slab, a sub-standard welded steel frame, cane, chicken mesh and cement mortar. After a structural assessment by Arup, the houses were considered unsafe in an earthquake or strong winds, and recommended to be retrofitted.

In 2011 the El Salvador Project successfully retrofitted approximately 28 houses in the high risk community of San Jose de Costa Rica. The retrofit consisted primarily of the installation of timber beams fixed with simple steel connections. In addition, the houses were given general maintenance, such as painting of the walls.

Project

A possible very useful project for the El Salvador Project this year would be the evaluation of the 2011 project, followed by the retrofit of other vara de castilla houses in another community in El Salvador. Engage suggest the following:

Visit the community of San Jose de Costa Rica to conduct a thorough evaluation of the project from both a technical and non-technical perspective.

Learn from the results of the evaluation to adapt both the technical details and the method of implementation of the retrofit, as appropriate.

Implement the retrofit fully in another high risk community within El Salvador.

Conduct a training workshop in the community, explaining the importance of regular maintenance.

Provide a maintenance manual for the community.

Prerequisites

For this project to take place, the following are prerequisites:

REDES must accept and be happy fully with the proposal.

A target community must be identified, and must be happy with the proposal.

Engage must be happy with the professionalism within the team from a project management perspective.

Arup must be happy with the professionalism within the team from a site contractor perspective.

The team must raise adequate funds by the end of June – approximately £1300-£1400/ person for general costs + material costs of £500 per house, so assuming 20 houses retrofitted, = £27,000.

2013 Project—Evaluation of Costa Rica

The project began with an evaluation of the original retrofit expedition in 2011, in the village of Costa Rica, El Salvador. The team of 2011, which included one team leader for the 2013 project Elizabeth Liu, retrofitted 28 houses in this community with the same design that was to be used in 2013. It was hoped that the retrofit was successful in its purpose, and also that it did not negatively impact the lives of the beneficiaries.

In addition to the original retrofit plan detailed in the previous section, the team of 2011 also rebuilt the walls of two houses in the community, which had suffered extensive damage due to landslides. Some of the houses were also fitted with roof extensions, small plastic corrugations which extended the roof edges by around half a metre, protecting the wall underneath from water. The team in 2011 did not have sufficient time to finish these, and had trained a group within the community to continue the work after their departure. Both walls and roof extensions are to be evaluated in addition to the retrofit in the scheduled two days.



Installing the roof extensions in 2011



Wall destroyed by a landslide in Costa Rica

The team travelled to the village of Costa Rica on Monday 22nd July with the aim of evaluating all 28 houses in the proceeding two days. Upon arrival on Monday morning, the afternoon was scheduled for a village meeting with the community, a chance for the team to familiarise themselves with the surroundings, meet the people they would be visiting and a chance for us to explain the purpose of the evaluation. It was also important to make sure that all members of the community were happy for us to inspect their houses and to answer

questions as well as to make sure that we visited them at a convenient time. The evaluation strategy was extensively discussed with our supporting charity, Engage for Development and it was decided that it would be split into two parts.

Part 1: Visual Inspection

A visual inspection of the house by the students, with the areas of particular interest agreed upon in advance. Most important were elements such as rusting and quality of fixings as well as signs of insects, damp and mould. Other factors that were to be noted besides the retrofit itself were the two walls that were rebuilt in 2011 due to damage caused by landslides as well as the quality of the paint and roof extensions.

Part 2: Interview with the Beneficiaries

A brief interview with the beneficiaries living in the retrofitted house. The questions would target the work done by the students and how it has affected their everyday life. However it was also a point of interest how the team interacted with the community two years ago, if they enjoyed the experience or felt like they had learnt or taught anything.



The 2013 team with members of the community in Costa Rica, El Salvador



Details of the evaluation and the results from the two parts follow.

2013 Project—Evaluation of Costa Rica

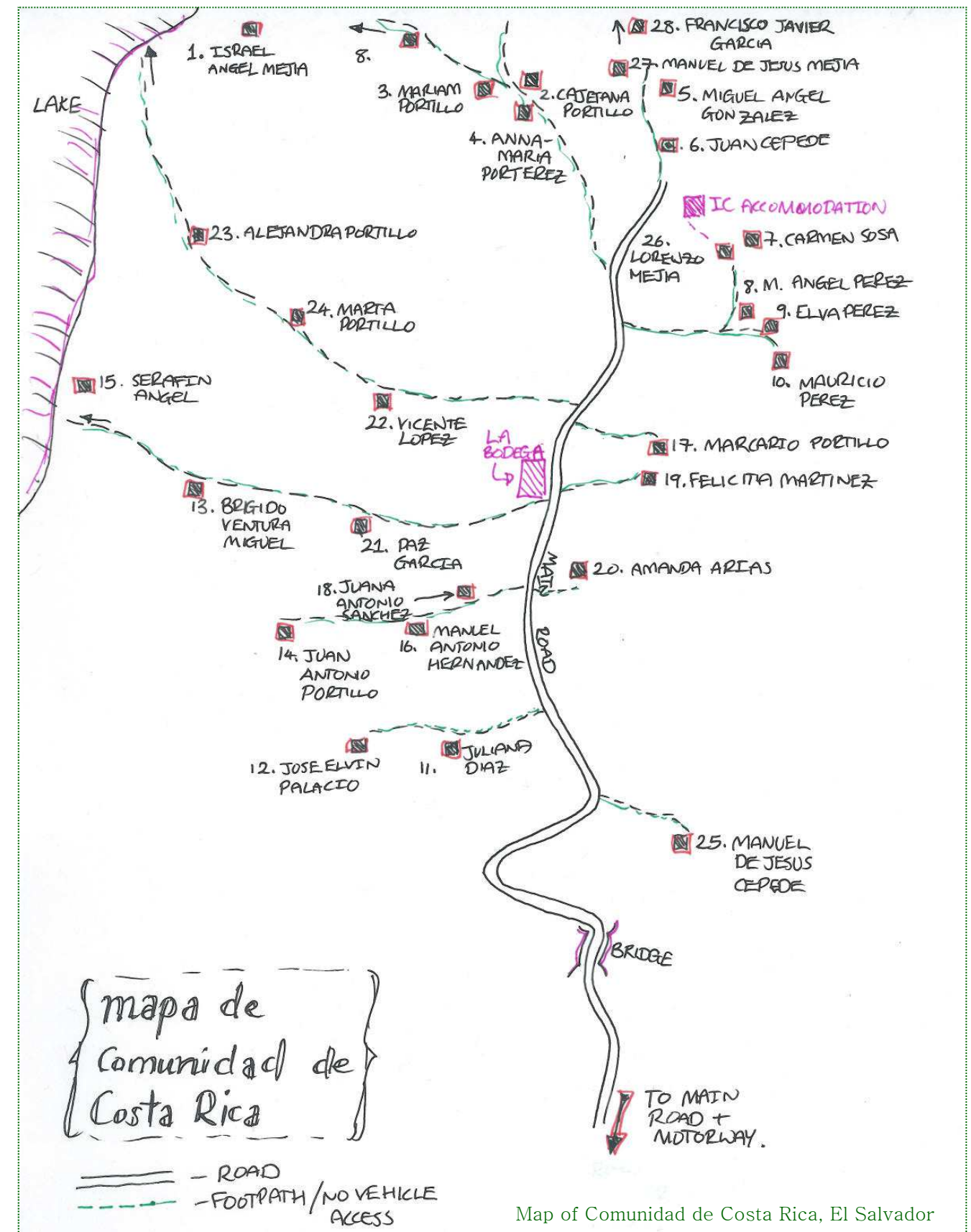
Part 1: Visual Inspection

Each of the retrofitted houses were subject to a visual inspection by 2 to 3 members of the team, with a list of criteria to examine at each location. The tick sheet that was used by the team members is given below, each aspect was to be given a score out of 5, which gives a primary indication of the house condition, with extra comments encouraged where necessary.

Quality of external plates		Paint on bottom of houses	
• Check for rusting	/5	• Check for cracked paint	/5
• Check for peeling of paint	/5	• Flaking and/or peeling	/5
Quality of internal plates		Porch angles	
• Check for peeling paint	/5	• Intact	/5
• Check for broken or sheared bolts	/5	• Rusting	/5
Quality of wood		Termite shelter tubes	
• Any damp or fungus growing	/5	• Are there shelter tubes and have they been knocked off?	/5
• Termite tubes, beetles or ants	/5	Roof extensions	
• Check ends of beams for damage	/5	• Are they functioning well	/5
Fixings in general		• Any sign of water leakage	/5
• All fixings and general quality	/5	Any other comments...	
• Check packers are braced and tight	/5	Please score between 1 and 5.	
• Rusting of bolts	/5	1 = Very bad	
		3 = Satisfactory	
		5 = Excellent	

A summary of the results from the visual inspection can be found on the next page, with the detailed observations from each house detailed in the appendix.

All houses which were retrofitted in 2011 were inspected, the complete list of beneficiaries with a rough map of their locations can be seen opposite.



Visual Inspection Summary

A summary of the visual inspection can be seen here. Each element was given a score out of 5, (1, poor condition to 5, excellent). The scores were averaged and are given below, with some additional comments given by inspection team. The areas that caused the most

Questions		TOTALS	AVERAGES
Quality of external plates	Check for rusting	111	3.96
	Check for peeling of paint	121	4.32
Quality of internal plates	Check for peeling paint	120.5	4.30
	Check for broken or sheared bolts	114	4.07
Quality of wood	Any damp or fungus growing	124	4.43
	Termite tubes, beetles or ants	120	4.29
	Check ends of beams for damage	136	4.86
Fixings in general	All fixings and general quality	113	4.19
	Check packers are braced and tight	104	3.71
	Rusting of bolts	109	3.89
Paint on bottom of houses	Check for cracked paint	118	4.54
	Flaking and/or peeling	115.5	4.44
	Bottom of houses are clean	120	4.29
Porch Angles	Intact	102	4.86
	Rusting	78	3.71
Termite shelter tubes	Existing/knocked off?	136	4.86
Roof extensions	Are they functioning well	72	4.24
	Any sign of water leakage	69	4.06

problems are also discussed further.

It can be seen from the averaged results that in general, the retrofit has satisfied the needs of the beneficiaries and have not deteriorated significantly with time. Although the time frame has been relatively short, with evaluation follow up only two years later, it was deemed sufficient to carry out the retrofit on other *vara de castilla* houses in El Salvador.

The average of the total score that was given by the team members conducting the retrofit was 4.53 out of 5, a relatively satisfactory level of maintenance and longevity in the structure. The results were reported back to the structural engineer at Arup who designed the system for analysis.

After the initial evaluation it was decided that the design was suitable, however further questions, such as how the team worked within the community and other aspects of the project are discussed further in the beneficiary interviews.

Additional Comments

A selection of the most commonly occurring comments given by the inspection team are given briefly below:

- Bottom of houses tend to be mostly free of growth but quite dirty.
- Some missing and loose packers, could have broken and fallen out with time.
- Roof extensions only installed very recently.
- Some concerning cracks in the wood, however after checking with the engineer these seem to pose no structural hazard.
- Porch angle is intact but bolts are fairly rusted.
- Many retrofit beams are being used as shelves and supports. Some may not be safe.
- Some roof extensions that have been drilled in the troughs are leaking through.

Inspection Analysis

It was concluded that in general the quality of the retrofit design was good and could be continued to be implemented in the new community of San Jose Villanueva. There were some interesting aspects of the evaluation however, which came to light. Most importantly many of the roof extensions that were left for the local community to complete were not installed until only one week before the 2013 project team's arrival. It was evident that it was due to our immanent visit that the community felt it was necessary to install the remaining roofs. Whereas it is a positive outcome that the work was eventually completed, it must be questioned whether the roofs would have remained uninstalled if the team had not revisited the community. It should be noted that this could be a sign that the community were not well informed about the importance of the work to be carried out, and better communication, knowledge exchange and education needs to be worked on in future projects.

However some minor adjustments were to be made following the evaluation to ensure a good project to follow.

- 1) The porch angles and some of the external bolts were noted to be fairly rusty, this was because the angle plate itself was painted with anti-corrosion paint but the bolts were missed out, as well as on some of the plates on the house. In San Jose Villanueva it was noted that after the installation, all the bolts should also be carefully painted over using the same anti-corrosion paint.
- 2) Packers were often a little loose and some were broken, extra care needs to be taken when drilling and selecting these for the retrofit. This was somewhat remedied in advance as many were ordered from the sawmill to be cut in their machines, as many in the 2011 project were sawed by hand, resulting in unsuitable or poorer quality pieces.

2013 Project—Evaluation of Costa Rica

Part 2: Beneficiary Interviews



giving interviews they did not want to, and also that we visited at a time that was convenient for the beneficiaries and that we did not arrive unexpectedly.

The detailed answers of each beneficiary who was interviewed can be found in the appendices, with the general overview of the village given here, as most of the answers we heard were in good agreement with each other. The assessment of the answers are also included below.

Question 1: Have you had any seismic activity in this area?

Most members of the village reported a minor earthquake within the last month. Evidently from the answers however, it was not strong enough to have been felt by everyone, thus would not have been sufficient to test the retrofitted structures fully. However there was reported movement in both the earth and walls of the house. All beneficiaries reported that very little to no damage was done to their houses or the additional works.

Question 2: In general have you had any problems with the retrofit?

In general the beneficiaries complimented the work and said that they had not experienced any problems within the last two years, since it had been fitted. Many have said that there have been a few cracks in the wood appearing but upon inspection and checking with the structural engineer, it was decided that these were mainly due to shrinkage of the wood post-installation and posed no structural hazard to their purpose. Few families have reported that during very strong hurricanes, the bolts which fix the wood to the external wall can sometimes leak water. However these were easily fixed with the addition of the roof extension. Some packers had also broken and fallen out, which cannot be replaced without unscrewing the whole bolt and re-drilling a new piece of wood.

Question 3: Has the retrofit inconvenienced you in any way? Has it been noticeable?

Most answered this question positively, saying it did not affect them in the slightest and some have even started using the wooden beams for shelving and hanging items on. It has noted by the inspection team that some of the beams were being used to support fairly large items. The families living in these houses were advised to be careful with what they were using the beams to shelf, there is a danger of the boxes affecting the integrity of the wood, and more likely it would be dangerous if such boxes fell from a height above people's heads.

One representative of each house was interviewed by the evaluation team. The project team was split into two, with a translator in each asking questions, and another Spanish speaker to write down answers to make the interviews run more smoothly. The list of questions that were asked are listed above.

The team first met with the community of Costa Rica on the first day when we first arrived. During this meeting, the purpose of our visit was explained briefly, and we enquired if the community would be willing and comfortable to take interviews from the teams. Upon confirmation of their agreement, we then gave them the time frames in which we would be conducting interviews and asked that they decided amongst themselves when they would like us to visit their homes. In this way it was ensured that no one was pressured into

Question 4: What maintenance have you carried out on your home since two years ago?

The responses to this question were slightly mixed, many of the beneficiaries had been maintaining their houses by cleaning the walls at the bottom to prevent damp spreading up the dirt and into the walls. Many others had repainted the walls and over the metal plates. However there were also many families who claimed that they did not know they were meant to maintain the houses and that the message was not delivered clearly on how to do so. This was a surprise for the evaluation team and it was decided that a second meeting to discuss maintenance with the community was necessary. This was arranged for the end of the trip, just before the team was to leave El Salvador. One of the team leaders as well as a translator travelled back to Costa Rica to give a talk, and the same workshop was also conducted in San Jose Villanueva, the new village to be retrofitted, by the second translator after the works were complete.

Question 5: What role did you play in the retrofit of your house? What was your experience like?

It was a requirement for the project in 2011 that each house to be retrofitted had a beneficiary to help the Imperial College project team, to aid the transfer of skills and to give the family a sense of ownership of the work. Most of the beneficiaries responded by saying they helped support beams during the construction process, or helped transport the wood to the houses at the beginning of the project. It was encouraging to see that most people answered that not only they helped, but also other members of their family, including their children and children's partners. The community were very complimentary to the Imperial College team, saying that they were fun to work with and they enjoyed the experience, and also suggesting that they had learnt a lot about construction as well. Some members of the community were also especially trained to install the roof extensions, which they helped with even after the project team's departure.

Question 6: Do you feel like you learnt anything from the Imperial College team?

Most of the beneficiaries felt that they learnt from the team but also that they taught them a lot of things as well. The main learning point was the retrofit itself, as many of them completed the construction with the team. Additionally many of them learnt the purpose for the retrofit, and how it would make their houses stronger. There were also many beneficiaries who said they had learnt how to maintain the house, although from the question above it can be seen that this was not transferred to all members of the community. Other basic learning points, especially for the women was learning how to use simple hand tools. The team learnt basic building methods from the local community as well, for example for to mix cement on the ground and mortaring.

Question 7: Do you have any concerns about the future of your retrofit or the future of your home in general?

The biggest concern for the beneficiaries currently are the quality and fixing of their roofs. This is not connected to the retrofit carried out in 2011 but the roof tiles that have been used to build the houses have become weak and cracks form which leak water. It was not possible to fix this during the time the team had in the village, but during the maintenance workshop, the community were advised on how best to fix this. Other major concerns are that some families still doubt the ability of the retrofit to withstand a very strong earthquake. However the general response was that there was much less worry now that they are sufficiently satisfied the retrofit would serve its purpose after the first small initial earthquake experienced in the last month.

Question 8: Are the roof extensions working well? Are they leaking?

Most of the roof extensions were installed by the local community, who were trained by the 2011 project team before their departure. The local team changed the installation procedure slightly by drilling the roof extensions in the peaks of the corrugation instead of the troughs, which is what the Imperial College team did. This meant that water could not pool and collect at the holes and run down the extension into the houses through the bolt holes, seeing a much more successful installation at keeping water out. However it was interesting to note that most of the roof extensions were installed very recently, some only one week prior to the 2013 project team's visit. The local team that were trained to install the extensions became busy and could not complete the work after the project left the country and only pushed to install the last few because they new of the 2013 evaluation team's arrival.

Question 9: Was there anything that inconvenienced you in the way the project was carried out?

In general the beneficiaries complimented the Imperial College team and said we were very professional in the way we installed the structures in their houses. There were some comments about the team organisation and how we could have been more clear about timescales so that the beneficiaries could organise themselves better. However overall they were happy to receive the retrofit and all said they really enjoyed working together.

2013 Project—Retrofit in San Jose Villanueva

The Retrofit

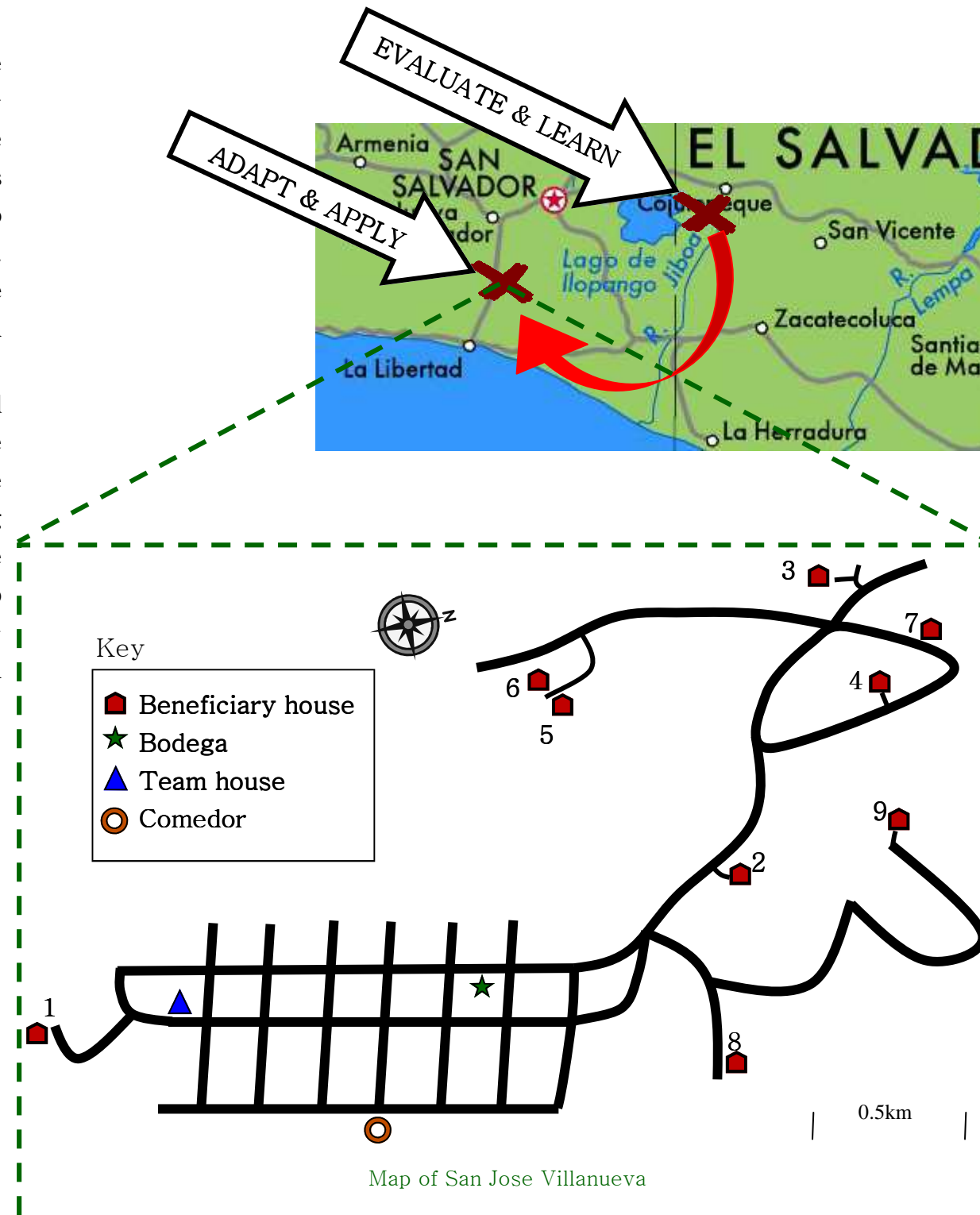
Having carried out the evaluation in the village of Costa Rica, the team travelled to the new village of San Jose Villanueva on 25th July 2013. The overall conclusion of the evaluation was that the retrofit had been a success, and no major changes needed to be made to the design. One minor addition was included however, which was the painting of the ends of the wooden beams with preservative where they had been cut in order to protect against termites.

Living Arrangements

The team had one main contact in San Jose Villanueva called Isaias, who is part of a community group in Villanueva and also has some involvement with REDES. It is through Isaias that the team rented a house for the team to stay in for the three weeks spent in Villanueva. The house consisted of one large room where camp beds were set up, and another open plan kitchen area with a fridge and gas stove. Although the house had a plumbed toilet and shower, the water pipe supplying the house had a leak, therefore the team filled up a large tank periodically to avoid constantly flooding the street outside. The team also shared the house with one other tenant, a local shop worker called Jordie. The team cooked breakfast and dinner most days, and used a local comedor for lunch.



The team hosting dinner for the locals in our rented accommodation



Beneficiaries

San Jose Villanueva has a total of 15 vara de castilla houses. Out of these, 9 families agreed to the remedial works and had their house retrofitted. However, two of the houses were not the standard vara de castilla design and an alternative retrofit design had to be produced impromptu, details of which are given on the next page. The beneficiaries are as follows:

1. Carlos Cordero
2. Jose Luis Mesia
3. Juan Paredes (Bety)
4. Rafael Perez Corpano
5. Dora Durman
6. Victoria Gertrudis
7. Ana Marlene (variant house)
8. Maria Antonia
9. Juan Mulato (variant house)



The team with the beneficiaries

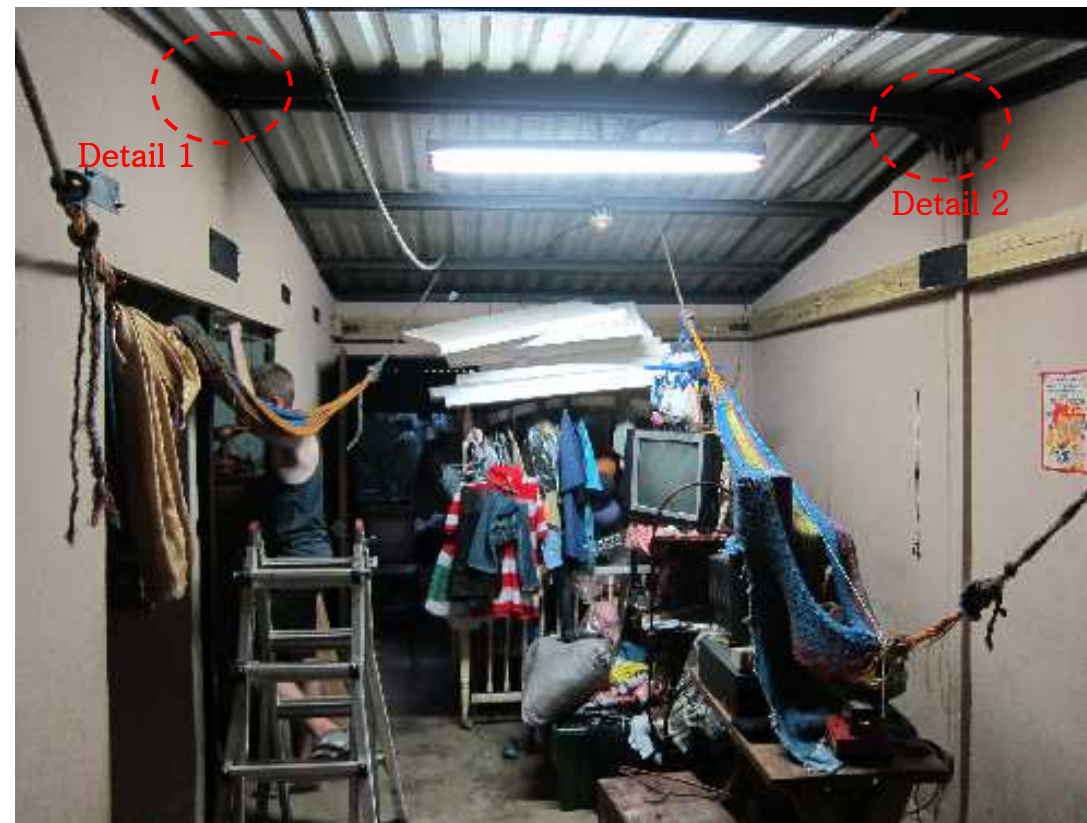
2013 Project—Retrofit in San Jose Villanueva

Operation

The team used a local bodega as a wood store and a place to hold meeting. The initial meeting with the community took place on Friday 26th July 2013. At this meeting the whole team were able to meet the local villagers who lived in the vara de castilla homes, and explain to them the benefits of the retrofit. A schedule was then made for those who wanted the remedial works. The whole team worked on the first house together, led by Elizabeth Liu who had undertaken the retrofit before in 2011. Having completed this house together, the students split into two teams of five, and retrofitted two houses at a time simultaneously. Each team consisted of one team leader and one translator, as well as any members of the local community that wanted to help. This provides knowledge transfer and helps facilitate the maintenance of the houses after the team has left. The teams were also mixed up at various points throughout the expedition to ensure that everybody got a chance to work with each other.

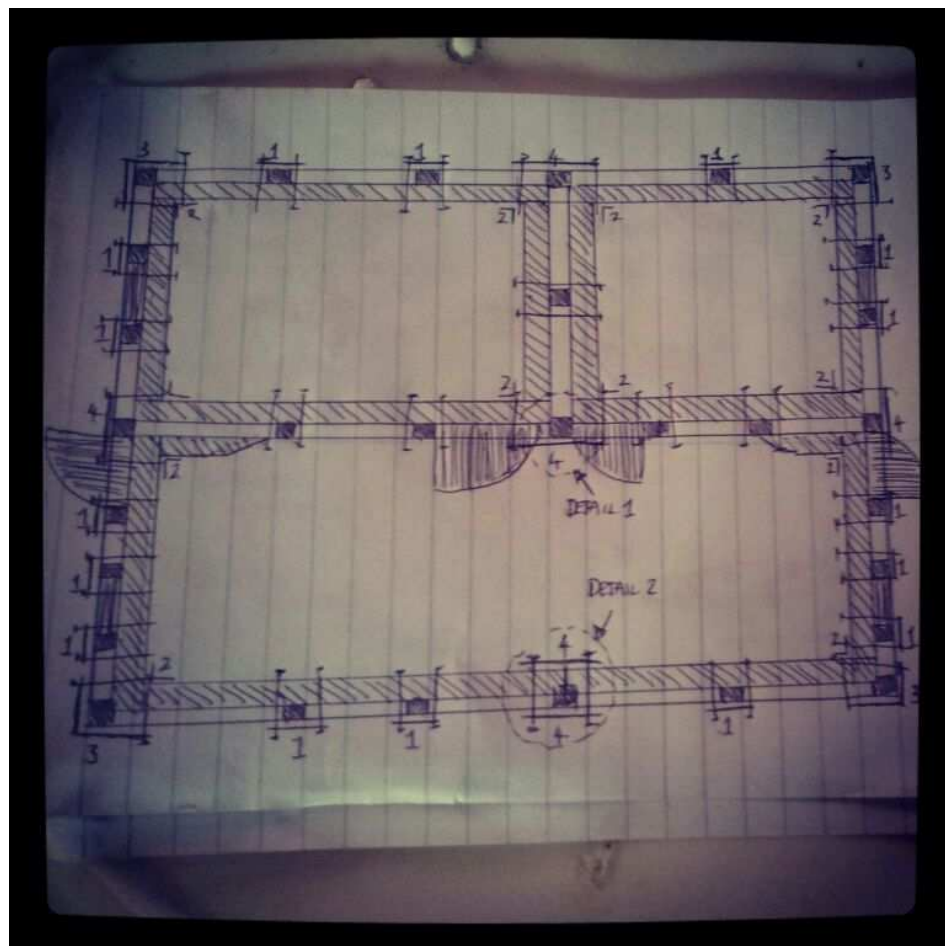
Retrofit Description

The retrofit involves installing internal wooden beams approximately 2m above floor level. The beams are braced by bolting them to external steel plates at each of the existing columns. A steel plate is also installed at the porch angle. This whole process stiffens the structure and adds stability during an earthquake. The house is also painted using waterproof paint on the external walls (up to a height of 60cm from the floor) to prevent leakage during the monsoon season.



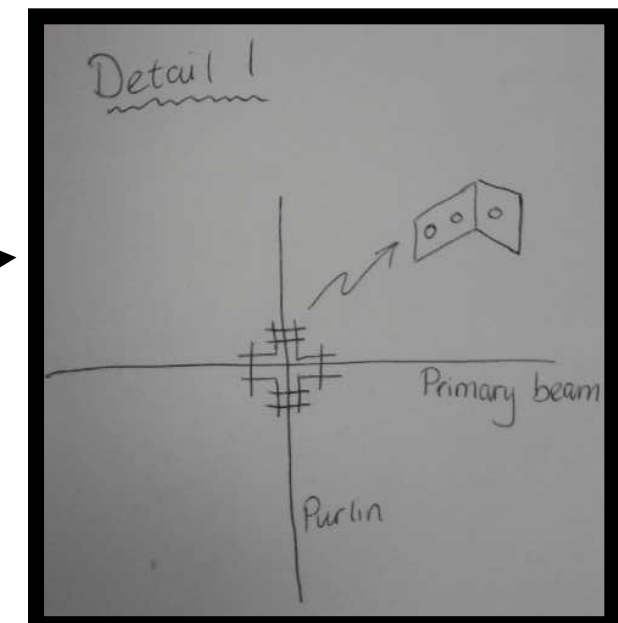
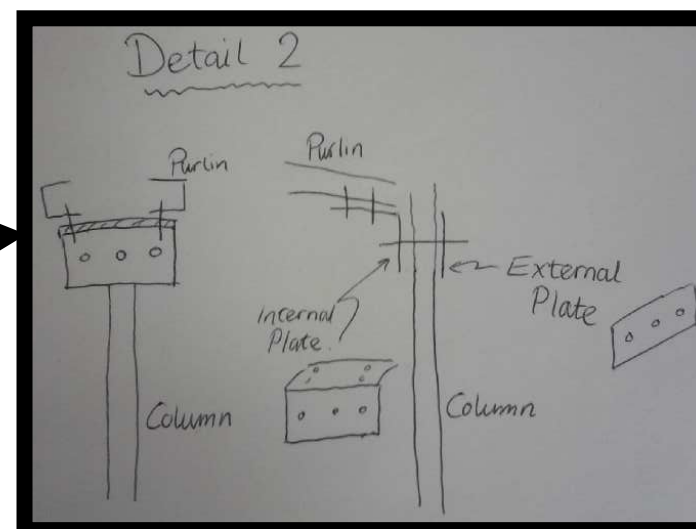
Variant House

The unexpected variation of the vara de castilla house required an impromptu design, which is shown here. The house is rectangular in shape (as opposed to the standard L shape), and did not have any porch attached to it. The new design required bespoke plates to be designed and ordered, which are also shown here. These plates are attached to the rafters in two locations.



The retrofitted house using the impromptu design

Impromptu design



2013 Project—Retrofit in San Jose Villanueva

Construction Process

1

First the wood is transported to the beneficiary's home. Transportation of the wood was carried out on foot or using one of the local's vans if available

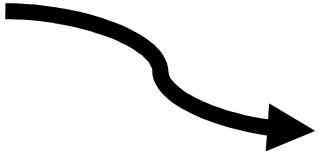
Enjoying the ride whilst transporting wood



2

The house is measured and holes are drilled in the correct place ready for the beams to go up.

A student drilling holes



3

The wood is cut to the correct size using power tools supplied by Hilti.



A student using a reciprocating saw



4

The beams are supported using props, and drilled through from the outside using the holes made in stage 2.



5

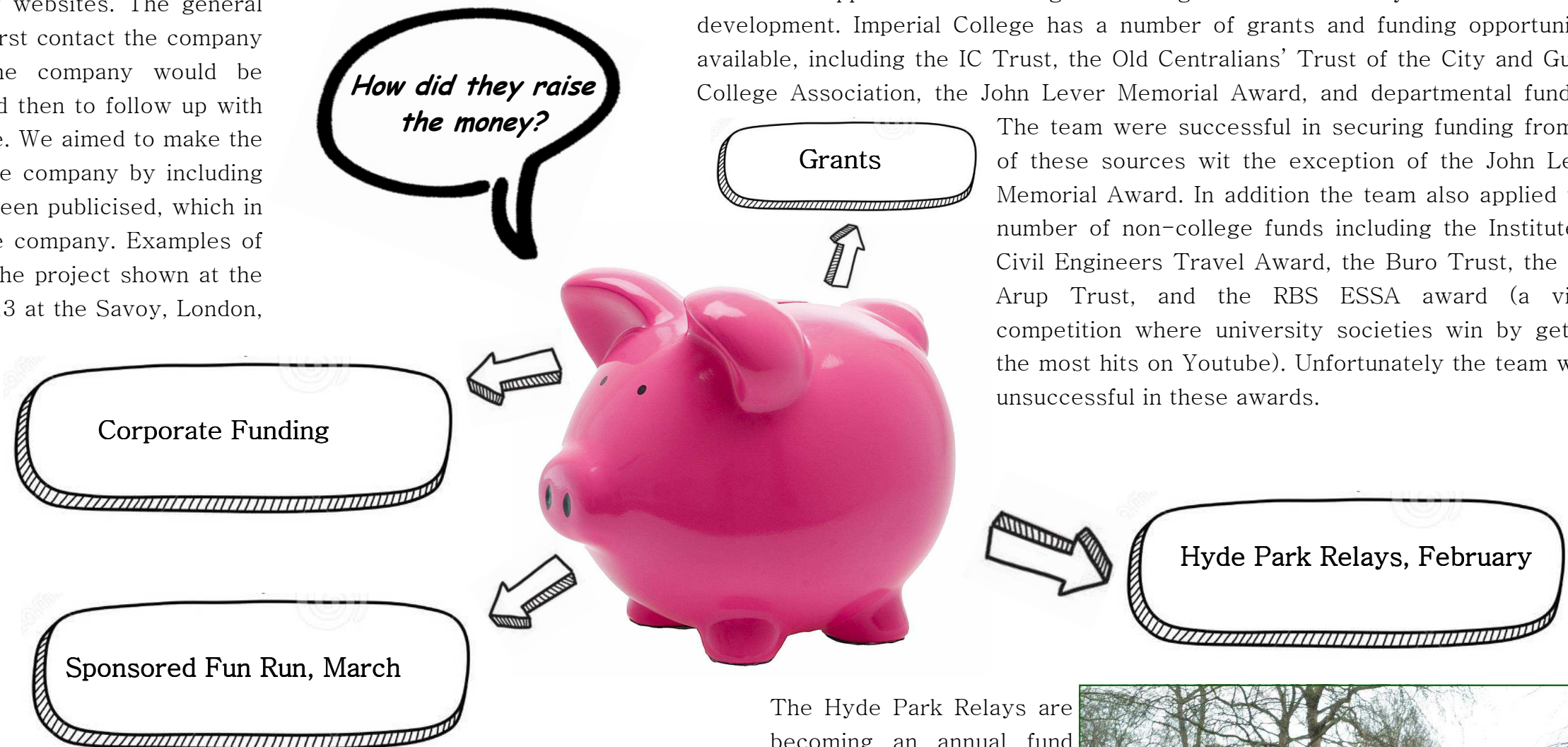
Plates are then installed on the external walls, and a bolt is pushed through the hole and tightened to secure the plate to the beam.



The team with Dora, post-retrofit

Project Fundraising

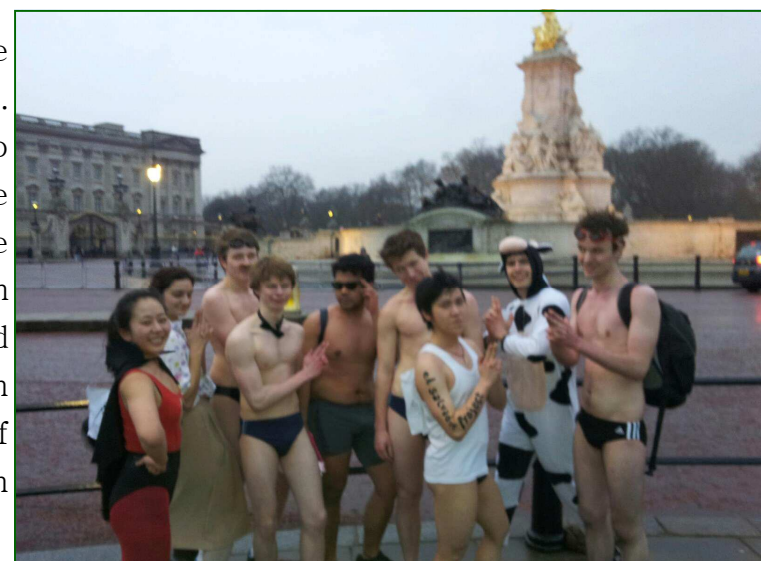
Approximately 35 companies were approached for funding. Some of these companies were approached using contact details given by previous members of the project (such as colleagues, friends or alumni), and others were identified through careers events or company websites. The general approach used by the team was to first contact the company via phone to enquire whether the company would be interested in funding the project, and then to follow up with an email if the response was positive. We aimed to make the email as appealing as possible to the company by including instances of where the project has been publicised, which in turn would result in publicity for the company. Examples of this include a promotional video of the project shown at the Global Grand Challenges Summit 2013 at the Savoy, London, as well as the team presenting at the International Development Conference at Imperial College London. We also advised them that their company logo would be displayed with all project publicity.



The team applied to various grants designed to aid charity work or student development. Imperial College has a number of grants and funding opportunities available, including the IC Trust, the Old Centralians' Trust of the City and Guilds College Association, the John Lever Memorial Award, and departmental funding.

The team were successful in securing funding from all of these sources with the exception of the John Lever Memorial Award. In addition the team also applied to a number of non-college funds including the Institute of Civil Engineers Travel Award, the Buro Trust, the Ove Arup Trust, and the RBS ESSA award (a video competition where university societies win by getting the most hits on Youtube). Unfortunately the team were unsuccessful in these awards.

This was an event organised by the students on the expedition to gain sponsorship from friends and family. The run was an 8km stint from the Tower of London to Imperial College Union on a Friday evening, and the team auctioned a choice of costumes to complete the run in. If sponsorship for an individual reached a certain value, the costume the team member would be required to wear to complete the run changed. The run generated nearly £2,500 for the project, and most of team members were required to complete the run in swimming costumes.



Fun Run, March 2013

The Hyde Park Relays are becoming an annual fund raising opportunity for the project. Each year a group of 6 students from the project team or committee run in the relays, and money is donated by friends and family through the Virgin Money Giving website. The relays are organized by the Imperial College Cross Country & Athletics Club at Imperial College, and are open to both teams of students at Imperial College as well as external groups. The event is also a good opportunity for us to raise awareness of the project by handing out flyers.



Hyde Park Relays, February 2013

Budget Report

EL SALVADOR PROJECT 2013 - INCOMES AND FUNDRAISING

SOURCE OF FUNDING	DESCRIPTION	AMOUNT (£)
Student fundraising events and donations	Student donations towards flights	7078.42
	Virgin Fundraising Page 1, Hyde Park Relays	431.09
	Virgin Fundraising Page 1 London Costume Run	2325.79
Industrial donations	AECOM	200.00
	Expedition Engineering	500.00
Charitable grants and University Involvement	Old Centralians' Trust	3300.00
	Imperial College Department of Civil Engineering	2500.00
	IC Trust	2000.00
Other	Refunded wood purchase overflow (converted)	618.27
TOTALS	POUNDS (£)	18953.57
	APPROX. EQUIVALENT DOLLARS (\$)	28430.35

EL SALVADOR PROJECT 2013 - EXPENDITURES

DESCRIPTION/DETAIL	AMOUNT (\$)	APPROX GBP EQUIVALENT
Total Cost of Flights	12491.33	8327.55
Transport in El Salvador	1126.56	751.04
Accommodation in El Salvador	1325.45	883.63
Food and Drink in El Salvador	786.80	524.53
Tools and Materials	10622.14	7081.43
Other Expenditures in country	63.07	42.05
TOTALS	26415.35	17610.23

EL SALVADOR PROJECT 2013 - FINAL BALANCE

TOTAL INCOME	TOTAL EXPENDITURES	LEFT IN ACCOUNT	CURRENCY
18953.57	17610.23	1343.34	GBP
28430.35	26415.35	2015.01	US DOLLARS

Notes:

- Students paid for the flights and were refunded 15% of the total upon return.
- Equivalent US Dollars and GBP converted at rate of £1.00=\$1.50

The team fundraised throughout the year leading up to the expedition, the amount of which would determine the scope of the project and how much money will be left to the following year's team. The bulk of the money raised came from affiliations with the university, with generous donations from both charitable trusts of the institution, as well as the Civil and Environmental Engineering department. The team also raised a large amount in organised events, such as sponsored runs.

Excluding flights, the bulk of the expenditures for the project was on materials purchase, as expected making up over 75% of the remaining outgoings. The biggest cost came from the wood and steel plates used on the retrofit of the houses.

A summary of the incomes and expenditures of the 2013 expedition can be seen opposite, with a more detailed breakdown in the appendices.

Of the remaining funds left in the account, part of the money remains in El Salvador, with the local NGO REDES. It has been agreed with them that this money will be kept for next year's expedition, to use when they arrive in country. The remainder is held in UK accounts, and will be used to facilitate the running of the society for the following academic year.

The Project would like to give a huge thank you to everyone who donated to the project, including friends and family that were kind enough to support the events organised by the students.

Materials Sourcing

As part of the project, it was very important for us to use materials in the retrofit that could be sourced by the local community, should they need to repair damage or want to implement the design across other houses in their village. It was required that each house should have at least 1 or 2 beneficiaries to help the team with the retrofitting process, so that they could gain an understanding of how to implement it, thus if it became necessary to repair anything, they should have a clear idea of how to do so. The materials that were used were largely purchased in the capital, San Salvador with a few minor exceptions. A brief description of each element is given below.

Wooden Beams- Aserradero el Triunfo

The wood that was used was an import from America, however the sawmill which we procured them from was located in central San Salvador, **Aserradero el Triunfo**, translated as the Sawmill of Triumph. The sawmill sells a wide variety of woods and plywoods as well as paint and fixatives. We purchased all of the 14 and 12 foot beams from here, as well as the wood that was used to build the props during the construction process. The sawmill also offer a cutting service for a small charge, which we used to produce our packers.



Metal Plates- Torno Lara

The plates that were used on the retrofitted houses were purchased from a small business in San Salvador called Torno Lara, who sell metal sheeting of different thicknesses, which they can then charge to be cut, bent into angles and drilled with holes. The plates were ordered to be custom made for each house.



TornoLara

Bolts and Fixings- La Palma and La Casa Del Tornillo

La Palma is a local hardware store in San Salvador with several chains across the capital. They sell mostly fixings and hand tools, as well as electrical tool accessories. All fixings for the wooden beams and plates were purchased in La Palma in the form of 1 metre long threaded bolts and then taken to another local service called **La Casa del Tornillo** for cutting into appropriate lengths for use. The nuts, washers and drill bits were also purchased from La Palma.



House Paint and all Tools- Freund

Freund is the largest chain hardware store in San Salvador and stocks most of the hand tools as well as the paints that were used for the retrofit. Both the waterproof paint on the bottom of the houses as well as the metal anti-corrosion paint was procured from Freund, as well as all hand tools such as spanners, monkey wrenches and hammers. Many of the drill bits that were used in the power tools was also purchased from Freund, mostly the bits that were used for drilling metal. Most of the wood drill bits were purchased from La Palma, as mentioned above.



Exceptions

Although we endeavoured to procure all tools and materials from El Salvador, there were some exceptions which needed to be taken with us from the UK.

- 1) The power tools were donated by Hilti in 2011 and were used for both the retrofit that year as well as on the project this year in 2013. In order to ensure compatibility the saw blades were also purchased from the UK, but all drill bits used in the power drills were bought in San Salvador.
- 2) The self tapping screws that were used to secure the small angle plates on the internal side of the wooden beams were also taken from the UK. In 2011 locally sourced bolts were used but problems were encountered when the bolts were not strong enough to take the shear force sustained during the installation process, and broke before it could be completely installed.
- 3) All personal protective equipment was taken from the UK as this was donated generously by Laing O'Rourke for free. However all items used can be easily procured from Freund or other hardware shops in the capital of El Salvador.

The El Salvador Project Committee

This year saw the El Salvador Project become an official society of the Imperial College Union and therefore has had a committee instated. Their role will be to act as an interface between the IC Union and the expedition team, and they will provide knowledge transfer between last year's team and the next. They also help out with fundraising and general admin.



A new committee will be elected each year at the Annual General Meeting (AGM). The committee members will generally be students who are not going on the expedition that year, but will consist of people who have been before or are interested in charity work and its general operation.

This Year (2012/13)



Undergraduate 4th Year
Chemistry

Oliver Garnett
Chair



Undergraduate 4th Year
Civil and Environmental Engineering

Ben Gaitskell
Treasurer



Undergraduate 4th Year
Civil and Environmental Engineering

Wui Yang
Chair



Undergraduate 2nd Year
Civil and Environmental Engineering

Orrin Lancaster
Vice Chair



Undergraduate 2nd Year
Civil and Environmental Engineering

Melanie Singh
Secretary



Undergraduate 3rd Year
Civil and Environmental Engineering

Bradley Pring
Treasurer



Undergraduate 3rd Year
Civil and Environmental Engineering

Melanie Singh
Secretary

The Future

Potential Future Project

Next year it is likely that the project will involve the construction of another prototype house, similar to the 2012 project. The main aim of the prototype house is to showcase and test a design that is low cost, buildable by locals using local resources and materials, and seismically resistant.

In preparation for this, a number of seismic experimental tests have been carried out on prototype walls built in the structures laboratory in the Department of Civil and Environmental Engineering. The research is led by Engage for Development and ARUP, as well as academics at Imperial College, including Dr Christian Málaga Chuquitaype.

It is anticipated that the designs for the new prototype house will be completed by November 2013, which would provide enough time to order materials, organise local labour in El Salvador, and ultimately construct these prototypes in summer 2014.

Future Fundraising Plans

The team this year came up with a number of ideas for fundraising events that weren't carried out due to time constraints. These include:

- **Seminars:** The team could host a seminar on charity and development work for primary/secondary school children. By charging a small amount to the participating school, this would raise money for the project as well as educate young people in engineering. The seminar would also be accompanied with a workshop where the students could work in teams to apply their new engineering knowledge. This year a small number of calls were made to schools in order to verify interest levels and a positive response was received. The event would however require that everyone participating has a criminal records bureau (CRB) check.
- **Union Bar Night:** The team could book the union bar (no charge for an IC society) and sell tickets for a bar night. This could also be coupled with a slave auction to raise additional funds.
- **Raffle:** We acquired a number of items that will be used in a raffle next year, including a bottle of wine (RRP £100), a book and Hummingbird vouchers.
- **Bake Sale:** There seems to be some restrictions on selling home made food but we believe it is worth investigating further.
- **BBQ:** Again there seems to be some regulations when setting up a BBQ, but we believe it would be a good fund raiser, particularly if undertaken around exam time when students are at their hungriest.



Experimental testing of the wall in the structures lab at Imperial College



Prototype house from the 2012 project during construction

Thank You

The project this year would not have been possible without the contributions made by our sponsors and supporters. We would like to thank everyone involved: the Old Centralians' Trust of the City and Guilds College Association, the Imperial College Trust, IC Union, the Department of Civil and Environmental Engineering of Imperial College, Expedition Engineering, AECOM, Edmund Booth, Engage for Development, REDES, ARUP, Hilti, and the friends and family of the team for their support and generous donation during our fund raising campaigns!



Appendices

Appendix A–Retrofit Technical Drawings

1.0 Scope

- a) The purpose of the works is twofold: firstly, to retrofit the existing housing with simple timber and steel details to structurally improve the houses in the event of an earthquake or strong winds; secondly, to prolong the life of the houses.
- b) The scope comprises:-
- installing timber beams and fixings as shown on drawings SK 002 - SK 017
 - extending the roofing beyond the gables to protect the wall from rain
 - patching any holes in the roof
 - filling any large cracks in the walls to limit water ingress
 - painting the outside of the houses
 - cleaning out the drainage channel at the base of the wall
 - all associated temporary works
- c) The timber beam connections have been designed to accommodate varying wall thicknesses from 50-90mm
- d) Any supporting props for the timber should not be removed until all bolts for that piece of timber are in place - the screws for example are not designed to carry the self-weight of the timber.
- e) Contractor is responsible for all temporary works

2.0 Risks

The contractor should be aware of the following residual hazards and suggested mitigation measures:-

- a) Asbestos roofing - no work should be done on houses that have asbestos roofing panels, and these houses should not be entered.
- b) Drilling and cutting
- wear suitable PPE such as gloves and safety specs and keep loose items of clothing away from the equipment.
 - when drilling through timber from outside ensure that hands are kept away from the timber when drilling through the wall
 - when drilling through mortar protect against spalling mortar
 - some elements of the existing structure are quite weak, so care must be taken when drilling through the walls not to apply too large a load and hammer drilling shall be avoided
- c) Working from height - suitable access must be provided.
- d) Chemical burns - wear suitable PPE such as gloves and safety specs if using materials such as wet lime or cement mortar
- e) Animal bites - El Salvador has biting animals such as spiders, scorpions and snakes, so suitable care must be taken if working in dark areas and PPE worn when required.

3.0 Materials

- a) All timber to be 2.5" x 5.5" minimum grade 1 Southern pine. Ends of timber beams to be cut if splitting has occurred. Beam 1B-1D to be graded at midspan - knots over 20mm diameter must not be visible at in the middle half of the beam on the sawn 5.5" face.
- b) All steel plate to be 3mm thick, minimum American grade A36 or equivalent mild steel (minimum yield strength = 235N/mm², 34ksi). Plate to be degreased and painted on site with suitable steel paint such as Hammerite.
- c) All screws to be self-tapping wood screws, stainless steel minimum Grade A2-70 (minimum tensile strength = 700N/mm², 100ksi) or equivalent. Size to be 6mm outer diameter (or 1/4") and 60mm long, with a dome Philips / Pozidriv head.
- d) All bolts to be mild steel minimum Grade 2 (minimum yield strength = 393N/mm², 57ksi) or equivalent. Size to be 8mm diameter (or 5/16") with a hexagonal head. Bolts to be fully threaded and either 250, 180, 120, 100, 80 or 60mm long as shown on the drawings. All washers to be 20mm diameter, mild steel. All nuts to be hexagonal, mild steel.
- e) All cracks over 1mm to be filled with waterproof filler such as mastic, lime or cement mortar, and painted over. All smaller cracks to be painted over.

4.0 Workmanship

- a) Self-tapping screws to be drilled in straight. Screws to be carefully tightened to refusal and not forced beyond this.

- b) When drilling through mortar, 6mm pilot hole is required to reduce risk of spalling. Make good any spalled mortar with adequate waterproof filler such as lime or cement mortar.
- c) Bolts to be hand tightened to refusal.
- d) Holes in steel plate for screws and bolts to be no more than 2mm larger than shank.
- e) Once construction is complete make good all scratches to steel with suitable steel paint such as Hammerite.

5.0 Material Schedule

		Number Per House
Southern pine Grade 1 (2.5" x 5.5")		
	3m long approx*	11
	1m long approx*	1
	4m long approx*	1
Steel plates and angles Grade A36		
	P1	13
	P2	12
	P3	5
	P4	4
	P5	1
	P6	1
	P7	1
6 x 60mm stainless steel screws Grade A2		96
8mm mild steel bolts		
	180mm long	62
	250mm long	8
	100mm long	2
	80mm long	1
	60mm long	1
	120mm long	1
Matching nuts		75
20mm washers		85

*Timber beams to be supplied oversize and cut to length on site to suit site dimensions.

Issue	Date	By	Chkd	Appd
-	24/05/11	SK	AL	AL

ARUP

13 Fitzroy Street
London W1T 4BQ
Tel +44(0)20 7636 1531 Fax +44(0)20 7580 3924
www.arup.com

Client

REDES

Job Title

El Salvador Housing Scheme
Remedial Works

Drawing Title

General Notes

Scale at A3

1:50

Discipline

Structural

Drawing Status

CONSTRUCTION

Job No

077989-82

Drawing No

SK001





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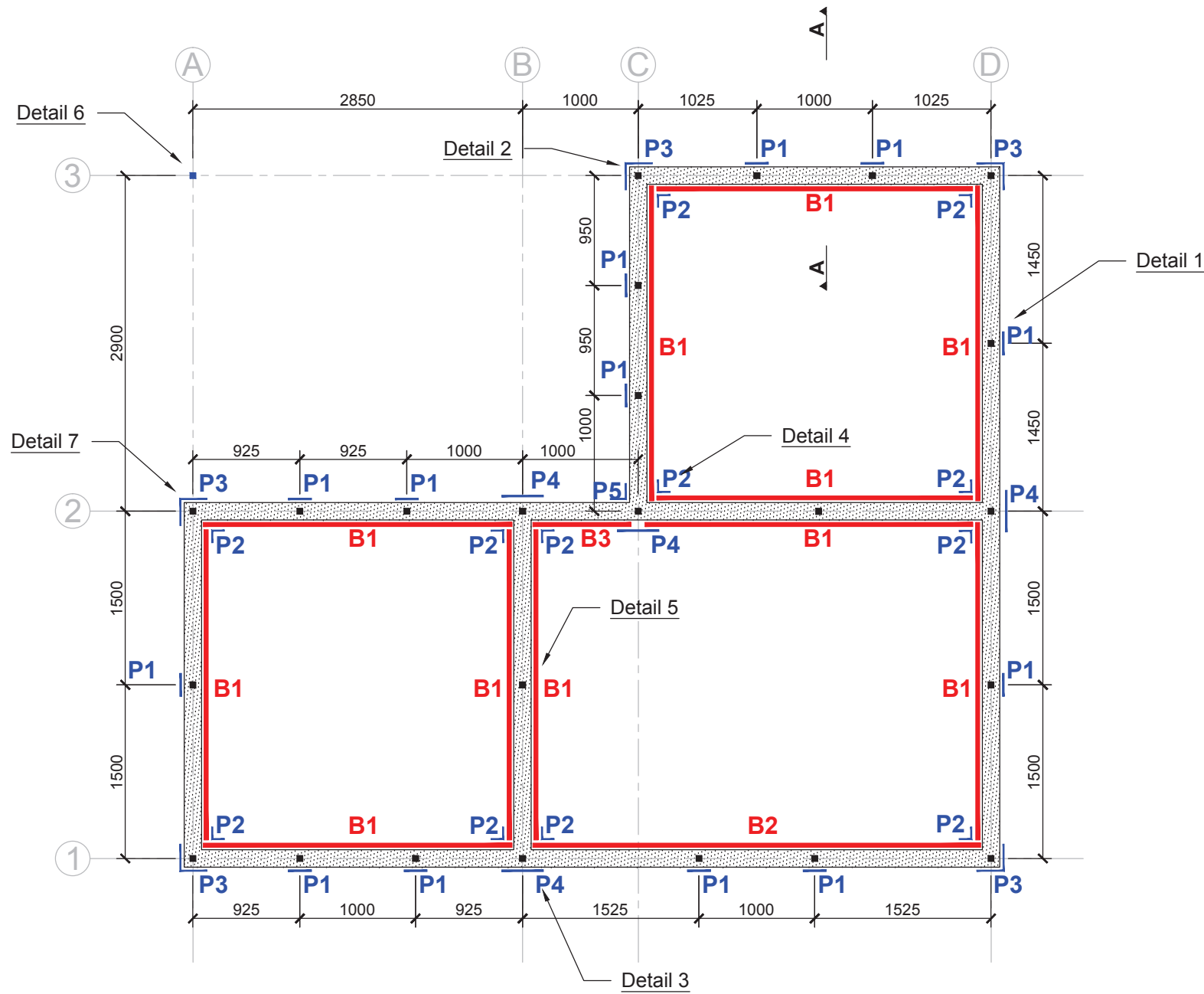
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Notes

- 1) All dimensions in mm unless noted otherwise
- 2) All dimensions approximate

Key

-  Existing wall. Typically 50-90mm thk
-  Existing steel columns. Typically 1"x1" or 2"x2" rectangular hollow sections
-  New timber beams
-  New steel angles and plates



Plan (1:50)

-	24/05/11	SK	AL	AL
Issue	Date	By	Chkd	Appd

ARUP

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 London W1T 4BQ
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 www.arup.com

Client
REDES

Job Title
**EI Salvador Housing Scheme
 Remedial Works**

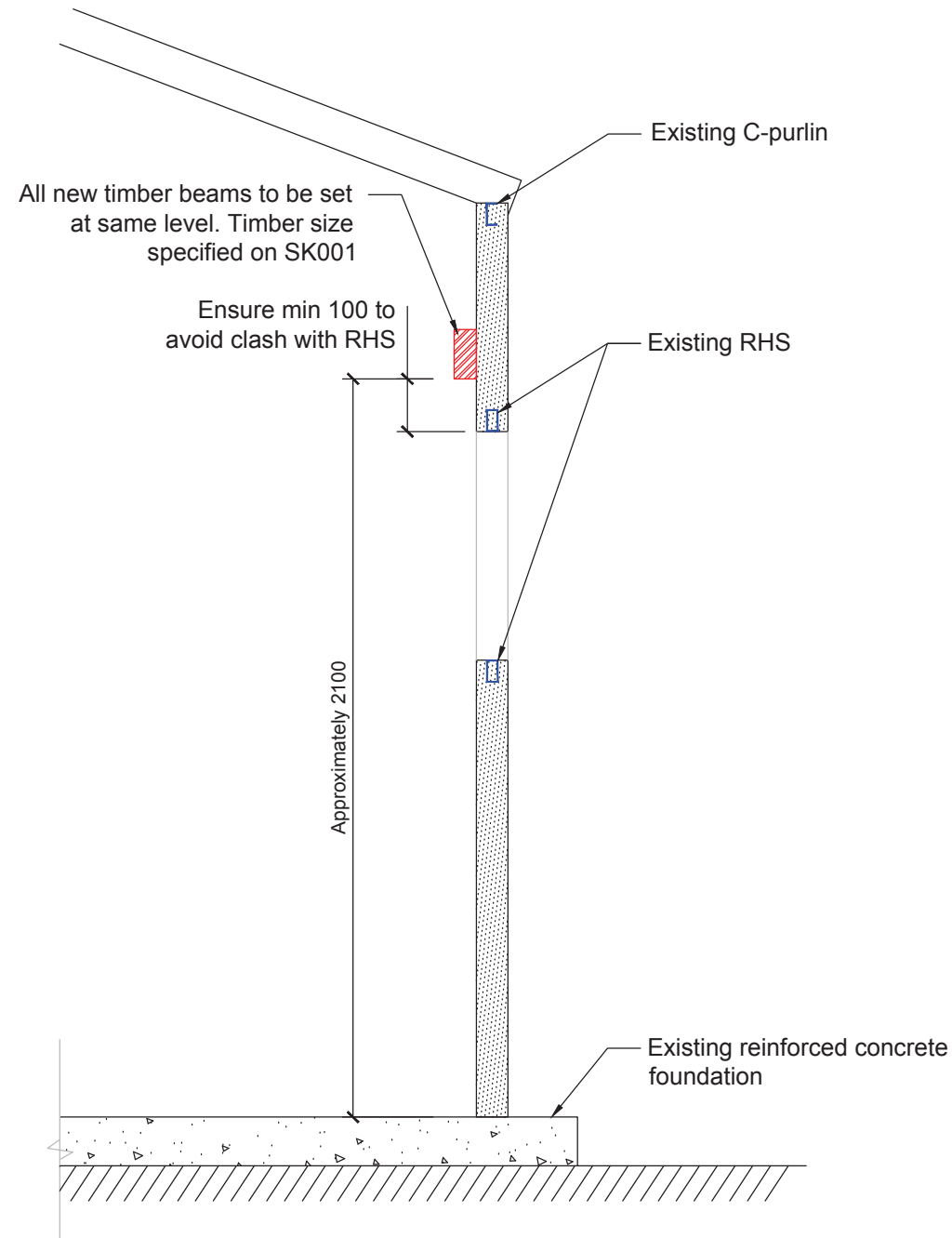
Drawing Title
Plan

Scale at A3
 1:50

Discipline
Structural

Drawing Status
CONSTRUCTION

Job No 077989-82	Drawing No SK002	Issue -
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Typical Section A-A (1:20)

Notes

1) All dimensions in mm unless noted otherwise

-	24/05/11	SK	AL	AL
Issue	Date	By	Chkd	Appd

ARUP

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www.arup.com

Client
REDES

Job Title
El Salvador Housing Scheme
Remedial Works

Drawing Title
Typical Section Through Wall

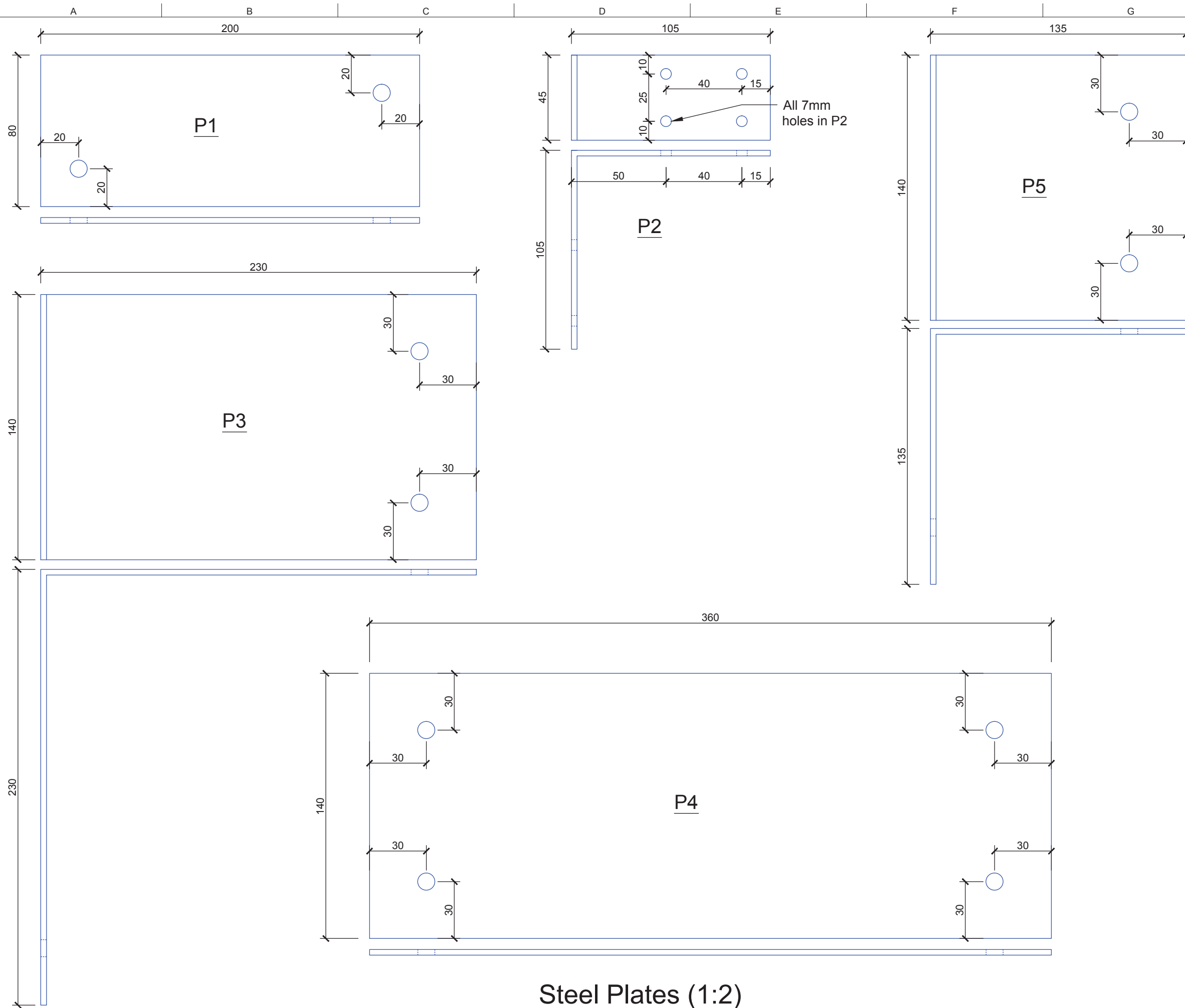
Scale at A3
1:20

Discipline
Structural

Drawing Status
CONSTRUCTION

Job No 077989-82	Drawing No SK003	Issue -
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A3



Steel Plates (1:2)

- Notes**
- 1) All dimensions in mm unless noted otherwise
 - 2) All hole sizes 10mm diameter unless specified otherwise
 - 3) Steel plate to be 3mm thick minimum Grade A36 (S235) or equivalent mild steel
 - 4) 90° bend in plate to be as tight a radius as possible

-	24/05/11	SK	AL	AL
Issue	Date	By	Chkd	Appd

ARUP

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Client
REDES

Job Title
El Salvador Housing Scheme Remedial Works

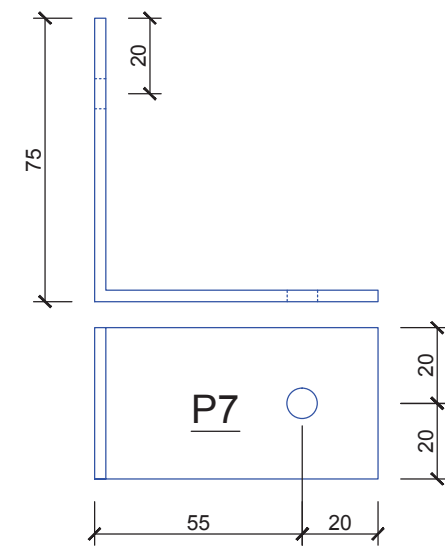
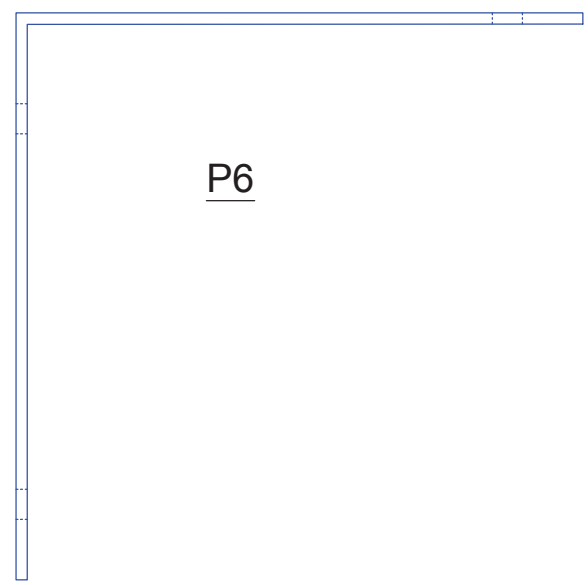
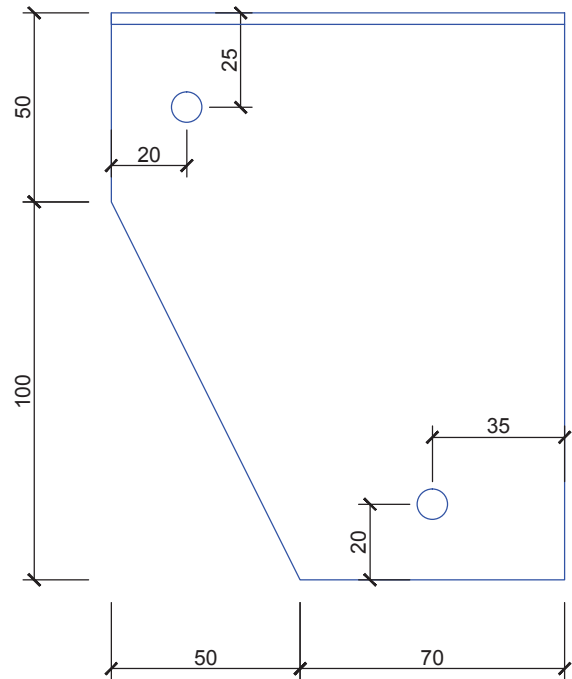
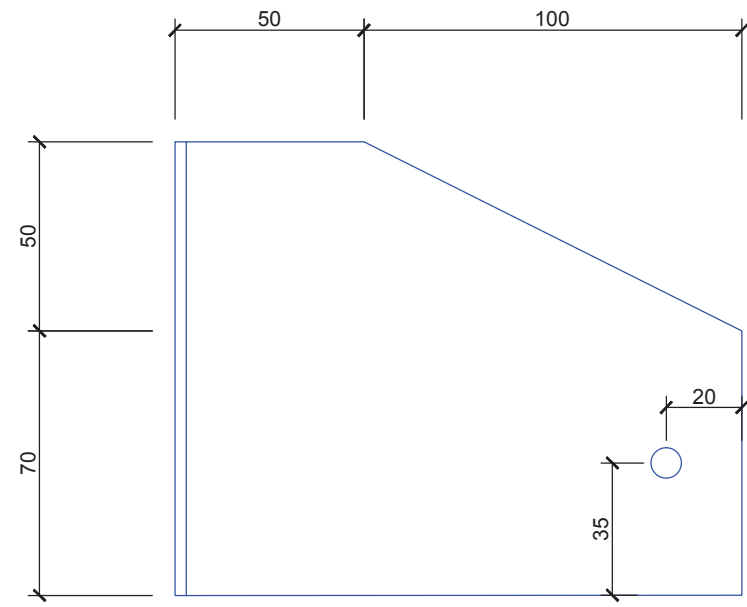
Drawing Title
Steel Plate and Bracket Dimensions (Sheet 1 of 2)

Scale at A3
 1:2

Discipline
Structural

Drawing Status
CONSTRUCTION

Job No 077989-82	Drawing No SK004	Issue -
----------------------------	----------------------------	------------



Notes

- 1) All dimensions in mm unless noted otherwise
- 2) All hole sizes 10mm diameter unless specified otherwise
- 3) Steel plate to be 3mm thick minimum Grade A36 (S235) or equivalent mild steel
- 4) 90° bend in plate to be as tight a radius as possible

-	24/05/11	SK	AL	AL
Issue	Date	By	Chkd	Appd

ARUP

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Client
REDES

Job Title
**El Salvador Housing Scheme
 Remedial Works**

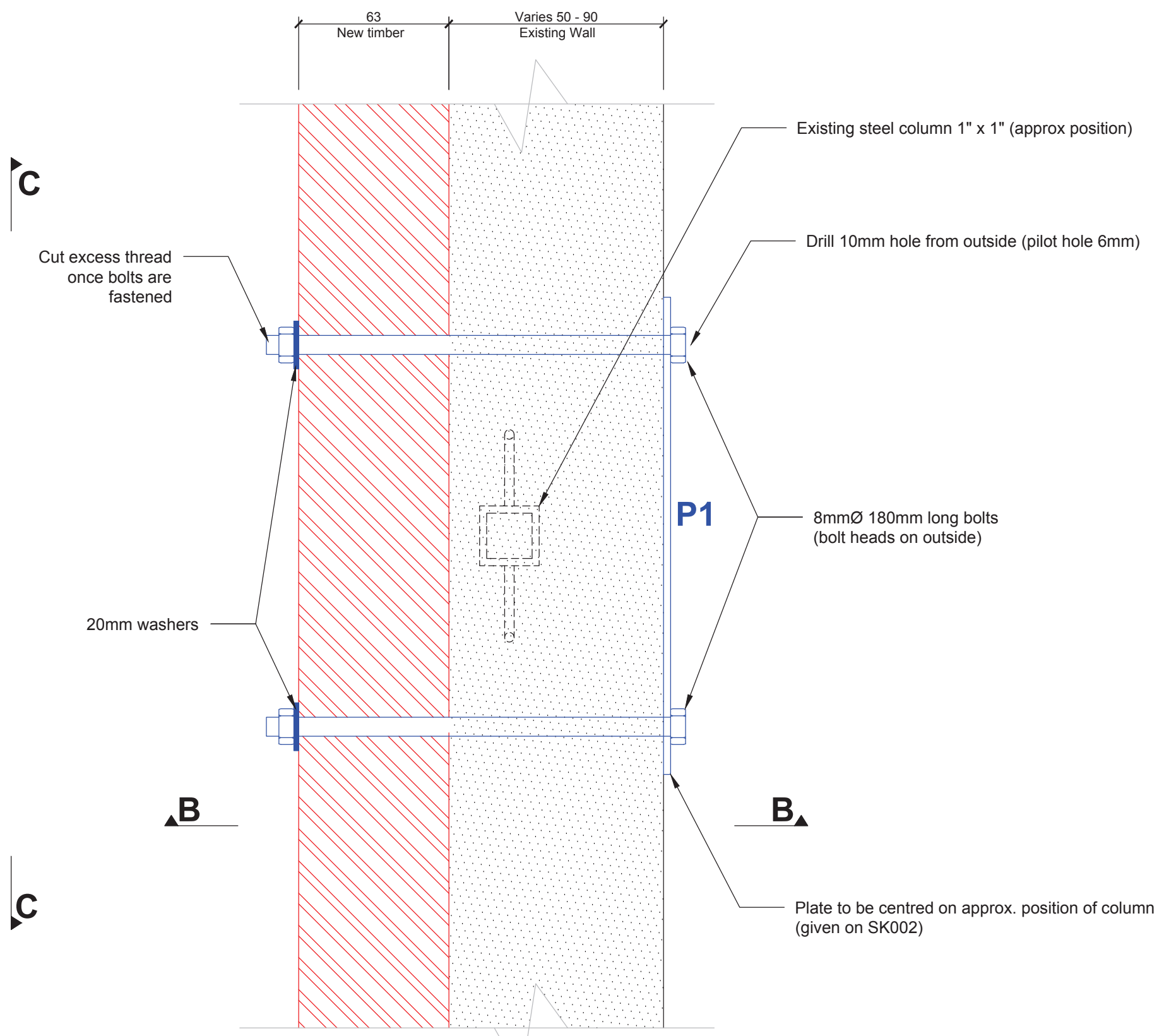
Drawing Title
**Steel Plate and Bracket Dimensions
 (Sheet 2 of 2)**

Scale at A3
 1:2

Discipline
Structural

Drawing Status
CONSTRUCTION

Job No	Drawing No	Issue
077989-82	SK004	-



Detail 1 (1:2)

Because column position may vary, there is a small possibility of hitting the existing steel column structure. If this occurs, redrill holes 30mm away horizontally and fill new open hole with mortar

Notes

1) All dimensions in mm unless noted otherwise

-	24/05/11	SK	AL	AL
Issue	Date	By	Chkd	Appd

ARUP

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Client
REDES

Job Title
**El Salvador Housing Scheme
 Remedial Works**

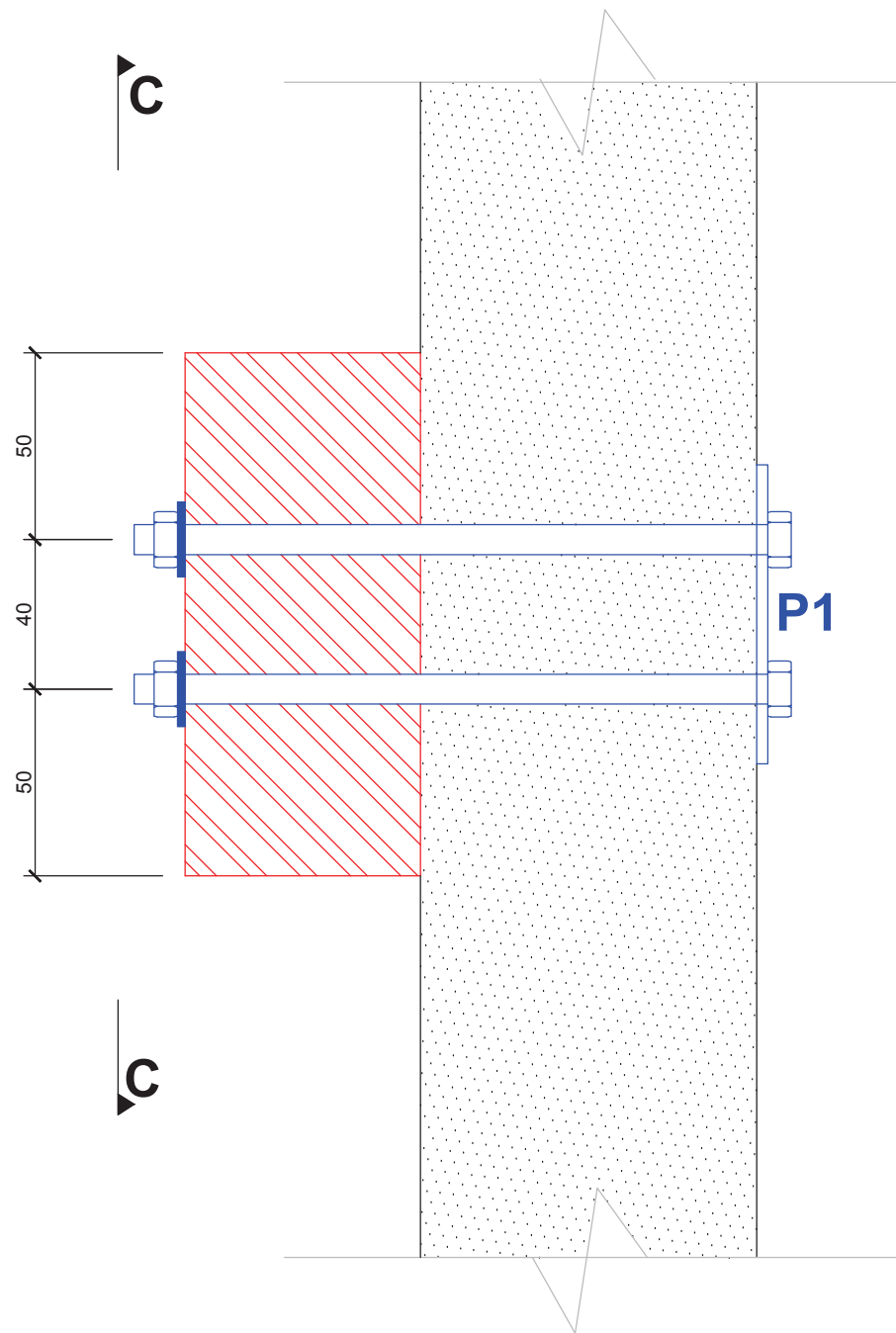
Drawing Title
Detail 1

Scale at A3
1:2

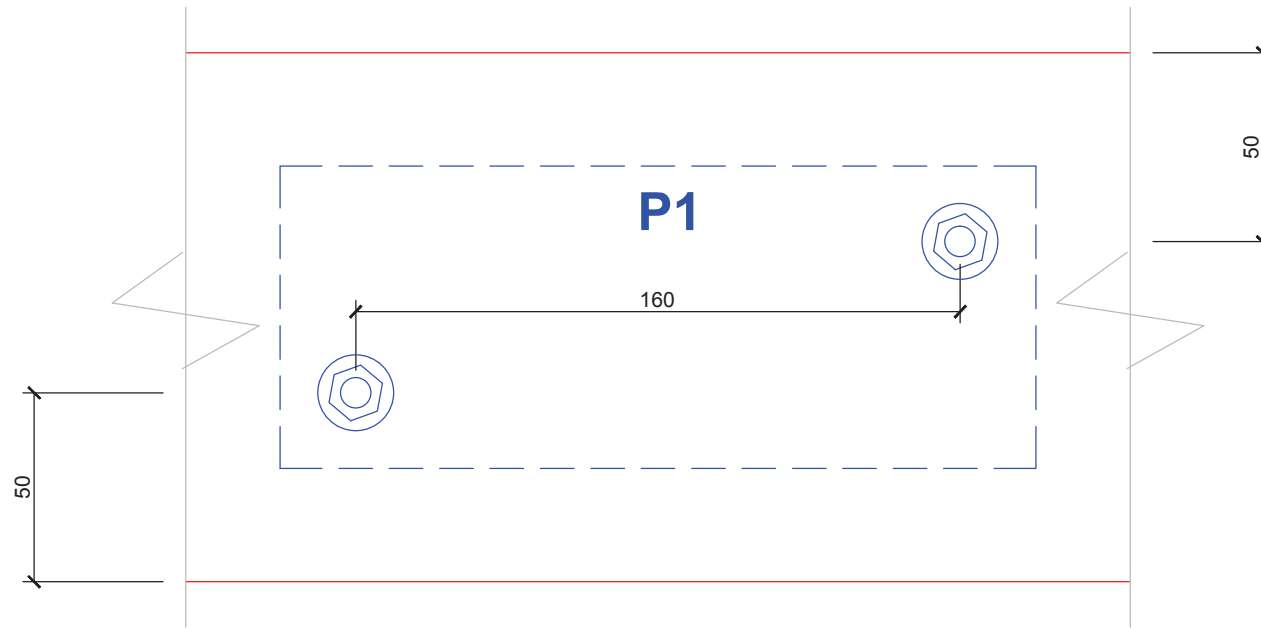
Discipline
Structural

Drawing Status
CONSTRUCTION

Job No 077989-82	Drawing No SK006	Issue -
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Section B-B (1:2)



Section C-C (1:2)

Notes

1) All dimensions in mm unless noted otherwise

Issue	Date	By	Chkd	Appd
-	24/05/11	SK	AL	AL

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Job Title
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Remedial Works**

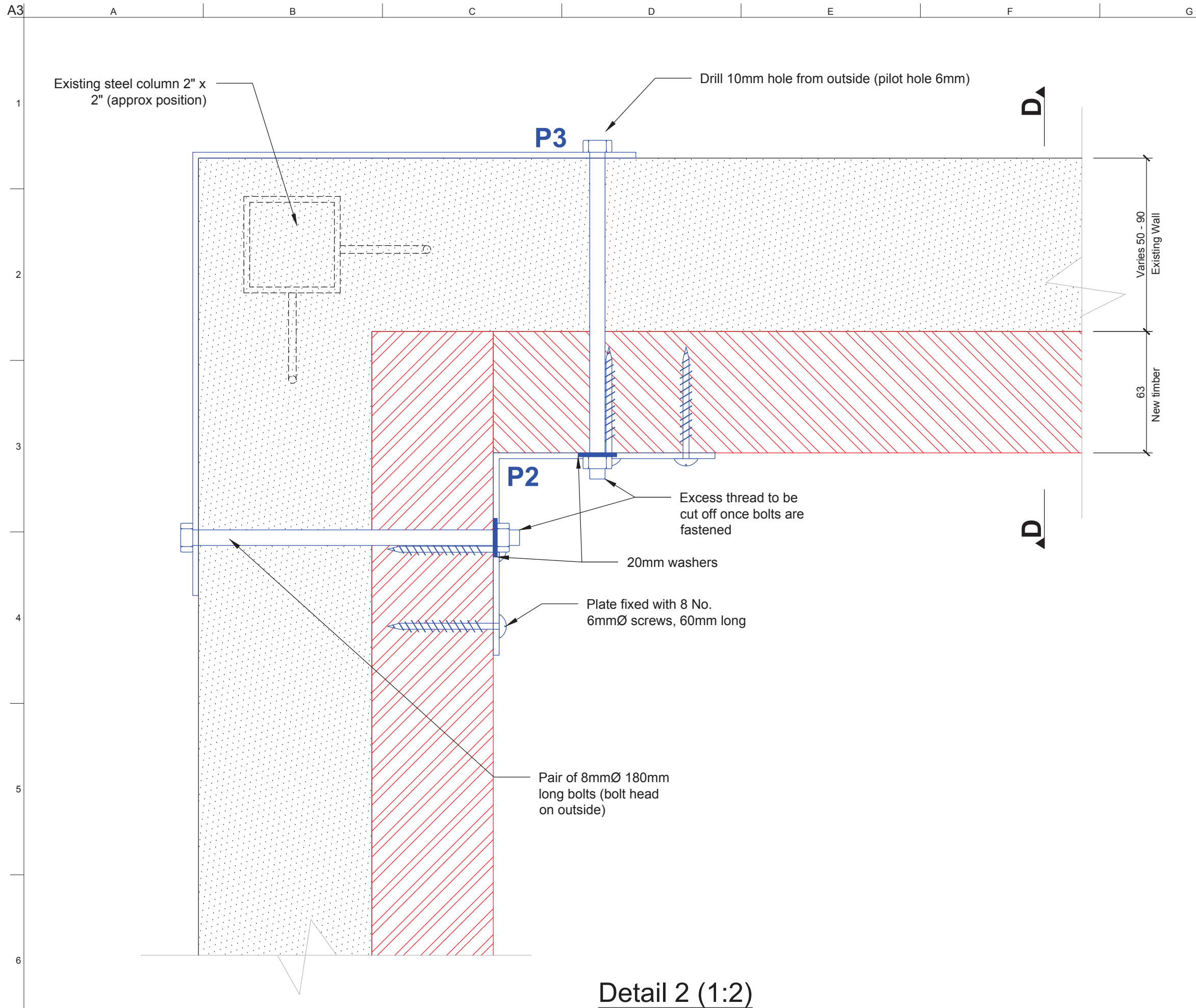
Drawing Title
Sections B-B and C-C

Scale at A3
1:2

Discipline
Structural

Drawing Status
CONSTRUCTION

Job No	Drawing No	Issue
077989-82	SK007	-



Detail 2 (1:2)

Notes
 1) All dimensions in mm unless noted otherwise

Issue	Date	By	Chkd	Appd
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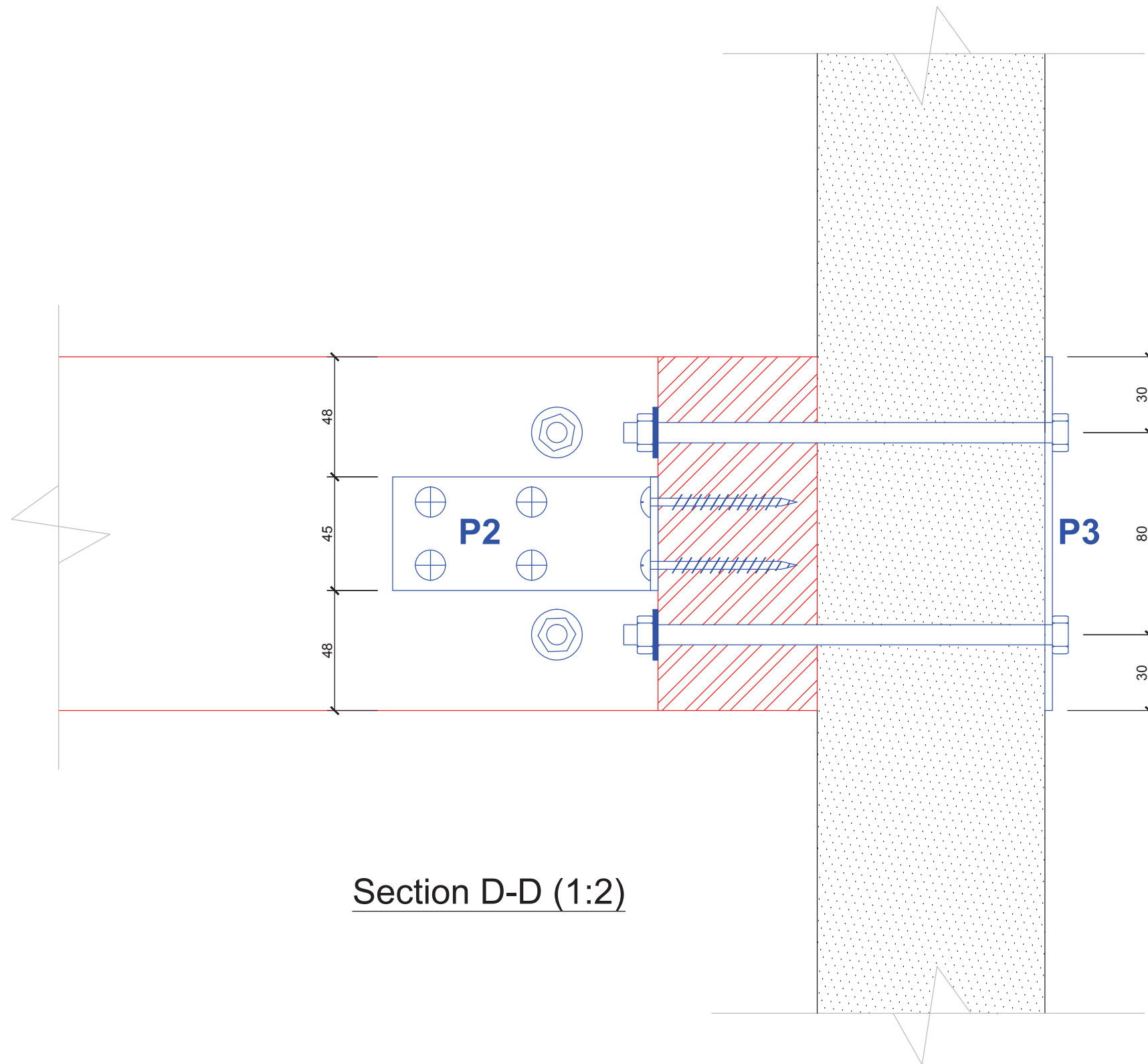
Drawing Title
Detail 2

Scale at A3
 1:2

Discipline
Structural

Drawing Status
CONSTRUCTION

Job No	Drawing No	Issue
077989-82	SK008	-



Section D-D (1:2)

Notes

1) All dimensions in mm unless noted otherwise

-	24/05/11	SK	AL	AL
Issue	Date	By	Chkd	Appd

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Job Title
**El Salvador Housing Scheme
Remedial Works**

Drawing Title
Section D-D

Scale at A3
1:2

Discipline
Structural

Drawing Status
CONSTRUCTION

Job No 077989-82	Drawing No SK009	Issue -
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A3

A B C D E F G

1

2

3

4

5

6

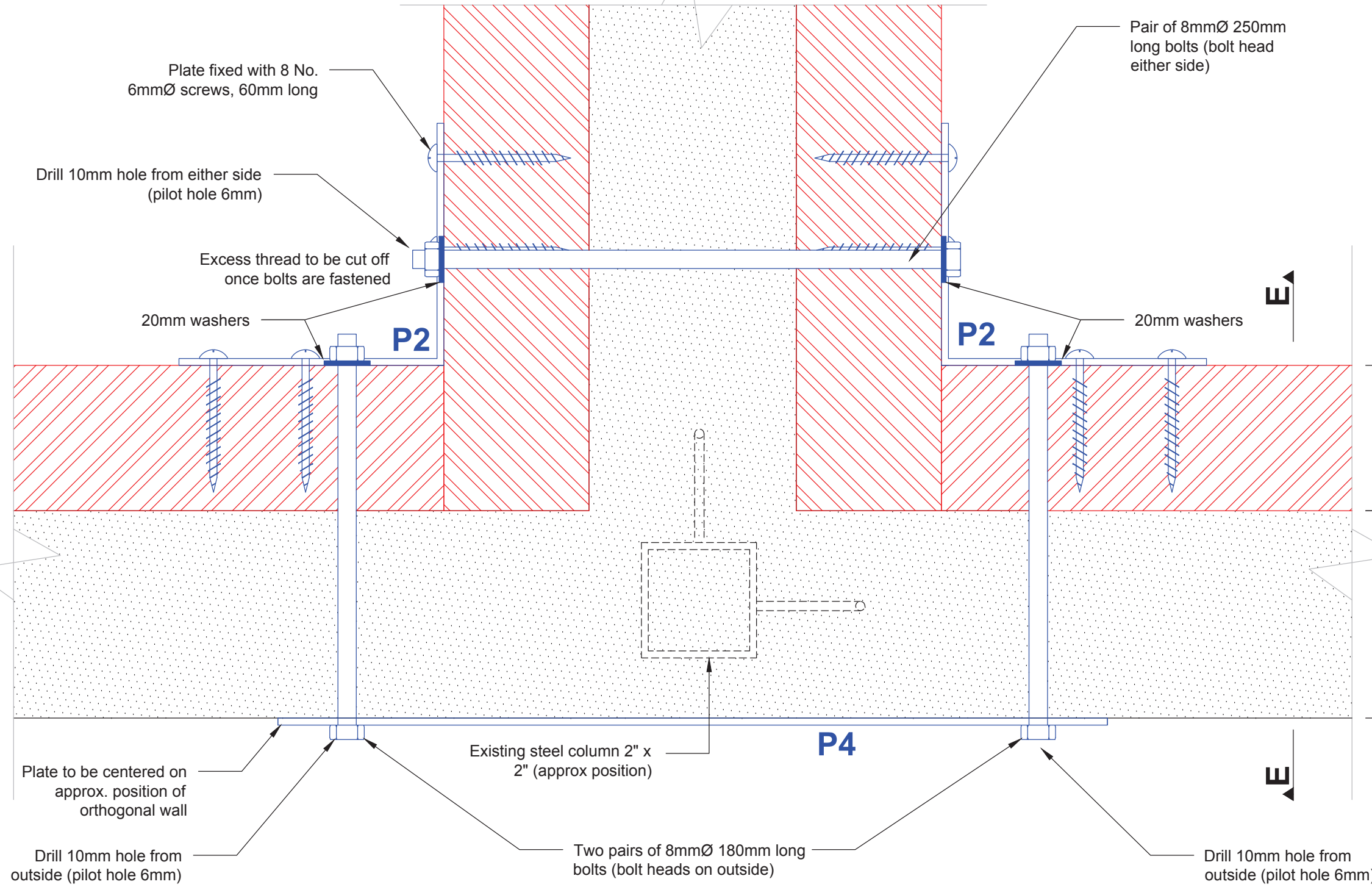


Plate fixed with 8 No. 6mmØ screws, 60mm long

Drill 10mm hole from either side (pilot hole 6mm)

Excess thread to be cut off once bolts are fastened

20mm washers

P2

Pair of 8mmØ 250mm long bolts (bolt head either side)

20mm washers

P2

63 New timber

Varies 50 - 90 Existing Wall

Existing steel column 2" x 2" (approx position)

P4

Plate to be centered on approx. position of orthogonal wall

Drill 10mm hole from outside (pilot hole 6mm)

Two pairs of 8mmØ 180mm long bolts (bolt heads on outside)

Drill 10mm hole from outside (pilot hole 6mm)

Detail 3 (1:2)

Notes

1) All dimensions in mm unless noted otherwise

-	24/05/11	SK	AL	AL
Issue	Date	By	Chkd	Appd

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Job Title
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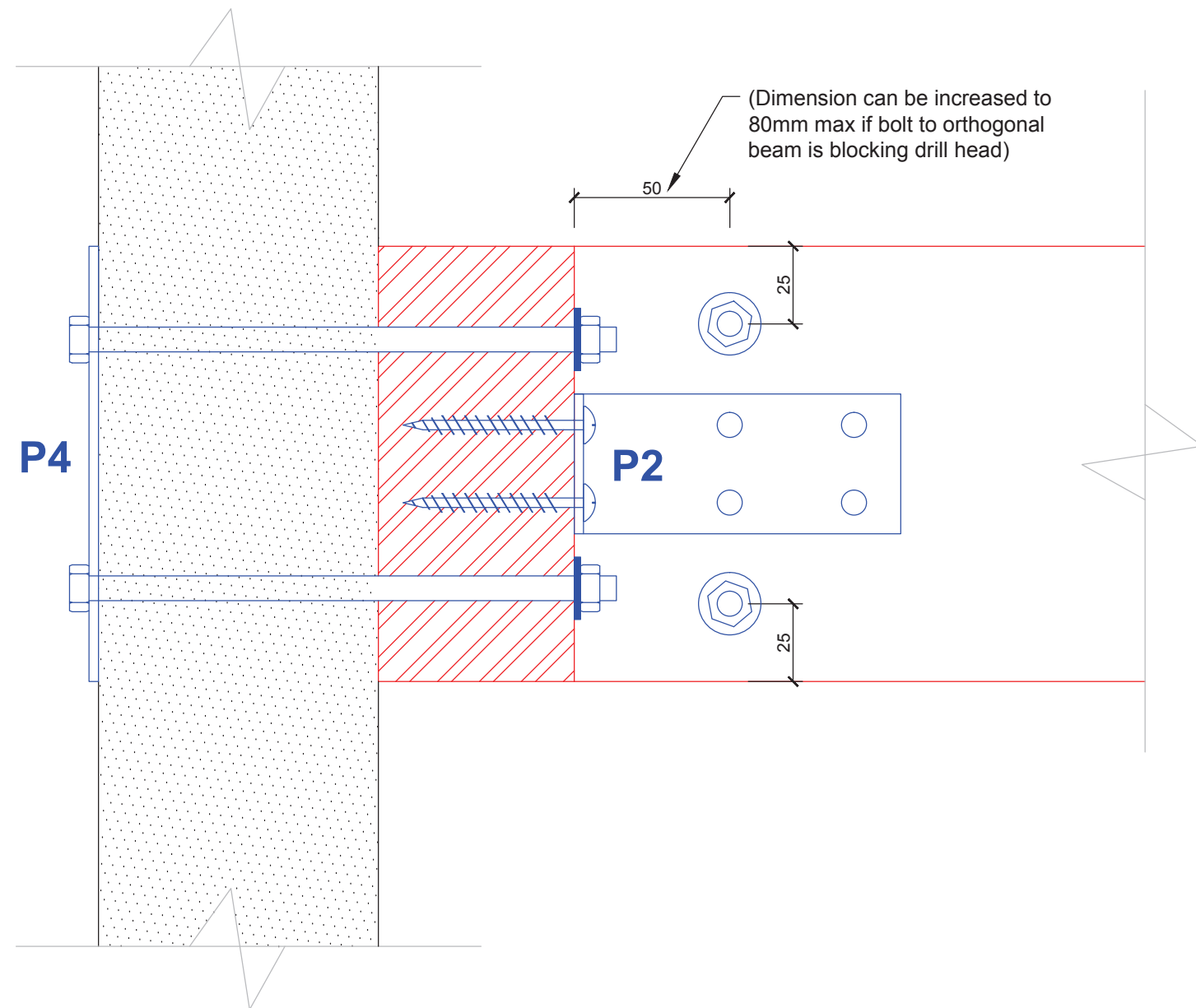
Drawing Title
Detail 3

Scale at A3
1:2

Discipline
Structural

Drawing Status
CONSTRUCTION

Job No 077989-82	Drawing No SK010	Issue -
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Section E-E (1:2)

Notes

1) All dimensions in mm unless noted otherwise

Issue	Date	By	Chkd	Appd
-	24/05/11	SK	AL	AL

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Client
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Job Title
**EI Salvador Housing Scheme
Remedial Works**

Drawing Title
Section E-E

Scale at A3
1:2

Discipline
Structural

Drawing Status
CONSTRUCTION

Job No	Drawing No	Issue
077989-82	SK011	-

A3

A B C D E F G

**Order of drilling bolts:
H1, H2, H3**

Varies 50 - 90 Existing Wall 63 New timber

Pair of 8mmØ 180mm long bolts (bolt head on outside)
Drill 10mm hole from outside (pilot hole 6mm)

Existing steel column 2" x 2" (approx position)

20mm washers

Cut excess thread once bolts are fastened

Plate fixed with 8 No. 6mmØ screws, 60mm long

Pair of 8mmØ 180mm long bolts (bolt head on outside). 1 of 2 bolts can be omitted if it does not line up with plate (see Section F-F)

Cut excess thread once bolts are fastened

Beam must not be continuous here

Pair of 8mmØ 250mm long bolts with bolt heads this side

Drill 10mm hole from this side (pilot hole 6mm)

Detail 4 (1:2)

Notes

1) All dimensions in mm unless noted otherwise

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Job Title
El Salvador Housing Scheme Remedial Works

Drawing Title
Detail 4

Scale at A3
1:2

Discipline
Structural

Drawing Status
CONSTRUCTION

Job No 077989-82	Drawing No SK012	Issue -
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A3

A B C D E F G

1

2

3

4

5

6

P4

P2

P5

P4

Section F-F (1:2)

Section G-G (1:2)

1 of 2 bolts can be omitted if it does not line up with plate. If this occurs, hole in wall to be filled with mortar and made good

Notes

1) All dimensions in mm unless noted otherwise

-	24/05/11	SK	AL	AL
Issue	Date	By	Chkd	Appd

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Job Title
El Salvador Housing Scheme
Remedial Works

Drawing Title
Sections F-F and G-G

Scale at A3
1:2

Discipline
Structural

Drawing Status
CONSTRUCTION

Job No 077989-82	Drawing No SK013	Issue -
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A3

A B C D E F G

63 New timber Varies 50 - 90 Existing Wall 63 New timber

20mm washers both sides

Drill 10mm hole from either side

Existing steel column 1" x 1" (approx. position)

8mmØ 250mm long bolts

250

H

H

Detail 5 (1:2)

Because column position may vary, there is a small possibility of hitting the existing steel column structure. If this occurs, redrill holes 30mm away horizontally and fill new open hole in wall with mortar

Notes

1) All dimensions in mm unless noted otherwise

-	24/05/11	SK	AL	AL
Issue	Date	By	Chkd	Appd

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Job Title
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Remedial Works

Drawing Title
Detail 5

Scale at A3
1:2

Discipline
Structural

Drawing Status
CONSTRUCTION

Job No 077989-82	Drawing No SK014	Issue -
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1

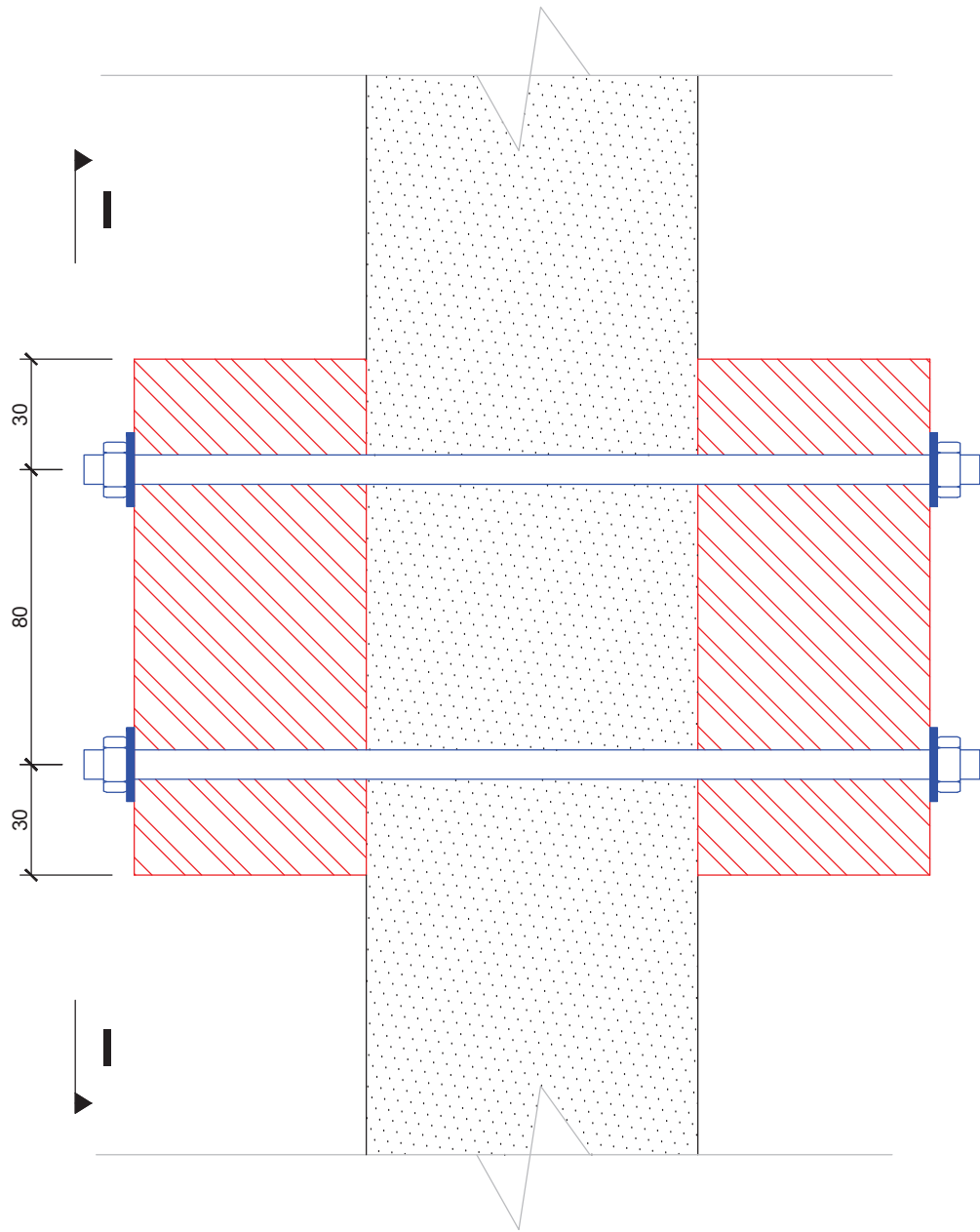
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3

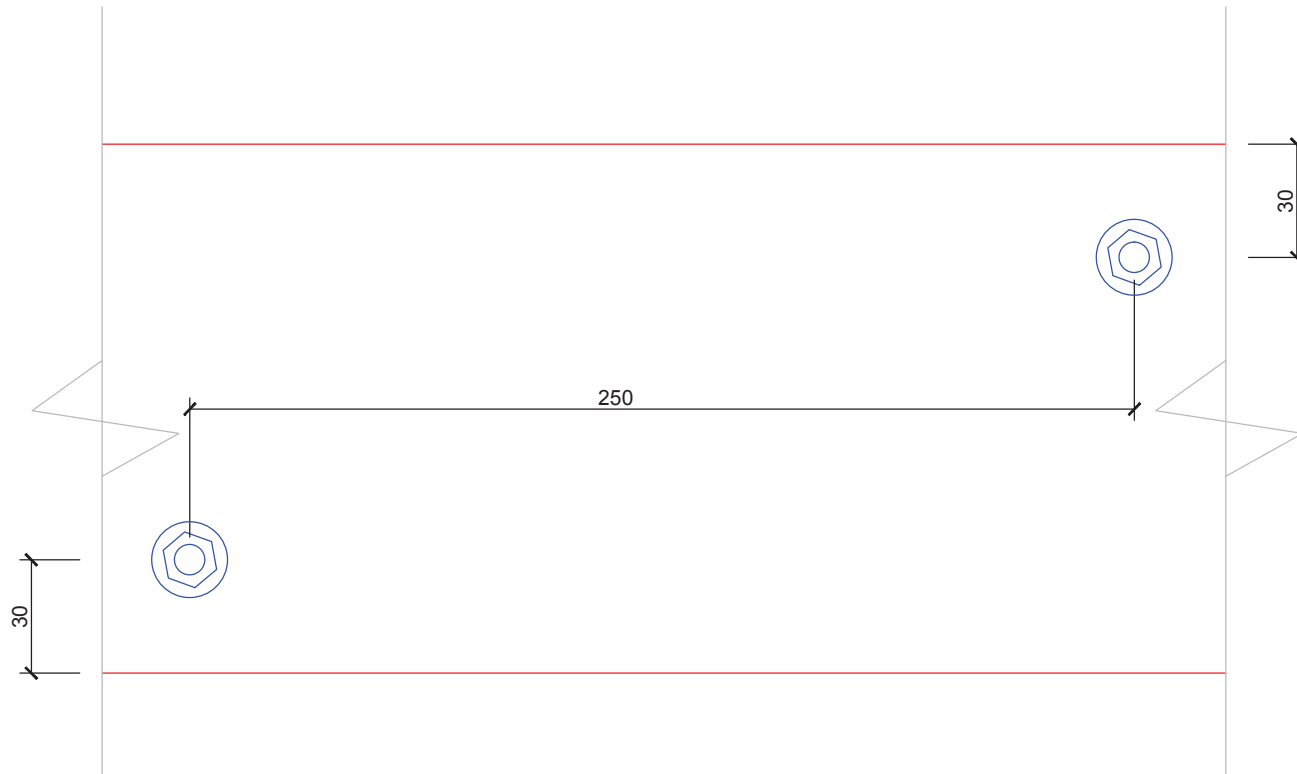
4

5

6



Section H-H (1:2)



Section I-I (1:2)

Notes

1) All dimensions in mm unless noted otherwise

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Job Title
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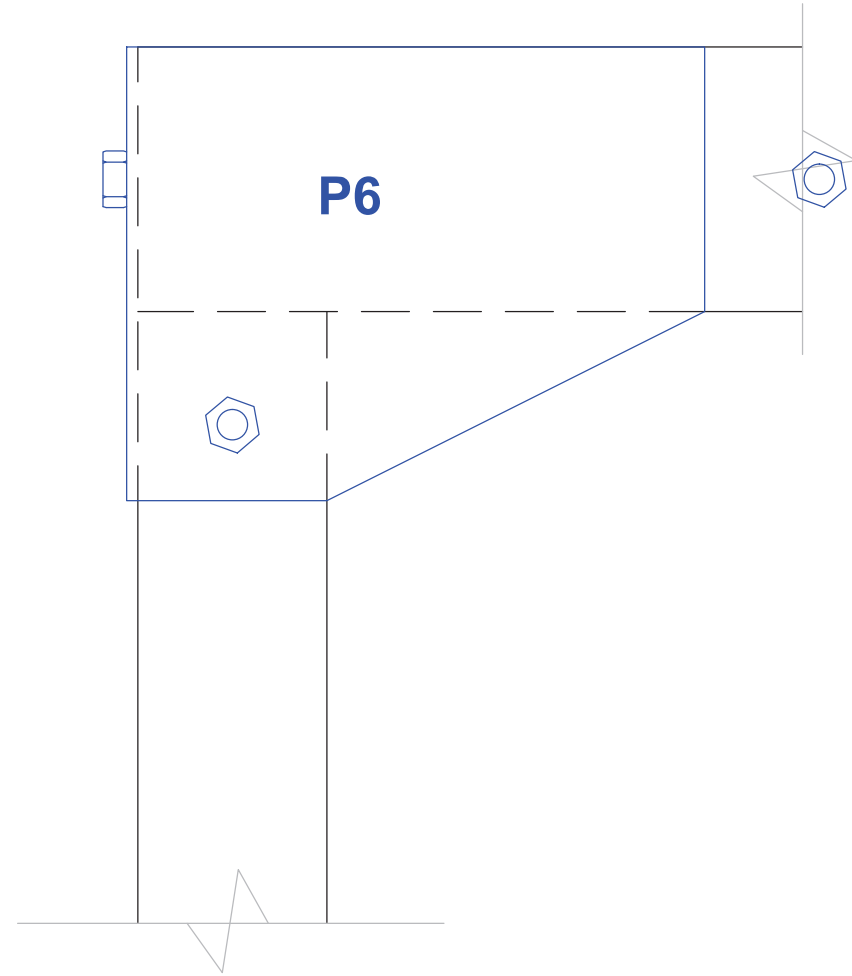
Drawing Title
Sections H-H and I-I

Scale at A3
1:2

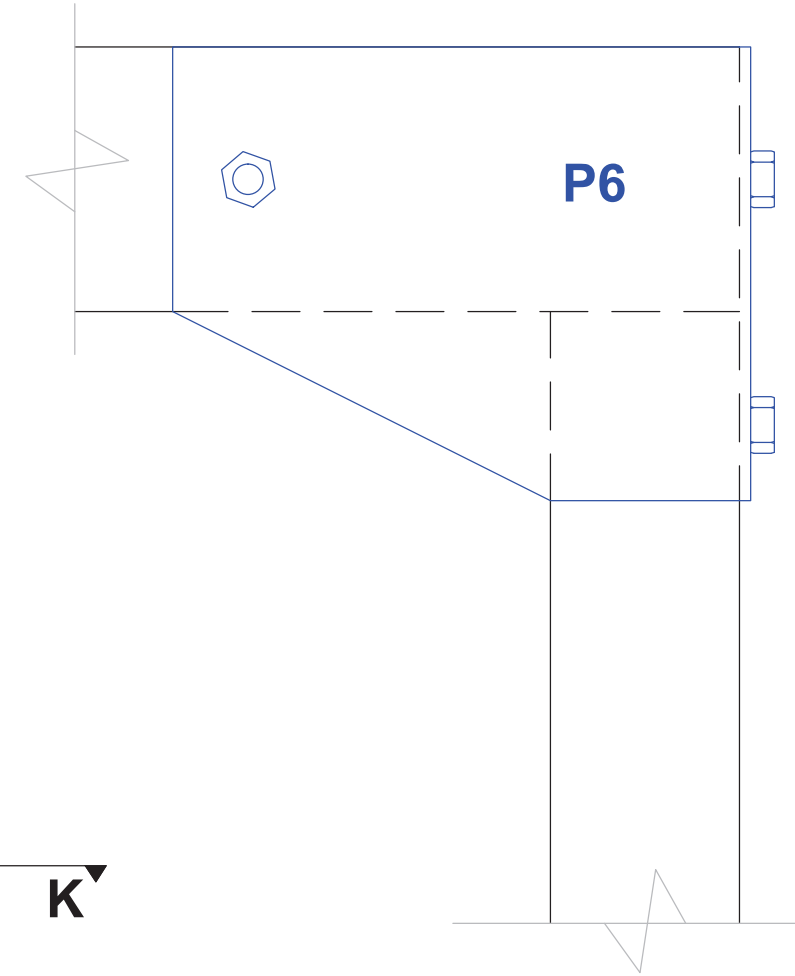
Discipline
Structural

Drawing Status
CONSTRUCTION

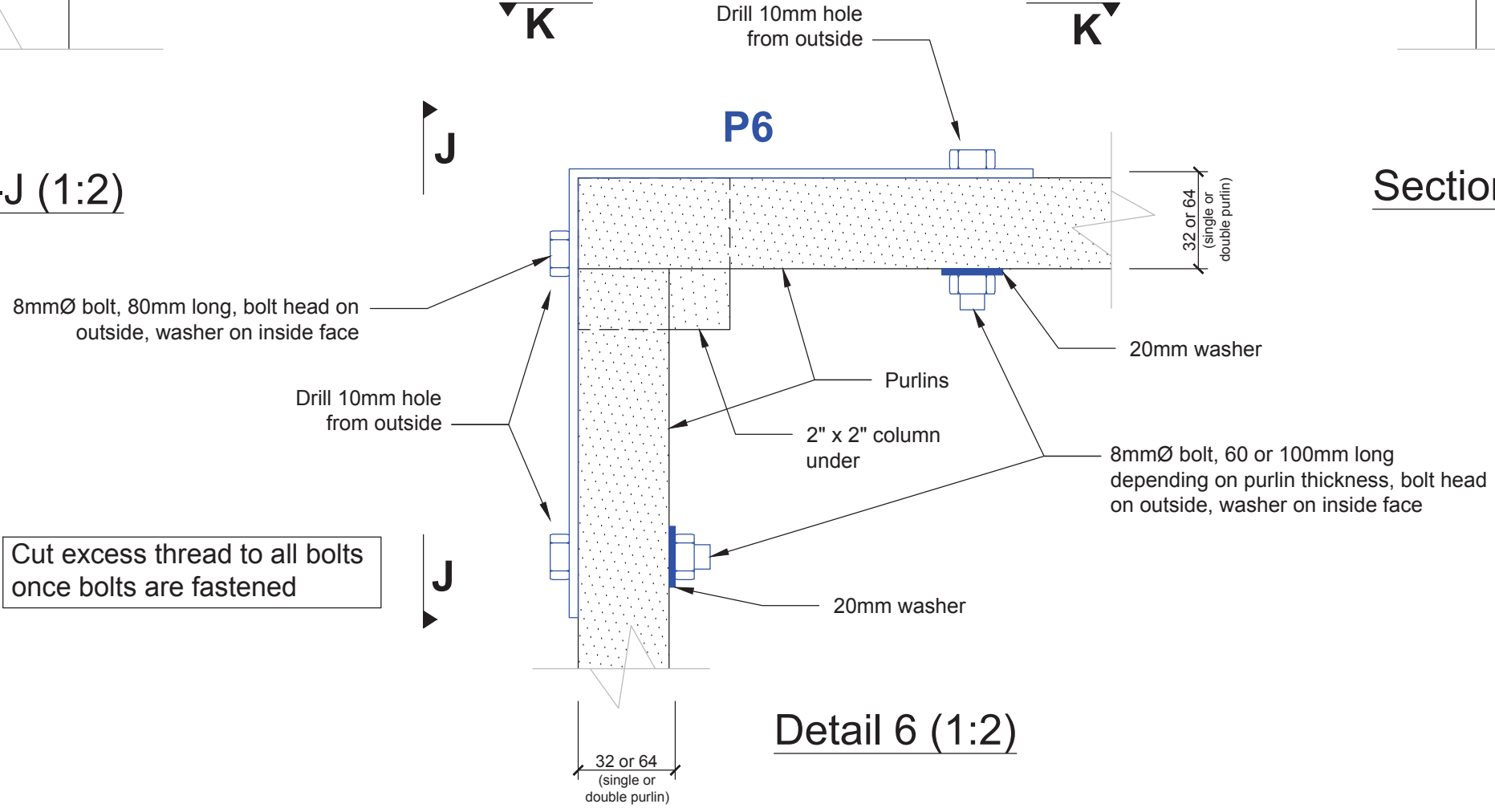
Job No	Drawing No	Issue
077989-82	SK015	-



Section J-J (1:2)



Section K-K (1:2)



Detail 6 (1:2)

Notes

1) All dimensions in mm unless noted otherwise

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Client
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Job Title
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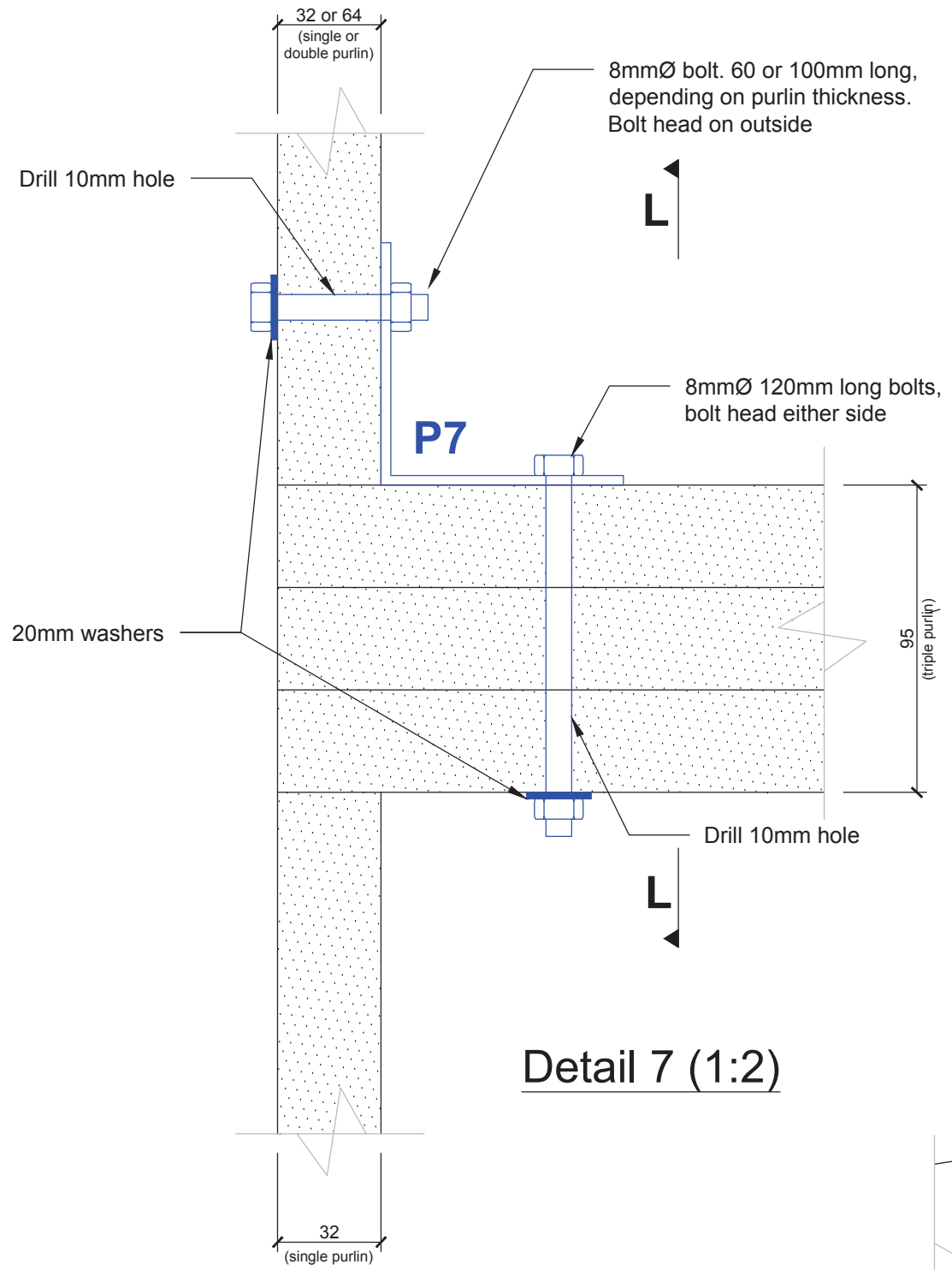
Drawing Title
Detail 6
Sections J-J and K-K

Scale at A3
1:2

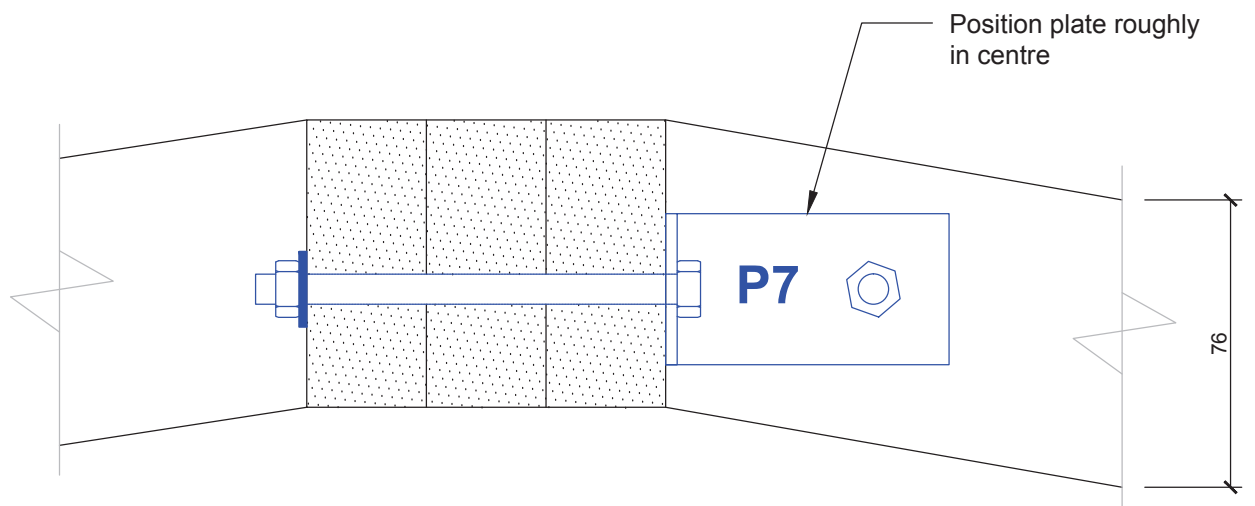
Discipline
Structural

Drawing Status
CONSTRUCTION

Job No 077989-82	Drawing No SK016	Issue -
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Detail 7 (1:2)



Section L-L (1:2)

Notes

1) All dimensions in mm unless noted otherwise

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Issue	Date	By	Chkd	Appd

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Job Title
**El Salvador Housing Scheme
Remedial Works**

Drawing Title
**Detail 7
Section L-L**

Scale at A3
1:2

Discipline
Structural

Drawing Status
CONSTRUCTION

Job No 077989-82	Drawing No SK017	Issue -
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Appendix B–Detailed Retrofit Evaluation

Part 1: Visual Inspection

	HOUSE NO.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	FORENAME	Israel Angel	Cajetana	Mariam	Anna-Maria	Miguel Angel	Juan	Carmen	Miguel Angel	Elva	Mauricio	Juliana	Jose Elvin	Brigido Ventura	Juan Antonio
Questions	SURNAME	MEJIA	PORTILLO	PORTILLO	PORTEZ	GONZALEZ	CEPEDE	SOSA	PEREZ	PEREZ	PEREZ	DIAZ	PALACIO	MIGUEL	PORTILLO
Quality of external plates	Check for rusting	3	4	4	4	4	4	5	4	5	1	4	4	5	5
	Check for peeling of paint	4	5	4	5	4	4	5	5	5	1	4	4	5	5
Quality of internal plates	Check for peeling paint	5	5	5	5	5	4	4	5	4	4	5	4	4	5
	Check for broken or sheared bolts	3	4	5	4	4	4	3	5	5	3	4	5	4	4
Quality of wood	Any damp or fungus growing	5	4	5	5	4	4	5	5	5	4	4	5	2	4
	Termite tubes, beetles or ants	5	4	5	4	4	5	5	5	5	1	4	4	2	5
	Check ends of beams for damage	5	5	5	5	5	5	5	5	5	5	5	5	4	5
Fixings in general	All fixings and general quality	5	4	4	5	4	4	4	4	4	2	5	4	4	4
	Check packers are braced and tight	5	4	3	5	3	4	4	4	4	2	3	3	5	5
	Rusting of bolts	4	4	4	4	4	4	4	4	4	2	5	3	4	5
Paint on bottom of houses	Check for cracked paint	5	3	3	5	5	3	5	5	5	4	-	5	4	5
	Flaking and/or peeling	5	3	3	5	5	3	5	5	5	4	-	4.5	4	5
	Bottom of houses are clean	4	5	2	4	5	5	5	4	4	4	5	5	3	4
Porch Angles	Intact	5	5	3	-	5	5	5	-	5	5	5	5	4	5
	Rusting	3	4	3	-	4	5	4	-	4	3	5	4	4	4
Termite shelter tubes	Existing/knocked off?	5	5	5	5	5	5	5	5	5	5	5	5	2	5
Roof extensions	Are they functioning well	-	5	5	-	5	5	-	5	-	1	5	5	-	5
	Any sign of water leakage	-	5	5	-	5	5	-	5	-	1	5	5	-	5

	HOUSE NO.	15	16	17	18	19	20	21	22	23	24	25	26	27	28	DATA EVALUATION	
	FORENAME	Serafin	Manuel Antonio	Marcario	Juana Antonio	Felicitia	Amanda	Paz	Vicente	Alejandra	Marta	Manuel de Jesus	Lorenzo	Manuel de Jesus	Francisco Javier		
Questions	SURNAME	ANGEL	HERNANDEZ	PORTILLO	SANCHEZ	MARTINEZ	ARIAS	GARCIA	LOPEZ	PORTILLO	PORTILLO	CEPEDE	MEJIA	MEJIA	GARCIA	TOTALS	AVERAGES
Quality of external plates	Check for rusting	4	5	5	3	5	5	4	3	4	3	2	4	5	3	111	3.96
	Check for peeling of paint	4	5	5	4	5	5	4	3	5	3	3	5	5	5	121	4.32
Quality of internal plates	Check for peeling paint	3.5	4	4	3	4	5	5	3	2	3	5	5	5	5	120.5	4.30
	Check for broken or sheared bolts	4	5	4	5	4	4	5	3	4	2	5	4	3	5	114	4.07
Quality of wood	Any damp or fungus growing	5	5	4	2	3	5	5	5	5	5	5	5	4	5	124	4.43
	Termite tubes, beetles or ants	4	5	5	5	5	5	5	4	4	4	4	4	4	4	120	4.29
	Check ends of beams for damage	5	4	4	5	4	5	5	5	5	5	5	5	5	5	136	4.86
Fixings in general	All fixings and general quality	5	5	-	4	4	5	5	4	4	4	3	4	4	5	113	4.19
	Check packers are braced and tight	4	5	3	3	2	4	3	4	4	5	4	3	1	5	104	3.71
	Rusting of bolts	4	4	4	4	4	4	5	3	4	4	3	3	4	4	109	3.89
Paint on bottom of houses	Check for cracked paint	5	5	5	5	5	5	4	4	5	5	5	5	-	3	118	4.54
	Flaking and/or peeling	5	5	4	4	5	5	4	4	5	5	5	5	-	3	115.5	4.44
	Bottom of houses are clean	5	5	4	4	4	5	4	4	5	5	5	5	5	1	120	4.29
Porch Angles	Intact	5	5	5	-	5	-	-	5	5	5	5	5	-	-	102	4.86
	Rusting	3	4	3	-	4	-	-	4	4	2	3	4	-	-	78	3.71
Termite shelter tubes	Existing/knocked off?	5	5	5	5	5	5	4	5	5	5	5	5	5	5	136	4.86
Roof extensions	Are they functioning well	2	5	-	-	5	4	5	5	-	-	2	-	-	3	72	4.24
	Any sign of water leakage	2	5	-	-	5	3	5	3	-	-	2	-	-	3	69	4.06
																TOTAL AVERAGE	4.53

Appendix B–Detailed Retrofit Evaluation

Part 2: Beneficiary Interviews

Question	Have you had any seismic activity in this area?
1	Has experience NO seismic activity and had no problem with the structure in his house.
2	Strong earthquake experienced 15 days ago
3	Was an earthquake 1 month ago that was quite strong but did not cause any problems
4	Strong earthquake experienced 15 days ago, though the house feels stronger than before
5	Strong earthquake experienced 15 days ago
6	Strong earthquake experienced 15 days ago
7	Strong earthquake experienced 15 days ago, feels safer than before
8	There was an earthquake around 2 to 3 weeks ago, it was quite strong but they did not really feel it. There was some movement but the walls were fine and the retrofit was fine.
9	
10	Strong earthquake experienced 15 days ago
11	Strong earthquake experienced 15 days ago
12	Strong earthquake experienced 15 days ago
13	House is fine – there was a small earthquake 2 weeks before interview that had no effect on the house
14	Earthquake of 6.0 strength 15–20 days before interview – he has not seen any damage but expected that earthquake would have caused some.
15	Strong earthquake experienced 15 days ago
16	-
17	Strong earthquake last month but house was fine
18	Had an earthquake 15 days ago but didn't really feel it–strongest earthquake in last 3 years
19	Earthquake 15 days before interview – did not feel much at her house
20	There was a little but long earthquake but she felt safe
21	Strong earthquake 21 days ago (from interview). Found no damage as a result
22	-
23	Strong earthquake experienced 15 days ago
24	Strong earthquake experienced 15 days ago
25	Earthquakes– Has had little ones with the largest being 15 days ago but has had no problems
26	Strong earthquake experienced 15 days ago
27	Strong earthquake experienced 15 days ago, house feels stronger during earthquakes now though
28	Strong earthquake experienced 15 days ago

Question	In general have you had any problems with the retrofit?
1	The retrofit has not affected his life in anyway during or since construction and he was very happy with the work from Imperial College.
2	No problems
3	No problems with retrofit – installation or current situation
4	No problems
5	Whole house has leaks and are concerned it'll break
6	Cracks in the wall though some were filled in new ones have appeared and water comes through the cracks and the bottom of the walls in the house
7	No problems
8	
9	The retrofit was fine and had no problems only the roof that leaks in 4 places.
10	No problems
11	No problems, were shocked at how it would look initially but have since decided it looks fine
12	No problems
13	He said the wood was fine (but cracks obvious)}
14	A tree fell on the roof after a hurricane one year ago and now the roof leaks –also leaks through bolts
15	No problems
16	-
17	No problems with the retrofit, but roof leaks.
18	Retrofit functions well and the walls are safe
19	No problems with reinforcement –some packers have fallen out and could not be put back in as they would fall out again
20	Reinforcement was causing no problem or annoyance but roof was leaking especially where connected to metal beams.
21	Roof leaked onto beam so they now keep it dry by covering it
22	No problems
23	No problems
24	No problems
25	Everything is great – one small crack in the wall
26	No problems
27	No problems, the walls feel much stronger now
28	No, though water leaks in through cracks in the roof

Question	Has the retrofit inconvenienced you in any way? Has it been noticeable?
1	No problems
2	No problems
3	Had problem with roof and so replaced it with corrugated iron
4	No problems
5	No problems
6	No problems
7	No problems
8	Used wood for shelving. The retrofit has not hindered their day to day activities and they have used the beams and shelves.
9	
10	No problems and feel safer than before
11	No problems
12	No problems
13	No inconvenience caused by the retrofit
14	No problem or annoyance caused by retrofit. Had no problem with the team.
15	No problems
16	
17	Retrofit has not effected his everyday life.
18	Uses the retrofit for shelving and storage
19	Retrofit does not effect her everyday life and is actually useful as shelving
20	
21	No inconvenience caused by the retrofit. Enjoyed the whole process. Loved the students
22	No problems
23	No problems
24	No problems
25	The retrofit does not annoy him and he has seen no problems with it – uses it as shelf.
26	No problems
27	No problems, with no new cracks appearing since the retrofit though not all were filled in the first time round
28	No problems

Responses by house number (see map for beneficiary names)

Question	What maintenance have you carried out on your home since two years ago?
1	He has been cleaning the retrofit and walls as maintenance but stopped recently as the harvest season meant he was too busy.
2	None
3	Trys to keep wood as dry as possible but has had leaks, has not painted. Stopped wood getting wet and stopped termites
4	Nothing but no problems
5	Nothing, paint is too expensive
6	Cleaning the walls
7	Cleaning the wood, would also like to paint it
8	They had built an extension on Elbas house in the last year which is built in the same way and from the same material as the original houses.They have repainted the house and also the metal purlins of the house. They moved Elbas roof extension to the other side as she got an extension on the house and needed to stop water coming in from the other side.
9	
10	Cleaning and removing insects. Plates were also painted
11	Have rerouted water flowing down around there house with concrete channels
12	Nothing
13	He keeps the wood clean but said the students did not tell him about keeping paint clean and so has not taken care of the walls.
14	Cleans walls every winter and paints plates, does not remember being told anything about maintenance
15	Cleaning the walls
16	Did not maintain the retrofit or the walls and had no money for painting the walls
17	Has done no maintenance and says he does not have the money to repaint the walls
18	She painted the bottom of the house to prevent water coming in.
19	Does not have any money to carry out maintenance and so has not done any
20	Cleans walls and has cemented a little to stop water leaking in through roof extension connection. Has painted metal roof beams to prevent rust.
21	Has not been cleaning but has painted metallic beams in house to prevent rust.
22	Cleaning wood and the outside walls
23	Cleaning the plates and wood
24	Cleaning plates
25	He does not clean walls – kitchen stove inside dirties walls and he needs a cleaning solution from the city. He wants to move his kitchen to prevent this. He says that last group did not tell him about maintenance but has been cleaning the walls anyway. Has built some walls to help stop landslides in earthquakes and plans to build a new floor soon.
26	Nothing
27	-
28	None

Responses by house number (see map for beneficiary names)

Question	What role did you play in the retrofit of your house? What was your experience like?
1	He helped carry the wood during the retrofit and was there to help with the actual retrofit.
2	Her and her daughter helped support beams
3	Helped transport materials and provided some tools
4	The sons helped
5	Lifting and supporting beams
6	Supported beams
7	Everyone helped during the retrofit
8	They helped carry the wood to the houses as well as in the building process. Miguel was also involved in helping build the roof extensions.
9	
10	Son helped with the house
11	Working and learning together
12	Went to help out at a few houses
13	he helped with the construction and by putting up wood beams
14	Her husband and children helped with the retrofit
15	Helping lift beams
16	Her husband helped transport wood and with the retrofit
17	Really enjoyed working with the students – he helped with the construction and is now happy that his house is safer.
18	They helped with cementing the wall and taught the team how to make a bamboo wall and helped with that
19	She helped the team and enjoyed working with them as she felt they had learnt from each other, she liked the 2 communities being together and appreciated the students came from far away to help and worked hard.
20	-
21	She and her family helped with the work
22	Helped with supporting beams
23	Everyone in the family got involved and helped
24	Helped with moving wood
25	He helped carry material
26	Fixed the cracks, the husband enjoyed the work
27	Helped a lot and were the last house in the community to be retrofitted. However the house wasn't painted and there was no time to fill in the cracks
28	Helped a fair amount

Question	Do you feel like you learnt anything from the Imperial College team?
1	He learnt how to maintain the house
2	Learnt about the reasons for the retrofit
3	Really enjoyed working with the students and learnt from them.
4	The reasons for the retrofit
5	Reasons for the retrofit
6	The reasons for the retrofit and the team working behind it
7	How to maintain the retrofit
8	Miguel felt that both the team and the community learnt from each other.
9	
10	The reasons for the retrofit
11	Working and learning together
12	Learning from each other
13	He learnt to maintain the wood from the students and enjoyed their company
14	-
15	Learnt to not smoke wood and keep it clean
16	-
17	-
18	She feel they learnt from each other
19	Daughter also helped with the retrofit.
20	Learnt a lot when building house about protecting walls and construction, she enjoyed having photos with the team
21	She learnt the maintenance process and why it was necessary
22	The reasons for the retrofit and how to maintain it afterwards. Also how to fix cracks and working in a team
23	Reasons for the retrofit
24	Learnt about the retrofit and the need to clean wood
25	He feels both sides learnt from each other – he learnt to use tools and feels he can now build an extension
26	They enjoyed working together as a team
27	Reasons for retrofitting the houses, initially they along with others thought the beams would fall and maybe crush someone during an earthquake
28	Learnt to work as a team

Question	Do you have any concerns about the future of your retrofit or the future of your home in general?
1	Has no concerns about the future
2	Concerned about the roof, apparently mangos falling from a tree near her house is seriously damaging the roof
3	At first did not understand how it would protect her house or how it was to be made but now feels safer
4	No roof extension installed behind the house and there should like to have one installed
5	Concerned about not being able to afford paint to maintain the retrofit. Water also flows down the hill into her house and she would like to build a low wall to prevent this. Another low wall as well elsewhere to shore up land that is steadily land sliding away
6	Concerned about the roof and the leaks
7	Roof is the only concern and think they need a new one
8	The roof on both houses is cracked and leaking they think this is to do with the person who made it creating too many holes, as well as the earthquake widening the cracks. Put something called sica on the roof but they are still having problems. He worries about himself but also for his family and friends, especially about the roofs of all the houses. He was also worried that some people had not maintained the metal purlins as they should have. They have become very rusty and he's worried it's too late to fix the problem. The new houses were a bit less warm.
9	
10	Large cracks appearing in the roof, the humidity of the rooms is also causing damp to appear
11	Walls are a bit thin due to the engineer running out of concrete during the house's construction, water coming in through the roofs, wall round the back can be shored up due to a landslide
12	Concerned about the roof and while there are cracks in the walls no water comes through them
13	Roof functions well with no leakage and he has no worries about the future
14	Concerned about strong earthquakes in future causing something to fail
15	Water comes in through the back of the house when it rains and the land around the back seems unstable and about to slide, leaks from the roof.
16	Humidity in one of the rooms?
17	-
18	Not worried about retrofit only about the roof which is broken in 6 places, the door is bent and so will not shut or work with the key. Water leaks from the roof.
19	Her main concern is the roof and that last winter they had a storm and the rooms flooded, Water enters through the wall but the new roof extension helps
20	Only worried about the roof it is easily broken
21	Worried about cracks in roof, did have a leak but fixed it herself
22	Worried about the cracks in the wall and the water coming through
23	Worried the roof isn't strong enough for the storms coming in
24	Cracks that were filled have reopened and new cracks have appeared as well, leaks from the roof
25	Has no worries for religious reasons. There are no other leaks in the house anywhere else, there were before but since the wall has been rebuilt the team fixed anything else wrong with the house.
26	Concerned about the roof, which they think may break soon
27	Only concern is the leaky roof
28	All well installed, only concerned about the cracks in the roof

Responses by house number (see map for eneficary names)

Question	Are the roof extensions working well? Any leaking water?
1	He did not get a roof extension, there is a leak in his porch where the bolts go through and some bolts are rusted.
2	Working well though only installed 2 weeks before our arrival
3	Wants a roof extension to protect walls but is worried damage will occur before they can afford it
4	All sides where installed it's working well
5	Roof extensions working well though one is missing on the north side of the house
6	Working well
7	Working well
8	-
9	-
10	Working well
11	Working well
12	Working well
13	No roof extensions
14	No leaks from roof extension but some from main roof.
15	Working well
16	Only worry is water coming in through the roof but on the whole really enjoyed the project
17	-
18	No roof extensions
19	Water enters through the wall but the new roof extension helps
20	Says the roof extension works
21	Roof extension working well to protect walls - no leaks
22	Working well
23	No roof extension
24	Working well
25	Roof extensions were originally letting in water, however they covered over the area with cement and now there is no longer a problem.
26	Working well but only installed the week before and would not have installed them if we didn't visit
27	Working well
28	Not installed

Responses by house number (see map for eneficary names)

Question	Was there anything that inconvenienced you in the way the project was carried out?	
Responses by house number (see map for beneficiary names)	1	No problems
	2	No problems
	3	No problems
	4	No problems
	5	No problems
	6	No problems
	7	No improvements
	8	He felt that the team should have put up the roof extensions before the left and sometimes they weren't as organized as they should have been. The roof extensions were left to the community to do but they got tired with it and had to try again just before the team arrived for the evaluation. However, he would like to say thanks for coming and the team were great.
	9	
	10	Good organisation especially at getting everyone to work together
	11	No improvements
	12	No improvements
	13	No problems
	14	No problems
	15	No problems
	16	They had a great experience with the team and enjoyed working with them
	17	No problems
	18	Feels that there was some badcoordination between the groups as only 2 people worked on the walls as others were retrofitting another house
	19	No problems
	20	had no problem with the team – was happy about the whole experience.
	21	No problems
	22	No problems
	23	No problems
	24	No improvements
	25	He said that the team were perfect, at the start he was a little bit scared because he didnt know what they would be doing but by the end understood, especially after the rebuilding of his wall.
	26	No improvements
	27	No problems
	28	No problems

EL SALVADOR PROJECT 2013 - EXPENDITURES

FLIGHTS				
Date	Company/Party Paid To	Description/Details	Amount (\$)	Approx. Amount (£)
10/6/13	Delta Airlines	Eric Shut Wai Leung	994.31	662.87
6/6/13	American Airlines	Jack Wilkinson	1166.18	777.45
7/6/13	Delta Airlines	Orrin Lancaster	993.59	662.39
8/6/13	American Airlines	Samuel Simanjuntak	1533.08	1022.05
7/6/13	United Airlines	Elizabeth Liu, Robert Wright, Carlos Poblacion	3741.53	2494.35
7/6/13	United Airlines	Maria Sunyer Pinya	1559.70	1039.80
6/6/13	Delta Airlines	Bradley Pring	1282.34	854.89
6/6/13	United Airlines	Andy Yunfan Xu	1220.63	813.75
TOTALS			12491.33	8327.55
TRANSPORT				
Date	Company/Party Paid To	Description/Details	Amount (\$)	Approx. Amount (£)
17/7/13	REDES	Petrol for transport	40.00	26.67
19/7/13	REDES	Petrol for transport	35.00	23.33
19/7/13	Aeropuerto Internacional	San Salvador Airport-Ximenas Guest House	28.00	18.67
20/7/13	Taxi	Jack Wilkinson, bus station pickup	8.00	5.33
21/7/13	Aeropuerto Internacional	San Salvador Airport-Ximenas Guest House	75.00	50.00
22/7/13	REDES	Petrol for transport	15.00	10.00
22/7/13	Aeropuerto Internacional	Ximenas Guest House-Costa Rica	75.00	50.00
25/7/13	REDES	Petrol for tools transportation to Villanueva	44.26	29.51
25/7/13	Aeropuerto Internacional	Costa Rica-San Jose Villanueva	90.00	60.00
28/7/13	Aeropuerto Internacional	Villanueva-El Tunco-Villanueva	100.00	66.67
29/7/13	REDES	Petrol for transport	40.00	26.67
30/7/13	REDES	Petrol for transport	30.00	20.00
1/8/13	REDES	Petrol for transport	25.00	16.67
2/8/13	REDES	Petrol for transport	25.00	16.67
4/8/13	Aeropuerto Internacional	Villanueva-Suchitoto-Villanueva	200.00	133.33
8/8/13	REDES	Petrol for transport	30.55	20.37
4/8/13	Aeropuerto Internacional	Villanueva-San Salvador	50.00	33.33
11/8/13	REDES	Petrol for transport	27.75	18.50
10/8/13	Aeropuerto Internacional	Ximenas Guest House-San Salvador Airport	25.00	16.67
15/8/13	REDES	Petrol for transport	38.00	25.33
15/8/13	Aeropuerto Internacional	Villanueva-El Tunco	50.00	33.33
17/8/13	Service Ernesto	Airport Service (3 trips)	75.00	50.00
TOTALS			1126.56	751.04

Appendix C-Detailed Budget Report

ACCOMMODATION				
Date	Company/Party Paid To	Description/Details	Amount (\$)	Approx. Amount (£)
17/7/13	Community Villanueva	Accommodation for duration of 3 week stay	150.00	100.00
22/7/13	Ximenas	Accommodation 19th to 22nd July	263.00	175.33
26/7/13	Tunco Lodge, El Tunco	Accommodation 16th to 28th July	200.00	133.33
29/7/13	Ximenas	Accommodation for 2 people	17.00	11.33
4/8/13	Platforma Global, Suchitoto	Accommodation 2nd to 4th August	200.00	133.33
11/8/13	Ximenas	Accommodation 9th to 11th August	161.45	107.63
14/8/13	Ximenas	Accommodation for 4 for one day	34.00	22.67
17/8/13	Tunco Lodge, El Tunco	Accommodation 15th to 18th August	300.00	200.00
TOTALS			1325.45	883.63
FOOD AND DRINK				
Date	Company/Party Paid To	Description/Details	Amount (\$)	Approx. Amount (£)
18/7/13	Nelly's El Lugar Pupuseria	Lunch for REDES	2.85	1.90
19/7/13	Angela in Costa Rica	3 meals per day for 3 days, 10 people	200.00	133.33
20/7/13	SuperSelectos	Bottled water	6.51	4.34
22/7/13	Uno Gas Station	Bottled water	5.00	3.33
25/7/13	Angela in Costa Rica	Food delivery	15.00	10.00
25/7/13	Puma Gas Station	Bottled water	3.04	2.03
25/7/13	Tienda (Villanueva)	Shopping for 2 meals and cleaning products	23.36	15.57
26/7/13	Tienda (Villanueva)	Shopping for 1 meal	8.70	5.80
28/7/13	Gas Station	Bottled water (including bottles purchase)	37.32	24.88
29/7/13	Tienda (Villanueva)	Breakfast (8 people)	7.50	5.00
29/7/13	Comodor (Villanueva)	Lunch for 7 people	14.00	9.33
29/7/13	Nelly's El Lugar Pupuseria	Lunch 2 people plus Domingo (REDES)	10.35	6.90
30/7/13	Tienda (Villanueva)	Shopping for 2 meals	11.25	7.50
30/7/13	Comodor (Villanueva)	Lunch for 9 people	18.00	12.00
31/7/13	Tienda (Villanueva)	Bottled water (refill)	5.00	3.33
31/7/13	Comodor (Villanueva)	Dinner for 10 people	11.00	7.33
31/7/13	Tienda (Villanueva)	Shopping for 2 meals	14.00	9.33
31/7/13	Comodor (Villanueva)	Lunch for 9 people	18.00	12.00
1/8/13	Comodor (Villanueva)	Lunch for 10 people	20.00	13.33
1/8/13	Tienda (Villanueva)	Snacks	5.00	3.33
1/8/13	Tienda (Villanueva)	Shopping for 2 meals	11.80	7.87
2/8/13	Comodor (Villanueva)	Lunch for 10 people	20.00	13.33
5/8/13	Comodor (Villanueva)	Lunch for 10 people	20.00	13.33

5/8/13	Tienda (Villanueva)	Shopping for 2 meals	20.45	13.63
6/8/13	Comodor (Villanueva)	Lunch for 10 people	20.00	13.33
6/8/13	Tienda (Villanueva)	Drinks	12.00	8.00
6/8/13	Tienda (Villanueva)	Snacks	3.25	2.17
7/8/13	Comodor (Villanueva)	Lunch for 10 people	20.00	13.33
7/8/13	Comodor (Villanueva)	Dinner for 10 people	20.00	13.33
8/8/13	Comodor (Villanueva)	Lunch for 8 people	16.00	10.67
8/8/13	Nelly's El Lugar Pupuseria	Lunch for 2 people plus Domingo (REDES)	11.25	7.50
8/8/13	Tienda (Villanueva)	Food and supplies	11.12	7.41
8/8/13	Tienda (Villanueva)	Dinner for 20+ people	25.35	16.90
9/8/13	Comodor (Villanueva)	Lunch for 10 people	20.00	13.33
11/8/13	Purpuseria	Lunch for Domingo	3.40	2.27
12/8/13	Tienda (Villanueva)	Bottled water (refill)	7.50	5.00
12/8/13	Comodor (Villanueva)	Lunch for 8 people	16.00	10.67
12/8/13	Tienda (Villanueva)	Shopping for 2 meals	11.25	7.50
13/8/13	Tienda (Villanueva)	Snacks for workshop (Villanueva)	6.75	4.50
13/8/13	Tienda (Villanueva)	Breakfast	8.00	5.33
13/8/13	Purpuseria	Lunch for 5 plus Domingo	15.25	10.17
13/8/13	SuperSelectos	Dinner for 4 people	10.95	7.30
13/8/13	SuperSelectos	Snacks for workshop (Costa Rica)	6.31	4.21
14/8/13	Comodor (Villanueva)	Lunch for 5 people	10.00	6.67
14/8/13	SuperSelectos	Lunch for 2 people	4.80	3.20
14/8/13	SuperSelectos	Dinner and Lunch for 2 people	9.50	6.33
14/8/13	Pizza Palour, Villanueva	Dinner	9.99	6.66
TOTALS			786.80	524.53
TOOLS AND MATERIALS				
Date	Company/Party Paid To	Description/Details	Amount (\$)	Approx. Amount (£)
18/7/13	Freund Hardware Shop	Small hand tools and drillbits	92.63	61.75
19/7/13	Pricemart Stores	Group food and materials	150.00	100.00
20/7/13	La Palma	Bolts, nuts, washers, drill bits	238.53	159.02
20/7/13	Casa del Tornillo	Bolt cutting service	63.70	42.47
21/7/13	Freund Hardware Shop	Small hand tools and paint	173.15	115.43
29/7/13	Service (Villanueva)	Wood transportation to houses	5.00	3.33
29/7/13	DolarCity, Metrocentro	Toolboxes	4.00	2.67
29/7/13	Freund Hardware Shop	Supplies	31.38	20.92
29/7/13	Aserradero el Triunfo	12" beams x119 pieces, 14" beams x 26 pieces	5251.56	3501.04
29/7/13	La Palma	Wood drill bits	27.12	18.08
29/7/13	TornoLara	Metal plates (card payment)	762.52	508.35
29/7/13	TornoLara	Metal plates (payment through REDES)	1400.00	933.33
31/7/13	TornoLara	Metal plates (payment in cash)	700.00	466.67
2/8/13	TornoLara	Metal plates (card payment) 2nd order	701.05	467.37
2/8/13	TornoLara	Metal plates (card payment) 2nd order	825.80	550.53
2/8/13	La Palma	Wood drill bits, nuts and washers	28.80	19.20
4/8/13	SuperSelectos	Food and equipment	28.72	19.15
8/8/13	Aserradero el Triunfo	Cutting cost for packers	15.00	10.00
8/8/13	Freund Hardware Shop	Drill bits and paint	45.15	30.10
8/8/13	La Palma	Wood drill bits, nuts and washers and bolts	12.98	8.65
13/8/13	Freund Hardware Shop	Storage boxes	34.55	23.03
14/8/13	Hardware Store (Villanueva)	Window Panes for house (Maria Antonio)	30.50	20.33
TOTALS			10622.14	7081.43

OTHER				
Date	Company/Party Paid To	Description/Details	Amount (\$)	Approx. Amount (£)
29/7/13	Tienda (Villanueva)	Washing Products	5.00	3.33
7/8/13	Hardware Store (Villanueva)	Toilet Unblocker	2.75	1.83
8/8/13	SuperSelectos	Plates/Mugs for the house	7.30	4.87
13/8/13	Print Shop (Villanueva)	Printing for house maintenance talk	4.60	3.07
13/8/13	SuperSelectos	Gift for Domingo	43.42	28.95
TOTALS			63.07	42.05

GRAND TOTAL	N.B. EXCHANGED AT £1.00=\$1.50	DOLLARS	POUNDS
		26415.35	17610.23

EL SALVADOR PROJECT 2013 - INCOMES AND FUNDRAISING

SOURCE OF FUNDING	DESCRIPTION	AMOUNT (£)
Student fundraising events and donations	Student donations towards flights	7078.42
	Virgin Fundraising Page 1, Hyde Park Relays	431.088
	Virgin Fundraising Page 1, London Costume Run	2325.79182
Industrial donations	AECOM	200
	Expedition Engineering	500
Charitable grants and University Involvement	Old Centralians' Trust	3300
	Imperial College Department of Civil Engineering	2500
	IC Trust	2000
Other	Refunded wood purchase overflow (converted)	618.27
TOTALS	POUNDS (£)	18953.57
	EQUIVALENT DOLLARS (\$)	28430.35098

TOTAL INCOME	TOTAL EXPENDITURES	LEFT IN ACCOUNT	CURRENCY
18953.57	17610.23	1343.34	GBP
28430.35	26415.35	2015.01	US DOLLARS