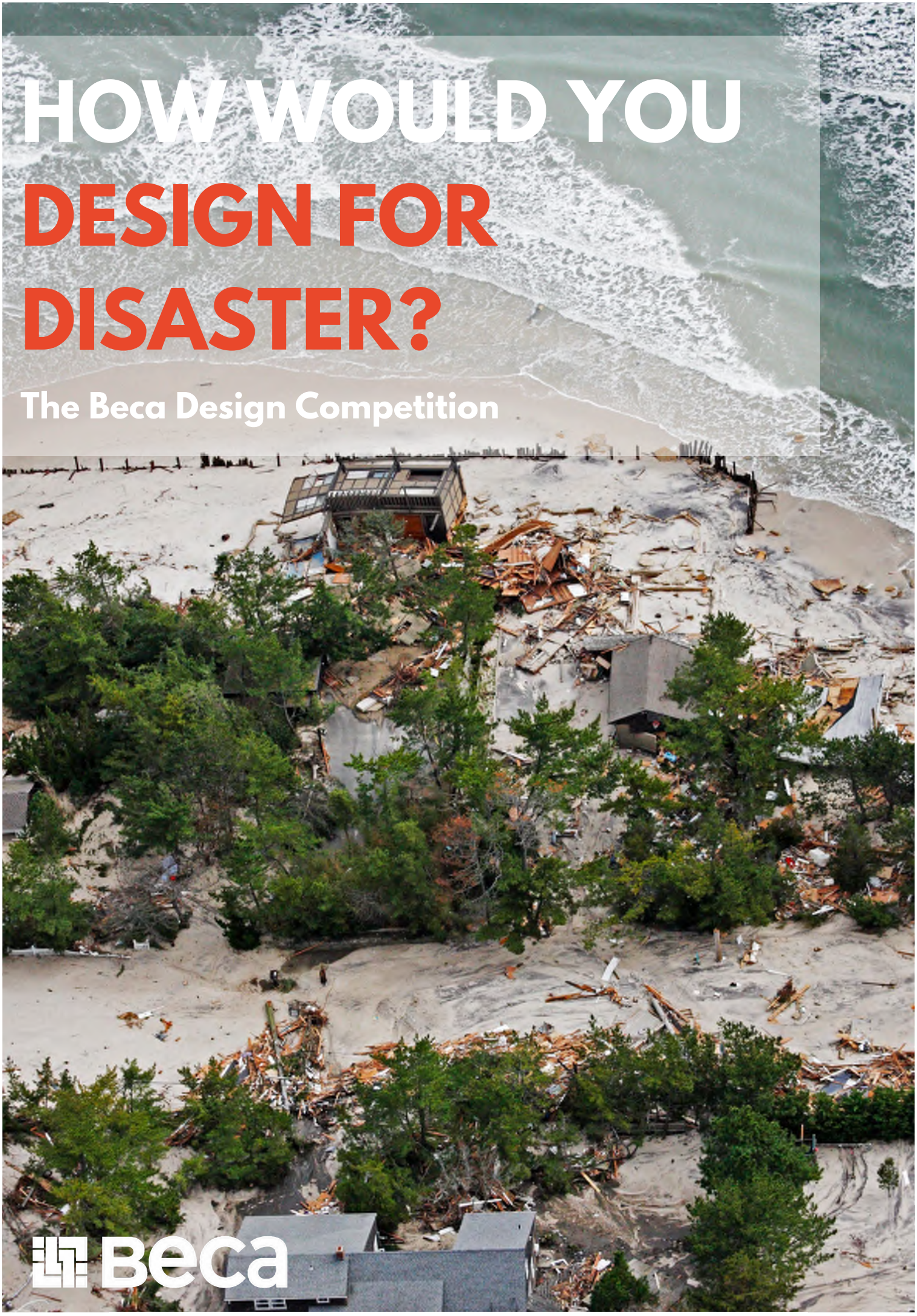
HOW WOULD YOU DESIGN FOR DISASTER?

The Beca Design Competition



Beca

#wemakethingshappen

The Beca Design Competition 2016

We are delighted that you have shown interest in the designs. Should they be of further interest it would be great to work with you to look at how we can develop these ideas further.

For all inquiries please contact James McLean on 04 460 1762.

Cover photo is by David Mariglos.

This magazine was published in April 2017 by Kris and the team at Apex Print & Design.

Beca

Tēnā koutou e hoa ma

The Beca Design Competition originated from an idea to promote more creative and innovative thinking in our young designers. It has encouraged them to think about a project holistically and develop a viable concept to meet a brief in a multidisciplinary team.

In total 24 teams from New Zealand, Australia, Singapore and Thailand submitted designs. The entries have far exceeded expectations and highlight the innovative and hard working future of Beca.

We hope you enjoy the work of our young designers.

Ngā mihi nui

The Beca Design Competition Team

Contents

SHELTERS

BRIDGES

WHARVES

BEYOND THE SCOPE

The Brief

Teams were asked to show how they would design for disaster. This was expressed through the design of a deployable wharf, bridge or shelter to be used in the event of a natural disaster in the Pacific.

DESIGN REQUIREMENTS

- **The design had to be deployable within a week.**
- **The design had to be deployable by a poorly resourced and unskilled workforce.**
- **Storage of the facilities needed to be considered.**
- **The bridge had to span 25 m and carry a 10 tonne vehicle.**
- **The wharf had to be able to stand in 5 m of water and have suitable clearance to unload a 20 m RIB.**
- **The shelter had to be able to house a minimum of 6 people, be weather tight and be able to withstand following aftershock disasters. The shelters also needed provisions for heating, cooling and basic life support functionality.**
- **All designs were required to be transported by a 12 m truck.**

Judging Criteria

DESIGN PHILOSOPHY

What is the motivation and overarching philosophy for the design?

INNOVATION

How is the design different to anything done before?

DEPLOYABLE

How will the design be deployed in a simple manner by an unskilled workforce in potentially challenging conditions?

FUNCTIONALITY

What makes the design suitable for an emergency situation? What makes it durable, easily transportable and deployable?

ECONOMICS

How much will it cost? An emergency shelter isn't of much use if people can't afford to use it.

Design For Disaster

A report from the United Nations found that since 2000

1.3 million people have died from natural disasters

The cost of recovery from natural disasters exceeds NZD$5.6 trillion

4.4 billion people have been affected by the long term impacts of disaster

What should we think about when designing for disaster?

RECREATING COMMUNITIES
A sense of community is essential for recovery. Promoting a sense of community is vital for the design.

DISTRIBUTING AID
How can the design supply aid in the very first instance?

PEOPLE CENTRED HUMANITARIAN RESPONSE
Design for maximum community involvement, giving affected people a feeling that they are contributing to their own recovery.

BEING RESOURCEFUL
A design is more valuable if it utilises existing resources. New is not always the answer and existing infrastructure may only need minor repairs to become functional again.

ADAPTABILITY
A design that can serve more than its primary purpose will be invaluable in a disaster situation.

Judging Panel

David Carter

Group Executive Chairman

Graham Crust

Principal Architect

Nigel Ewels

Development Manager, Auckland,
Ministry of Foreign Affairs & Trade

Neil Horsfield

Operations Manager - Building Structures

Jon Williams

Group Delivery Manager - Technical Practice

SHELTERS

“

...by keeping families together, our shelter adds some normality and stability to a turbulent time...

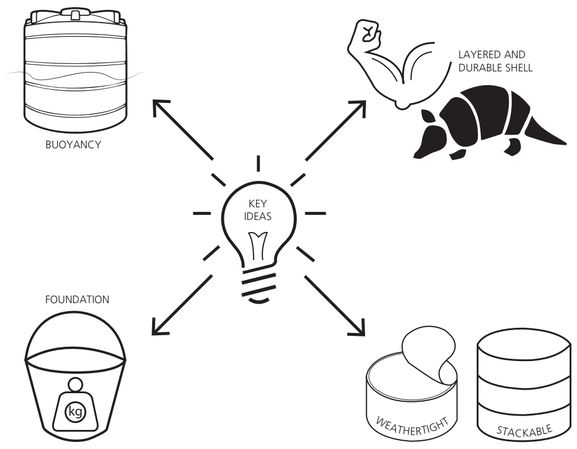
”

Team C.O.H.A

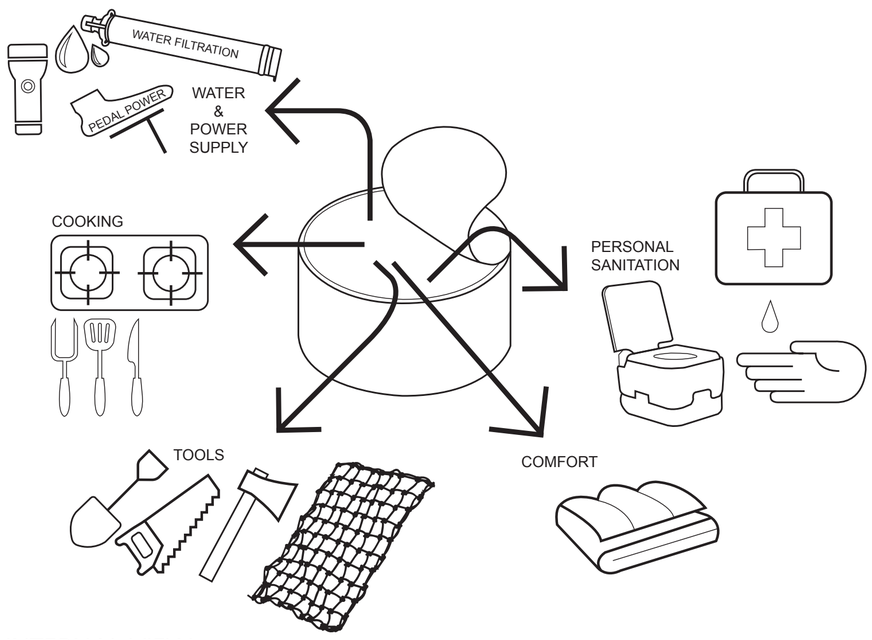
ARMA SHIELD

THE SHELTER IS A NEW INNOVATIVE DESIGN USED TO COMBAT POST DISASTER SITUATIONS WHICH CAPITALISES ON PATRON SAFETY. THE DESIGN IS DRIVEN AROUND OPTIMISING GEOMETRY AND SUSTAINABILITY BY UTILISING RECYCLED MATERIALS IN A STRUCTURE WHICH WILL WITHSTAND CATESTROPHIC CONDITIONS. COMPACTABILITY AND DEPLOYABILITY HAVE BEEN A MAIN DESIGN BENCHMARK FOR DIMENSIONING WITH RESPECT FOR TRANSPORTABILITY. THE INJECTION MOULDED FIBRE REINFORCED (TIMBER) STRUCTURE ALLOWS SIX PEOPLE TO CARRY THE SHELTER TO SITE. THE ITEMS STORED INSIDE THE WEATHERTIGHT CONTAINTER ARE REMOVED AND IT IS THEN FILLED WITH SOIL AND DEBRIS PROVIDING A SECURE FOUNDATION TO ALLOW ANCHORAGE DURING HIGH WIND SPEEDS. THE EXTERNAL SHELL IS THEN ERECTED FROM THE CONTAINER TO PROVIDE A DURABLE SHELL FROM THE OUTSIDE ELEMENTS. THE SHELTER HAS THE ABILITY TO BE SET UP WITHIN AN HOUR PROVIDING THE ULTIMATE DEGREE OF SHELTER FOR AN AFFORDABLE FINANCIAL COST WHICH ALLOWS FOR REUSABILITY.

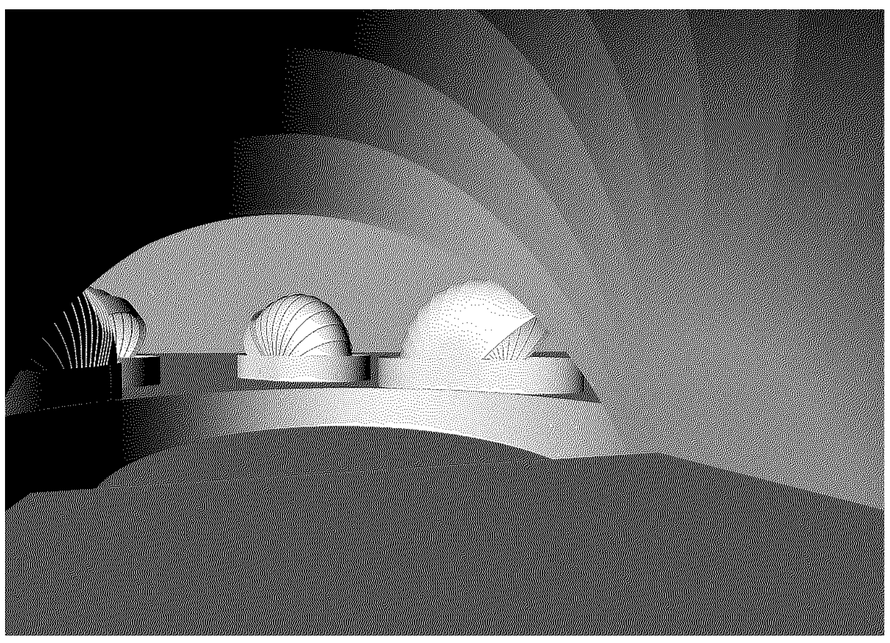
DESIGN THEORY

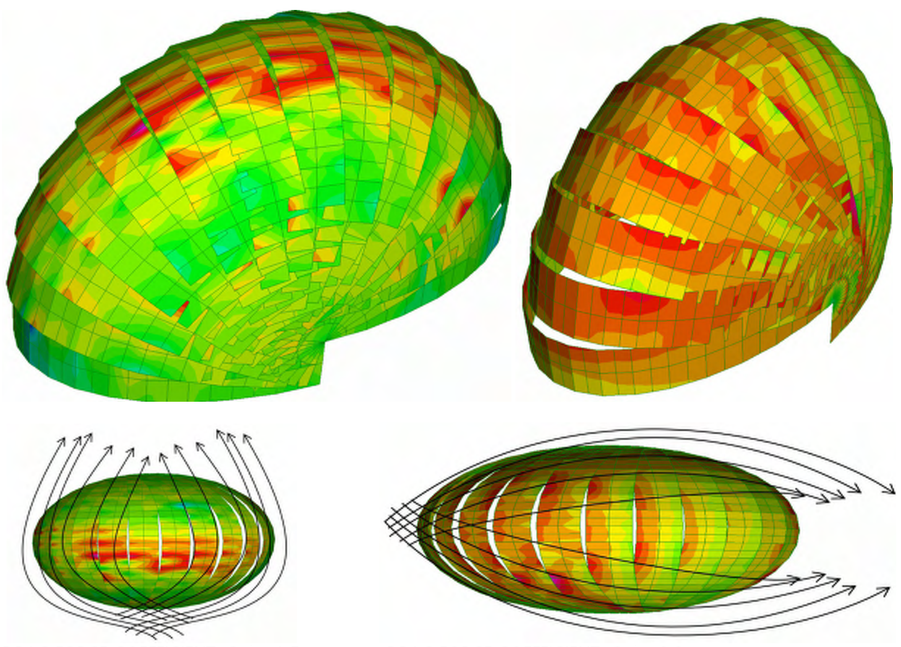


CONTENTS OF THE CONTAINER



INTERNAL VIEW





DRAG FORCE COEFFICIENT, C.d = 1.5

DRAG FORCE COEFFICIENT, C.d = 0.3

STRESS DIAGRAMS

THE DOME ALLOWS FOR THE MOST ROBUST DESIGN POSSIBLE TO WITHSTAND CATEGORY 5 CYCLONIC WIND AND IMPACT LOADING. THE DOME SHAPE ALLOWS THE WIND PATH TO FLOW AROUND THEREFORE REDUCING THE PRESSURE ON THE STRUCTURE. RED RESEMBLES THE MOST CRITICAL STRESSES WITHIN THE DOME AND GREEN RESEMBLES THE LOWEST STRESS AREAS.
UNDER A CATEGORY 5 CYCLONE (325KM/H WIND). THE CAPACITY OF THE FIBRE REINFORCED PLASTIC SHELL IS STILL WITHIN THE MATERIAL STRESS CAPACITY, AS EACH SHELL ACTS COMPLETELY IN COMPRESSION AND IS SUPPORTED BY THE LIP OF THE ADJACENT SHELLS.

COST AND ECONOMICS

WATER FILTER STRAW (x6)	$240
BLANKET (x6)	$120
VARIOUS TOOLS	$50
WATER (10L = $4)	$40
FIRST AID KIT	$50
FARDAY TORCH	$5
PLASTIC 2.4 x 0.61	$55
STEEL	$100
COMPRESSIBLE JOINTS	$1760
CANVAS DOOR	$90
FLYSCREEN	$15
KINITEC ENERGY GENERATOR	$100
ALCOHOL STOVE	$30
ALCOHOL FOR STOVE	$30
CHEMICAL TOILET	$80
MANUFACTURING LABOUR	$2000
BUILD TOTAL	$4795
SHIP TRANSPORTATION	$2000

TEAM

252 INDUSTRIAL BUILDINGS

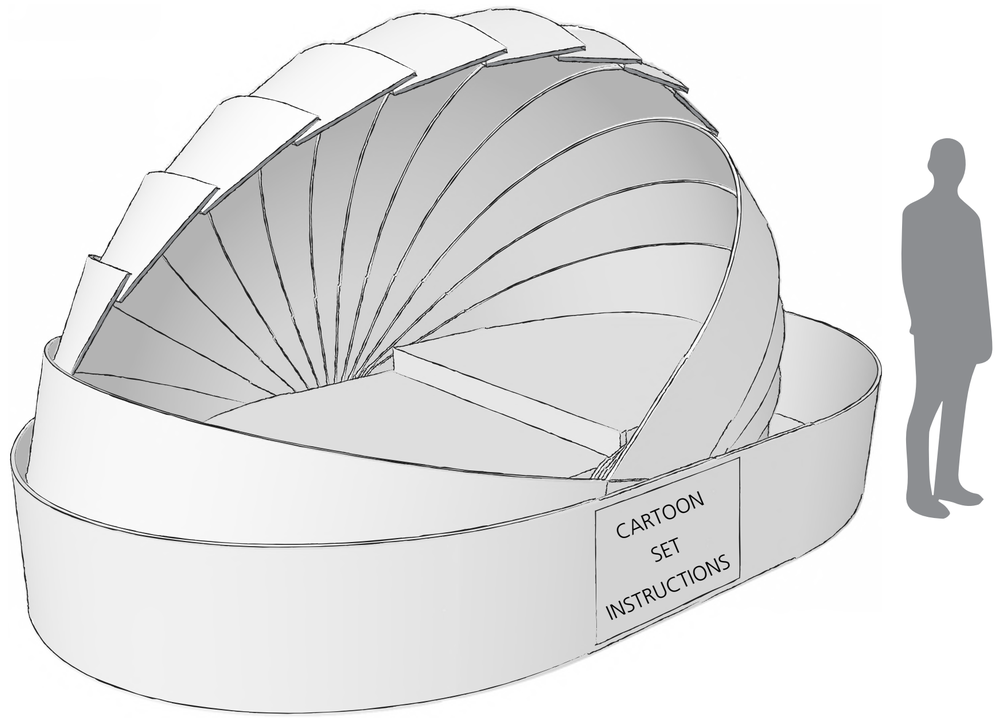

STEPHANIE TRAKAS


SAM BERRY-SMITH


SUZANNAH COLES


CHRIS MULLER

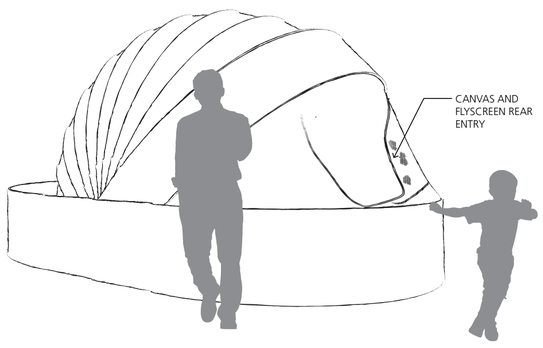
MENTOR - MARK NANKERVIS



3D CROSS SECTION

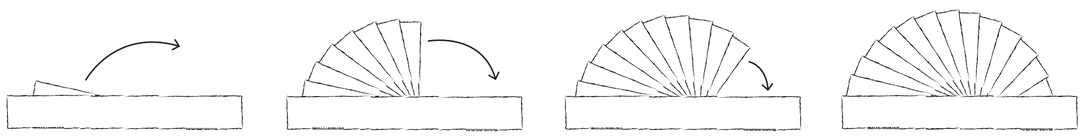
REGARDLESS OF THE SUN'S ORIENTATION, LIGHT TRANSMISSION IS DIRECTLY AT RIGHT ANGLES AT ANY TIME OF THE DAY AND SEASON OF THE YEAR. EXCELLENT AIR FLOW IS MAINTAINED EVEN IN WARM, STILL WEATHER CONDITIONS.

PERSPECTIVE - CYCLONE MODE

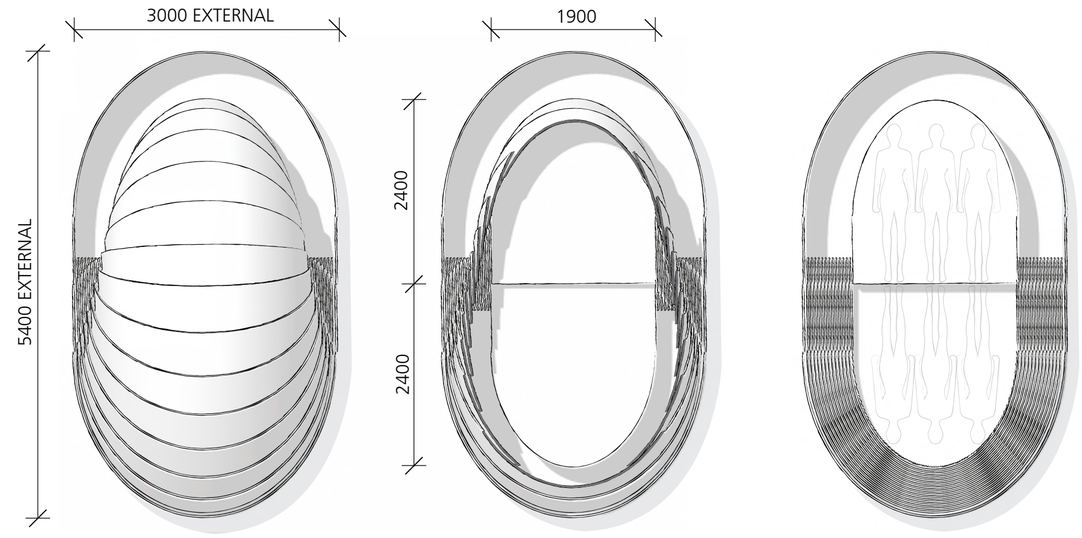


PERSPECTIVE - CALM DAY REAR ENTRY

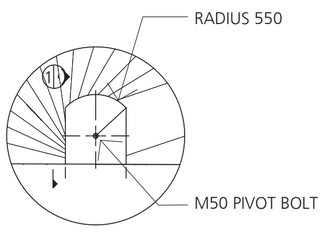
PERSPECTIVE - CARRYING SHELTER

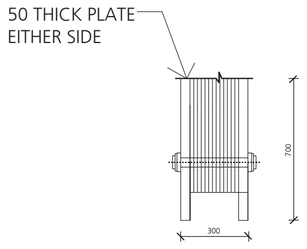


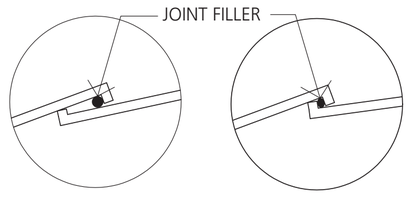
SEQUENCE OF ASSEMBLY



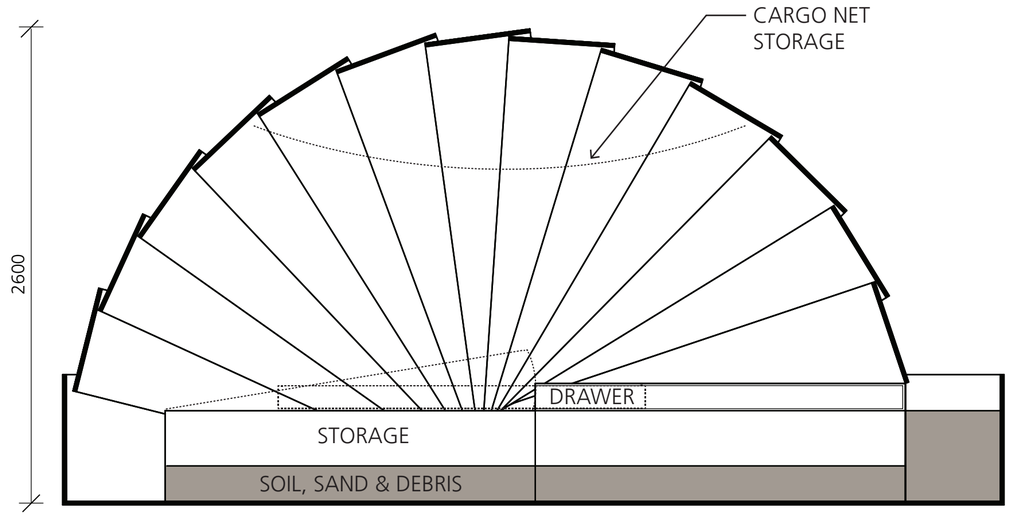
PLAN VIEW



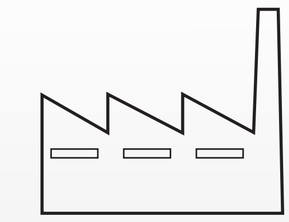




DETAILS

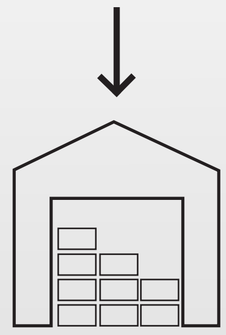


SECTION



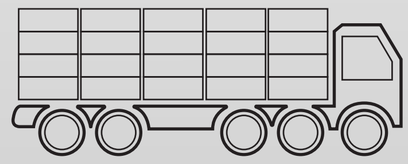
MANUFACTURE

INJECTION MOULDED FIBRE REINFORCED RECYCLED PLASTIC INSULATED WITH FOAM



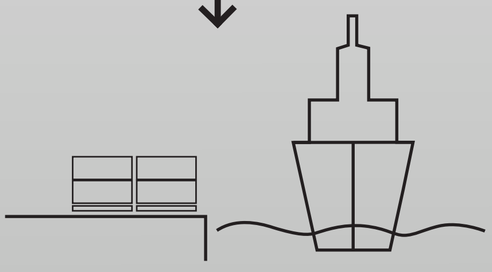
STORAGE

AIRTIGHT AND WATERPROOF CONTAINER TO BE STORED IN A WAREHOUSE READY FOR TRANSIT



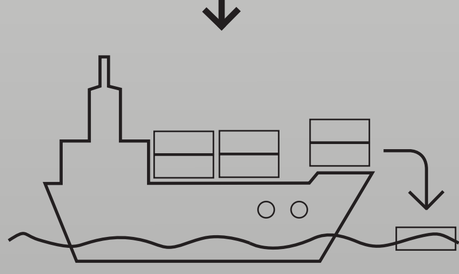
STACKABLE & EFFICIENT

SHELTER CONTAINER SIZED FOR MAXIMUM EFFIENCY DURING DELIVERY TO WHARF
20 UNITS PER 12m TRUCK BED



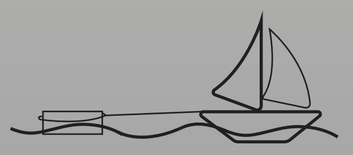
WEATHERTIGHT CONTAINER

AIRTIGHT AND WATERPROOF CONTAINER REQUIRING NO PROTECTION OR COVER IN SEA TRANSIT



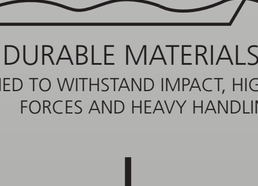
DURABLE MATERIALS

DESIGNED TO WITHSTAND IMPACT, HIGH PRESSURE FORCES AND HEAVY HANDLING



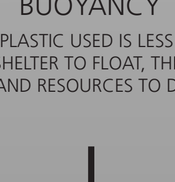
BUOYANCY

DENSITY OF PLASTIC USED IS LESS THAN WATER ALLOWING THE SHELTER TO FLOAT, THEREFORE UTILISING LOCAL SKILLS AND RESOURCES TO DELIVER QUICKLY



EASILY ASSEMBLED

SURVIVAL ITEMS ARE REMOVED AND THE BASE IS FILLED WITH SOIL AND DEBRIS FROM SITE AND FALSE FLOOR IS PLACED ONTOP. SET UP IS WITHIN ONE HOUR WITH NO TOOLS AND LABOUR



REUSE & REPAIR

MATERIALS DESIGNED TO BE EASILY CLEANED AND PLASTIC WELDED FOR REPAIRS ALLOWING THE SHELTER TO BE REUSED

Process

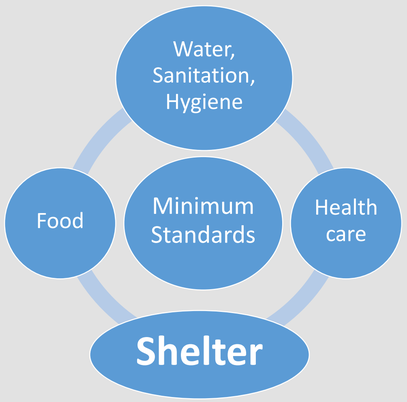
Understanding the disasters

2004 Indian ocean earthquake and tsunami

2011 Japan's Tōhoku earthquake and tsunami

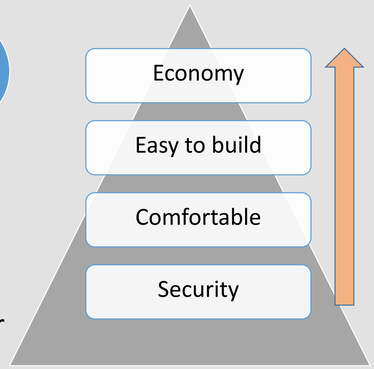
2016 Fiji's Cyclone Winston, Etc.

The Needs



We based our surrounding condition in Thailand and other ASEAN countries.

Design Concepts



We aimed to build a Temporary Shelter
Which its Life span is 3 – 6 months.

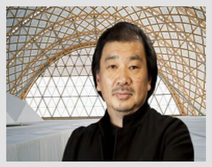
We choose Bamboo as the main material, which they have been through the strengthening process (uses of Borax, and dried process)

Recycled Pallet, Strong and cheap, used as base of the slab, covered with rubber sheet

Nail Plate, for the connection of the timber structure. Light, cheap, and easy to use, comes in various shapes for different joints.

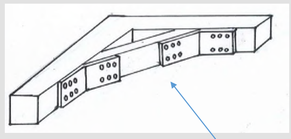
Fabric, for ceiling and Roof

Recent works that inspired us.



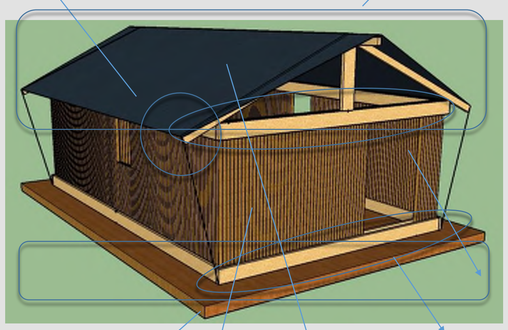
Shigeru Ban's Architecture, Pallet recycle uses, Bamboo Structure.

Designing

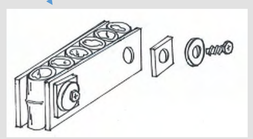


beams and bottom chords are linked by nail plate.

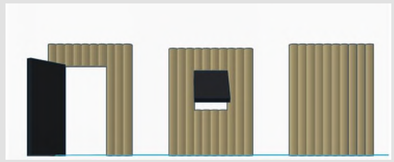
PVC canvas is combined with wooden roof-structure for the se following purposes
1.Weight reducing
2.Easy to build
3.Sunlight transparency



The collection of typical wooden pallets are used as a base of the shelter



The Bamboo wall-structure is fixed by bolt-nut system with wooden plates every 1 m. according to the pic. above



There are 3 types of bamboo structure come as a bundle
1.Door bundle
2 Window Bundle.
3.Plain bundle

This roof will be covered by canvas fabrics. By the ridge is going to be over to our from vertical structure . Then we will use canvas cover to them all. Anyway, we could use tires for loading our roof.

Why ours?

Here's why

- It's Cheap! Why not!? Because all of our structure cost just a little. And some of them are recycled.
- Easy to build! Estimated by our senior, it can be built within three hours by only two people.
- It's safe! Because our structures are very light so they will be no serious damage to the habitants, in case the calamity happens again.
- Everything!

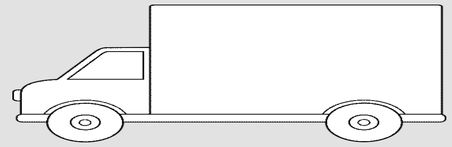
Deploying

1. place all the pallets on the ground level
2. Assemble wooden plate and the bamboo bundle to form the structure.
3. Also , braces the top of all bamboo walls.
4. Temporary props the structure perpendicular to the ground
5. Assemble all the roof frame separately.
6. Combine the roof structure and our main frame by using nail plates.
7. Hold the canvas which we'll use as the roof and ceiling to the roof structure.
8. Tie the Roof sling to the base of our structure.
9. Remove temporary braces
10. Recheck our structure thoroughly for flaws and errors. Fix them if you find one.

Estimated Cost

For a single unit should cost around 14069 THB (550 NZD)

Transportation



For one 12 m truck, we can carry 3 modules in a single truck.

For a single shipping container can contain 2 of our modules

Community

Joining our Shelters, we can form a small community.

Not only housing shelter, but also can use it as church, cooking area, or medical center

We hope our work would be benefit to whomever needs it

Sincerely, Tom Yum Kungz (BECA WARNES THAILAND)

beCARE PACKAGE

SETTING THE SCENE

Post-disaster temporary shelters are designed to provide short term relief (months) and temporary housing whilst damage is assessed and rehabilitated. These are more holistic than emergency shelters, with extensive provisions for cooking, heating, cooling and sanitation.

Common temporary shelters currently in use include tents or mass public shelters. Challenges include complex and long period of deployment, lack of space planning and socio-cultural issues.

LOW COST

Minimalistic approach to design with low cost materials and self-sustaining methods of power generation and water supply. Robust design means these units are reusable with lower life cycle cost. Availability of proprietary product also reduces production cost.

Preliminary costing of each unit (inc prorated cost of the communal services) totals $14,000.000. This is approx. $2400 per person and is within a 80% accuracy range.

DURABLE DESIGN

Combinations of lightweight steel framing and insulation panels to provide lightweight structure capable of withstanding aftershocks and extreme wind events. Each unit is raised slightly of the ground to mitigate flooding and improve insulation.

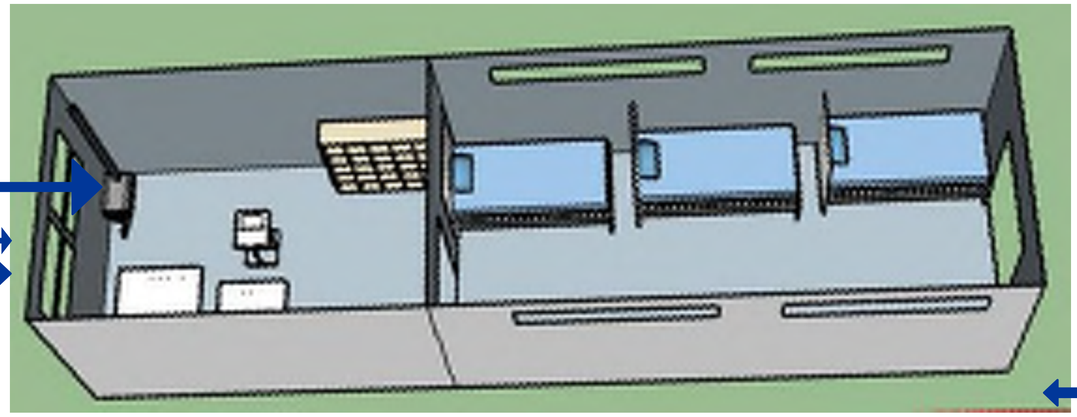
SIMPLE SET-UP

beCARE units are capable of being raised by crane mounted trucks of forklifts. These units have been designed with no complex connection and maximum setup time of 1 unit per hour.

The beCARE PACKAGE capitalises on the simple construction methodology developed by Humanihut, with a simple 'pop up' feature.

Frontier Portable Stove - Cooking stoves can be easily assembled by one person and can completely portable. These are fuelled by sawdust pellets, and eventually wood.

Large ventilation windows with mosquito nets



Folding solar panels - Situated on top of each beCARE unit. These are compact and easy to setup and dismantle.

Hyder Water tanks - The beCARE unit roofs are sloped slightly to catch rainfall runoff. Rainfall runoff is collected in large unfolding rainwater units and used for the shower units

Composting Toilets - All showers and toilets are located in a 'communal' units, allowing for simpler utility design. Facilities are gender separated and consist of propriety composting. These units are waterless and urine diverting.
Shower units consist are modular and can be easily arranged within a 'communal' beCARE unit. The 'communal' beCARE unit will be predrilled to allow for pipping of water from the rainwater tanks. All shower units have a common pipe connection, allowing for easier setup.

REBUILDING A COMMUNITY

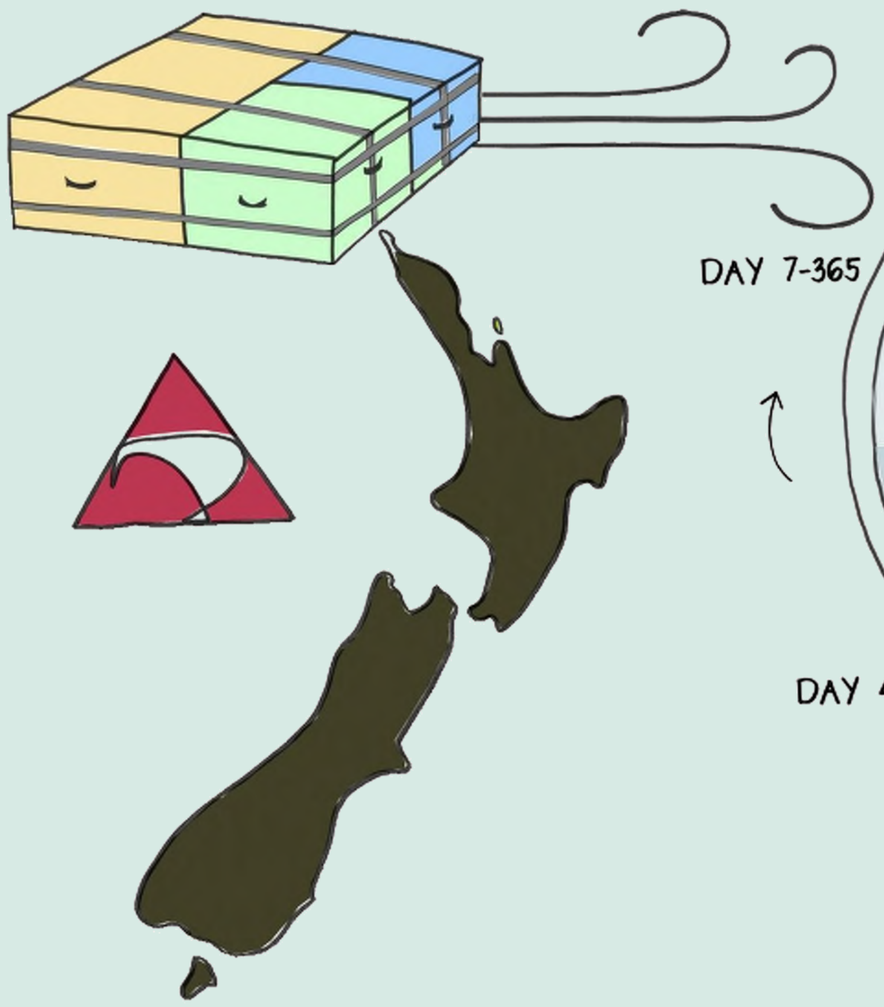
Communal living layout with common cooking and eating areas. Sufficient privacy and security is provided by separate dwelling spaces. Each unit can comfortably accommodate a family of 6.

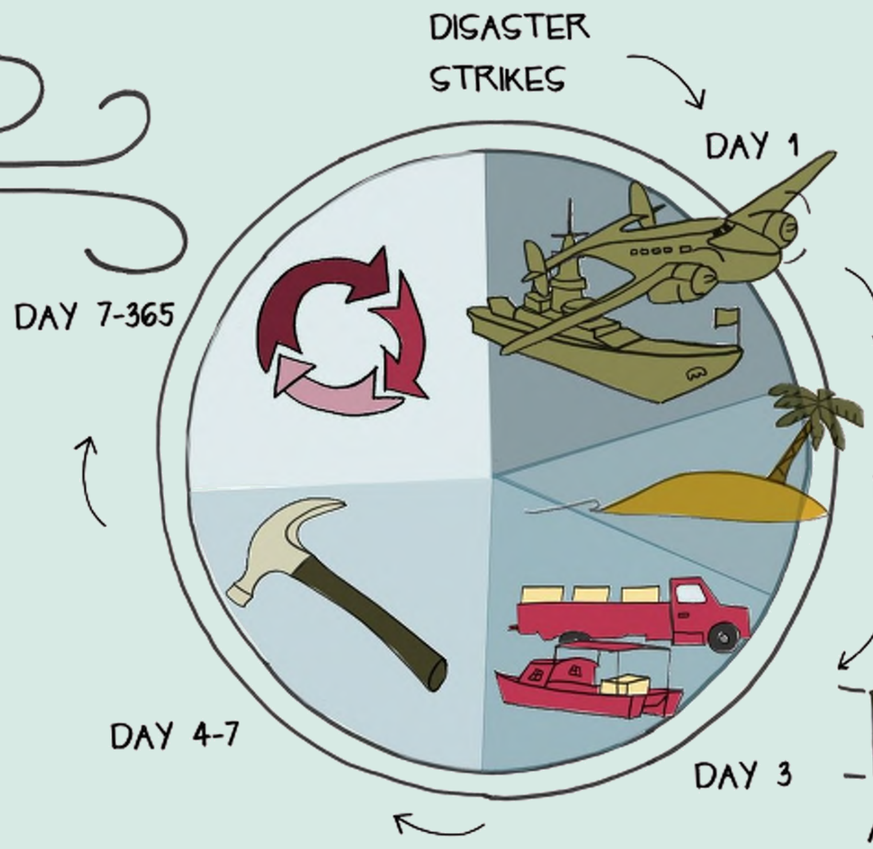
EASILY DEPLOYABLE AND TRANSPORTABLE

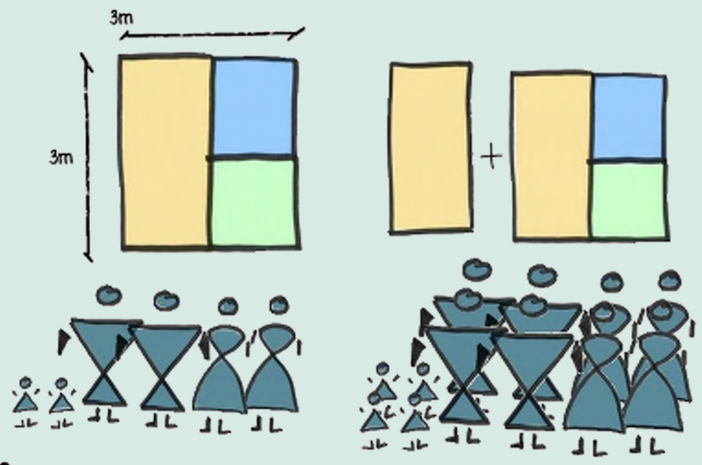
Units are flat packed and designed for stacking in a conventional 40 ft shipping container. These shipping containers are loaded and stored in close proximity to Auckland and Brisbane Ports. This improves service the broad geographic footprint of the Pacific Region, reducing shipping times by 2-3 days. Alternatively, these loaded containers can be stored locally within each country, eliminating the need for shipping.

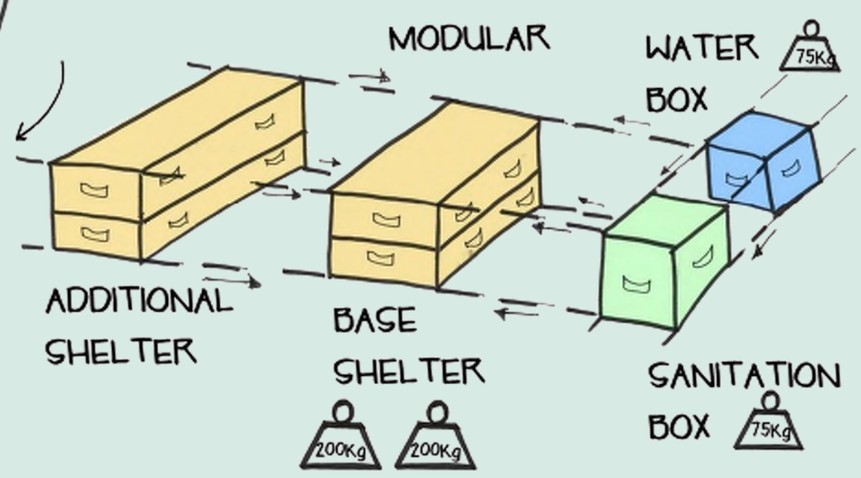
Modular design allows for a staged deployment process. The beCARE First Response Package consisting of amenities, food, water, water purification, first air and blankets to be distributed ahead of the complete beCARE package, allowing for quicker distribution of key life support items.

DAY 1	DAY 2	DAY 3	DAY 4	DAY 5	DAY 6	DAY 7
beCARE PACKAGE loaded onto container ship – Auckland NZ	beCARE PACKAGE shipped to disaster area (max 4 days)				Package trucked to relief location	Service connection and commissioning
beCARE PACKAGE loaded onto container ship - BRISBANE, AUS	beCARE PACKAGE shipped to disaster area (max 4 days)				Package trucked to relief location	Service connection and commissioning
beCARE First Response Package loaded into Airplane	First Response Package flown to disaster area	Package trucked to relief location	First Response Package setup (1 hour per unit)	Service connection and commissioning		









C.O.H.A

COMMUNITY ORIENTATED HUMANITARIAN AID

THE COHA SHELTER IS DESIGNED TO PROVIDE RELIEF TO THE **PACIFIC ISLANDS** FOLLOWING THE AFTERMATH OF A DEADLY **TROPICAL CYCLONE**. THE SHELTER HAS BEEN DESIGNED FOR A **TEMPORARY** ONE YEAR LIFE FUNCTION. THE PRIMARY FUNCTION OF THE COHA SHELTER IS TO **KEEP COMMUNITIES TOGETHER**. KEEPING THE **COMMUNITY** IN MIND SETS IT APART FROM OTHER CONTEMPORARY SOLUTIONS. THE **MODULAR** STYLE CAN ADAPT TO FAMILIES OF ANY SIZE BY ADDING AN EXTRA SHELTER BOX. COMMUNITY AND FAMILY ARE PARAMOUNT IN ALL PACIFIC ISLAND CULTURES SO BY **KEEPING FAMILIES TOGETHER** OUR SHELTER ADDS SOME NORMALITY AND STABILITY TO A TURBULENT TIME. THE STRUCTURE FITS IN WITH THE CURRENT INFRASTRUCTURE AND SOCIETAL NEEDS, TARGETING THE LEAST ABLE IN THEIR TIME OF NEED. THE MATERIALS ARE **NEW ZEALAND SOURCED** FOCUSSING ON CHEAP, STRONG AND SUSTAINABLE PRODUCTS. THE UNIT IS **SIMPLE TO CONSTRUCT** USING BASIC TOOLS AND CONSTRUCTION METHODS. ALTHOUGH THE LIFECYCLE OF THE STRUCTURE IS ONE YEAR, THE STRUCTURE CAN BE **EASILY MODIFIED** INTO A PERMANENT HOME, ENHANCED AND PERSONALISED WITH **TRADITIONAL MATERIALS**, OR PACKED UP AND REMOVED FROM SITE READY TO **BE RE-USED** BY ANOTHER FAMILY OR ANOTHER DISASTER.
THE COHA SHELTER HAS BEEN DESIGNED TO PROVIDE RAIN **WATER** COLLECTION, BASIC **VENTILATION**, SOLAR **LIGHTING**. THERE ARE FEATURES SUCH AS PRIVACY SCREENS TO ENSURE **WOMEN AND CHILDREN** RECEIVE ADEQUATE PRIVACY IN THE CONSERVATIVE ISLAND COMMUNITIES. THE SHELTER COMES TO SITE AS **ONE UNIT** CONSISTING OF A MINIMUM OF THREE **MODULES**. EACH MODULE HAS A UNIQUE PURPOSE; THE BASE SHELTER CONTAINS ALL MATERIALS REQUIRED TO BUILD THE SHELTER, THE SANITATION BOX CONTAINS THE **SEPARATE TOILET** FACILITIES, THE **WATER** BOX CONTAINS A WATER BLADDER AND **FILTRATION** EQUIPMENT. AN ADDITIONAL SHELTER UNIT OR AN ADDITIONAL WATER UNIT CAN BE ADDED EASILY FOR LARGER ISLAND FAMILIES. THE MODULES HAVE BEEN DESIGNED TO FIT AND STRAP TOGETHER AND APART FOR **EASY TRANSPORTATION**. EACH MODULE CAN THEN BE LIFTED BY LESS THAN FOUR PEOPLE.

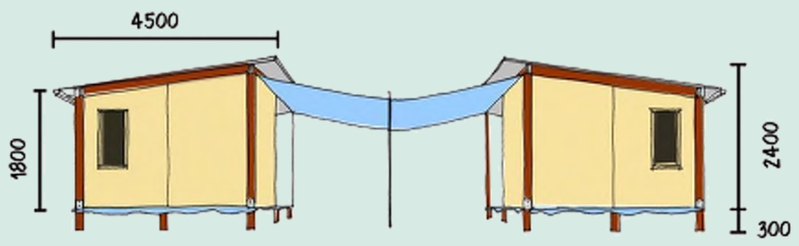
EACH COHA BASE SHELTER AN **AREA OF 22m²** AND HOUSES **6 PEOPLE**. THE SHELTER FLOOR HAS BEEN **RAISED 300MM** OFF THE GROUND TO AVOID FLOOD WATERS. TEMPERATURES IN THE PACIFIC RARELY DROP BELOW 18°C, REDUCING THE NEED FOR AN ACTIVE HEATING SYSTEM. THE LARGEST AREA WALL IS UNDER REDUCED SHADING TO FACILITATE **NATURAL VENTILATION** BY CREATING CONVECTIVE AIR MOVEMENT AND VENTILATING AT HIGH LEVEL. WINDOW OPENINGS A LOCATED EITHER SIDE OF THE STRUCTURE TO ENCOURAGE **CROSS VENTILATION**. THE AVERAGE WATER REQUIREMENT FOR A COMBINATION OF DRINKING, WASHING, AND COOKING IS BETWEEN **7.5 AND 15L PER PERSON PER DAY**. SAFE WATER ACCESS IS ONE OF THE BIGGEST CONCERNS POST-DISASTER WITH THE POTENTIAL OF CONTAMINATION OF LOCAL RESOURCES. USE OF **RAINWATER** AS A SUPPLEMENTARY WATER RESOURCE IS A SAFER OPTION THAN RELYING ON LOCAL WATER SUPPLIES. A COHA SHELTER HAS A **ROOF PITCH OF 11°** TO ASSIST WITH COLLECTION. THE SYSTEM HAS A **1000L** CAPACITY, BASED ON A **2 – 3 WEEK SUPPLY** FOR 6 PEOPLE. A KEY COMPONENT OF THE SUCCESS OF THIS RAINWATER CATCHMENT IS THE **FILTRATION + DISINFECTION** OF THE WATER. A SEPARATE TOILET CONSISTS OF A BASIC STRUCTURE (FOR PRIVACY), AND A BOX THAT IS **ADAPTABLE** TO EXISTING TECHNOLOGIES SUCH AS URINE DIVERSION DEHYDRATION TOILETS, BAGGED TOILETS, LATRINES, CHEMICAL TOILETS, OR RUDIMENTARY LONG DROPS. THE BOX HAS A SET OF STAKES THAT ARE USED TO PREVENT UNWANTED MOVEMENT, AND THESE STRUCTURAL FEATURES DOUBLE HAS HANDLES, MAKING IT MORE **ACCESSIBLE** TO ELDERLY AND DISABLED INDIVIDUALS. TO EXTEND ACTIVE HOURS INTO THE EVENING **SOLAR LIGHTING** IS PROVIDED. A BASIC **LIGHT SHELF** HAS ALSO BEEN INCLUDED TO UTILISE NATURAL LIGHTING. PROVISION IS TO BE MADE FOR ELEMENTARY ELECTRICAL WORKS IN CASE RELIABLE CONNECTION BECOMES AVAILABLE. THIS INCLUDE TWO SOCKETS AND BASIC INTERIOR LIGHTING. A **WIND-UP RADIO** HAS BEEN INCLUDED FOR COMMUNICATION. EACH COHA SHELTER HAS AN OVERALL COST OF **1816USD**. THIS INCLUDES MATERIALS, BASIC TOOLS, RAINWATER COLLECTION SYSTEM, TRANSPORTATION, AND DEPLOYMENT.

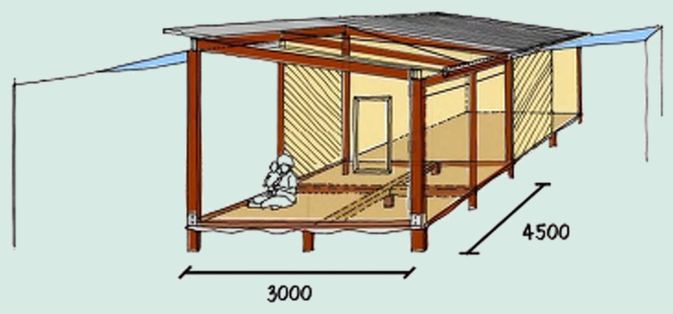
INNOVATIVE SOLUTIONS

WIND-UP RADIO

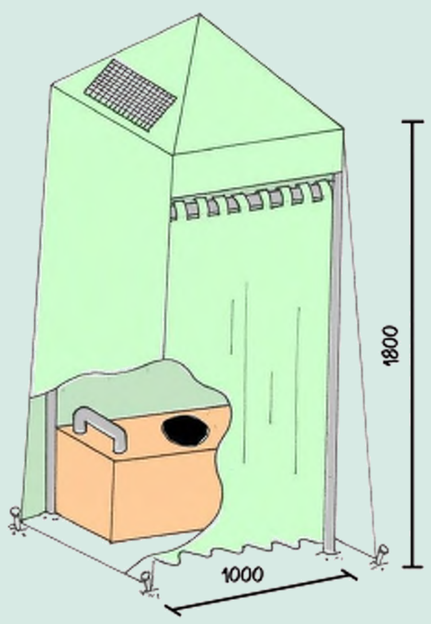
ADDITIONAL EQUIPMENT

MODULAR CONFIGURATIONS TO SUIT SITE AND FAMILY

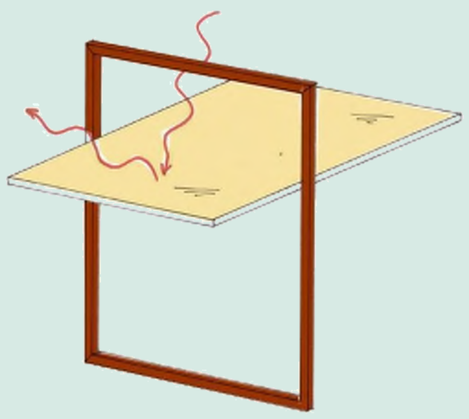


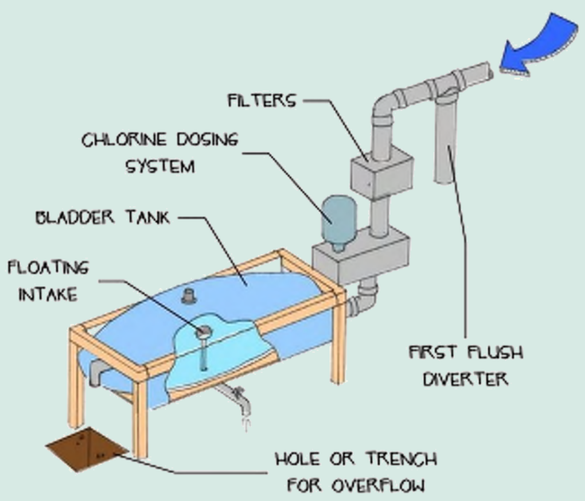


TOILET: LIGHT, PORTABLE, PRIVATE

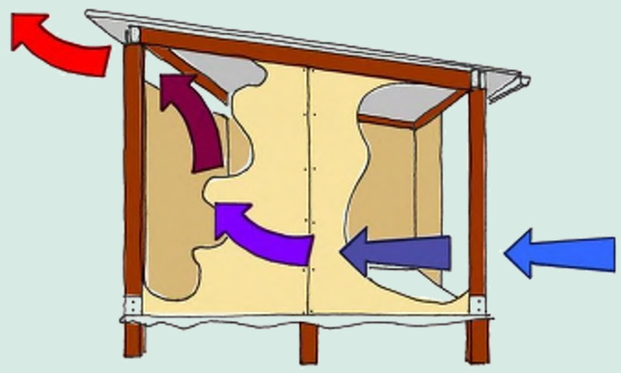


REFLECTIVE LIGHT SHELF





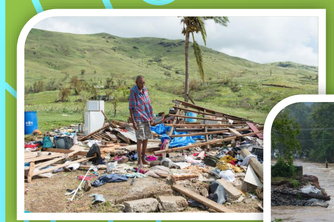
NATURAL VENTILATION AIR PATHWAY



Structure: timber frame: 150mmx50mm x19m, 100mmx100mmx15m, plywood 10mmx26m2, steel connections: joist hangers x8kg, column supports x9, bolts x5kg, coach screws x2kg, steel straps/ ties x4, trade equipment: hammers x2, saw x2, socket wrenches x2, shovels x4, weather resistance: polycarbonate roofing x22m2, fabric/ tarpaulin x33m2, alternative items: 12mm plywood x15m2, floor joist x28m----1241USD.
Building services: rainwater catchment: 1000L bladder tank x1, floating intake x1, soft pipe x15m, first flush diverter kit x1, gutter x5m, PVC pipe x5m, PVC elbow fitting x3, cartridge filters 50, 20, 5 micron each, automatic siphon doser x1, cooking: cooking grille x1, lighting: reflective coating x2m2, color lighting x4, entertainment: wind-up radio x1----405USD.
Transportation, management and education----217USD.
TOTAL COST----1863USD (10%) per shelter

DISASTROUS DWELLING DESIGNING DESPERADOS

Challenges of the Design



Mass Destruction of Houses

Flooding Makes Transportation and Foundations Difficult

No Power and Only Basic Tools

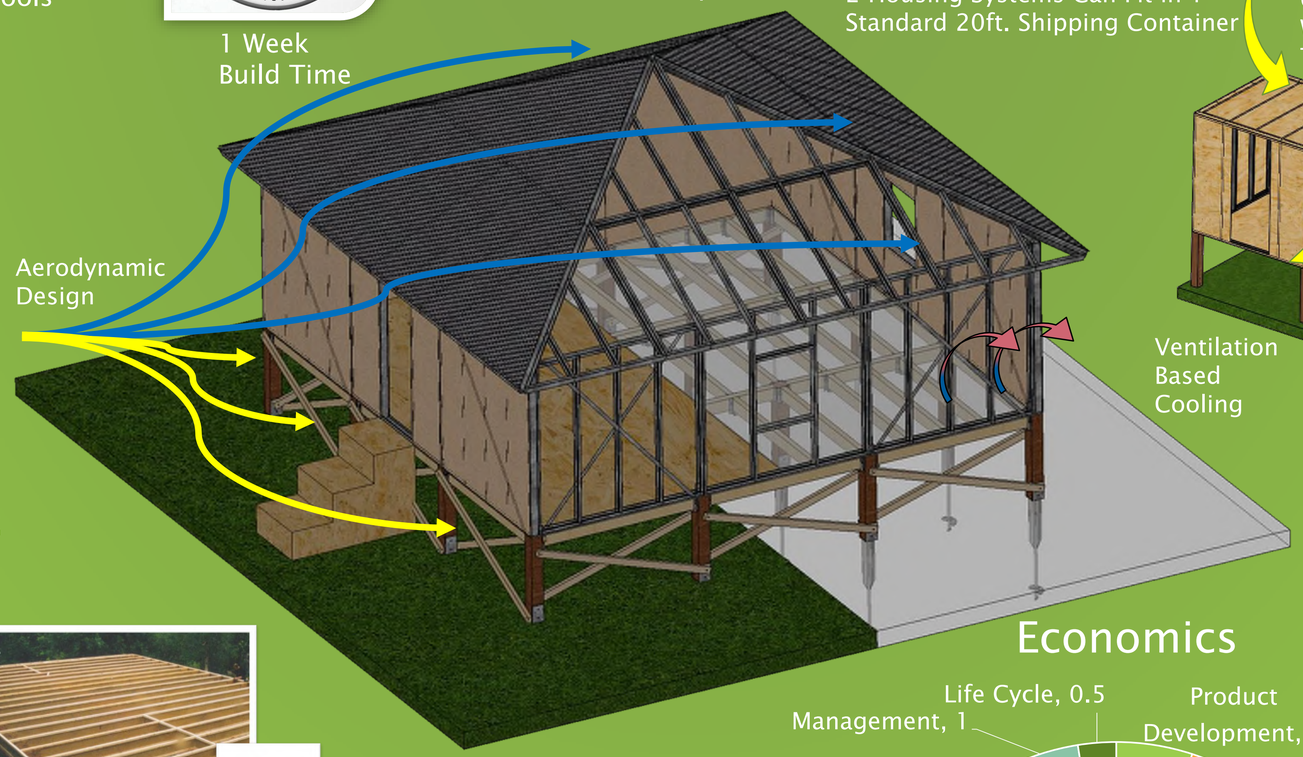
1 Week Build Time

Sanitation

Affordability

Design Features

- Category 4 Cyclone Survivability
- Flood Resistant
- 5 Year Design Life, but Adaptable for Future Use
- Sleeps up to 10 People
- Sweat Equity used for Assembly
- Local Styling Encourages Community Acceptance



Materials

Recycled Plastic Sheet Cladding

- Sustainable
- Light Weight
- Commercially Viable

Cold Formed Steel (CFS) Wall Panels

- 3x Stronger than Timber and Similarly Priced
- Recyclable
- Does not Warp
- Mass Prefabrication
- Not Combustible

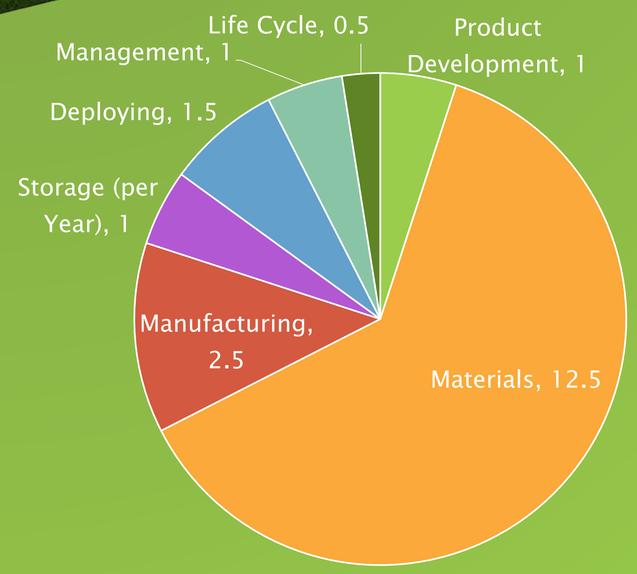
Traditional Timber Flooring

- Rigid Flooring
- Cultural Acceptance
- Familiar Material
- Relatively Light
- Pleasing Aesthetics

Screw Anchors

- Can be Installed by 1 Person
- Adjustable for Easy Levelling of Building
- Good Uplift Capacity
- No Setting Time
- Relatively Cheap

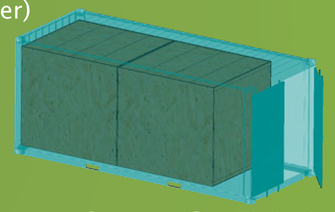
Economics



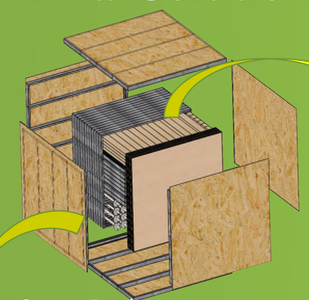
Cost per Shelter (Unit $1,000 NZD)

Final Solution

Box Can be Sealed for Water Tightness and Towed by a Boat (Box Has 1/8 the Density of Water)

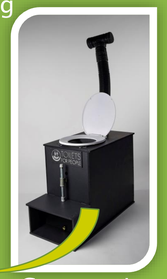


2 Housing Systems Can Fit in 1 Standard 20ft. Shipping Container

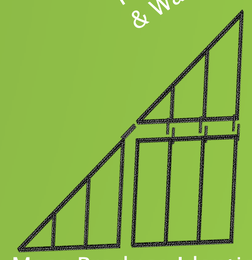


Outer Package Walls Form Toilet Framing

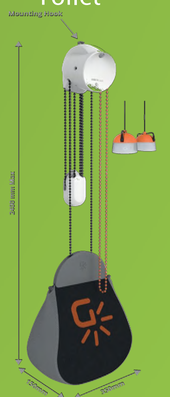
Ventilation Based Cooling



Composting Toilet



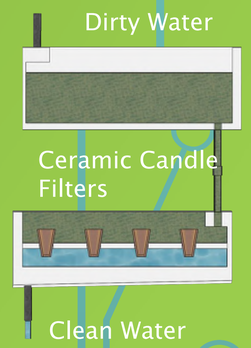
Mass Produce Identical Panels for Compatible Tool-less Connections



Gravity Powered Generator Provide Cheap, Safe & On-Demand Lighting

Flame Stower Uses Thermo-Electric Effect to Charge Devices from Cooking Fire

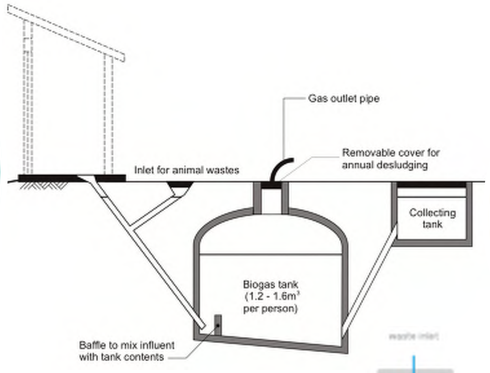
Locally Constructed Clay and Bamboo Rainwater Tank



Ceramic Filters Can be Produced Locally

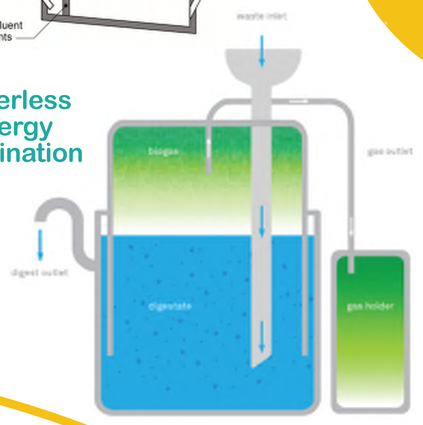
HOUSEHOLD & COMMUNAL TOILET

At a cost of AUD$300 per toilet & no on-going costs, a bio-digester toilet can provide sanitation & gas for cooking indefinitely.
(Waterless Toilet)



We believe that waterless toilets and clean energy are a winning combination

300$



18$

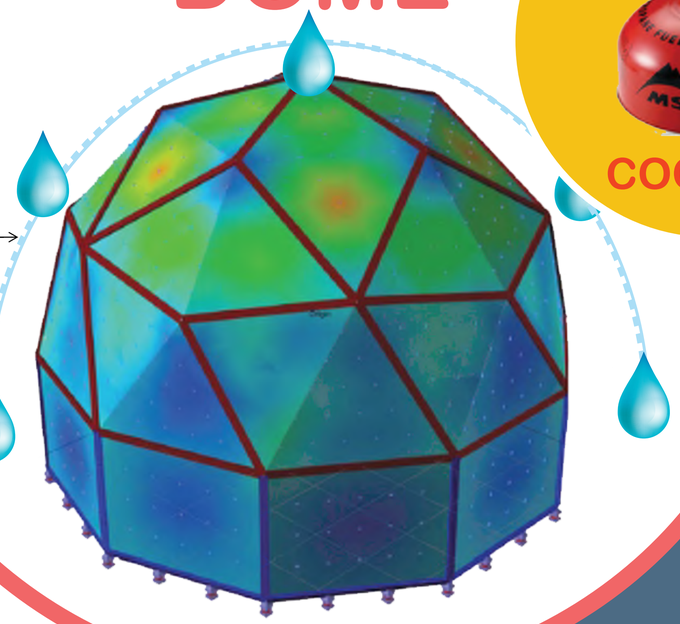
SOLAR LIGHT

Roof is to be made up of
Concrete Canvas

PROPERTIES & ADVANTAGES OF CONCRETE CANVAS

1. The thickness ranges from 5mm-13mm
2. 10 day compressive strength can be 40MPa
3. Weight is 1500 kg/m3
4. Easy to construct and easy to remove
5. Easy to transport & deploy because of it's weight and rolling ability
6. Uses 95% less material than conventional concrete
7. Environment friendly

DOME



Water Bag
Potable Storage Water
Temperature Protection
Covering the Dome

10$

COOKING

Before bio-digester toilets are in service, a temporary solution for families to cook is with a temporary stove with gas canister attached. These can easily be stored & distributed to families in the event of a disaster at a cost of approximately AUD$10 each.

ADVANTAGE

1. Earthquake Resistant
2. Wind Dissipation

MATERIAL SELECTION

- Disaster type dependent
(Bamboo/Steel)

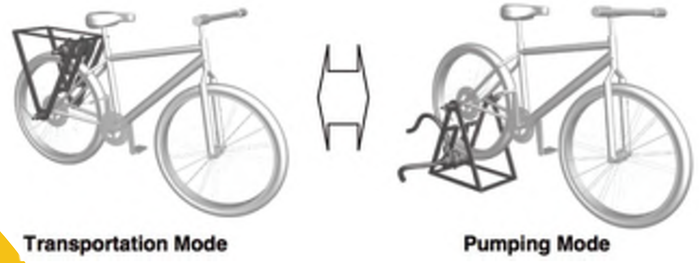
COST

- Material Dependent
(3.5k to 5k)

WATER PURIFICTION

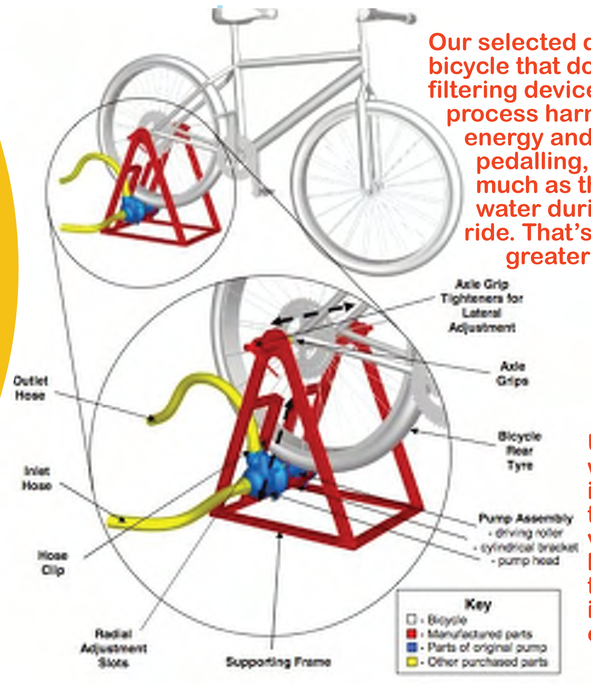
- Ready for shipment straight away
- Bikes made to last (10+ years) and filters can last upto 2 years
- Costs $6,000 ($8 per person)

8$/Person



Transportation Mode

Pumping Mode



Our selected design is a bicycle that doubles as a water filtering device. The filtering process harnesses kinetic energy and is powered by pedalling, which produces as much as three tons of clean water during a ten hour bike ride. That's enough to supply greater than 750 people for one day.

Users can ride to any nearby body of water, park the bike and insert a hose into the unsanitary lake or river. Next, the rear wheel is lifted off the ground via the bike's stand and the rider hops back onto the bike to start pumping. As the rider peddles, the water is pumped into the filtration system and comes out clean.

SELF SUSTAINABLE

ELECTRICITY LESS
- Water Purification
- Cooking
- Temperature Control

WATERLESS (Sanitation)
Toilets>by product - bio gas used for cooking

STRUCTURE
Dome, covered with concrete canvas with water layer bag on top.

HOW IS IT DIFFERENT FROM EXISTING DESIGN?

1. Able to suit for different weather condition: Earthquake resistant, High velocity wind resistant
2. Easily transportable
3. Height of the shelter and occupying area can be increased readily

Total Cost - 3542 $

CONTEXT

Pacific Island Disaster Relief
Cyclone – Drought – Flood – Tsunami – Earthquake

CASE STUDY- Cyclone Pam:
- 68% of wells contaminated
- 110,000 without clean drinking water
- 75,000 people needing shelter
- 45% people without toilets
- 10 years for coconut palms to grow back
- 22 Islands affected

NATURE OF THE PACIFIC
- Total population of Pacific Islands – 2.3 million
- Tropical climate - average temperature 22°C, high rainfall
- Live in large communal families

TRADITIONS
- Steel roofing and bush thatching
- Communal cooking over fire
- Communal toilets
- Sleep on mats

'Many people were still living under tarpaulins as they waited for bush material to grow back so they could rebuild their houses'

"we need material, iron roofs, nails and hammers to rebuild our shelters."

DESIGN BASIS

AFFORDABLE · DEPLOYABLE · STORABLE

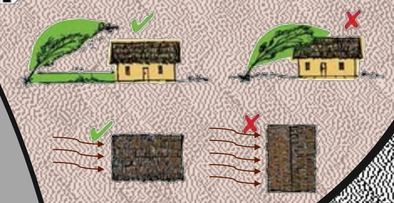
Transitional Metal Shelter (TMS)

- Existing design used widely after Pakistan earthquake 2005, Nepal Earthquake 2015
- Steel pipe frame
- Corrugated iron roof
- Simple, resilient design
- Re-usable materials
- Customisable by locals

LIGHTWEIGHT · REUSABLE · MULTIFUNCTIONAL

DESIGN PHILOSOPHY

- 3 Medium-term life span - 3 years
- Focus on improving a proven design
- Lightweight design to reduce risk to life in future disasters
- Reuse provided material in permanent homes = little waste
- Well-known materials that are traditionally used. Teach locals how to assemble shelters themselves
- Deployable within 1-2 weeks – easy to source, transport and assemble
- Encourages "build back better" techniques

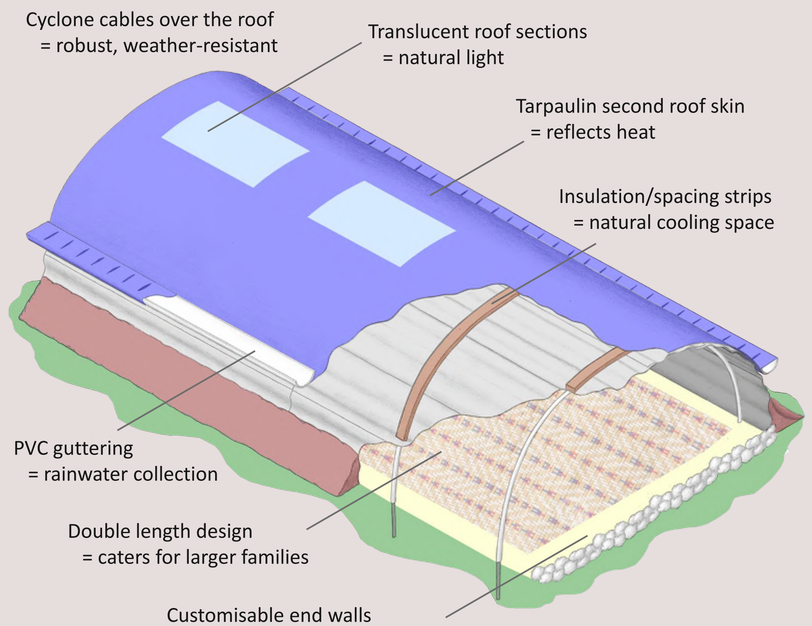


'what contributed to the low death toll was the use of light materials for construction'

Design by: TEAM READY

The *Improved* Transitional Metal Shelter

A proven design, customised to meet the needs of Pacific Island communities



Matt Girvan - Kirk Walker - Emily Hinton - Claire Fell - Mentored By Graeme Roberts

ONE SURVIVAL KIT PER FAMILY MEETS BASIC NEEDS

WATER

20 L filter bag - quick fix until main sources repaired

SANITATION

Bathe in sea, rinse under shower bag. Longdrop toilets

COOKING · POWER · OTHER

High-efficiency wood burner

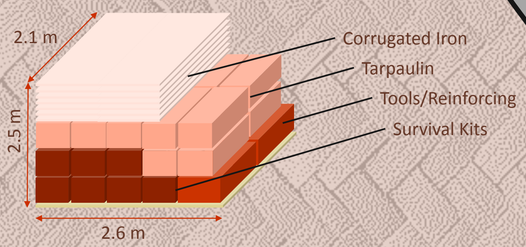
All delivered in container, also for water storage

Solar-powered lamp/charger

DEPLOYMENT

Option 1 – rapid deployment
- C-130H Hercules
- 6 pallet capacity
- Air drop capable

Option 2 – large quantities:
- Bulk transport by ship - Canterbury multi-role vessel
- Drop-off by boat or NH90 military helicopter – 1 pallet or 200 steel tubes underslung

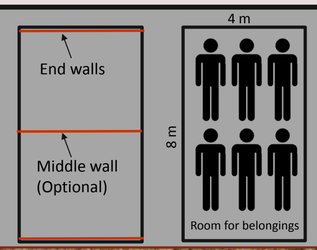


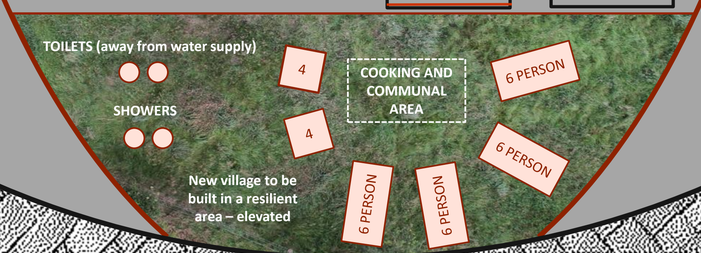
- Shelter deployment based on standard military pallet size with 4000 kg load
- Approximately 14 shelters per pallet (excluding steel tubing)
- Separate deployment required for steel tubing and pipe bending jig as 6m in length

TRADITIONAL · RESILIENT · CONSTRUCTABLE

HOME/COMMUNITY LAYOUT

- Floors made out of river rock and sand
- Build structures either parallel or perpendicular to prevailing wind
- Built away from trees
- Optional middle wall (curtain for privacy and cultural separation of men and women)



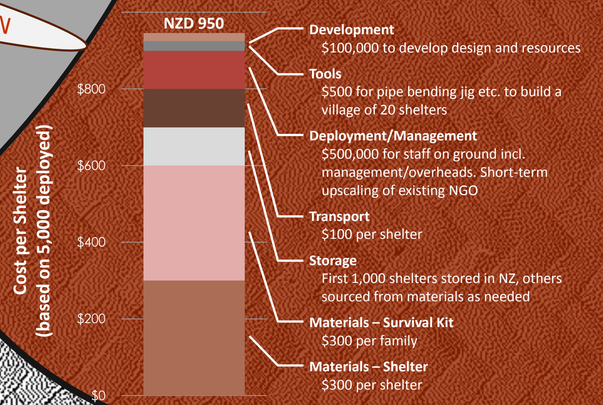


3 YEAR LIFE SPAN · CULTURAL · SIMPLE

'Lessons learned from past natural disasters around the world shed light on the way forward'

IMPLEMENTATION

1. Partner with an established organisation like Habitat For Humanity
2. Plan for rapid upscaling and deployment in event of emergency
3. Deploy from NZ, quantity scalable to suit emergency (typically approx. 5,000)
4. Empower recipients by training local teams to rebuild



Total budget for 5,000 shelters = NZD 4.5m ± 30%

THE IRON SHELTER

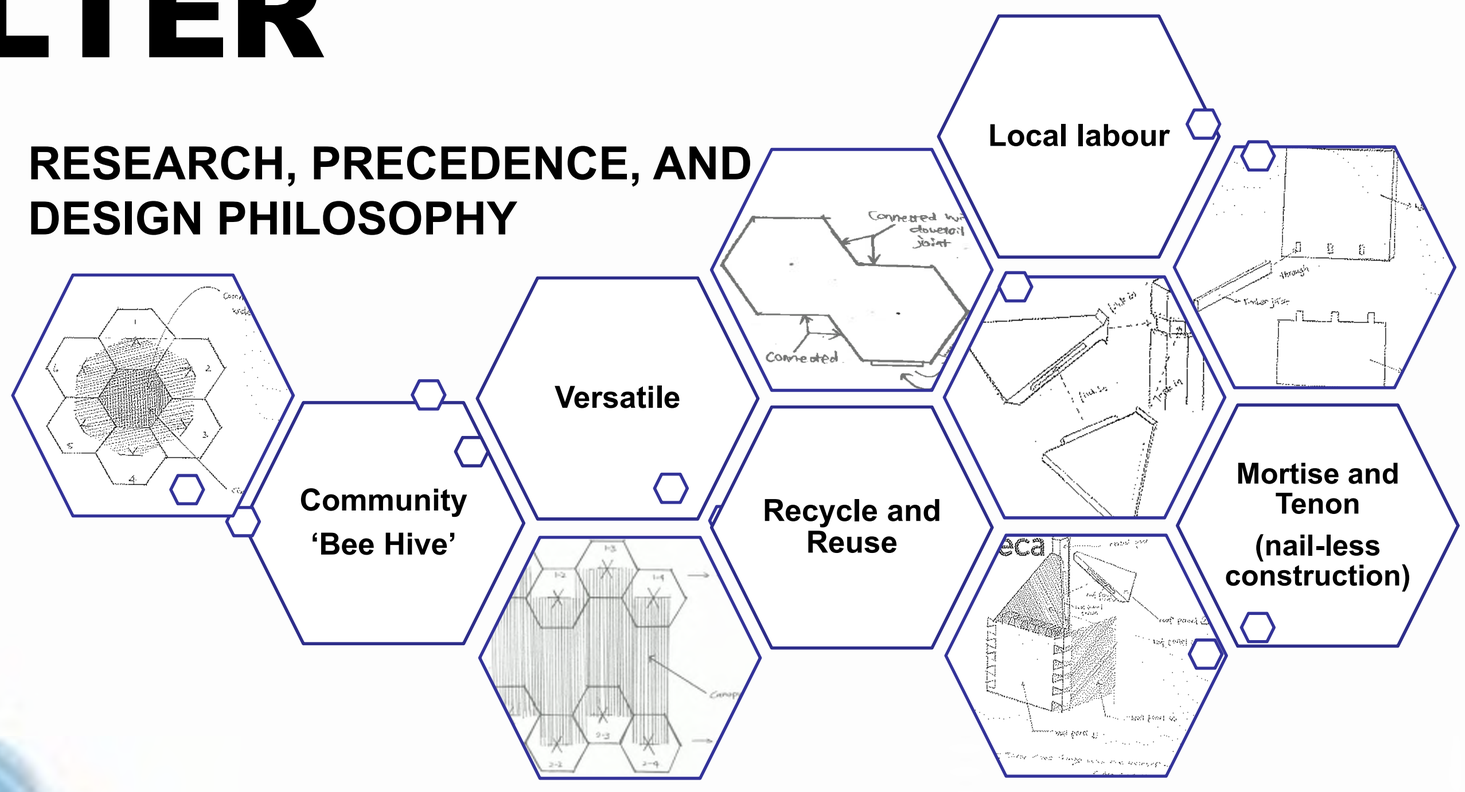
POST DISASTER EMERGENCY SHELTER

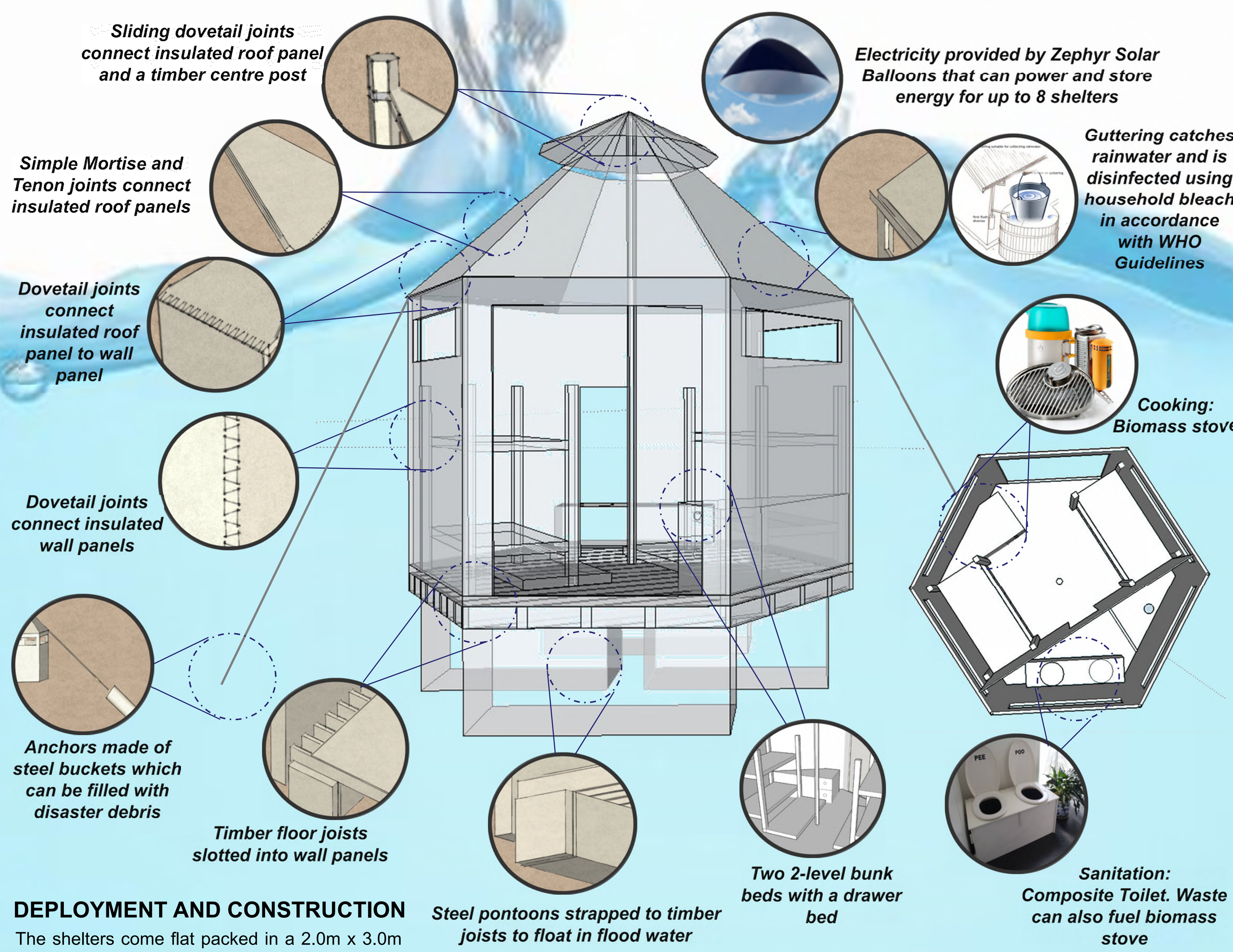
OVERVIEW

The Iron Shelter is an essential part of emergency response in times of disaster in a tropical climate. Our shelters are designed to:

- Unite people after disaster: our shelters have the ability to be interconnected to form communities.
- Cater for both short-term and long-term use due to their ability to float on water or be constructed on land.
- Be deployed and constructed easily with the application of Mortise and Tenon technology. This also allows for quick disassemblement.
- Save costs: The hexagonal shape provides the most space with the least materials.
- Rely on passive cooling through cross ventilation.

RESEARCH, PRECEDENCE, AND DESIGN PHILOSOPHY





DEPLOYMENT AND CONSTRUCTION

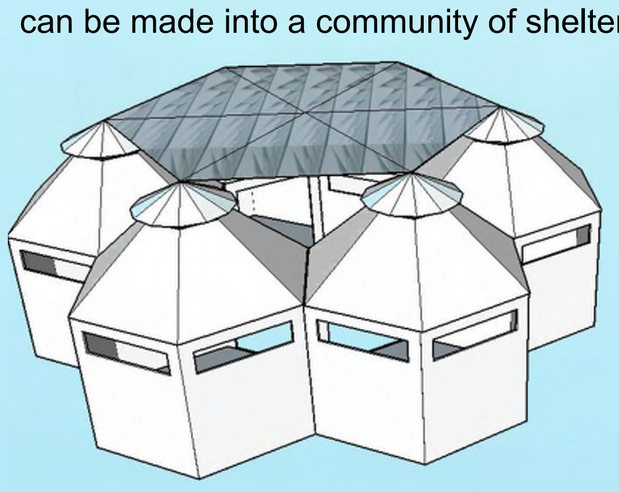
The shelters come flat packed in a 2.0m x 3.0m x 3.0m package. Four shelter packages can fit onto a twelve metre truck. The shelters can be built easily from ground up and anchored to the ground using contained debris. All members can be connected without nails using local labour and minimal tools. The shelter will automatically float in the presence of high flooding, and the pontoons provide a raised floor in muddy conditions.

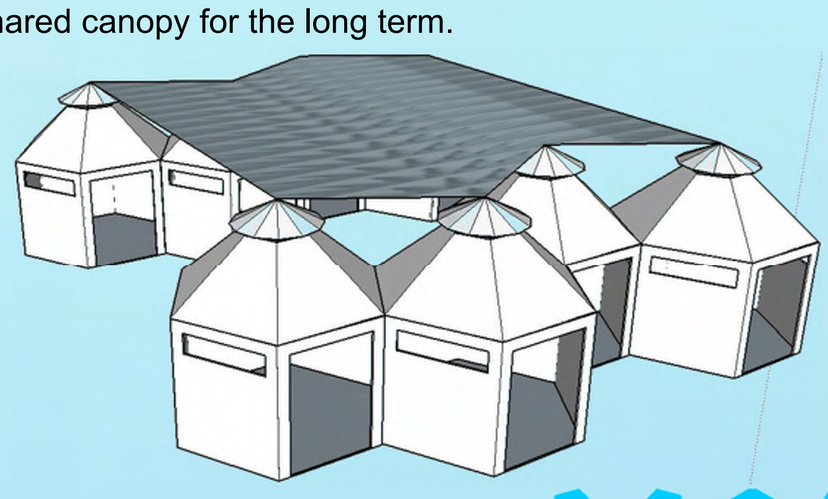
ECONOMICS

Each shelter will cost $10,000NZD +/- $2,000. This includes materials, manufacturing, storage, deployment, and management of the construction. This also includes the services, bunks, shower, stove and toilet within each shelter. Based on production of 100 shelters.

VERSATILE

The shelter is able to float on flood waters as an individual shelter in the short term, or a number of shelters can be made into a community of shelters with a shared canopy for the long term.





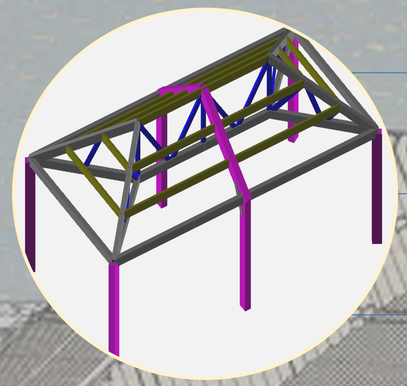
Anthony Leung, Peter Chen, Yiyue Chen, Victoria Toner

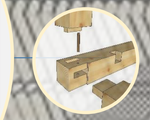
DESIGNING FOR DISASTER

CONSTRUCTION

SCREW PILE FOUNDATIONS

LIGHTER THAN CONCRETE
EASY MANUAL INSTALLATION
ADJUST FOR UNEVEN SOIL
SCREW DOWN TO GOOD SOIL





MORTISE AND TENON JOINERY WITH TIMBER PEGS AND WOVEN BINDINGS. BUILDABLE AND EASILY REPLACEABLE

LIGHTWEIGHT WOVEN PLASTIC USED FOR INITIAL WALLS. MAY BE REPLACED WITH PLANT WEAVE PANELS OVER TIME.

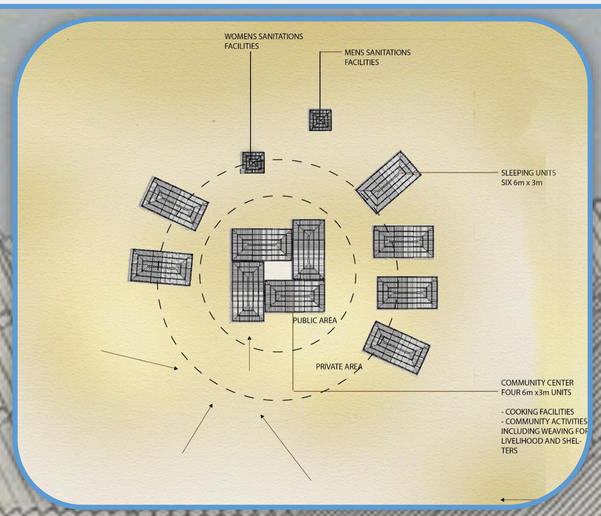
TREATED WOVEN FLAX MATS AS FEATURE PANEL IN SHELTER. A LABOUR OF LOVE FROM NZ COMMUNITY INITIATIVE.

OPAQUE PFC SHEETING USED AS ROOF MATERIAL. FIRE-RATED AND WATERPROOF.

PHILOSOPHY

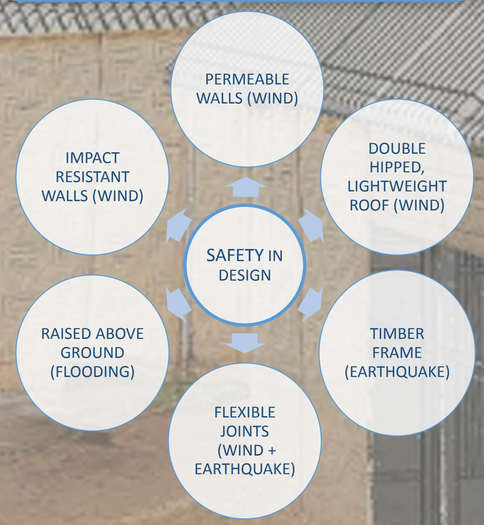
'A labour of love'. Our concept is a timber framed modular unit that can be combined into larger structures.

The focus of our design is keeping communities together after a disaster. We will achieve this by arranging unit shelters around a communal centre equipped with most of the facilities. People will be able to cook and socialise in this space to keep life going as smoothly as possible.



The shelter is intended to be more than a mere building – by integrating our own culture into the structure by way of the woven flax panels, our response to the disaster can pave the way for strengthened relationships between New Zealand and the affected country.

We chose timber for the main structure for familiarity and ease of construction, in addition to its cost effectiveness when compared to light gauge steel. The bricks used to raise the building can be locally sourced.



Historically, homes in areas that are prone to natural disasters were built using methods that were inherently resistant to damage. With our shelter, we aim to bring back some of these more traditional methodologies and incorporate the resilient aspects into our design. The result is a lightweight, damage resistant building that will not endanger lives during an event and is able to be repaired using locally sourced materials if necessary.

PROCESS

PHASE 1: PREPARATION
SHELTER STRUCTURE CONTAINERIZED AND SENT TO HOTSPOTS
NZ INITIATIVE: FLAX MATS

PHASE 2 : FIRST RESPONSE
EMERGENCY RESPONDERS BRIEF KEY LOCAL LEADERS IN AFFECTED AREAS
TYPE 1 AND 2 CARRIERS BEGIN JOURNEY FROM NZ AND HOTSPOTS

PHASE 3 : IMPLEMENTATION
EXISTING MATERIALS USED TO RAISE GROUND AT SHELTER
COMMUNITY CENTRE AND SANITATION AREAS BUILT FIRST

PHASE 4 : BUSINESS AS USUAL
SHELTERS FIT OUT TO BE SUITABLE FOR LONG-TERM INHABITANCE
TEMPORARY CLADDING GRADUALLY REPLACED WITH CHOICE OF WALL TYPE

TYPE 1 CONTAINER

LIGHTWEIGHT CARTON CONTAINING SINGLE SHELTER STRUCTURE

TYPE 1 CONTAINER CARRIERS INCLUDE PRIVATE SEAGOING VESSELS AND HELICOPTERS -EASIER ACCESS FOR FIRST RESPONSE

TYPE 2 CONTAINER

40 FOOT SHIPPING CONTAINER WITH MULTIPLE SHELTER STRUCTURES

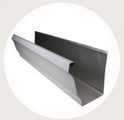
TYPE 2 CONTAINER CARRIERS INCLUDE LARGER CARGO SHIPS AND NAVY VESSELS

HOTSPOTS

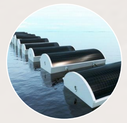
LOCATIONS THROUGHOUT AT-RISK AREA WHICH ARE PERMANENT STORAGE AREAS FOR CONTAINERIZED SHELTERS – EXAMPLE BELOW OF PACIFIC REGION

FITOUT

LIFE STRAWS SUPPLIED TO PROVIDE FRESH DRINKING WATER IN THE FIRST INSTANCE.



GUTTERING AND MATERIALS FOR RAINWATER COLLECTION DURING RAINY SEASON.



DESALINATION KIT TO PURIFY SEAWATER DURING THE DRY SEASON

EMERGENCY COMPOST TOILET – DISABILITY MODEL

- 1 SEPARATE MALE AND FEMALE TOILET PER COMMUNITY CENTRE. EXCEEDS SPHERE'S REQUIREMENTS OF 1 TOILET PER 20 PEOPLE.
- TIMBER FRAME STRUCTURE BUILT AROUND THE TOILETS
- SPADES PROVIDED TO DIG HOLES

SHOWERS

SOLAR ENERGY TO PROVIDE A FEW WARM SHOWERS PER PERSON PER WEEK – BECAUSE NO ONE LIKES A COLD SHOWER!

SOLAR SHELTER LIGHTING

36 HOURS OF LIGHT ON A DAY'S CHARGE

TO PROVIDE OUTDOOR LIGHTING FOR SAFER LIVING. CAN ALSO CHARGE CELL PHONES

COMMUNAL LIGHTING

24 HOURS OF LIGHT ON A DAY'S CHARGE

FOR COMMUNAL SPACES TO ASSIST WITH COOKING AND SOCIAL ACTIVITIES

COOKERS

ENVIROFIT WOOD COOKER. LARGE SIZE ASSISTS WITH COMMUNAL COOKING – CAN SERVE UP TO 10 PEOPLE. HIGHER EFFICIENCY TO REDUCE FUEL USE.

ITEM	SUB ITEM	COST (PER UNIT)	COST (PER CENTRE)
STRUCTURE	TIMBER FRAME	750	3000
	FRAME FABRICATION	200	800
	WALLS	65	250
	ROOF	150	600
	FLOOR	50	200
	SCREW PILES	300	1200
		1515	**6050**
INTERIOR	SOLAR LIGHTS		400
	DOOR FITTINGS	35	140
		35	**540**
EXTERIOR	GUTTERING		100
	SOLAR LIGHTS	300	
	WATER DESALINATION		250
	SANITATION		630
		300	**980**
TOTAL		**1850**	**7570**

PAC ♦ POD

BECA DESIGN COMPETITION 2016

The Pac-Pod consists of two elements; a modified shipping container and two accommodation pods. Once unpacked the system provides for a total of 12 -16 people. Each pod provides accommodation for 6 - 8 people while the container provides shared bathroom and cooking facilities for all.

Careful thought has been given to produce a shelter that not only is easily deployed and assembled, but can be used in the rebuild effort, and most importantly considers the cultural needs of the Pacific people.

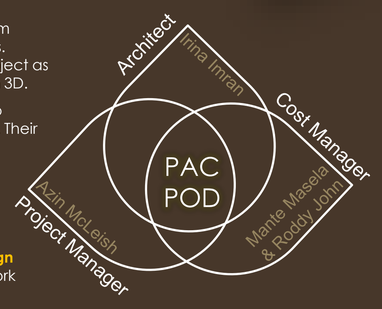
THE TEAM

The idea was the product of a cross discipline team including an Architect, Cost and Project Managers. The Architect helped bring a design eye to the project as well as **space planning** and **visualising** concepts in 3D.

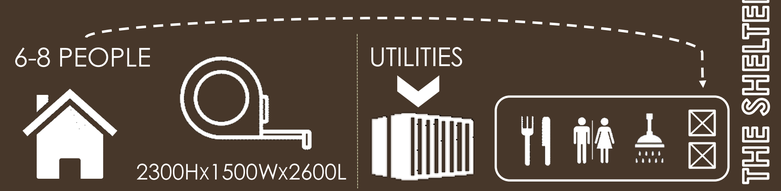
The Cost Management team utilised their skill set to challenge the **economic** and **practicality** of ideas. Their knowledge of construction added a **whole of life** dimension to concept generation.

The whole process was managed against a set **programme**, which the team bought into from conception through to finalising the deliverable.

The team researched **case studies**, agreed a **design brief** and scheduled regular design meetings to work towards achieving project milestones as a team.



THE SHELTER

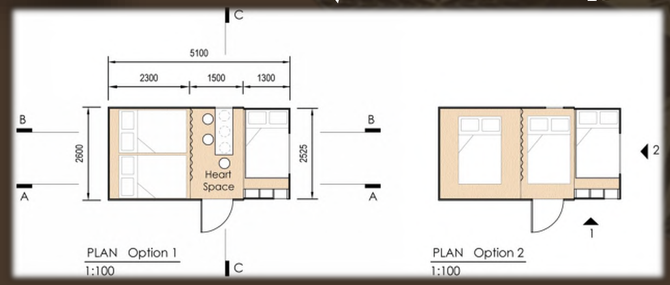


OUR DESIGN BRIEF

Following an initial case study exercise, the Project Team developed a design brief consisting of **6 key criteria**, which we reflected back on throughout to validate our concept and focus our ideas.

This is how we believe Pac-Pod rates against our original brief:

FROM WAREHOUSE TO PACIFIC



Pac-Pod

Note:
When pods are removed, area becomes a kitchen space

20-Foot Shipping Container

ESTIMATED COSTS

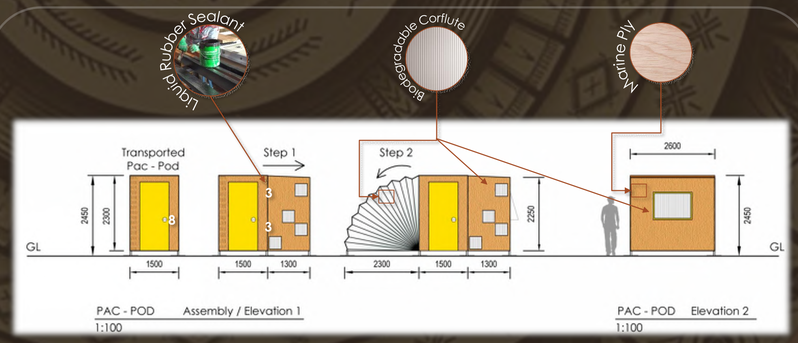
Per Unit	Per Person	Per Day	Re-Sale Materials	NET COST
$7,250	$1,200	$8	-$3,125	$4,125

± 15%

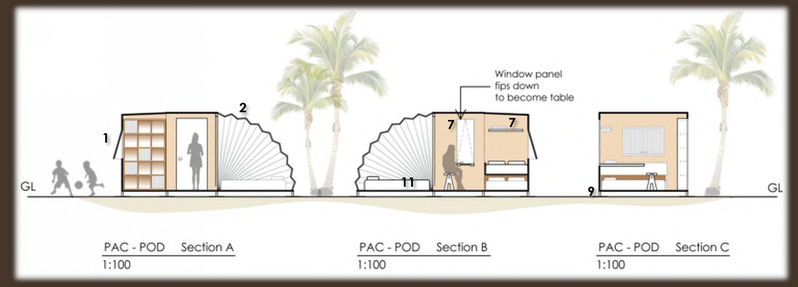
vs.

$12,600

UNICEF TEMPORARY STRUCTURES



1. Hinge to keep window open
2. Corflute system
3. Latch to keep shelter open against natural forces
4. Shower facilities *to utility unit*
5. Liquid Rubber waterproofing to joints
6. Gas stove top *to utility unit*



7. Flat pack compact furniture for beds and dinning facilities
8. Simple latch and lock on doors and windows for security
9. Footings to keep structure off the ground
10. Toilette facilities *to utility unit*
11. Air beds for all sleeping areas
12. Solar lanterns for Pac-Pod lighting.

PRELIMINARY DESIGN & FINISHES

Pop-Up Shelter

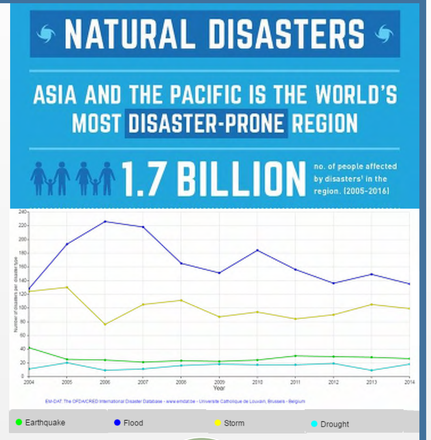
Challenge

ASEAN has a population of over 600 million people and it is also the most natural disaster-prone region in the world[1]

The three most common type of natural disasters occurred during the period of 2004 to 2014[2] are Flood, Storm and Earthquake

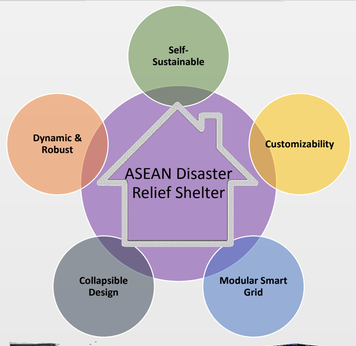
Temporary shelter will be provided for the vulnerable region

[1] United Nations' 2015 Revision of World Population Prospects
[2] *Source: RSIS calculation from Global Disaster Database at emdat.be*



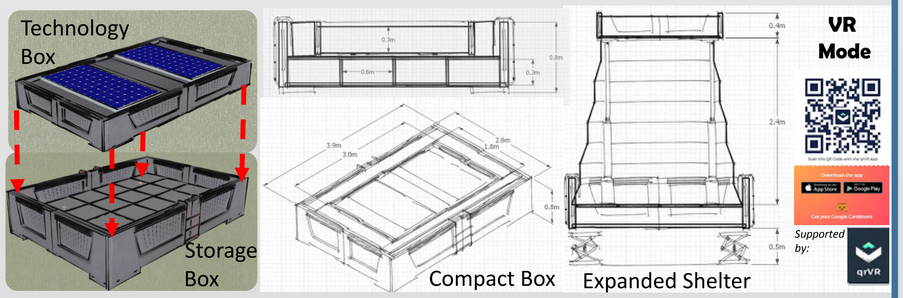
Our Solution

- Provide a robust & self-sustainable temporary shelter for short to intermediate term(2 - 6 weeks) for post disaster shelter within the ASEAN region
- The shelter will allow fast deployment and easy set-up
- Supplemented with technology & design features to provide the basic necessities including food, shelter, water, sanitation & communication

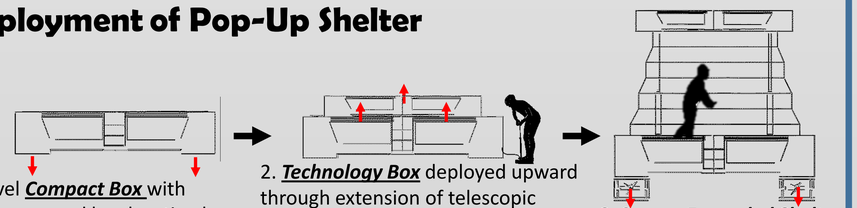


Design Concept Evolution

Overview



Deployment of Pop-Up Shelter



1. Level ***Compact Box*** with uneven ground by elevating base plate support
2. ***Technology Box*** deployed upward through extension of telescopic structural pole via pneumatic hand pump tool
3. Secure ***Expanded Shelter*** with fastener to ground

Durable and Robust

Base Design

- Shell made of HDPE (High-density Polyethylene) which is durable and lightweight.
- Pallet box design of the base incorporate multiple intermediate stiffeners for a sturdy configuration, that doubles as storage compartment
- Molded steps provide easy access into and out of the shelter
- Recessed handles allow easy lifting and deployment

A Secure Base

- Adjustable feet allow for level setup on uneven surface
- 300mm x 400mm base plate for 25kPa and above bearing , up to 1 ton weight (with 6 people)
- Large base plates can be provided for greater ground bearing capacity in wet soils

Collapsible for Compactness

- The silicone skin is flexible, UV resistant, waterproof, windproof and high thermal insulation.
- Telescopic column design allow a 2.4m shelter height & can support a roof loading up to 100 kg
- Integral pneumatic mechanism to raise & lower the shelter roof
- Zipper Door with Velcro Tape to ensure rain-resistance & easy use

"Kampong" Community Design

Foster the "kampong" spirit to build a cohesive and vibrant community of survivors for mutual support.

Modular Design

- 1 dedicated module similar to the design of shelter come with Power Generator, Additional Water Storage, Fuel Storage, Medical kits & pop up temporary compost toilet
- 5 Shelters with canvas roof for kitchen cooking area

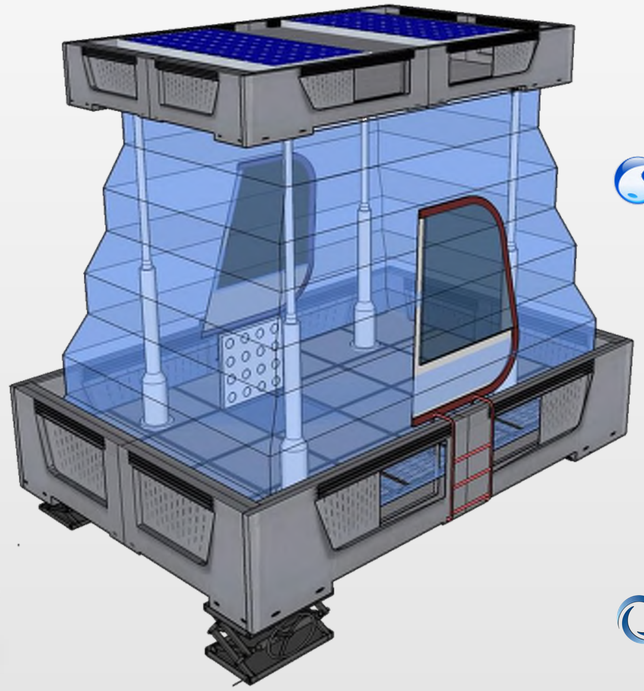
Smart Grid (Electrical & Water Supply)

- Plug-and-play from the shared facilities provide electrical and water supply

Engineering Design Team

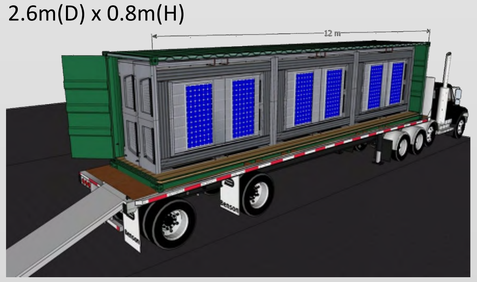
Members : Rocky Lee, Johnson Chua , Shaun Yeo, Ler Han Qiang

Mentor: Steve Perkins

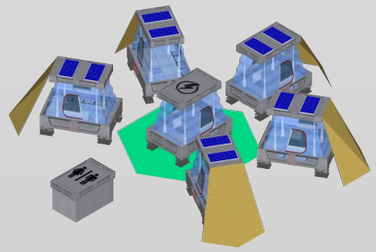


Transportation

- Collapsed Compact Box size is 3.9m(W) x 2.6m(D) x 0.8m(H)



- Fits a total of 6 units (5 shelters + 1 communal unit) in 12m container



Self-Sustainable Technology

Power & Communications

- 2 x 150W Photovoltaic Panel to provide power
- 50Ah Li-Ion Battery Packs for power storage
- ~ 13W LED Lighting for illumination integrated with roof
- 2 nos. 5V USB Socket Outlet for Phone Charging power
- Rechargeable using secondary source as options

Water

Rainwater Harvesting Design

- Roof designed for rain water harvesting with a catchment area of 2.5m^2 with flexible downpipe connect to water storage tank capacity of 650L
- Built-in ceramic membrane micro-filtration (0.5 micron) with water storage tank for treating of non-potable water sources from rain water or rivers
- Access of potable water via Bib-Tap outlet from water storage tank

Storage Design

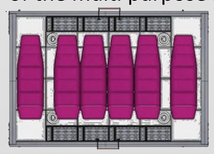
- Preloaded with potable water for consumption - 210L for 14 days

Passive Ventilation

- Operable slot ventilator opening at the top and bottom of the shell allow natural airflow for effective passive cross-ventilation

Large Flexible Storage & Accommodation

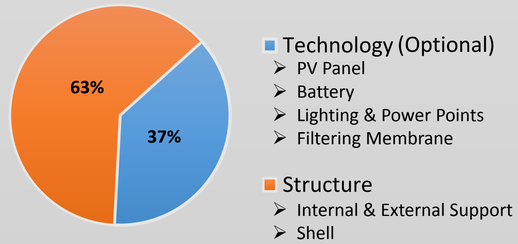
- Comfortably cater for 6 people sleeping on top of the multi purpose storage compartments.



- Total storage capacity of 1.7 m^3 in 16 compartments within floor structure to maximize free space.
- Sufficient storage for 2 weeks of necessities

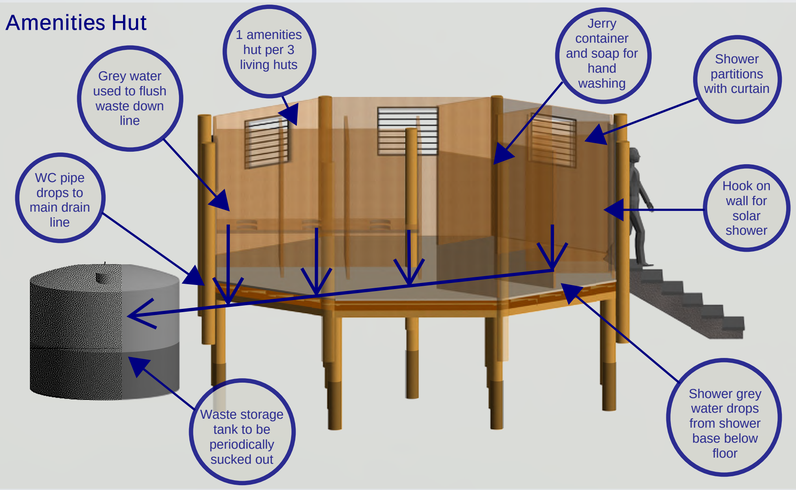
Economics

Estimated Cost : USD 1,500



Beca

Amenities Hut



Hut Kit:

- Sanitary Kit (soap, toothbrushes)
- Emergency Kit (disinfectant, bandages)
- Solar Shower
- Solar Panel Phone Charging Multi-plug
- Solar Lights- LED lights
- Flint
- Bucket and Water Filter (HLS1 filtering system)
- 6 x foam mats
- Water Bottles
- Jerry Water Container
- Fire Pit Grill Plate

The Octo-pod is an innovative approach to providing shelter to displaced people following a major civil emergency event. Three housing units and one amenity block can be pack into a standard shipping container. Thus a fully loaded container ship could provide shelter for approximately 350,000 people.

Key benefits of the Octo-pods are being locally sourced and relatively simple to construct. An unskilled workforce can build it in a matter of days. The design can be adapted to almost anywhere in the world.

The displayed design is modelled for the Pacific. For adaptation to cold climates the walls and roof can be constructed from thermal-panels.

A local member of the community will be trained in the construction and design intention of the Octo-pod. This brings ownership of the dwelling and education into the community.

Key Data

Houses 6 people

Withstand category 4 cyclone

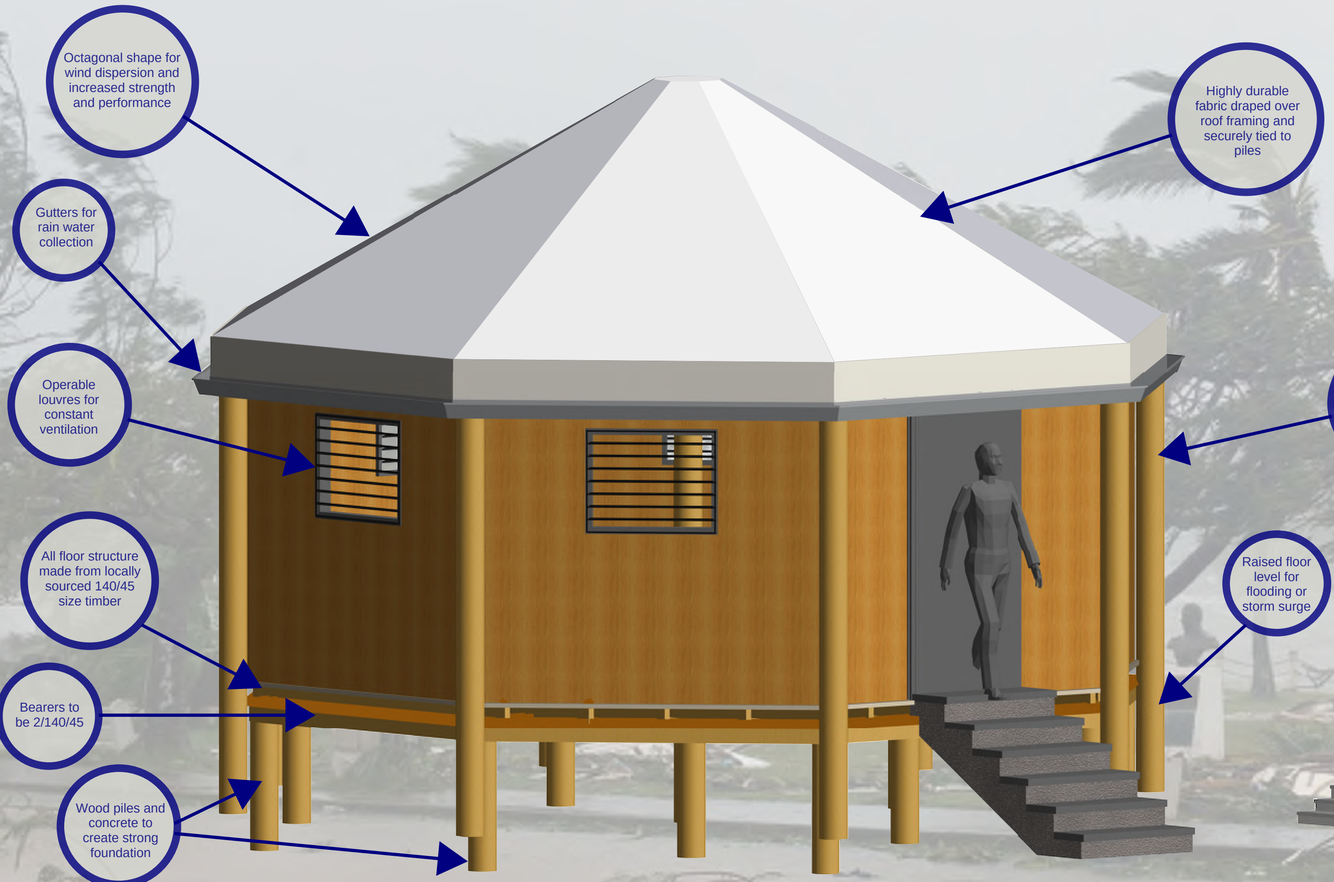
27 m²

$ 15,000 NZD (+/-30%)

OCTO-POD ©

STRONG, EFFECTIVE, COMMUNAL

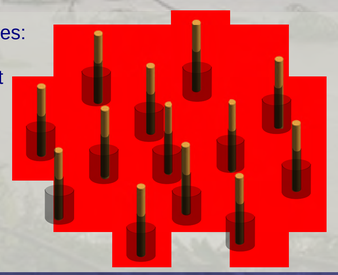
Design Team: Frank Smith, Hayley Annear, Lucy Clarke and Callum Knox
Contributors: Craig Lavin, Joe Briffa, Robert Crosbie, Graham McIlroy



Transported by sea, land or air

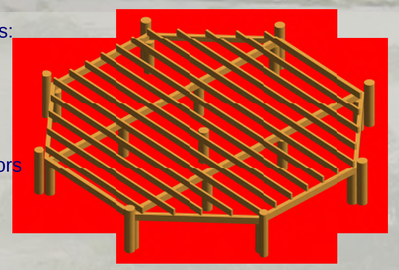
DAY 0

Resources:
- spade
- cement
- posts
- gravel
- water



DAY 1

Resources:
- hammer
- spanner
- timber 140/45
- nails
- connectors
- bolts



DAY 2

Resources:
- plywood
- hammer
- nails

Resources:
- canvas
- timber 2/140/45
- nails
- connectors
- bolts
- spanner
- guttering

DAY 3

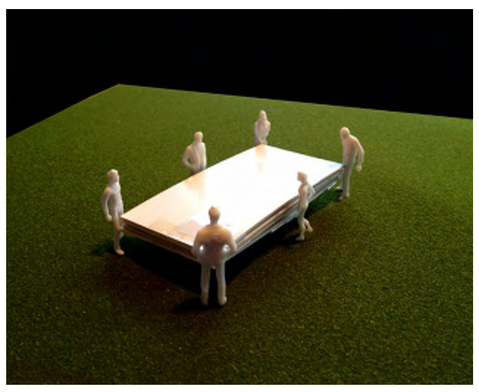
Onyx Consultants

Whakahou Hut

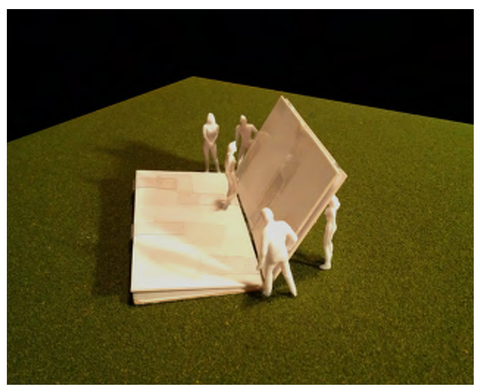
(verb) to renew, rebuild, restore

Foldable / Deployable / Simple

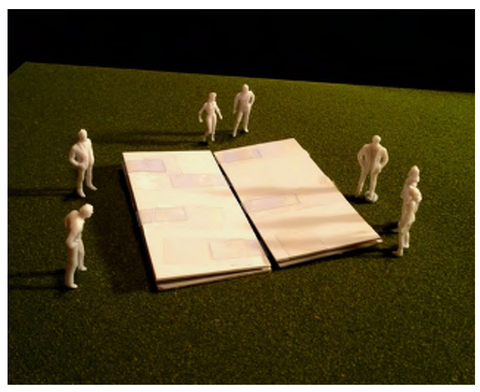
...a gift from Aotearoa to restore māna to disrupted communities



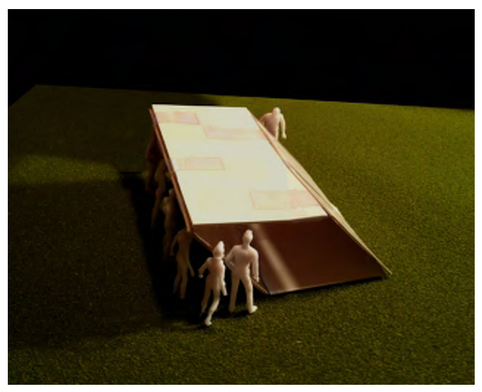
1. Carry



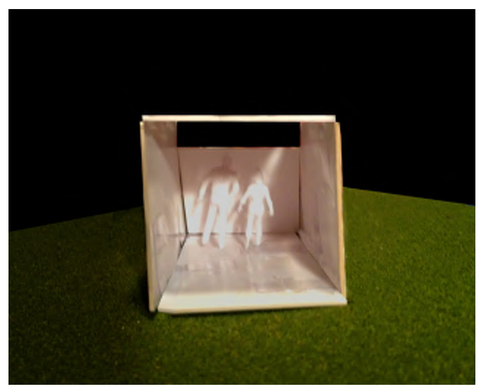
2. Unfold



3. Unpack

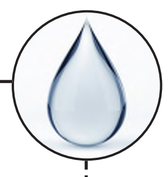


4. Pitch



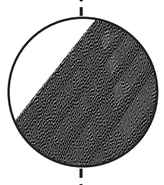
5. Brace

An adaptable, rapidly deployed all-in-one unit



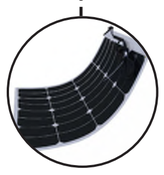
Water

- Water collection from purpose-moulded roof panel into solar-sterilisation pipes to provide drinking water.
- Also provides non-potable water for cleaning and sanitation.



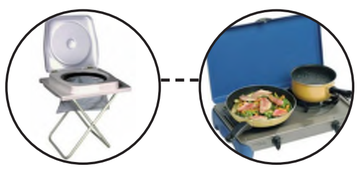
Awning

- Fold-down, rigid and lightweight recycled plastic awning with integrated supports.
- Can combine with other Whakahou Huts to provide community cohesion and multi-purpose space
- Provides protection for solar panels and water collection pipes when unit is flat-packed.



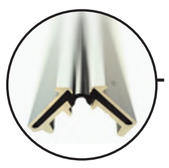
Power

- Power provided by flexible solar panel.
- Optional connection to grid or backup generator power if available.
- Low wattage radiation heater panel built integral with wall.



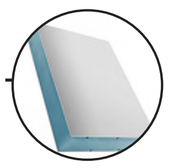
Facilities

- Foldable toilet with the ability to dispose of waste easily.
- Cooking area provided under awning.
- Gas hob included in unit package.
- Contained within the folded unit.



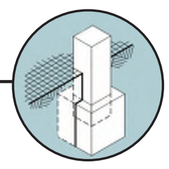
Hinges

- Continuous polyurethane hinge provides waterproof seal; when closed, aluminum extrusion locks hinge in place and provides high in-plane rigidity.



Wall Panels

- Polystyrene core, sandwiched between recycled PVC linings.
- Light and durable.
- Thermal efficiency means warm in winter and cool in summer.
- Strong in-plane bracing to longitudinal direction; out-of-plane resistance to floor and roof.



Foundations

- Can be founded upon level bare earth.
- Alternatively, where flooding/wind/earthquake may be an issue, it can be founded above ground on simple, rammed-earth piles.

Bracing & Ventilation

- Simple fold-up end walls complete the construction process without the need for tools.
- Marine-grade plywood secured in place with simple slide bolt.
- Natural hardwood appearance links to traditional local building materials.
- Slots at top allow natural airflow to ventilate and cool.
- Provides in-plane bracing to transverse direction.

Possible configurations

Cost per unit
+/- 20%

Materials: $3,500
Manufacture: $480
Shipping: $200
Storage: $4 per week

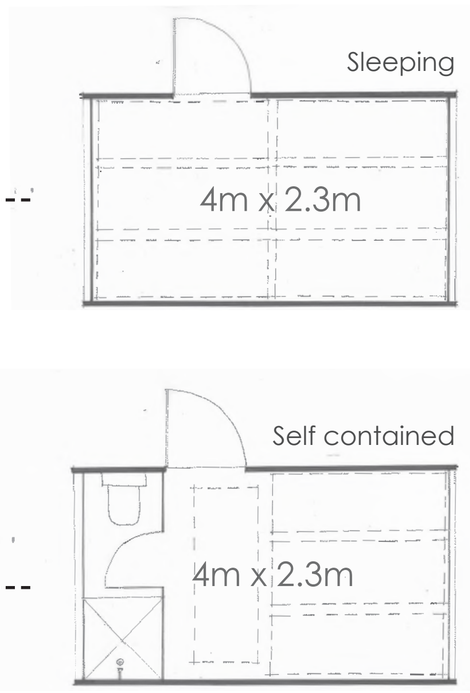
15 units per shipping container

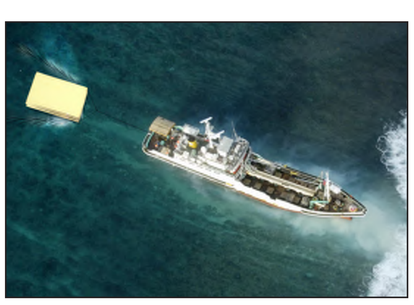
Quickly deployable for immediate use

Constructed by local workers within two hours

Adaptable for long term recovery

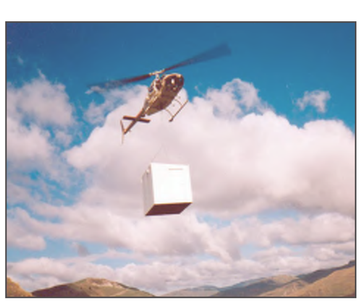
Rebuilds communities





Float

Stack



Lightweight

Ben Waterhouse / Craig Muir / Martin Swaffield / Lachlan Munro

BRIDGES

“

...ensures community involvement through the ease of construction...

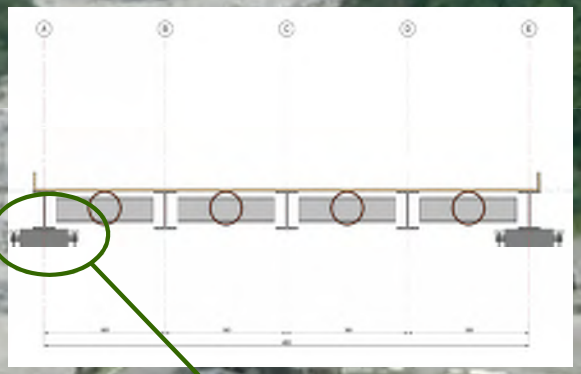
”

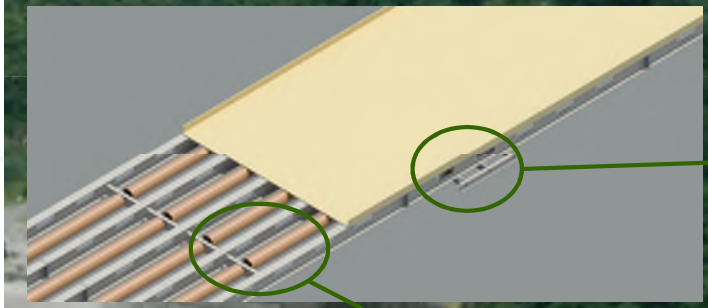
Team QuickBridge

ALUMINIUM BRIDGE – ROLL OUT!!

Research

- Bailey Bridge
- Wire Bridge
- Origami Scissor bridge





Reducing Lateral Load

- Voids present in beams to allow flow of water and wind through beam to reduce lateral force on bridge

Design Philosophy

To create a simple and effective bridge with following features:

- Lightweight
- Easy to assemble with manpower
- Readily available materials
- Cost effective
- Potential to modify into a permanent bridge

Roller System

- Allows for ease of assembly
- Pushing of bridge done via the delivery vehicle
- No heavy machinery required

Floatation Aid

- EVA foam tubes coated with Polyurethane Elastomer.
- Provides buoyancy and support during periods of high water levels.

Material and Manufacturing

- Bridge structure is made of aluminium and timber.
- Standard Aluminium I-beams and bolts
- Total weight of the bridge 12 tonnes
- Approx. cost $50000

Base Platform

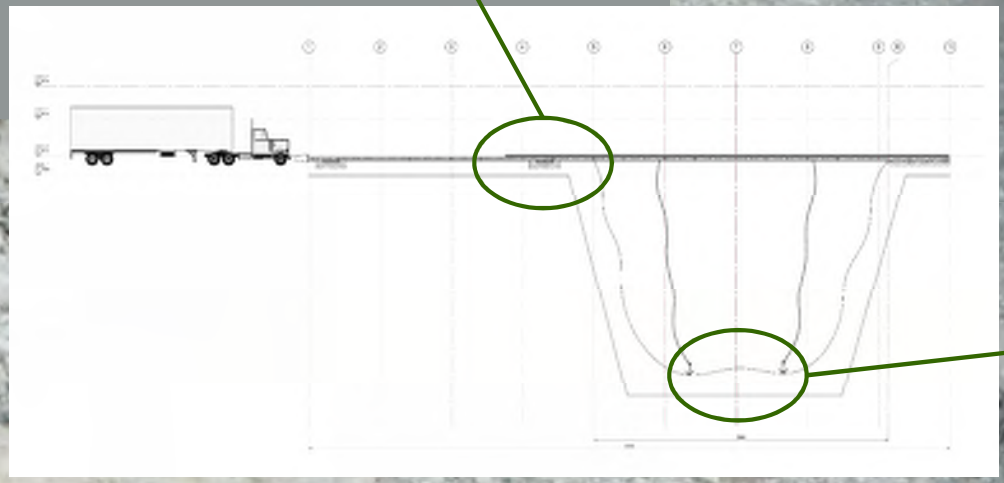
- Provides larger surface area to reduce bearing pressures

BIM Based Design

- Improves design accuracy and reducing time through integrating analytical and geometrical model

Storage and Deployment

- All bridge components can be stored in one container. The container can be placed in a strategic location for ease of access.
- All bridge components can be transported via a single truck



Management and Life Cycle

- The bridge structure assembly shall be government responsibility. Local reps will be trained on the assembly of the bridge.
- Design life cycle of 50 years

Anchoring System

- Secondary stability system in event of high flooding or major soil erosion.
- Prevents bridge from drifting down the river and becoming a hazard.

ERC Brought to you by: Iggi Bello, Harry Greenwood, Aidan Martin & Corin Roland

Emergency Relief Containers

"Ready to go at a moments notice!"

Aid Requirements

- **Multipurpose –** Configurable for any situation or location
- **Deployable –** Rapid deployment using conventional transport systems
- **Functional –** Designed for specific requirements
- **Scalable –** Can quickly respond to size of community disaster
- **Simple –** Able to be assembled by an unskilled workforce
- **Economic –** Cost optimised solutions using

The devastation and disruption to communities caused by natural disasters drives the need for humanitarian response.

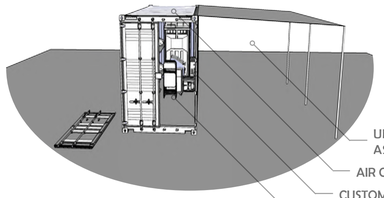
Communities need rapid access to basic transport infrastructure to deliver the essentials of life; shelter, food, water and sanitation.

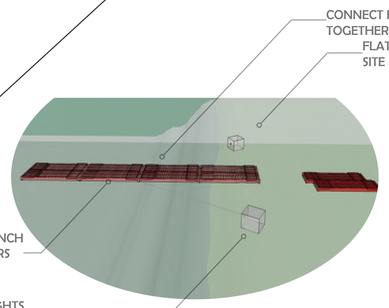
ERC emergency relief container systems provides off the shelf containerised solutions to meet the needs of disrupted communities and aid relief organisations.

Design Solution

- **Standardized –** Containers are used as a basic building block.
- **Deployable –** Utilises ubiquitous container technology able to be delivered by truck, rail or ship.
- **Functional –** Standard solutions designed to meet basic needs.
- **Scalable–** Ready to go solutions can be used to respond to any sized disaster scenario.
- **Simple –** Fully configured solution in a simple metal box
- **Economic –** Using second hand containers and local resources
- **Versatile-** ERC's solutions can be configured to match the needs

The off the shelf containerised solutions have been designed to meet the specific needs of effected people and aid relief organisations who need to quickly respond to emergencies using conventional transport at minimum cost.

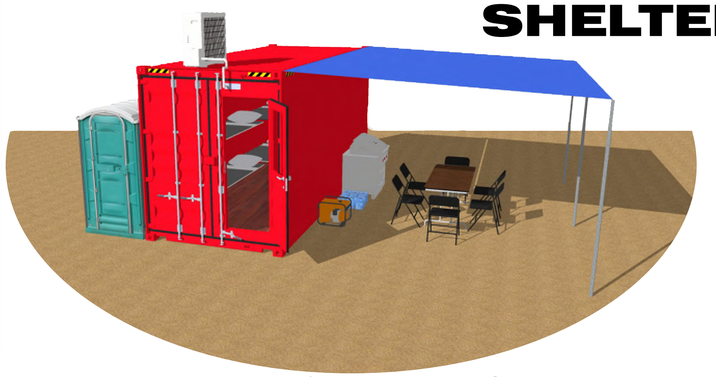




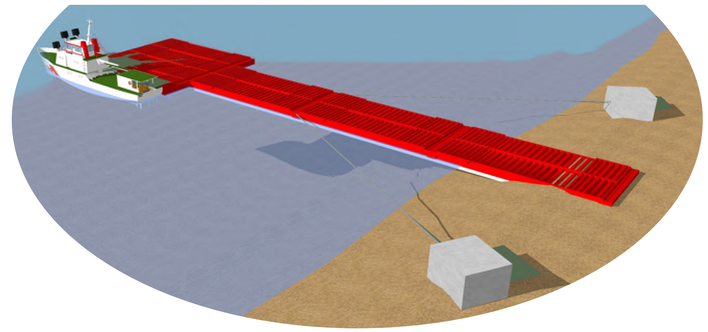
POWER + FOOD & WATER + SANITATION + SHELTER

FLATDECK + POLYSTYRENE + WIRE ROPE + ANCHOR

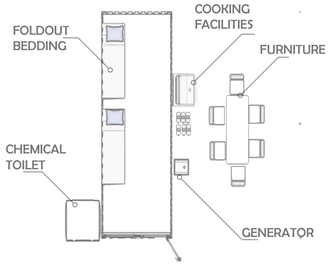
SHELTER



WHARF (FLOATING)



A standard 20ft shipping container is fitted out with all the requirements to provide shelter, means to store water, cook food and provide heat, light and sanitation for six people.

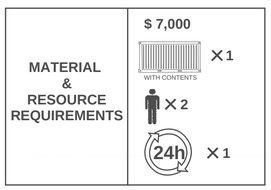


Design features

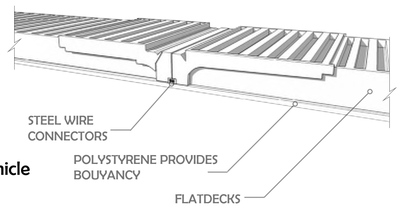
- Designed for any weather conditions
- Lockable door with opening window for ventilation
- Bunks for 6 people
- Camp style table and chairs
- Sunshade awning
- General items including tool kit, FM radio, First aid kit, washing & cleaning consumables, cooking & eating utensils

Services

- Diesel operated 240V power generator & fuel storage
- LED lighting, power outlets
- Electric cooking facilities
- Water tank, water heater
- Heat pump provides heating & cooling
- Chemical toilet with hand basin
- Food storage and refrigerator



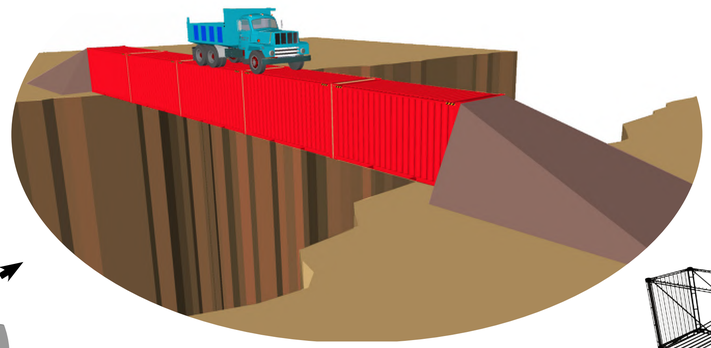
The design involves the use of interconnected container flat decks. Buoyancy is provided with polystyrene panels. The wharf structure is moored to onshore containers.

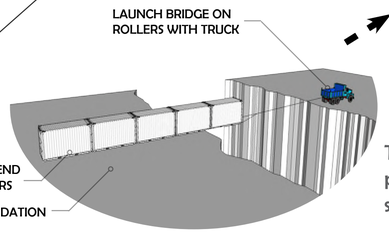


Design features

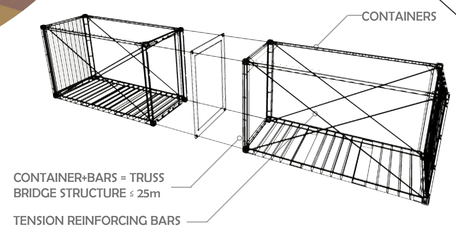
- Configurable to any shape or length to suit topography and boat
- Suitable to moor and unload a 20m RIB or can be configured for larger vessels or vehicle loads.
- Can be built by 6 unskilled people with a truck and boat in less than one week.
- All materials required are delivered in standard containers.

BRIDGE



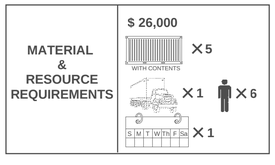


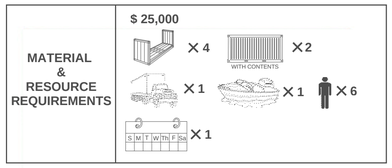
The design consists of shipping containers assembled with steel end plates and conventional reinforcing bars to f orm a trussed bridge structure.



Design features

- Can be configured for spans up to 25m
- Designed to support a 10 tonne truck
- Can be launched using Baily bridge techniques if required
- Able to be built by 6 unskilled people with a truck in one week
- **Timber decking and handrail if required**
- **Double up containers for wider deck**





See www.ERC.com for the full range of containerised systems available to meet every community need imaginable.

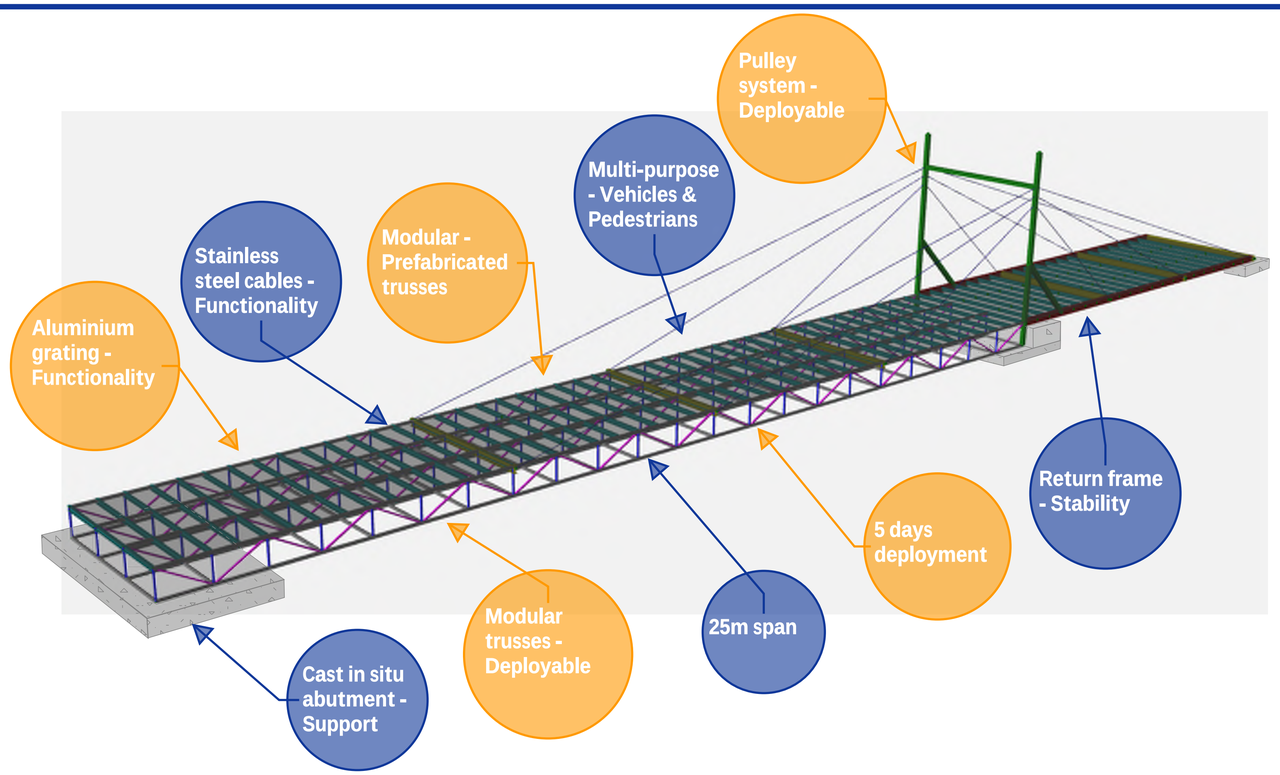
QuickBridge

DESIGN PHILOSOPHY
To Design a rapidly deployable bridge that contributes **positively** to the **community** following disaster. Low cost, short erection time, **safe solution.**

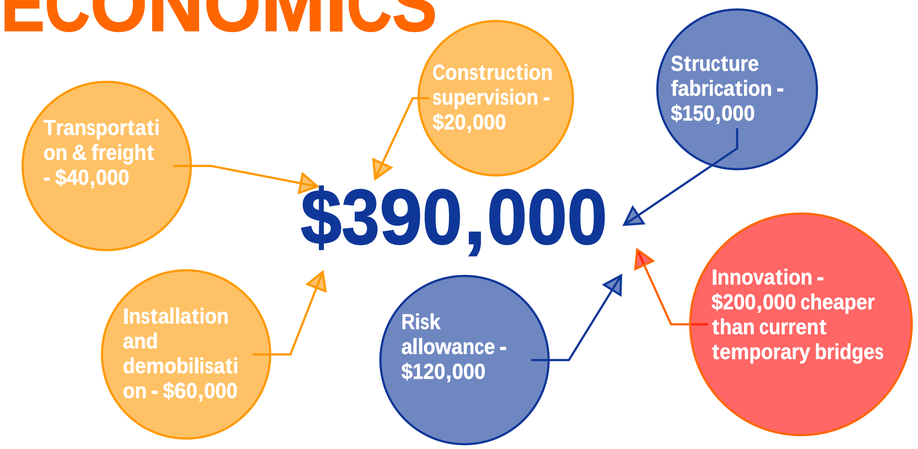
DEPLOYABLE
Pre fabricated and tested construction materials: Allowing for **immediate distribution** following a natural disaster. Ensures community involvement through ease of construction.

FUNCTIONALITY
The design solution is **robust** and delivered in segmental form to ensure ease of packaging and transportation. With a **high load** rating the solution is able to ***'bridge the gap'*** until a permanent solution can be constructed.

ECONOMICAL
Contributes to the local and regional economy by ensuring areas remain **accessible** following natural disaster.



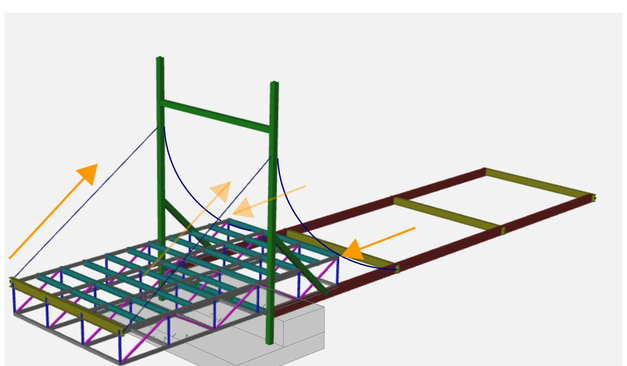
ECONOMICS



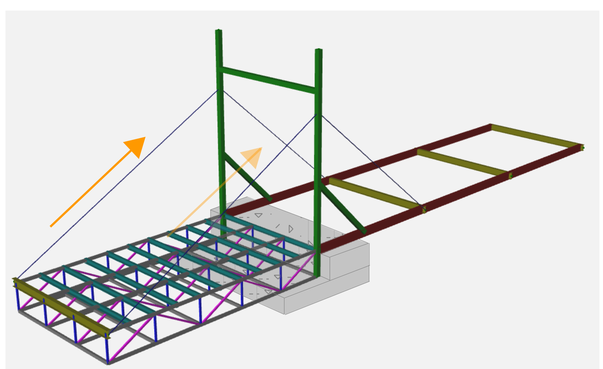
INNOVATION

- Higher spans than market alternatives
- Simplicity of construction
- Standard prefabricated materials
- Flexibility and adaptability
- High load carrying capacity

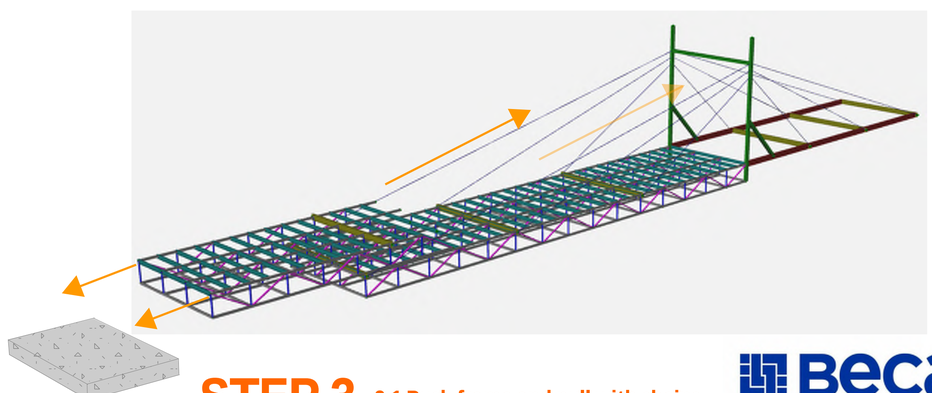
CONSTRUCTION



STEP 1 1.1 Assemble frame on ground
1.2 Push frame out using cables as pulley system



STEP 2 2.1 Drop frame onto abutment
2.2 Repeat



STEP 3 3.1 Push frame and pull with chains
3.2 Drop frame seating on truss

Beca Design Competition 2016
Designers:
Demi Van Den Heuvel
James Burley
Mike Rankin
Mohammad Alshami

WHARVES

“

...with only three repeated main components, and a child's "jigsaw puzzle" inspired design, we believe this jetty is as simple as can be...

”

Team Jigsaw Jetty

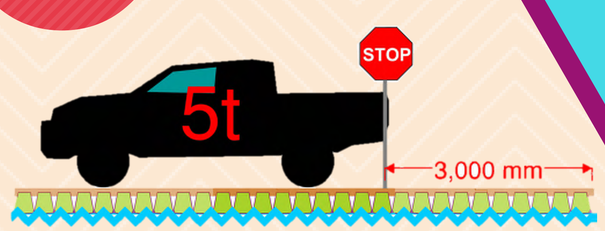
B.E.R.T & E.R.N.I.E

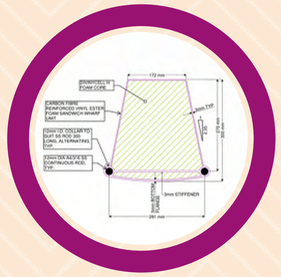
BECA EMERGENCY RESPONSE TEAM
&
EXTENDABLE RAFT for NAUTICAL INTERIM ENTRY

Design BASIS

- *Side on berthing of 20ft RIB,* **along wharf edges or wharf end**
- *Mass produced & assembled in flat-packed portions,* **made in NZ, AUS or low cost centres**
- *Transportable by road or sea,* **in flat packed or rolled units**
- *Vehicular traffic to travel along,* **centre of wharf**
- *Deployable* **within hours!**
- *3m x 4.5m non-trafficable* **section at wharf end**
- *Live load allowance of a,* **single ute + light pedestrians**
- *Erectable in hours by a team of,* **3-4 unskilled people**

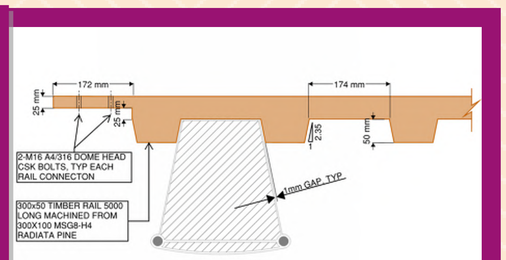
DEPLOY -MENT

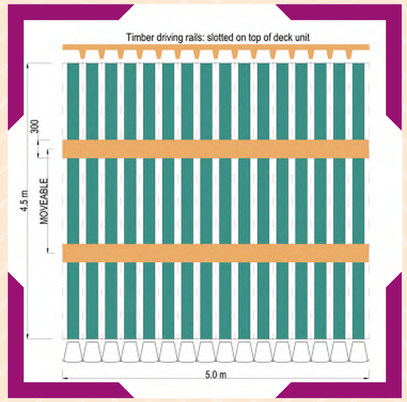




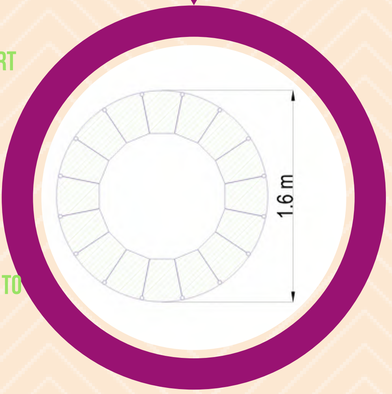
THE STRUCTURE COMPRISES OF CARBON FIBRE REINFORCED POLYESTER-FOAM SANDWICH UNITS JOINED BY STAINLESS STEEL PINS. TWO TIMBER RAILS CAN BE OVERLAIN ALONG THE LENGTH OF WHARF TO PROVIDE A RUNNING SURFACE FOR A SINGLE UTE TO DRIVE ACROSS

300MMX400MM
DECK UNITS
4.5M LONG PINS
&
TWO TIMBER RAILS





ROLL OUT
ROLL UP



E.R.N.I.E

A floating wharf structure

deployed & erected at

ANY

Coastal Location

Structure description

- DECKS UNITS SPAN TRANSVERSELY ACROSS THE WATER SURFACE AND SUPPORT IMPOSED LOADS
- TRAPEZOIDAL FOAM CORES ARE LIGHTWEIGHT AND STIFF, CAPABLE OF RESISTING VERTICAL AND LONGITUDINAL SHEAR FORCES
- LATERAL LOADS (WINDS&WAVES) RESISTED BY DIAPHRAGM ACTION OF DECK UNITS CONNECTED WITH STAINLESS STEEL DOWELS
- GROUND ANCHORS ABOVE THE HIGH TIDE LEVEL PROVIDE LATERAL RESTRAINT TO THE DECK
- TIMBER RAILS WITH SHEAR KEYED CONNECTIONS TO DECK UNITS PROVIDE A STIFF DRIVING/WALKING SURFACE

CAPITAL COST

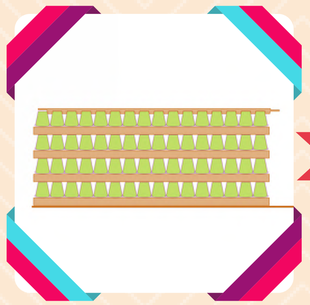
- FOR ONE UNIT (5m LONG) = NZ$18,000
- EACH SUBSEQUENT UNIT = NZ$12,000
- EXAMPLE 20m LONG = NZ$67,000

MAINTENANCE COST

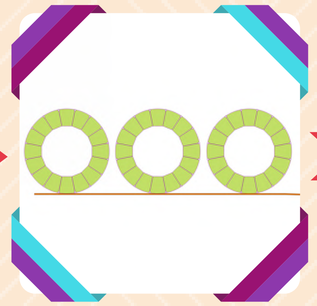
per 20 years
- FOR EACH UNIT : NZ$2,000
- EXAMPLE 20m LONG = NZ$8,000

Note:
1. excludes design, shipping and storage cost.
2. Concept design only, level of accuracy is +/- 30%
3. GST exclusive

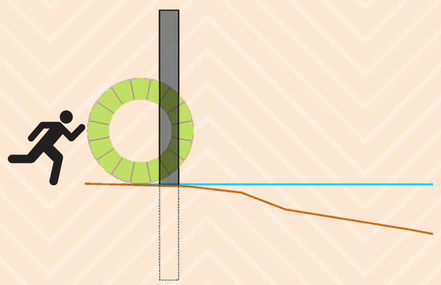
SHIPPED IN FLAT-PACKED SHEETS



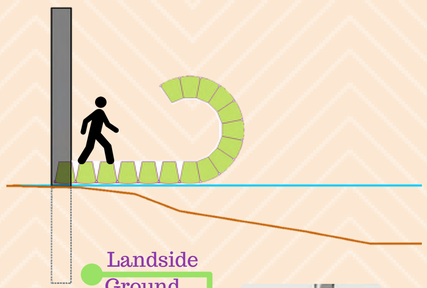
ROLLED INTO NEAR PERFECT CIRCULAR OUTER DIAMETER PORTIONS & ROLLED TO POSITION



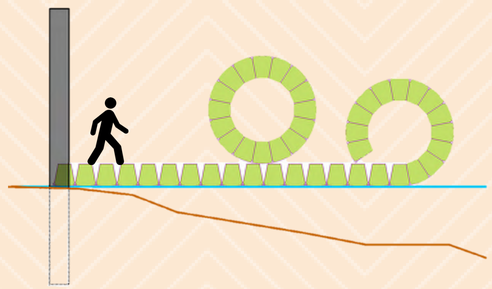
UNROLLED ABOVE HIGH TIDE & ANCHORED TO THE SHORE WITH LANDSIDE GROUND ANCHORS

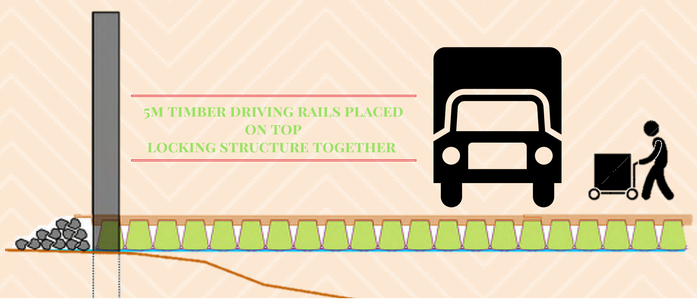


EACH CONSECUTIVE PORTION ROLLED OUT OVER PRECEDING WHARF PORTIONS & CONNECTED WITH STAINLESS STEEL DOWELS

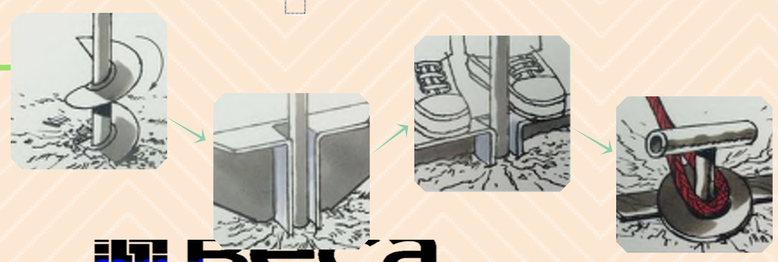


REPEATED UNTIL REQUIRED LENGTH ACHIEVED
MAX 35M





Landside Ground Anchors



Material Specifications

TIMBER RAILS - 300X100 MSG8-H4-RS TO NZS 3622
CARBON FIBRE COMPOSITES - QUANTUM COMPOSITES AMC 8590BK
53% CARBON FIBER REINFORCED VINYL ESTER SMC
FOAM CORE - DIVINYCELL H100
FASTENERS/DOWELS - GRADE A4/316 STAINLESS STEEL

Beca

produced by Kirstyn Goodger, Scott Minahan, Peifen Chua & Peter O'Brien

JIGSAW JETTY

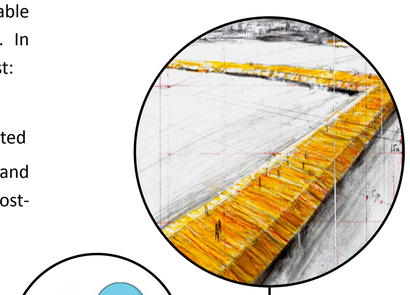
DESIGN PHILOSOPHY

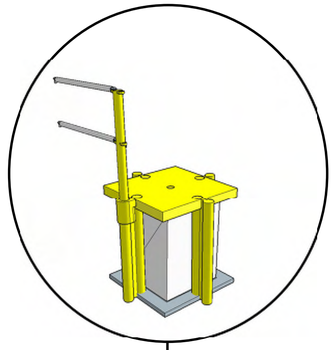
Pacific Islands are hugely affected by natural disasters. Providing aid in the form of food, water and medical attention can make a world of difference. However, infrastructure such as bridges or roads are often unserviceable after a disaster. Boat access is often the most reliable means of accessing a community in need. In order to be an effective solution this jetty must:

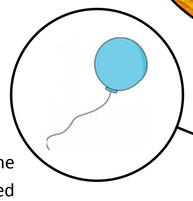
- Be easy to assemble
- Be compact and able to be easily transported
- Be durable to withstand wave, mooring and service loads which can be expected post-storm
- Be cost-effective
- Be adaptable

RESEARCH & INSPIRATION

Tessellating shapes and structures formed the basis of preliminary design discussion. This led onto a “Jigsaw Puzzle” inspired design which stemmed from the desire to have the product assembly process as intuitive as possible, like a child’s toy. Several existing wharfs, including the Italian art feature, “The Floating Piers”, were drawn upon for ideas on modular design, suitable materials, and piling/anchoring mechanisms.





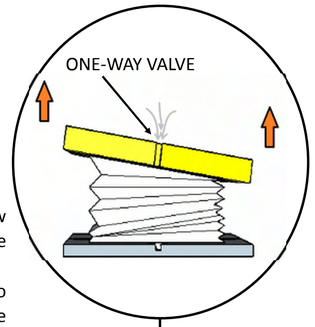


STRUCTURAL INTEGRITY

- Gaps between inflated bags and columns to allow water to wash through the central area of the jetty, reducing wave forces.
- Light and air-filled structure (<100kg/m^3) to improve buoyancy, resulting in a vertical service load capacity of 900kg/m^3.
- Robust materials
- Locking mechanisms within the column fix the column between the top and bottom plates and give rigidity to the structure.

EASE OF ASSEMBLY

Given the unknown skillset of the community in need, it was deemed crucial that the assembly of the jetty is as intuitive as possible. With only 3 repeated main components, and a child’s ‘jigsaw puzzle’ inspired design, we believe that this jetty is as simple as can be. Simply lift the top deck off the bottom, secure the airtight cap on the top deck, slot in the column piece between the two deck components, and repeat.



DEPLOYABILITY

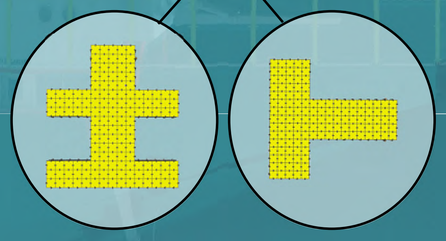
- Inflatable components
- Storage volume less than ⅕ of the assembled jetty itself
- One 20 ft shipping container to store 125 m^2 of wharf
- Deliverable by land, sea or sky

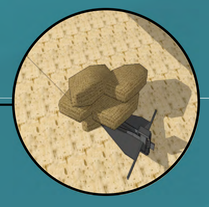
ECONOMICS

- Low relative cost due to reusability
- Components easily disassembled and placed back in the container
- Cheap yet robust materials
- Favourable life cycle costs
- Estimated development cost of $100,000. Manufacture cost of roughly $450/”puzzle-piece” unit

FLEXIBLE LAYOUT

Puzzle-like pieces means the design is not just limited to one configuration—there are endless options. The height of the deck units can be made adjustable to accommodate for the slope and layout of the beach or riverbank.





ANCHOR POINTS

Small anchors are to be cast out to sea as shown. Sand bags are then to be filled with sand (or rocks), hooked onto the top of the anchor cable, and allowed to slide down the cable to join the anchor at the seabed. This way, strong supporting tie-down points are achieved using readily available materials.

MATERIALS

Key design criteria

- Reusable
- Recyclable materials where possible
- Affordable
- Durable/lightweight
- Maximise available materials (air, sand)
- Weight per m^2 of jetty = 30 kg

DECK UNIT

(EPS foam, double layer polyurethane alloy, aluminium)

HANDRAIL POST

(Aluminium with locking mechanism)

ANCHOR

(Steel)

SANDBAGS

(Hessian)

COLUMN CONNECTOR

(Aluminium with locking mechanism)

Hannah Liddell, Manon Tabak, Steve Halliday and Victoria Buckton-Wishart

WHARFTIMUS PRIME

Deployable Wharf For Post-Disaster Relief

DISCOVER

VISION

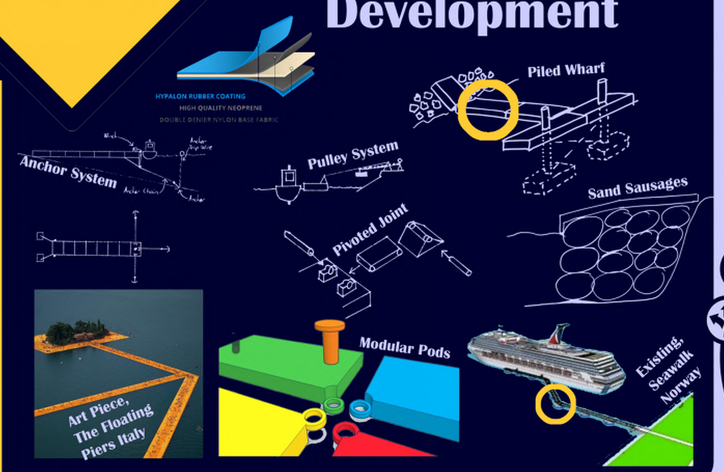
"To reduce the impact of disasters and build community resilience through innovative engineering solutions."

Design Philosophy

Resilience · Community · Adaptability · Sustainability · Safety

ENVISION

Research & Concept Development



DESIGN

CONTAINER SETUP

1. STORAGE PHASE

- Full wharf fits in one custom transformable 40ft shipping container
- Inflatable modules pack down compactly

2. BUILDING PHASE

- Converts into workshop during wharf construction
- Container prefitted with fold-down workbenches and shade canopy.

3. OPERATIONS PHASE

- Container available as:
  - community hub
  - aid distribution centre
  - port operations centre

CONTENTS SUPPLIED

WHARF MATERIALS

1x	Transformable 40ft container	
60x	Inflatable modules	(20 spare)
2x	Rotating end joint	(1 spare)
120x	Fenders - 2 needed per module	(40 spare)
8x	Anchors (screw auger + cable)	(2+ spare)
120x	Clip-in handrails	(40 spare)
2x	Pulley system	(1 spare)
800m	Rope	(for multiple purposes)
800m	Heavy duty chain	(for multiple purposes)
3x	Folding gangway	(1 spare)

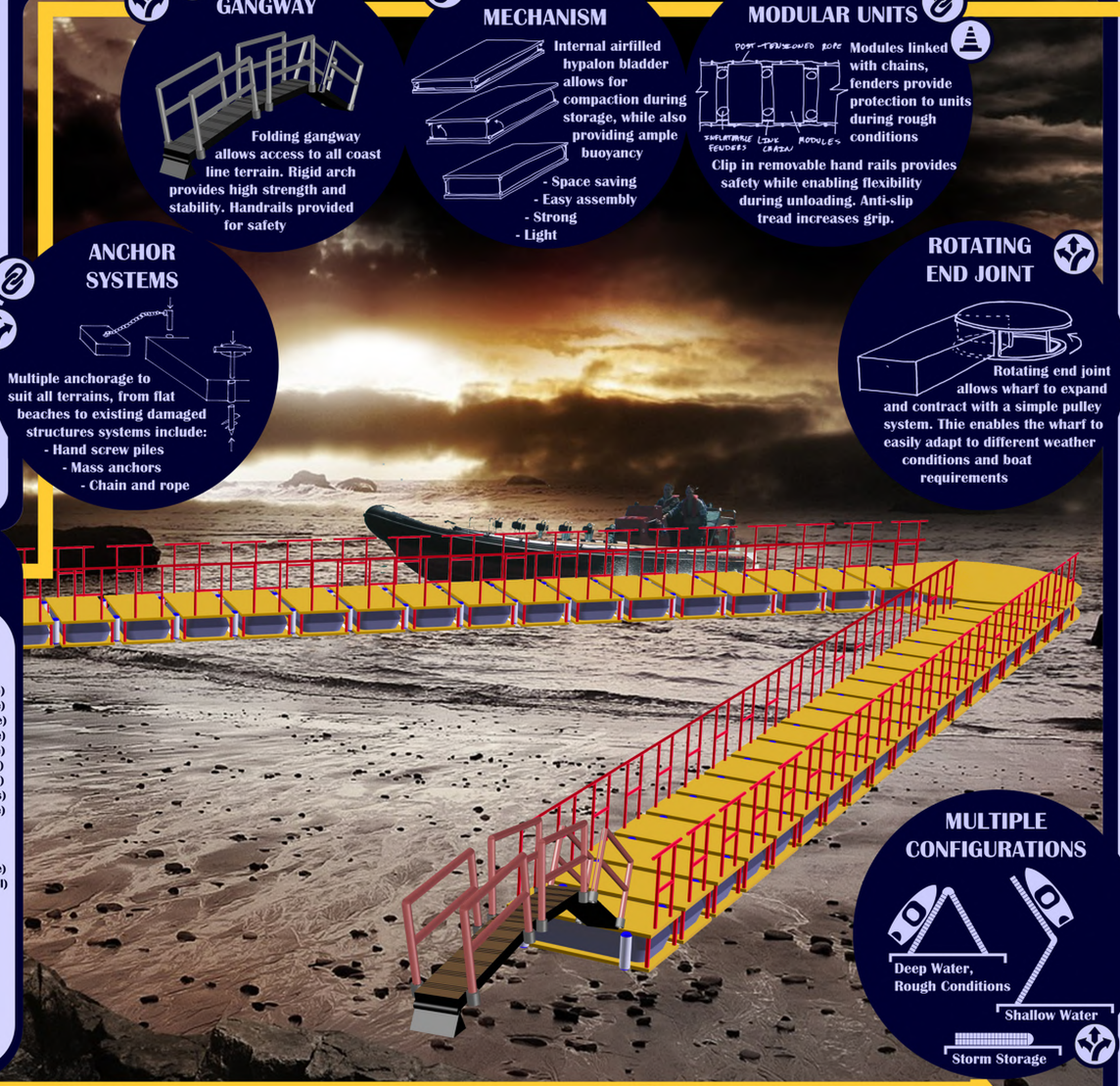
CONSTRUCTION REQUIREMENTS

2x	10kW generators + electric air pumps	
100L	Diesel	(includes spare for other use)
5x	Hand pumps	(for back up, or to save fuel)
1x	Site manager + trainer	
5x	Instruction manuals	

EXTRA PROVISIONS

Water filters and purification tablets
Basic food supplies

20x	First aid kits	
2x	VHF Radio	
8x	Large tents (for shelter)	
2x	Workbenches	
5x	Sets of basic handtools	



GANGWAY

Folding gangway allows access to all coast line terrain. Rigid arch provides high strength and stability. Handrails provided for safety

COLLAPSIBLE MECHANISM

Internal airfilled hypalon bladder allows for compaction during storage, while also providing ample buoyancy

- Space saving
- Easy assembly
- Strong
- Light

INFLATABLE MODULAR UNITS

Modules linked with chains, fenders provide protection to units during rough conditions

Clip in removable hand rails provides safety while enabling flexibility during unloading. Anti-slip tread increases grip.

ANCHOR SYSTEMS

Multiple anchorage to suit all terrains, from flat beaches to existing damaged structures systems include:
- Hand screw piles
- Mass anchors
- Chain and rope

ROTATING END JOINT

Rotating end joint allows wharf to expand and contract with a simple pulley system. Thie enables the wharf to easily adapt to different weather conditions and boat requirements

MULTIPLE CONFIGURATIONS

TRANSPORT

- Single 40ft Container
- Transport by Land, Sky or Sea

UNLOAD

- Packed in order for easy unloading
- Container converts to workshop to aid in emergency response

BUILD

- Training provided
- Assembled on dry land with no power tools
- Sense of community (built by locals for locals)

INSTALL

- Modular design can be extended out to sea (assembly line)
- Several anchor options to suit different conditions

USE

- Wharf moves out to meet seperately anchored boat, reducing loads on structure
- 'Human chains' for manual unloading of cargo

RECYCLE

- Entire wharf can be packed up and re-used
- Nothing left behind
- Environmentally sustainable

EVOLVE

Stakeholder Liaison

The wharf design was evaluated in several discussions, leading to important tweaks to improve functionality and design:
- Critiquing session with Lyttelton Port Christchurch (experts on post disaster response in harbour environment)
- Discussion with senior Beca engineers
- Inhouse peer review

lpc Lyttelton Port of Christchurch

Resulting Changes

- Less rigid joints to help accommodate swell
- Added redundancy by providing spare parts
- Isolated boat loads from wharf structure - Wharf moves out to meet anchored boat

EXECUTE

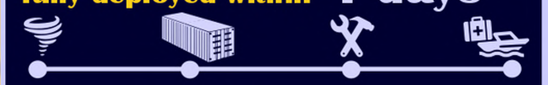
67.6m³ storage volume

whole life cost $137,000

ITEM	COST	RISK OF EXCEEDANCE
Design development	$0 (pro bono)	Low
Materials & Construction	$100,000	Medium
Storage (per year)	$7,000	Low
Management & Training	$3,000	Low
Deployment	$10,000	High
Retrieve, Refurbish, Reuse	$5,000	Medium
Contingency (10%)	$12,000	Medium

serves 20m boat in any depth

fully deployed within 4 days



80 man hours to construct

100% reusable

30kg per module

module size 1m x 2m

BEYOND THE SCOPE

“

Our design philosophy: Empower affected communities.

”

Team Find Shelter From Disaster

Bridge Over Troubled Water

Ellie Craft, Nina Ives, Ella Priest Forsyth and Michael Green

Special thanks to: Michael Howden, Vaclav Hirsch, Tom Armstrong, Abhishek Sharma and Jerry Khoo

Problem

The access and movement of supplies can be threatened by **disasters.** Current thinking **focuses** on fixing something once it is **broken.**

Approach

Our goal is a **proactive** approach to disaster management. We want to improve the **resilience** of the **transportation network** before a disaster strikes.

Method

RASMAP (Resilience and Strengthening Map) was developed to address threats to **access** and **movement** from a natural **disaster.** The process of finding a **solution** incorporated interviews with Beca staff in Fiji which helped gain a detailed **technical** knowledge. This in turned identified key issues of a natural disaster leading us to the development of **RASMAP**.

"Mitigation is the cornerstone of emergency management. It is the ongoing effort to lessen the impact disasters have on people and property."
- Senior Official
(Federal Emergency Management Agency)

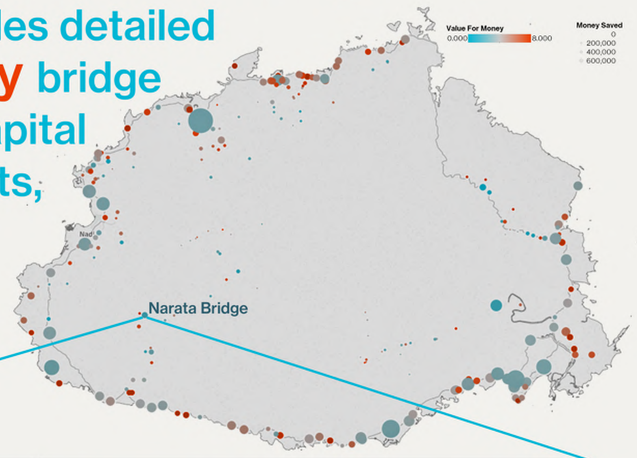
The Winning Formula

$$S < R(I + D)$$

Strengthening Inputs	Risk	Infrastructure	Disruption
-Total cost to Strengthen	- Vulnerablity - Threat	- Cost of temporary bridge - Cost of replacement bridge	-Economic cost -Social cost

Case Study

RASMAP provides detailed insights into **every** bridge in **Fiji** including capital and economic costs, vulnerability, as well as site photos.



Narata Bridge

Infrastructure: $8.34m
Disruption: $1.15m
Strengthening: $800k
Vulnerability: 1/25 Year

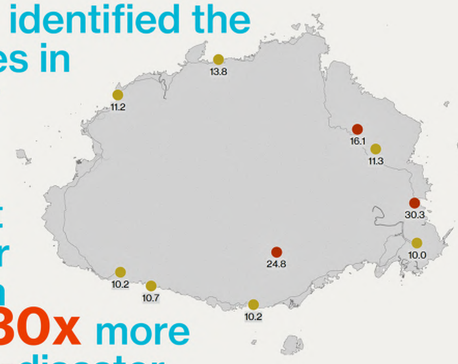
Narata Bridge - Eastern approach

Narata Bridge - From river bed

"On small island nations there is usually no secondary route if a bridge goes down. It therefore affects the entire transport network and therefore affects response and recovery efforts."
- Abhishek Sharma
(Country Manager, Fiji Engineering, Beca)

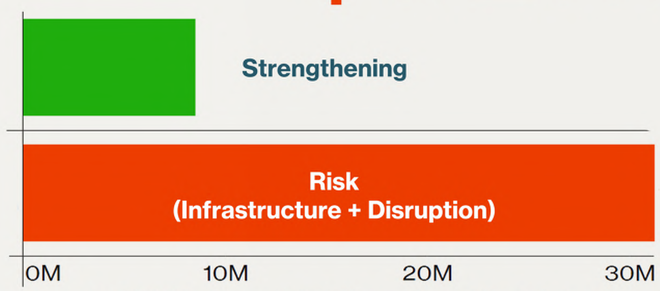
Solution

RASMAP identified the top 10 bridges in Fiji that offer the best **value.** Money spent post-disaster can be worth as much as **30x** more if spent **pre-**disaster.



The Whole Point

$8m < **$32m**



From a data set of 800 bridges in Fiji. It was found that doing the required strengthening work for each bridge could save the country $24 million if a disaster were to hit.

These figures demonstrate the cost saving benefits of using RASMAP to identify critical bridges worth strengthening pre-disaster.

Conclusions

In a natural disaster, **transportation** is critical. Best solutions aim to minimise the **consequences** of the disruption.

RASMAP aims to reduce the impact of a natural disaster by **improving** infrastructure resilience.

Proactive intervention **saves.**

References:
1. Yeo, S. W., Blong R.J., McAneney, K. J. (2007). Flooding in Fiji: Findings from 100-year Historical Series. Hydrological Sciences Journal / Journal des Sciences Hydrologiques, 52(5), 1004-1015. https://www.researchgate.net/publication/233142298_Flooding_in_Fiji_Findings_from_a_100-year_Historical_Series
2. Asian Development Bank. (2014). Proposed Loan and Technical Assistance Grant Republic of Fiji: Transport Infrastructure Investment Sector Project. Retrieved from https://www.adb.org/projects/documents/transport-infrastructure-investment-sector-project-rrp

DISASTER RELIEF PROJECT-SURVIVAL KIT

OVERVIEW

Disasters in the Pacific have the potential to cause considerable damage resulting in injuries and fatalities along with adverse economic and environmental impact. Earthquakes, Tsunamis, Cyclones, landslides and floods are set to increase in frequency and intensity for island nations as regional surface temperature increases. Hence innovative approaches are needed.

For a shelter to be affordable and reliable the raw materials which need to be stored long term must be minimized. There is often an abundance of debris and raw material available after the events of a natural disaster, however the local community lack the tools and knowledge to create a temporary shelter. If communities are provided with tools following the event of a natural disaster, post disaster shelters could be created by using what is available.

Following the devastating impacts of Cyclone Winston on Fiji in 2015 , the need for better preparedness for future disasters in the South Pacific became apparent. Following a natural disaster, those affected require water, sanitary facilities, medical care, shelter and food. This project design addresses these issues.

DESIGN METHOD

With a short design frame and a broad scope, a number of assumptions were made in order to come to a feasible solution. Assumptions:

1. Pre disaster funding. It was assumed that various charities would put money into the project proactively rather than all acting reactively. If the design shows promise then this should be viable and provides faster response time.
2. Locally available materials. To provide a streamlined design, local materials such as sand, rocks and debris from damaged infrastructure were assumed to be available to be used.
3. Pacific Disaster. While providing a versatile disaster relief design, the project was aimed at pacific based disasters. The solution could be modified later to adapt to other scenarios.

From the scope provided in the project outline, and initial concept design it became apparent that not all of the scope criteria could be met in a technically and economically feasible design. The conceptual design stage outlined the need to focus on addressing the criteria well rather than spreading the design into a plausible design which ticked all the boxes.

Components of the design which were determined to be key were:

- **Economics** – The cost of the kits had to be minimal but not sacrifice quality.
- **Deployable**– The kits needed to be as easily storable and transportable.
- **Functionality** – The kits needed to be simple to setup and provide effective shelter from the elements.
- **Philosophy** – The design had to be simplistic, innovative and viable.

Conceptual design and the above design criteria came together to form the idea of a versatile design; a versatile disaster kit. This was iterated and developed into the final design.

STORAGE

In order to disperse the disaster relief kits quickly, proximity of storage location is key. The design approach chosen uses both storage facilities in disaster prone countries, such as Fiji, in conjunction with storage supplies in New Zealand. This approach provides disaster relief kits close at hand to be distributed when deemed relevant. It is also flexible as the New Zealand based kits can easily be transported with New Zealand aid to multiple destinations.

The design of the kits provides for easy storage. The barrels can tessellate easily on a pallet and stack on top of each other for an efficiently packed design. Storage facilities both within New Zealand and the host country are required however the cost of this should be minimal as it is simply storage space that is required.

FUNCTIONALITY

How is it functional to the people of Fiji?

The Survival Kit is an easy to assessable disaster relief kit which helps people affected by disaster conditions to help themselves by constructing temporary shelters, in most situations, where worker aid may not always be readily available for weeks, and sometimes months.

What is needed for those affected by Natural Disasters?

The Survival Kit contains the following which are imperative for people to access in the first 72 hours of a natural disaster:

Water	**Shelter**
Sanitary Facilities	**Community Facilities**
Medical Care	**Food**

The contents:

Landscapes differs considerably for island nations affected by natural disasters. Therefore rather than providing a template design to assist people in building a shelter the Shelter Kit contains a number of multipurpose tools and accessories to help people in different scenarios.

150L or 120L barrels contain the materials needed to construct temporary shelters.
- Easily transportable in all scenarios.
- In the event of a flood, or in the cases where barrels need to cross water, the barrel is able to float with contents inside.
- Once in a location where the shelter is to be made, the barrel can be constructed into a slow sand filter.
- The slow sand is a type of filter used in water purification to supply those affected by the natural disaster with potable water. This will contain instructions on how to install it, including the use of natural materials such as sand and rocks.

The shelters will use the *Polyturf Tarpaulin (4.9m x 6.1m) Heavy Duty* as a roof or wall to protect inhabitants from the elements such as wind and rain, or alternatively used as a mat. The tarpaulin is reversible and can be used to absorb or reflect heat in different weather conditions. Tarpaulin pegs and rope will also be provided to bind/hold down shelter material. Duct tape will also be provided to repair/hold together any materials such as PVC pipes for water collection.

- Fuller Hardpoint Handsaw 350mm
- Nails Jolt Head 90 x 3.55mm 500g (Large)
- NZ Nails Flat Head 25 x 1.6mm 250g (Large)
- Spear & Jackson Round Mouth Shovel D Handle
- Trojan Claw Hammer 450g
- Zenith Tie Wire Coil 20G x 60m Galvanised
- Mc Gregors Wavy Blade Hedge Shears
- Gerber Gator Machete

Tools listed may be used to help the people affected rebuild temporary shelter frames from debris and other materials within the vicinity of the area. It is likely trees will be felled during natural disaster events, and these can be re-used to build temporary shelters. Refer to the Economics table for a full list of materials and tools included.

TRAINING

The preferred training method is to offer predominantly distributable courses, such as booklets which can be distributed as part of the barrels. Large scale classroom style learning pre-disaster are likely to absorb a large amount of resources to effectively run. And if the frequency and penetration of these courses isn't sufficient the outcomes during a crises are likely poor.

This means that training will consist of classroom style teaching for volunteer members of the distribution team along anyone directly involved with the project. In contrast the recipients of the disaster barrels will have booklets distributed to enable training at the time of the disaster

These booklets will be
- Easy to understand
- Use mainly visual aids. However, the words will be printed in English, Samoan, French, Fijian.
- As Brief as possible while still conveying the information
- Will be toughly tested

The design team will also work together with leading humanitarian agencies to closely develop relevant new content.

ECONOMICS

In order for the kits to be distributed quickly they require funding before the event of a disaster. Groups such as the NZ Government, Red Cross, Unicef, and Rotary International are to be approached to help fund the kits. The price per kit is estimated to be $526 per kit. The more funding made available the more kits can be created providing greater distribution.

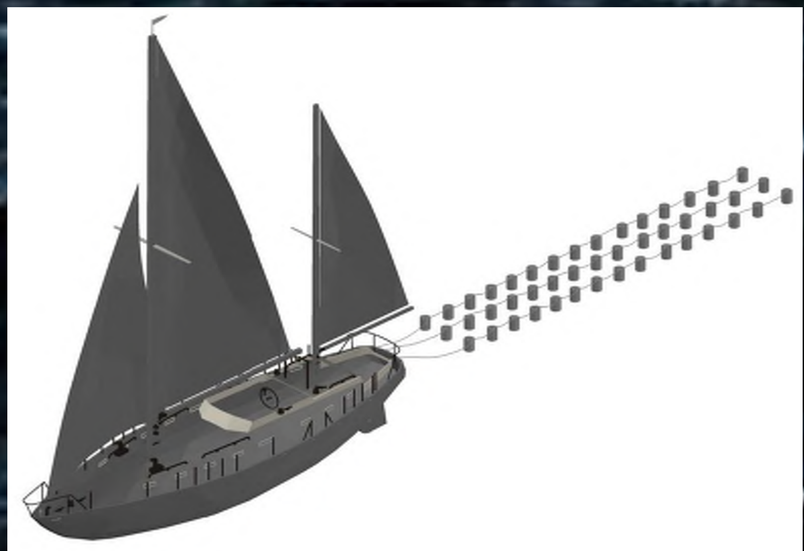
Item	Cost
Tarpaulin (4.9m x 6.1m) (Heavy Duty) and Pegs	$34
Rope (12m)	$12
Hardpoint Handsaw	$11
Assorted Nails	$25
Shovel	$40
Trojan Claw Hammer	$32
Tie Wire Coil	$9
Shears	$42
Machete	$50
Barrell	$55
PVC Piping	$30
Duct Tape	$22
Torch	$12
Fold Knife	$15
Candles and Matches	$19
First Aid Kit	$20
PPE	$18
Total Cost	$526

DEPLOYMENT METHOD

Immediately after a disaster has hit the relief kits stored within the host country can be released to be distributed to those in need. Distribution was identified as a key component in the design and a great deal of effort went into making the design as easy as possible to transport. Using a barrel provides and easily rollable storage container that is also buoyant and can be towed behind boats made this design easier to transport.

On arrival on site the kit can be unpacked and used in conjunction with debris and other available materials to construct suitable shelter.

While the local kits are being dispersed and sent to provide immediate relief, the second wave of shelter kits can be inbound from New Zealand. Once these have arrived they too can be distributed and supplement the kits which have already arrived on site.



FIND SHELTER from DISASTER

OUR DESIGN PHILOSOPHY

- Empower affected communities
- Communities already have the skills and resources to aid their own recovery
- Avoid assuming local needs
- Direct efforts toward gaps in local skillsets

OUR POINT OF DIFFERENCE

- Utilise local resources
- Customisable
- Bottom-up approach
- Deployed before disaster
- Prepares locals for danger
- Digital site-manager toolset

COMMUNITY PARTICIPATION

- Local communities are a key part of relief programmes and need to be involved in all steps
- Utilise skills and resources of local businesses

SCIENTIFIC DATA

- Combine available data from experts and local knowledge
- App and data is downloaded beforehand so it can be used without signal

TECHNOLOGY

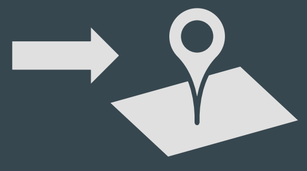
- Simple to use platform
- Can be used over both cell networks and wifi, or relayed using portable radio devices
- Easily modifiable for different countries

TRADITIONAL DESIGN

- Cyclone resilient design
- Uses easily available resources
- Locals inform and deploy design
- Users can pick what features they need

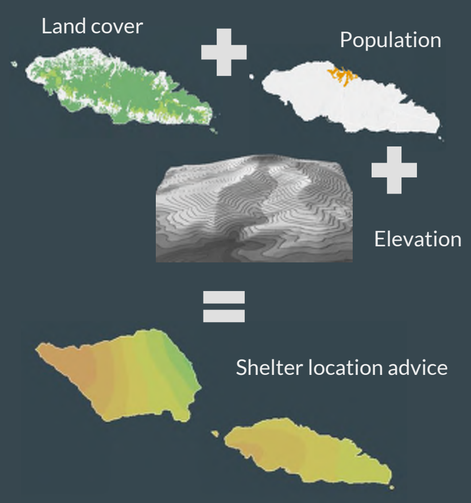
OUR DESIGN

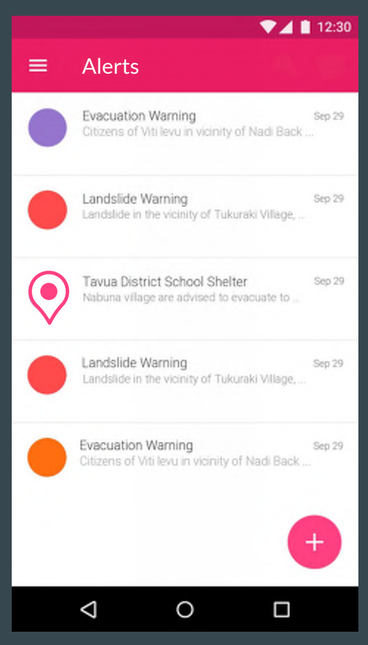
- Our design provides simple shelter concepts that survivors can modify based on the resources available, the quantity of people who will be using it and the specific needs of those people.
- The app is made prior to disaster events
- App is to be deployed to communities through community centers and leaders
- Maps and shelter sections can be printed into booklet format using durable, waterproof paper for easy distribution alongside app.
- Our app is simple and highly visual to cater for an unskilled workforce and can be translated into the official language.
- Aid organisations are able to use the app to help locals with their recovery
- Many emergency apps do not consider the needs of communities beyond the first few days. Our app provides people with the ability to instigate their own recovery.
- Locals already have the skills and resources and our app guides them how to leverage those.

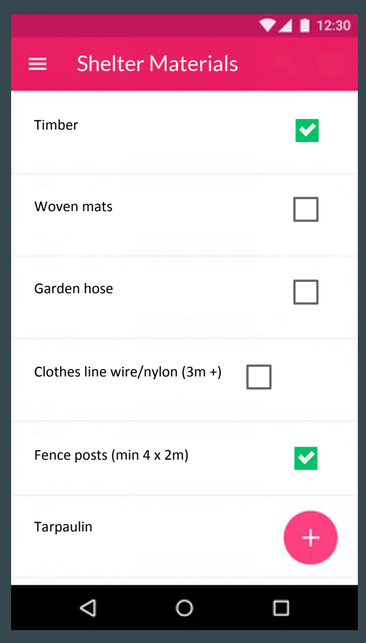


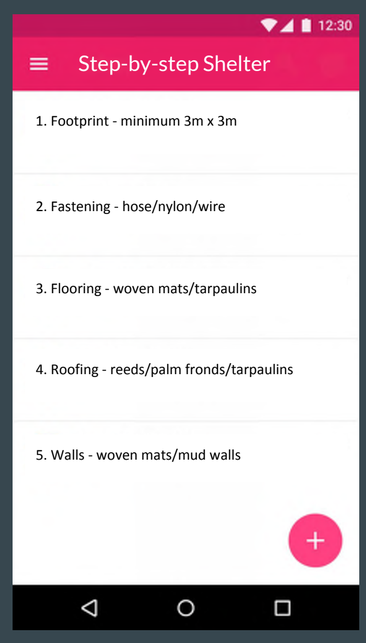
SHELTER LOCATIONS

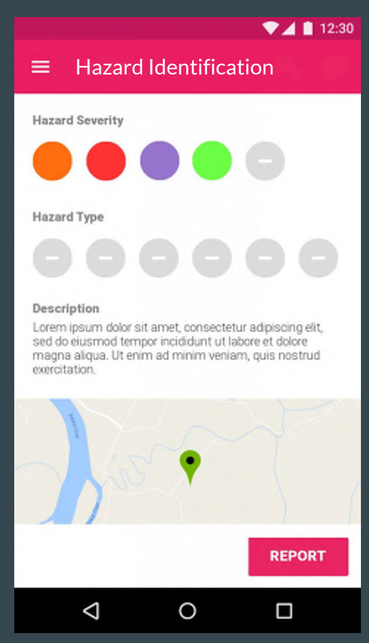
- Local knowledge combined with spatial data helps identify suitable shelter locations. Each input layer is assigned a weighting:
  - \+ 've = contribute to safe shelter locations.
  - \- 've = detract from safe shelter locations.
- Locations with the highest summed weightings are the safest places to build the shelters.
- Weightings are influenced by the type of natural disaster planned for. E.g., elevation would have a positive weighting for a tsunami but a negative weighting when planning for a tropical cyclone
- The model can easily be updated with adapted weightings for different disaster and location scenarios.











COST

- Shelter placement model: $11k
  - $3k - Data collection/country
  - $8k - GIS Analysis/country
- App initial construction: $20-30K
  - $15k - development
  - $10k - management and design
- Shelter construction:
  - Reclaimed materials
  - Manual labour costs
- **TOTAL = ~ NZD$40k**

(Note: After initial development, the app and shelter site model can be adapted for other countries with reduced cost)

- Shelter for the immediate short term time frame
- Minimum floor space of 3m x 3m for 6 people
- Step-by-step instructions for each section of shelter - each step leads to 'how to' diagrams with listed tools and time frames
- Includes information on ventilation, outdoor sanitation, water, external cooking facilities etc.

- List of easily recoverable resources after a disaster
- Each resource leads to different construction options
- Users can choose what materials and resources they have available

- Alerts from NGO's and AID organisations show disaster updates, new shelters or community centers
- The application leverages the use of software defined radio technology (e.g. goTenna) to send and receive critical information such as geolocation and plain text data.
- The use of this technology allows for the real-time reporting of hazards and shelter deployments independent of the cellular infrastructure.

POSTER BY
- Hanna Coysh
- Zack Kite
- Hannah Mountfort
- Miriam Munster

A SOLUTION FOR THEN AND NOW.
A SOLUTION FOR FOREVER.

We have the solution.
A solution that prepares before disaster,
That educates the people to build for disaster.
Lets's give the people the control.
Let's help them be disaster ready.

Every culture is different.
Every disaster is different.
But everyone wants independance and control over their lives.
We have designed with these fundamentals in mind
to come up with a solution that does all three.
... And then some.

Temporary shelters are required because local housing is not adequately designed for disasters. This problem will not be fixed with the deployment of temporary shelters, but rather with a focused educational and management program to teach locals how to retrofit or build new homes designed for disaster. Our concept walks people through the considerations and methods needed to build a home for their family that is disaster resistant, well equipped, easily modified to meet their cultural needs and is simple enough to build with no prior experience. A home that they can call their own then, now and forever.

Our educational booklet contains the essentials of living. Different techniques to ensure power, water, sanitation and resilient homes are produced to withstand disaster. The booklet will be categorized by different disasters and building techniques to ensure the best chance of survival. The look and layout will be left for the people to decide.

Aid has now moved from being the ambulance at the bottom of the cliff, to the fence at the top. Post disaster, money and time will be saved with improvements made each time disaster hits.

This feedback process will ensure the best for people in disaster prone areas while allowing their independance and dignity to remain intact.

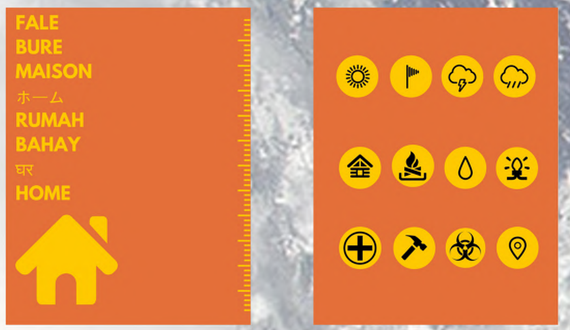
James McLean, Eremia Tapsell, Alaa Jaralla, Derryn Bracey

EDUCATION PROGRAM
- Consultation with local communities.
- In-country programme manager roles established
- Training

<0.01% GDP

DISASTER STRIKES

IMMEDIATE RESPONSE
- Water and food will be the biggest priorities
- Mobilise programme managers
- Deploy booklets



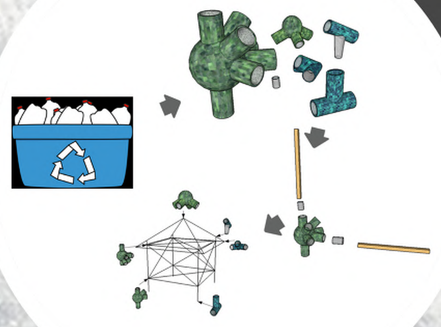
BUILDING RESILIENCE
- Locals in control of their recovery, culture, resources, & their lives.
- With the book, locals build or repair their communities to be disaster resilient.

Cost of materials
EST $850 per house

CONSTANTLY EVOLVING
- Adapts to new learnings and technology.
- Constant improvements & more resilient infrastructure.

DISASTER READY
- Comunities are ready for disaster
- Reduced time and cost of recovery.
- A solution for forever.

Reduces future cost



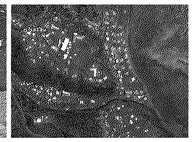
REIMAGINING THE COASTAL EDGE

CASE STUDY | NASAU, FIJI

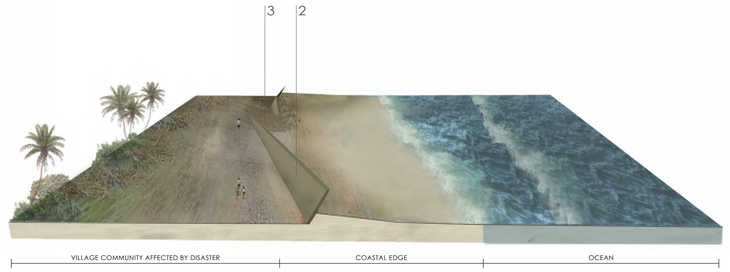
CLIMATE CHANGE IS INDEED A COMPLEX PROBLEM OF GLOBAL PROPORTIONS. IT ENGAGES DESIGNERS TO FUNDAMENTALLY RECONSIDER WHERE AND HOW WE LIVE AS SOCIETIES. OUR COASTAL AREAS ARE SOME OF THE MOST VALUABLE NATURAL PUBLIC SPACE ASSETS. ALL THE THREATS THAT CLIMATE CHANGE MAY BRING TO LOW-LYING COASTAL ENVIRONMENTS WILL ALMOST CERTAINLY FORCE CHANGE TO THE COASTAL LIFESTYLE. COLLABORATIVE DESIGN HAS THE FULL POTENTIAL TO DEFINE THAT CHANGE, PROVIDING RESILIENCE IN COMMUNITIES TO BEST SECURE OUR PROGRESS TO DATE AND ADVANCING EQUITABLE AND SUSTAINABLE HUMAN DEVELOPMENT.

WITH A STRONG FOCUS ON RETAINING THE COASTAL LIFESTYLE, OUR CONCEPT FOCUSES ON MINIMISING THE VULNERABILITY AGAINST STORM SURGE FOR THE PEOPLE OF NASAU. WE LOOKED AT INNOVATIVE DESIGN STRATEGIES, WHICH MANIPULATED COASTAL PROCESSES. OUR CONCEPT ENCOURAGES THE NATURAL DEVELOPMENT OF A SAND DUNE, ACCELERATED BY THE PROPOSED COASTAL RETAINING STRUCTURE BY INTERCEPTING SEDIMENT TRANSPORTATION BY AEOLIAN PROCESSES. IMPLEMENTED IN SEGMENTS OVER TIME, THE RETAINING STRUCTURE SUPPORTS THE BUILD-UP OF THIS DYNAMIC DUNE BUFFER, PROVIDING SAFETY WITHIN THE COASTAL COMMUNITY. ACCESSIBILITY TO THE COASTAL ENVIRONMENT IS RETAINED ALLOWING THE COMMUNITY OF NASAU TO UTILISE THE RESOURCES WITHIN THEIR PRIME COASTAL LOCATION.

THE DUNES ENCOURAGE THE USE OF SOFT ENGINEERING TO DISSIPATE THE ENERGY OF COASTAL SURGE, AND UTILISES THE ECOLOGY OF COASTAL SYSTEMS TO NATURALLY BOUNCE BACK FROM DISASTER. THE CONCEPT PROLONGS THE ABILITY TO RESIDE WITHIN THE COASTAL ENVIRONMENT AND ALLOWS FOR EXPANSION OF SETTLEMENT AND AGRICULTURE PARALLEL TO THE EXTENSION OF THE RETAINING STRUCTURE TO SUPPORT LIFE AT THE COASTAL EDGE FOR THE PEOPLE OF NASAU.

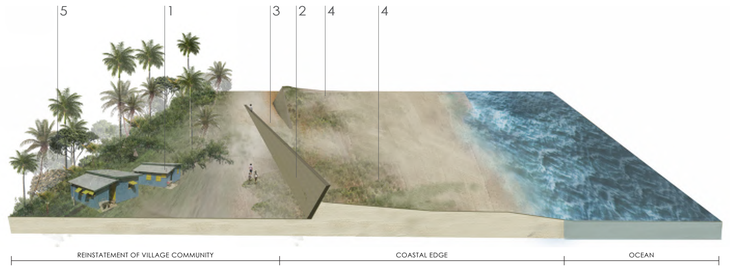


0-5 YEARS



1 INCREASE SECTORS FOR AGRICULTURE AND HOUSING, PROLONGING THE ABILITY FOR THE PEOPLE OF NASAU TO RESIDE IN THEIR RESOURCEFUL COASTAL ENVIRONMENT | **2** COASTAL DEFENSE MECHANISM: RETAINING WALL TO ACCELERATE AND SUPPORT SAND DUNE BUILD UP (INTERCEPTING SEDIMENT TRANSPORTATION FROM PREVAILING WINDS) | **3** COASTAL ACCESS RETAINED BY IMPLEMENTING STRUCTURE IN SEGMENTS | **4** PROPOSED SAND DUNE COASTAL BUFFER, NATURALLY FORMED THROUGH COASTAL PROCESSES AND SUSTAINED BY ROOT SYSTEMS OF PLANTING. THE DUNES AIM TO ENCOURAGE THE USE OF SOFT INFRASTRUCTURE TO ABSORB THE INFLUX OF ENERGY DURING STORM SURGE, AND BOUNCE BACK DURING CALM COASTAL CONDITIONS | **5** BANK STABILITY STRENGTHENED BY REVEGETATION TO SUPPORT HIGH GROUND HOUSING. OPPORTUNITY TO REIMAGINE AGRICULTURE ACROSS EMBANKMENT.

5-10 YEARS



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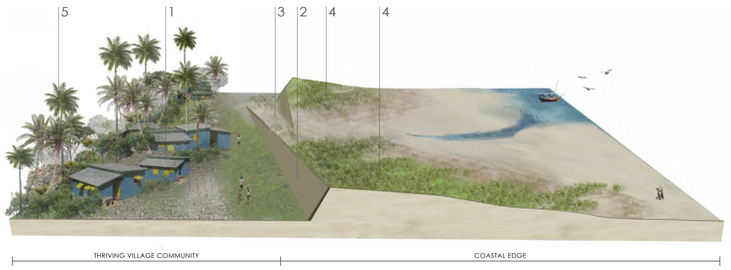
10+ YEARS



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We make things happen.

Our clients do incredible things every day. They are transforming their communities and changing lives through the structures they build, the products they manufacture, the services they provide, and the families they support. And we are right there alongside them.

We are the problem-solvers – the thinkers, the creators, the planners and practitioners – who understand their vision and make things happen!

With teams across the Asia Pacific, we combine our skills and insights with those of our clients, using the power of partnerships to think, design and develop creative solutions together. From engineering, architecture, planning and advisory, to project and cost management, valuations and technology, our skilled team of 3000-plus turn ideas into reality.

While our experience has been 98 years in the making, it is the fresh talent we're nurturing, the innovative thinking we're developing and the connections that we're forging that get us most excited for the future.

Beca

CREATE
INNOVATE
COLLABORATE

THE BECA DESIGN COMPETITION

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