Toitu He Whenua

[illegible]

Toitu He Whenua Whatunarongaro He Tangaata

THE LAND IS PERMANENT,
BUT MAN DISAPEARS

EXECUTIVE SUMMARY

An embodied energy study has been conducted to determine the negative impacts that The Department of Conservation's standardized hut designs have on the natural environment and whether the material palettes used in these designs can be altered to reduce the negative impact posed.

The results of the calculations conducted on the original design demonstrate that the larger the size of the hut, the larger the total embodied energy value. The two bunk huts total value is 20,911 MJ, followed by the four bunk hut with 32,839 MJ, the six bunk hut with 38,806MJ, the ten bunk hut with 58,318 MJ, and the twelve bunk hut with 61,252 MJ. The results regarding this can be found in chapter 4 – original results.

The initial results informed the changes to be applied to the standardized designs. The alterations realised included: replacing the highly manufactured materials such as steel, fibreglass insulation, and plywood with more natural, regenerative materials. This produced significant results over all five of the standardized designs, with reductions ranging from 34% to 61%. These alterations, and the embodied energy results from the altered design can be viewed in chapter 5 - altered design.

The altered design had minimal effects on the durability and maintenance that would be required by altering the design, nor with the overall weight and transportability that the altered design would create. However the price increased significantly, ranging from $17,448 - $25,302. The details regarding this can be found in chapter 7 – cost comparison.

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1

INTRODUCTION

The negative environmental impacts from the built environment are immense. Globally, 40% of all energy and building resources are used to build and operate buildings, 40% of greenhouse gas emissions come from building construction operations, and 40% of total waste results from construction and demolition acitivties (UNEP, 2007). In 2003, the United Nations warned that if current patterns did not change, the expansion of the built environment would distroy or disturb natural habitats and wildlife on more than 70% of the Eearths surface by 2032.

This is an especially troubling concept for New Zealand as the environment is central to the Kiwi way of life. Our iconic landscapes have shaped our identity as a nation, and the resources from the land, freshwater and sea underpin our valuable primary industries. The varied urban and rural landscapes in which we live, work, and spend leisure time form an integral part of our social, culteral, and economic well-being. Careful stewardship of our natural landscapes and resources is therefore important: both tourism and our primary production sectors rely on New Zealands 'clean and green' reputation internationally (Ministry for the Environment, 2007). We also need to recognise that we have a responsibility to the future generations to ensure the experience of New Zealand's natural environment remains a way of life.

There are opportunities for central government organisations to show leadership and take New Zealand forward to a sustainably built environment, by helping develop momentum for adopting these approaches (Jenkin & Zari, 2009). One such government organisation in a good position to achieve this is The Department of Conservation, which is the central government organisation charged with promoting conservation of the natural and historic heritage of New Zealand. Much of the departments work takes place on the more than eight million hectares of conservation land that it manages. This land makes up about 1/3 of our country, and includes over 1000 huts scattered throughout varrying locations. The huts provide unique places to stay, refuge from bad weather and a place to rest and recover when out exploring the many parks and reserves.

Although The Department of Conservation make desicions thoughtfully when designing and specifying materials for these huts, unless an objective analysis is carried out, it is not possible to determine the impact that these particular buildings have on our environment.

From the Mountians to the Sea From the Forests to the Cities, Our Place is Beautiful

1.1 AIM

An embodied energy study will be conducted to determine the level of environmental impact created by new Department of Conservation huts, which will be constructed in New Zealands natural environment. The research is intended to enlighted The Department of Conservation of the current status of their designs, and where they could make informed and conscientious changes to the selected material pallets. If appropriately implemented, then the new stock of Department of Conservation huts could be built with a lesser impact on out environment, but would also further propel The Department of Conservation foreward as leaders and role models for sustainability in New Zealand.

1.2 HYPOTHESIS

An embodied energy study will be used as a calculation method to determine that The Department of Conservation huts impact the environment negatively and could be easily improved by selecting the material palette more thoughtfully.

1.3 SCOPE

The embodied energy study will be conducted on the five varying sized standard hut designs, set out by The Department of Conservation, as these are what are used for the substantial proportion of newly constructed huts in New Zealand. The study will focus specifically on Coloursteel clad huts as opposed to board and batten clad huts as these are significantly more occurring, the study will also be restricted to huts with verandas and decking that occur on two facades of the building, as opposed to other varying options available. The embodied energy data that has been obtained and used for the study has been produced by Andrew Alcorn, and has been used for this research due to its specific relevant to New Zealand. However, before embodied energy values could be calculated, an in depth breakdown of every item used to construct each standard hut design was obtained, and the weights of each material found.

1.4 REPORT OUTLINE

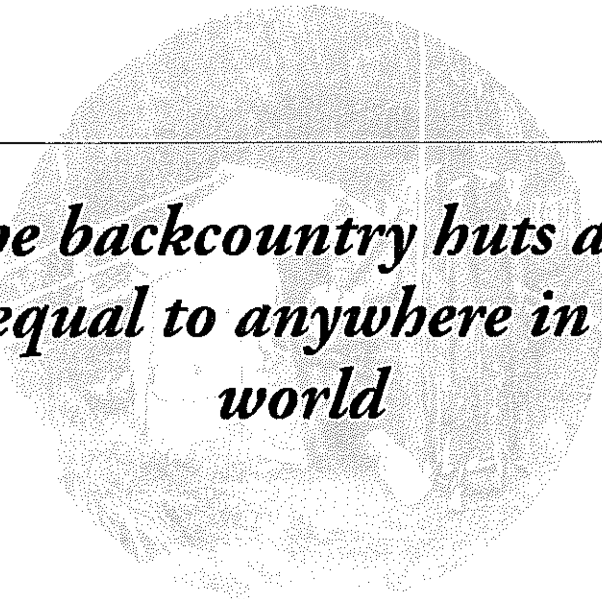
This report has been structured to enable the reader to follow the course of the research easily. Section One – Introduction explains the significance of the research and why it is being undertaken; the research aim; the scope; and an outline of the report structure. The second chapter, Section two – Methodology, provides a hypothesis and introduces the key concepts of the embodied energy study: it describes what embodied energy data was used and why; the parameters of the research, and; the steps undertaken to ensure the information is valid and accurate. Section three - covers the embodied energy calculation process. Section four and five– Results, contains firstly the results for the original huts designs and then the results of the altered designs. Chapter 5 – durability analysis compares the life span of the original design to the altered design and also the amount of maintenance which would be required for each. Following on from this are sections 6 and 7 which compare the transportability of the two designs and the cost of the to designs. Finally, chapter 8 - conclusions and recommendations discusses the result outcomes and how they could be implemented by DOC for their future work.

PHOTO: KAREN BROWN, 2010

2

RESEARCH DESIGN

This section of the report contains an overview of the methods used in this study. Firstly the method used to calculate the level of environmental impact the buildings pose is investigated, and highlights why you would use this method of calculation. It goes on to examine the buildings that are to be researched, briefly identifying their history, the owner and operators, and what aspect of the buildings is to be studied and researched. It then discusses the process for gathering the required information and what measures were implemented to ensure the information is accurate and reliable.



The backcountry huts are unequal to anywhere in the world

2.1 EMBODIED ENERGY

There are many varying methods which can be used to determine the environmental impact of a building or structure. Embodied energy is a method which analyses one aspect of the environmental impact, human made objects have on the environment. One definition of the process states that it is the quantity of energy required by all the other activities associated with a production process, including the relative proportions consumed in all activities upstream to the acquisition of natural resources and the share of energy used in making equipment and other supporting functions. i.e. direct plus indirect energy (Treloar, 1994).

2.2 WHY WAS EMBODIED ENERGY USED

An embodied energy analysis calculates one aspect of sustainability, and is a good calculation method to use for these specialized buildings as they are not used like buildings found closer to civilization. The huts therefore do not comply with the majority of the categories tested for in the many sustainability calculations available. For example Department of Conservation huts do not have power, places for waste disposal, or a means of transport to the building other than walking, which are components taken into account for sustainability calculation methods such as Green Stan, LEED and Bream. An embodied energy study is an appropriate method to use as it focuses on the materials used to construct the building, which is essentially all these buildings are – a selection of materials to form a shelter. Each component used to construct the building is given a number value, therefore comparisons can easily be be made between varying materials types in order to determine which has a lesser impact on the environment.

2.3 EMBODIED ENERGY COEFFICIENTS

Andrew Alcorn's embodied energy coefficients have been used for this research due to their specific relevance to New Zealand. This is an important aspect of the research design as the embodied energy values depend on the materials used and the source of the materials, therefore, this is why data for a building material in one country may differ significantly from the same material manufactured in another country. A 'cradle to the factory gate' analysis is used – i.e. the impacts associated with making the product are considered, but not the impacts of getting it to site, using it on site and disposing of it after the end of its useful life. The information captures some key environmental concerns (including resource use and climate change related indicators). However it doesn't differentiate between renewable and non-renewable energy forms and it doesn't provide any information on other environmental impacts – such as ozone depletion, human toxicity and eco-toxicity (VUW, 2003).

2.4 HUTS HISTORY

The backcountry huts of New Zealand contain a heritage of about 1400 huts that is unequal to anywhere in the world. A great number of these huts were built in the 1900's as part of the wild animal control operations by the New Zealand Forest Service and, to a lesser extent, by its predecessor, the Deer Division of the Department of Internals. Because the huts were built in remote locations the provision of the building materials was a big constraint . Often the resources available on site were exploited, with results that many old crafts were applied for the last times. Alternatively, if materials were transported to the site, it was on the backs of men or packhorses, and this strongly influenced the design. The result is vernacular buildings that are physically distinctive from those found closer to civilisation (DOC, 2010). Although more advanced transportation and construction methods are used, today's huts are reminiscent of their predecessors, with similar characteristics, traits and material pallets.

2.5 THE DEPARTMENT OF CONSERVATION

Today, The Department of Conservation is the only significant owner and builder of backcountry huts in New Zealand, and is responsible for building, alteration and management of these buildings, however due to the scale and purpose of the operation it has become necessary that the buildings comply with the Building Act and the Building Code along with the specifications set by The Department of Conservation. In order to achieve this successfully five standard huts have been designed which comply with all of the necessary codes and documents. The five standard designs are all very similar however vary in size – two, four, six, ten, and twelve bunk. The specifications, construction details and plans can be found in The Department of Conservation's hut procurement manual.

2.6 PARAMETERS

The embodied energy study will be conducted on the standard hut designs, as set out in The Department of Conservation's Hut Procurement Manual. It is intended to benefit the future huts to be built, it could also aid in the specification of materials for renovations or maintenance needed to be conducted on existing huts. This is in comparison to calculating the environmental impact of the existing hut stock.

It has been decided to conduct the study on the future huts to be built as to calculate the impact of the existing hut stock would be difficult due to the large, varying range of sizes, construction methods and material palettes used in the past. Also it is unlikely that the large collection of existing buildings could be replaced or renovated as a) it would be a very expensive and timely exercise, b) it would be an unnecessary waste of

recourses, and c) it would be unsustainable to replace or renovate existing huts that are in good condition. It appears more logical and realistic to identify areas for improvement for the buildings that have yet to be constructed or renovated.

The hut procurement manual provides varying design and material choices. For the purpose of this research the most commonly implemented options have been selected to represent the body of possible outcomes.

The Department of Conservation has advised that the significant proportion of huts are clad with Coloursteel in comparison to board and batten, and that the design which allows the deck and veranda to engulf two facades as opposed to one is more commonly preferred.

The study has only been conducted on the building structures only, internal fittings such as bunks, tables, benches, and hooks have been excluded as these items will be consistent regardless of the huts construction methods and material selection. Also additions such as long-drop toilets and water tanks have also been excluded.

All five of the standardised huts had their embodied energy calculated as they are not proportional in size, and therefore one hut is not representative of all five of the designs.

Our iconic landscapes have shaped our identity as a nation

2.7 RELAVENCE OF RESEARCH

The Department of Conservation have stated that approximately ten new huts are constructed each year, and this number is expected to carry into the future, maintenance on the huts is also continual. This is a significant number of new huts to be constructed in order to deem the research relevant. The research would not only help reduce the negative impact these structures have on the environment but would give The Department of Conservation the chance to show leadership and take New Zealand forward into a more sustainable built environment.

2.8 MAKING ALTERATIONS

Having an embodied energy value for the huts is irrelevant unless comparable, therefore alternative material possibilities were also calculated. The alternative materials were selected based on the concerning areas highlighted in the initial results. The alternative materials were selected conscientious of the specific characteristics associated with these specialised buildings. These characteristics include the isolated locations that the huts are located in, the specialized use of the buildings, the difficulties involved with transport to the site, the beautiful environments would be placed into, and the stringent budget; as The Department of Conservation is a government organisation. The alternative material selections were also limited to the coefficient values available in Andrew Alcorn's data. This is because it is important that the values are specifically relevant to New Zealand, and also for consistency with the previous data obtained from the original designs.

POET HUT, 1961: PHOTO TED SMITH

3

METHOD

Tourism and our primary sectors rely on
New Zealand's ' clean and green' reputation
internationally

Beauty in New Zealand is everywhere

3.1 COMPARATIVE ANALYSIS

Comparative analysis is the method which has been used to analyse the results obtained from the embodied energy calculations conducted on the original hut designs and then the re-designed huts. It can be described as the comparison between two or more comparable alternatives, processes, products, qualifications, sets of data etc. Comparative research is a broad field, as in a strict scene all analysis is comparative. However Pickvance argues that the following two must be met:

-Data must be gathered on two or more cases; and
-There must be an attempt to explain rather than describe

It should be noted that comparative analysis requires the things being compared to be commensurable, but not necessarily identical. Commensurable but means that they can be placed at the same or different points on a dimension of theoretical interest (Pickvance, C., 2001).

3.2 PROCESS

In order to gain an embodied energy value for a building, the material weight of each individual material used to construct the hut is needed, which is then multiplied by its assigned embodied energy coefficient. This process was applied to both the original hut and the re-designed hut. This section of the report covers the methods used to conduct the embodied energy calculations. It provides a description of how the trade break up was conducted, how the material weights were obtained, and what measures were undertaken to ensure that the altered design could be accurately compared with the original design.

3.3 TRADE BREAKUP

The analysis is only as valid as the data; therefore it was important that a qualified quantity surveyor conducted the trade break-up. Using all five of the standardised huts plans, obtained from The Department of Conservations Hut Procurement Manual, the trade break up could be conducted. It was split into the main components which make up the building – sub-structure, walls, roof, floor, windows and doors, hardware, and deck and steps. This was to help identify problem areas, and to easily compare how specific changes would affect individual components of the hut.

3.4 MATERIAL WEIGHTS

As with the trade break-up, it was important that the material weight information was also accurate. Therefore, were possible, this data was obtained from the manufacturers of the individual materials, and then the New Zealand Institute of Quantity Surveyors handbook if the manufacturers' data was unavailable.

3.5 EMBODIED ENERGY COEFFICIENTS

The embodied energy study has been calculated as accurately as possible, however the results rely on Andrew Alcorn's coefficients. As would be expected, there is not a coefficient for every individual material or object used in the huts. Therefore assumptions need to be made as to which coefficient should be applied to a material or object. In some cases there were no comparable coefficients, and materials or objects needed be excluded from the calculation. Consistency was important when apply this, so that the results from the original design and the altered design could be accurately compared. Further details on what coefficients have been applied to which materials, and were materials have been exempt can be found in the appendix.

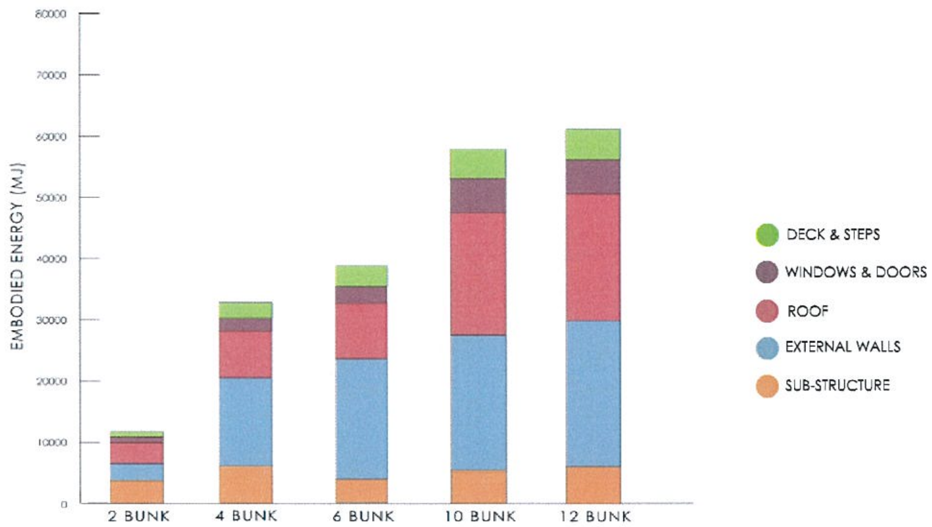
HOLYFORD TRACK. PHOTO: KAREN BROWN, 2010

4

ORIGINAL RESULTS

This section of the report contains the calculated embodied energy results for the five standardised hut designs. The total embodied energy value for each of the five standardized huts is presented, followed by the embodied energy per metre squared for each of the five standardized huts.

GRAPH 1: TOTAL EMBODIED ENERGY OF ORIGINAL HUT DESIGNS



4.1 TOTAL EMBODIED ENERGY

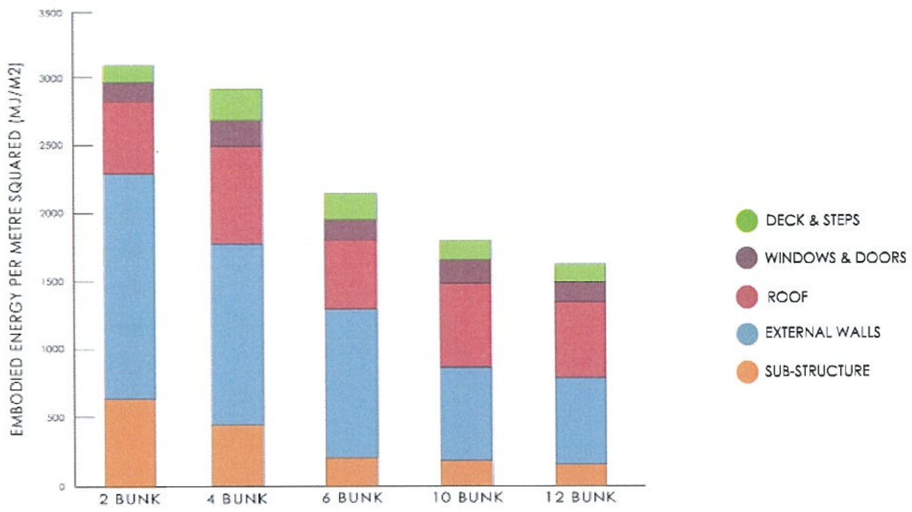
Graph 1 shows the total embodied energy for each of the huts, from the two bunk hut up to the large 12 bunk hut. The Y-axis of the graph is the embodied energy value in mega joules, and the X-axis is the hut size. The coloured sections within each bar represent the different components which make up the hut and include sub-structure, external walls, the roof, windows and doors and the deck and steps.

The graph indicates that the larger the size of the hut, the larger the embodied energy value, therefore reflecting a greater negative impact on the environment. The two bunk hut has a total embodied energy of 20,911 MJ, followed by the four bunk at 32,839 MJ, the six bunk with 38,806 MJ, the ten bunk with 58,318 MJ and the twelve bunk with 61,252 MJ. As the huts do not increase with size proportionally, neither do the total embodied energy figures for each hut. The embodied energy values increase with the size of the huts as larger quantities of materials will be required to construct the huts as the sizes increase.

The roof and walls, i.e. the blue and pink colours, contribute the largest embodied energy value, this is because the Coloursteel used to clad each of these components, has a large embodied energy coefficient of 34.8 MJ/Kg in comparison to rough-sawn, treated, pinus radiata which has a value of 3.0 MJ/Kg (Alcorn, A., 2001). The walls of the two bunk hut contribute 11,173 MJ (53%) to the total embodied energy value of that hut, followed by the 12,423 MJ (44%) to the four bunk hut, 19,719 MJ (51%) to the six bunk hut, 22,444 MJ (38%) to the ten bunk hut, and 23,885 MJ (39%) on the twelve bunk hut. The roof contributes less to the total embodied energy value of each hut as there is less area than the walls, however the values are still significant, with the roof of the two bunk hut contributing 3609 MJ (17%) to the total embodied energy value of that hut, followed by the roof of the four bunk hut contributing 7699 MJ (23%), 9059 MJ (23%) to the six bunk hut, 20,025 MJ (34%) to the ten bunk hut, and 20,736 MJ (34%) to the twelve bunk hut. As you can see, the roofs total embodied energy value increase with the area of the roof.

Pinus radiata had been used to construct the sub-floor structure and the deck and steps; this has resulted in a low contribution to the total embodied energy, represented by the orange and green sections of each bar. The variation in the orange areas, which are the sub-floor structure; with the two and four bunks sub-structures total of 4353 MJ and 6114 MJ, which is large in comparison to the six, ten and twelve bunk huts at 3835 MJ, 5462 MJ, and 6073 MJ. This occurs because the two and four bunk huts use steel floor joists as opposed to the other three huts, which have a timber sub-floor.

GRAPH 2: EMBODIED ENERGY PER METRE SQUARED



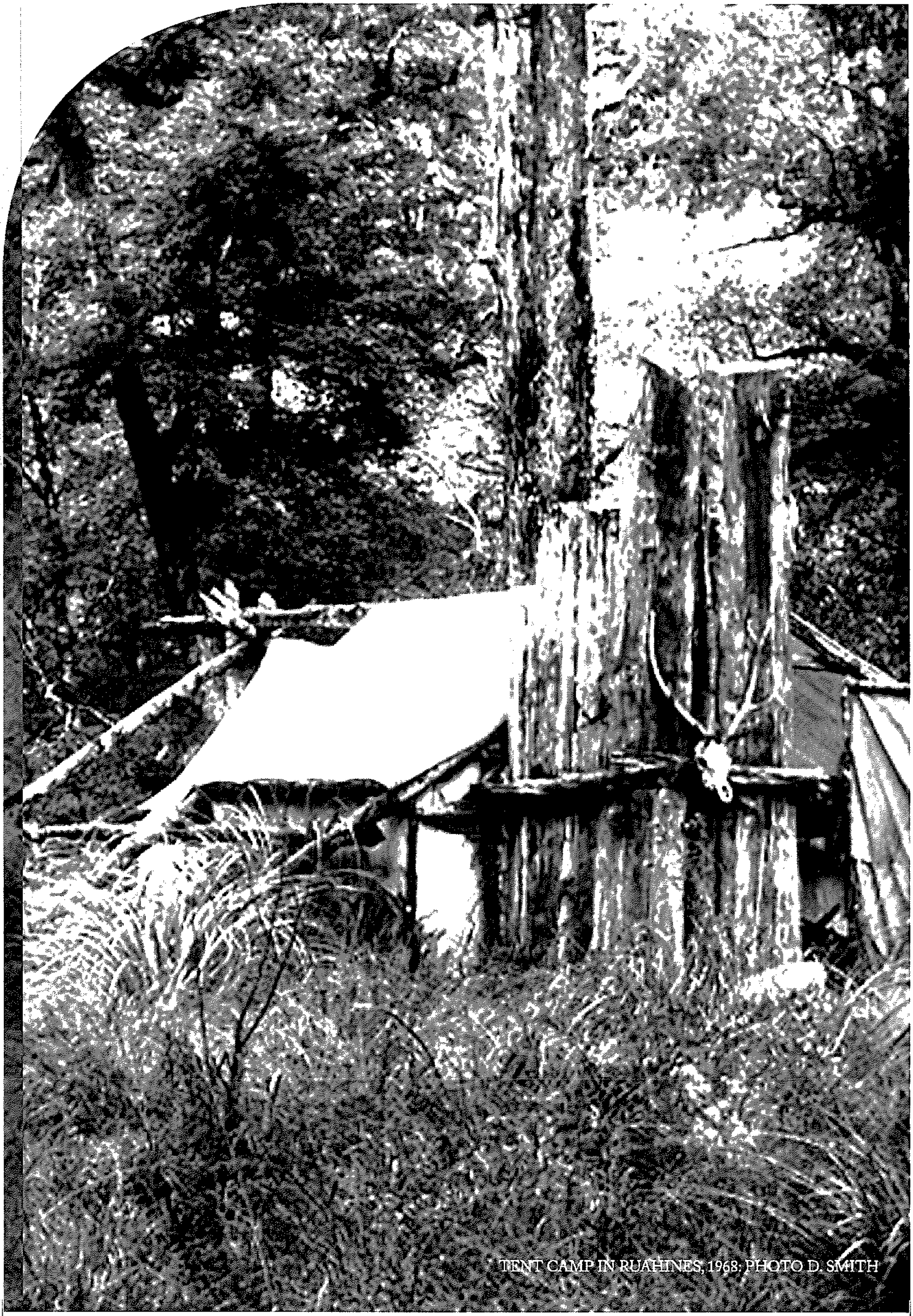
4.2 EMBODIED ENERGY PER M^2

Graph 2 shows the embodied energy per metre squared for each of the five standardized Department of Conservation hut designs, from the two bunk up to the larger twelve bunk hut. The Y-axis of the graph is the embodied energy per metre squared in mega joules, and the X-axis is the hut size. As with the previous graph the coloured sections within each bar represent the different components which make up the hut and include sub-structure, external walls, the roof, windows and doors and the deck and steps. The five huts do not increase in size proportionally with the square metres of each of the huts as follows – two bunk hut: 6.75m2, four bunk hut: 10.8m2, 6 bunk hut: 18m2, ten bunk hut: 32.76m2, and the twelve bunk hut: 37.44m2.

Calculating the embodied energy per metre squared now indicates that the two bunk hut has the largest embodied energy value at 3097 MJ, followed by the four bunk hut with 3040 MJ, the six bunk hut with 2155 MJ (51%), the ten bunk hut with 1780 MJ, and the twelve bunk hut with 1636 MJ.

As with the previous graph, the roof and walls, i.e. the blue and pink colours, contribute the largest embodied energy values. The walls of the two bunk hut contributed 1655 MJ/m2 (53%) to the total embodied energy value for that hut, 1356 MJ/m2 (44%) to the four bunk hut, 1096 MJ/m2 (50.8%) to the six bunk hut, 685 MJ/m2 (38.4%) to the ten bunk hut, and 638 MJ/m2 938.9%) to the twelve bunk hut.

The summary of this graph is that the initial outlay of embodied energy is high but as you add additional area to the huts this value decreases.



TENT CAMP IN RUAHINES, 1968. PHOTO D. SMITH

5

ALTERED DESIGN

From the initial results and graphs, the key areas contributing to the embodied energy totals could be identified. Therefore alternative materials could be suggested and tested to attempt to reduce the total embodied energy of each hut. The main contributors to the embodied energy total of each hut were identified to be the steel used in the sub-floor and framing of the two and four bunk huts, the Coloursteel cladding the walls and roof of all five huts, the fibreglass and polystyrene insulation, and the highly manufactured timber products such as plywood which is used in all five huts to line the walls, ceiling and floor.

ORIGINAL DESIGN		ALTERED DESIGN	
MATERIAL	MJ/KG	MATERIAL	MJ/KG
Steel Framing	31.3	Timber Framing	3.0
Fibreglass Insulation	32.1	Wool Insulation	14.6
Plywood flooring	10.4	Tounge & Groove flooring	3.0
Coloursteel Roof Cladding	34.8	Cedar Shingle roof cladding	3.0
Coloursteel Wall Cladding	34.8	Board & Batten Wall Cladding	10.4

(ALCORN, A., 2001)

TABLE 1: EMBODIED ENERGY COEFFICIENT COMPARISONS

5.0.1 USE OF STEEL

Energy and CO2 implications of building construction in New Zealand has been examined by Buchanan. A detailed analysis of net carbon emissions resulting from construction of buildings (in New Zealand) using different structural materials has been made. The study concludes that significant decreases in CO2 emissions and energy would result in constructing building of wood in comparison to steel, concrete or aluminium (Buchanan, A., 1998). Significant amounts of energy are used in the manufacture of virgin steel, as it is usually made by one of the two following methods:

-Integrated blast furnace and basic oxygen furnace, using the raw materials iron ore, limestone and coke.
-electronic arc furnace, using mainly scrap steel which is re-melted with additives.

In addition to this there is visual impact from the removal of ironsand from New Zealand open cast mines, although once the iron is extracted the sand is returned to the mine site and the natural environment reinstated. There is also potential for damage to local ecosystems during raw material extraction (Level, 2010).
Alternatively, timber can be used in the construction of buildings. Timber has many significant advantages over competitive building materials, particularly from a sustainability perspective, being plentiful and renewable. Wood is the only major building material that is a sustainable and renewable resource. Environmental impact assessments consistently show the sustainable benefits of using timber and biological products, due to the comparatively small amount of energy used in the extraction, manufacturing and construction phases (Buchanan, A., 2008).

As of a result of this research the external coloursteel cladding was replaced with board and batten, the Coloursteel roof was replaced with cedar shingles and the steel sub-floor systems and steel framing in both the 2 bunk and four bunk huts have been replaced with timber. The embodied energy coefficients of each material are compared in table 1 above.

5.0.2 INSULATION

Pink Batts fibreglass insulation has been specified in the walls and ceiling of the original standardized hut designs. Fibreglass insulations are made from materials such as rock slag, recycled glass, quartz sand, soda ash, lime stone, and boron which are melted and spun into fibres. Fibreglass insulation could be described as the most commonly used insulation material in New Zealand as it is readily available, has a high R-value to price ratio, and is easily worked with. However, significant amounts of energy are required in the manufacturing of fibreglass insulation, as recycled glass has to be heated to extremely high temperatures and spun into fibres, which are then densely layered into mats or batting. This subsequently gives it a high embodied energy value of 32.1 MJ/Kg (Alcorn, A., 2001). Alternatively, a building can be insulated with wool insulation. Wool is a sustainable, allergen-free, natural form of insulation that provides an environmentally alternative to fibreglass or polystyrene. It is made using a significant amount less energy that fibreglass batts, therefore giving it a lower embodied energy value of 14.6 MJ/Kg; at least half of the fibreglass batts value (Alcorn, A., 2001). These values can be compared in table 1 on the previous age.

No alternative could be found for polystyrene, as it is used beneath the floor. To insert a material such as wool insulation into an area such as this it would then need to be concealed with plywood to ensure it did not blow away, damaged by the weather, animals or natural environment, however to achieve this it would use a higher total embodied energy than it would to use the polystyrene.

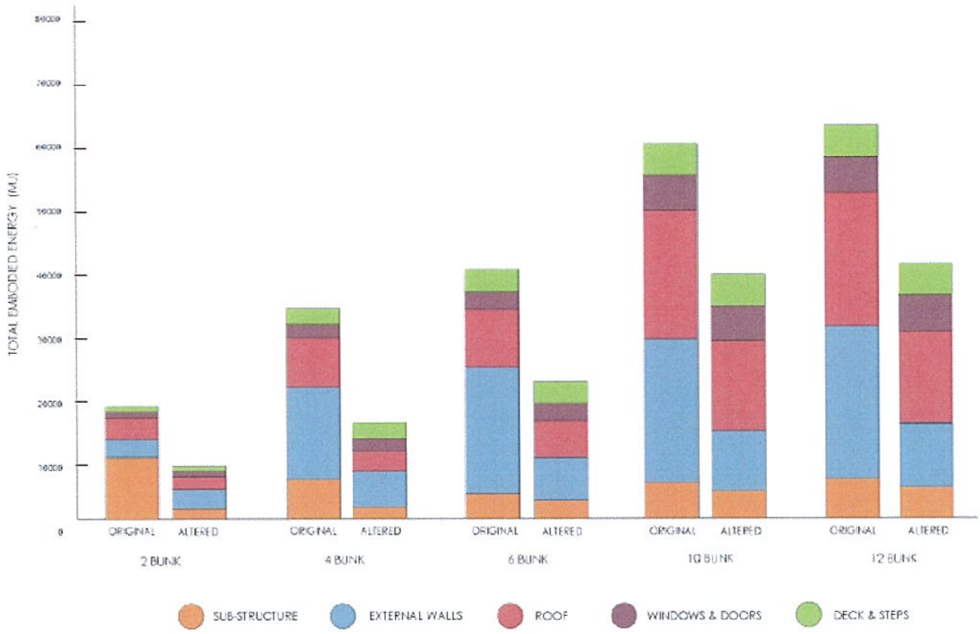
5.0.3 MANUFACTURED TIMBER

Internally, the walls, floor and ceiling are lined with plywood. Plywood is an assembled product comprising thin layers of wood bonded together with the grain usually at right angles. Sheets of plywood are made by applying phenol formaldehyde resin to veneers of predetermined grade in a specific arrangement. These veneers are hot pressed to cure the adhesives and form the plywood panels (Buchanan, A., 2007). Plywood is a more manufactured material than treated timber and therefore its embodied energy value of 10.4 is higher than standard timber with a value of 3.0; the comparison of these materials can be viewed in table 1 (Alcorn, A,. 2001). The plywood flooring in all 5 standardized huts have been replaced with pine tongue and groove flooring. Appropriate alternatives could not be found for the walls and ceiling therefore they were left as they are.

5.0.4 MATERIALS NOT ALTERED

The aluminium window and door joinery have not been replaced with timber frames. Aluminium is the most commonly used framing material in New Zealand as it is light, strong, durable, and requires low maintenance. Although timber would have a significantly lower embodied energy value, is more expensive, less durable, and requires regular maintenance, which would not be an appropriate solution for The Department of Conservation huts. The deck and steps have also obtained their original design and materials, as they are already constructed from timber, and no appropriate alterative could be realised.

GRAPH 4: DIFFERENCE IN TOTAL EMBODIED ENERGY



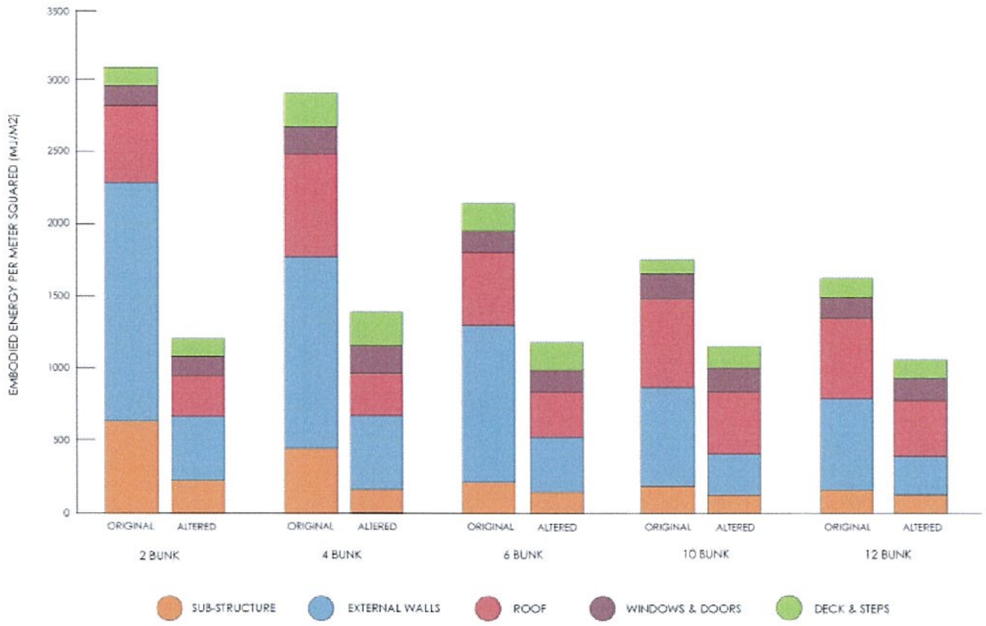
5.1 TOTAL EMBODIED ENERGY

Graph 4 now demonstrates the reduction in total embodied energy that the changes previously described would make. Once again the X-axis shows the hut size and the Y -axis shows the total embodied energy in megajoules. Each hut now has two bars on the graph – the original design and the new improved design.

The reduction in total embodied energy is significant with the two bunks embodied energy reducing by 12,673 MJ (61%), four bunk by 17,813 MJ (54%), six bunk by 17,408 MJ (44.9%), ten bunk by 20,304 MJ (34.8%) and the twelve bunk by 23, 279 MJ (38%). Although a significant reduction in total embodied energy occurs across all five huts, the largest reduction occurs in the two bunk hut closely followed by the four bunk hut. This is due to the fact that initially these two designs incorporated steel floor joists and framing, therefore greater reductions could be achieved.

The largest reduction occurs in the blue sections, i.e. by changing the external wall cladding from Coloursteel to board and batten. The embodied energy of the wall components was reduced by 8140 MJ (73%) for the two bunk hut, 8940 MJ (62%) for the four bunk hut, 12881 MJ (65%) for the six bunk hut, 13045 MJ (58%) for the ten bunk hut, and 13903 MJ (58%) for the twelve bunk hut. Significant reductions in embodied energy were also achieved by replacing the Coloursteel cladding on the roof with a cedar shingles system. The embodied energy for the roofing component for the two bunk hut reduced by 1709 MJ (47%), 4538 MJ (59%) for the four bunk hut, 3382 MJ (37%) for the six bunk, 5996 MJ (29%) for the ten bunk hut, and 6296 MJ (30%) for the twelve bunk.

GRAPH 5: DIFFERENCE IN EMBODIED ENERGY PER METRE SQUARED



5.2 EMBODIED ENERGY PER M²

Graph 5 now demonstrates the reduction in the embodied energy per metre squared when the huts material pallet has been altered. As with the previous graphs the X-axis shows the hut size and the Y-axis shows the total embodied energy per metre squared.

The graph demonstrates that the 4 bunk huts altered design has the highest embodied energy per metre squared with a value of 1391 MJ/m2, followed by the two bunk hut with a value of 1220 MJ/m2, the six bunk hut with a value of 1189 MJ/m2, the ten bunk hut with a value of 1160 MJ/m2 and the twelve bunk hut with a value of 1160 MJ/m2.

The embodied energy per metre squared of the two bunk hut has been reduced by1877MJ/m2, by 1649MJ/m2 for the four bunk hut, by 967 MJ/m2 for the six bunk hut, 620MJ/m2 for the ten bunk hut, and 622 MJ/m2 for the twelve bunk hut. Therefore indicating that the two bunk huts embodied energy per metre squared has had the greatest reduction, however the twelve bunk hut has the lowest embodied energy value per metre squared.

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6

DURABILITY ANALYSIS

Indoor and outdoor cladding materials are subject to deterioration. Weather, use and vandalism can all impact on the useful life of a material or building. This is especially so for The Department of Conservation huts, which are located in difficult to access sites, in extreme weather conditions, and have a high turnover of visitors. Therefore The Department of Conservation has expressed the need to consider the durability of the chosen materials for the huts, and take into account the maintenance that will be required on each. This section of the report compares the durability and maintenance required for the altered hut design against the original design.

6.1 METAL ROOFING & WALL CLADDING

Corrugated, galvanised mild steel has a long history of use in New Zealand and has become a construction icon. Corrosion is the primary issue with metal roofing. New Zealand's vey high atmospheric salt content means that corrosion occurs just about everywhere in the country (Elkink, A., 2008). Mild steel roofing requires protection as it is particularly susceptible to corrosion from atmospheric salts and pollutants. A protective coating acts as a 'sacrificial' metal, that is, it will corrode over time but provide protection to the underneath. Paint may be applied after installation, or as a factory – applied finish that provides a low-maintenance coating until the end of its serviceable life (typically 15 years in severe environments and up to 30 years in mild environments) (Elkink, A., 2008).

6.2 TIMBER SHAKES & SHINGLES

Shingles are sawn to produce a tapering thickness with relatively smooth front and back faces; shakes may be split and tend to have a more highly textured surface than shingles.

When the timber is suitably treated, or naturally durable timber is used, shingles and shakes provide a low maintenance roofing material. The serviceable life depends on the environment. In damp conditions, they made need replacing in 7-10 years, but will last much longer in a drier climate (Elkink, A., 2008).

The timber should be premium or No. 1 grade. Most shakes and shingles available in New Zealand are made from imported western red cedar, a timber popular in North America for its durability, low thermal and moisture movement properties, high strength to weight ratio, and ability to be pressure treated (Elkink, A., 2008).

7

TRANSPORTABILITY

Due to the remote locations the huts are constructed in and the inaccessibility of the sites, helicopters are utilised to transport construction materials, labourers and tools to site. The helicopters are not only expensive to run, but also have a negative impact on the environment as they burn a significant amount of fuel and also cause fly over noise and visual disruption. This section of the report compares the total weights of the original designed huts with the weights of the re-designed huts to better understand the impact in which the transporting of the materials to site will impact the total embodied energy values of the original hut compared to the re-designed hut.

	OPTION ONE	OPTION TWO	OPTION THREE
COLOURSTEEL WALL & ROOF CLADDING	Re-paint after 15 years, every 7 years thereafter. Blast clean at 40 years. Replace at 50 years	Blast clean/repaint after 15 years. Re-paint at 10 year intervils. Replace at 50 years	Hose down every year. do not re-paint. replace at 40 years.
ROOFING SHINGLES	Replace and paint cracked shingles after 10 years, then every 10 years. Replace after 70 years.	Replace cracked tiles after 5 years, then ever 10 years. Replace after 40 years.	Replace cracked shingles after 10 years only. no other maintenance. Re-
BOARD & BATTEN WALL CLADDING	Standard acrylic 2 coats every 7 years. Replace at 50 years	No coating, no maintenance. Replace at 30 years	N/A

(BRANZ, 1997)

TABLE 2: LIFE EXPECTANCY AND MAINTENANCE REQUIREMENT OF EXTERNAL CLADDINGS

6.3 BOARD & BATTEN CLADDING

Vertical board and batten as a cladding material in New Zealand is tried and true, reaching back to the early days of settlement. The 12 inch wide boards in native timbers are no longer available in New Zealand, but H3.2 – treated radiate pine boards are a good substitute as they are versatile, can be left to weather naturaly, can be painted, are easily worked, come in a large varaity or sizes and it is a system which is well known to builders and trades people (Conder, T., 2004).

6.4 DURABILITY RESULTS

Table 2 compares the durability and maintenance requirements of the external cladding materials of both the original and altered hut designs. The table demonstrates that with different levels of maintenance, each cladding material has a prolonged life expectancy.

Roof Cladding: Altering the roof cladding can extend the life expectancy of the roof, from 50 years achieved by the Coloursteel, to 70 years achieved by the cedar shingles. In order to achieve this life span maintenance and painting is required every 10 years in comparison to Coloursteel which would require maintenance after 15 years and then every 7 years thereafter. In the 70 year life span of the cedar shingle roof it would need theoretically need maintenance 7 times, and 5 times in its 50 year life span, therefore indicating that it requires less maintenance than a Coloursteel roof system which would need maintenance 6 times within its 50 year life span.

Wall Cladding: With maximum maintenance, both the Coloursteel wall cladding and board and batten wall cladding have a life expectancy of 50 years. However, within this time frame the board and batten cladding would need two additional doses of maintenance as this is required every 7 years, as opposed to the Coloursteel which can go for the first 15 years without maintenance before needing it every 7 years thereafter. At minimum Coloursteel cladding requires to be hosed down once a year, reducing the maintenance but also reducing the life expectancy of the material to 40 years. The board and batten cladding, if desired can be left unmaintained, however, significantly reducing its life expectancy to 30 years.

8

COST COMPARISON

The Department of Conservation are a government organisation and therefore budget restraints do occur. The building, maintaining and operating of the huts throughout New Zealand can be a costly venture due to the remote locations these buildings are constructed in, therefore, a cost analysis is an important process to undertake.

	2 BUNK		4 BUNK		6 BUNK		10 BUNK		12 BUNK	
	ORIGINAL	ALTERED	ORIGINAL	ALTERED	ORIGINAL	ALTERED	ORIGINAL	ALTERED	ORIGINAL	ALTERED
SUB-STRUCTURE	447	579	378	462	576	524	1120	1009	1218	1180
EXTERNAL WALLS	325	487	1153	1170	1512	1830	2007	2317	2149	2500
ROOF	135	297	2000	2100	2300	2514	2500	2922	2600	3100
WINDOWS & DOORS	53	53	121	121	160	160	324	324	324	324
DECK & STEPS	88	88	456	456	582	582	892	892	892	892
TOTAL (KILOGRAMS)	1048	1504	4108.4	4309	5130	5610	6842	7464	7225	7996
TOTAL (TONNES)	1.05	1.5	4.11	4.3	5.13	5.3	6.84	6.94	7.23	8.41

TABLE 3: WEIGHT COMPARISON OF ORIGINAL DESIGN AGAINST ALTERED DESIGN (KILOGRAMS)

	ORIGINAL DESIGN	ALTERED DESIGN
2 BUNK	1	1
4 BUNK	4	4
6 BUNK	5	5
10 BUNK	6	7
12 BUNK	7	7

TABLE 4: HELICOPTER TRIPS COMPARISON OF ORIGINAL DESIGN AGAINST ALTERED DESIGN

The weights of all five of the re-designed huts are larger than the weights of the original designed huts; this is because the Coloursteel cladding, and steel framing – which is reasonably light, has been replaced with timber – which is a heavier material. The re-design of the five standardized huts has caused a weight increase to the two bunk hut of 456Kg, 201Kg to the four bunk hut, 480Kg to the six bunk hut, 633Kg to the ten bunk hut, and 771Kg to the twelve bunk hut. These results can be viewed in table 3 above.

As no sites have been specified for this research, and the sites and locations that the huts will be built in will vary considerably when constructing them throughout New Zealand, it makes it difficult to determine the fuel consumption of the helicopter to transport the huts materials to site. Information regarding the total weight that helicopters can lift has been obtained from Dion Matheson, a helicopter pilot for The Department of Conservation. From this information the number of trips the helicopter will need to take to transport the huts materials to site can be calculated and therefore indicate which designs consume the least fuel, and reduce flyover disturbance.

A Squirrel B3 can lift the greatest weight –1160 Kg; therefore by dividing the total weight of each hut by this figure the number of trips the helicopter will need to take to delivered the materials to site can be calculated (Matheson, D., 2010). As table 4 above demonstrates, the increased weights of the re-designed huts have had minimal effect on the number of trip which would be required to get the building materials to site. The 10 bunk hut is the only size which has been affected, which the re-design needing 7 trips in comparison to the original designs 6 trips.

	2 BUNK		4 BUNK		6 BUNK		10 BUNK		12 BUNK	
	ORIGINAL	ALTERED	ORIGINAL	ALTERED	ORIGINAL	ALTERED	ORIGINAL	ALTERED	ORIGINAL	ALTERED
SUB-STRUCTURE	$8167	$5653	$4437	$5356	$6954	$8445	$11,028	$14,168	$11,617	$15,244
EXTERNAL WALLS	$4412	$7571	$10,601	$18,302	$13,595	$24,907	$17,366	$28,853	$18,327	$31,418
ROOF	$4619	$3601	$5989	$9326	$7795	$12,440	$18,480	$21,427	$18,937	$27,521
WINDOWS & DOORS	$4033	$4033	$5171	$5171	$5870	$5870	$10,957	$10,957	$10,957	$10,957
DECK & STEPS	$1796	$1796	$6722	$6722	$8755	$8755	$12,296	$12,296	$12,588	$12,588
TOTAL	$23,027	$22,654	$32,920	$44,877	$42,969	$60,417	$70,127	$87,701	$72,426	$97,728

TABLE 5: COST COMPARISON OF ORIGINAL DESIGN AGAINST ALTERED DESIGN (KILOGRAMS)

The total cost of the construction materials of the original standardized hut designs have been compared against the total cost of the construction materials of the re-designed huts. The costs have been broken down into the main components which make up the huts – sub-structure, external walls, roof, windows and doors, and deck and steps; so that the main contributors to the total cost can be recognised. The results show (excluding the 2bunk hut) that the re-designed huts materials are more expensive than those of the original hut design. The results are presented in table 5 above.

By altering the design the four bunk hut has reduced in cost by $373.00 (1.6%). Although the re-design has increased the wall cladding costs by $3500, reductions have be achieved through replacing the steel floor joists with timber, saving $3211. Reductions have also been achieved in the re-design of the roof, saving $168 by replacing the steel rafters with timber. The remainder of reductions is made up through the reduced cost of fixings in the re-designed hut.

The re-design of the four bunk hut has increased the estimated cost of the building by $11,956 (26%). Contributing to the cost increase is the tongue and groove flooring which has been specified in the re-design, increasing the price by $920. The board and batten cladding on the redesigned hut has significantly increased the price by $8607. As has the cedar shingle roofing tiles; increasing the roof cladding price by $3700.

The six bunk hut's estimated price has raised $17,448 (29%) when re-designed. As with the two and four bunk huts, the major contributors to this price increase is through replacing the Coloursteel cladding with board and batten, this has increased the price by $10,460. By applying a cedar shingle roofing system to the re-designed hut the price has increased $4315. The tongue and groove flooring specified in the re-design has also increased the price by $1481.

The ten bunk huts estimated price has raised $17,574 (20%). This is a lesser percentage increase than the four and six bunk huts, however still significant. The use of board and batten external wall cladding has increased the price by $9567, by replacing the roof cladding to cedar shingles the price increases by $11,813.

The twelve bunk huts estimated price has also raised also, $25,302 (26%). As with the previous huts, the main contributors to the price increase were the board and batten wall cladding, with a significant price increase of $12,657, and the cedar roof cladding, with an increase of $3008.

By re-designing the huts with more environmentally concious materials, a significant price increase has occured, ranging from $17,448 to $25,302. The main contributors to this price increase, over all of the huts was from the tongue and groove internal flooring, the board and batten external wall cladding, and the cedar shingle roof cladding

The immense strain that the building and construction industry has put on the natural environment is immense. Globally 40 per cent of all greenhouse gas emissions come from building construction and operation, and 40 per cent of total waste results from construction and demolition activities (UNEP, 2007). This is especially troubling for New Zealand as the environment is central to the kiwi way of life. The careful stewardship of our natural landscapes and resources is also important: both tourism and our primary production sectors rely on New Zealand's 'clean green' reputation internationally (Ministry for the environment, 2007).

As The Department of Conservation own and manage over 1000 huts throughout New Zealand's natural landscape,and hut continue to be constructed, it is important that these buildings scar the environment as little as possible.

The aim of this research was to determine the negative impact created by new Department of Conservation huts so that alterations can be suggested to the material palette, to reduce the negative impact that these buildings pose. The embodied energy calculations conducted on the original designs indicated that the larger the size of the hut the larger the embodied energy value, therefore placing a larger negative impact on the environment. This is because a larger amount of materials is required to construct a larger building. However when calculating the embodied energy per square metre, the larger 12 bunk hut has the lowest embodied energy value and the smaller two bunk hut has the highest value. Therefore indicating that the initial outlay of embodied energy is high, but decreases per square meter as additional area is added. The calculation results indicated that the roof and walls contributed the highest percentage to the total embodied energy of each hut, this is because the Coloursteel used to clad each of these components has a high embodied energy coefficient. The components of each hut which contributed the least to the total embodied energy value was those constructed of timber, such as the sub-structure.

From these initial results alterations could be suggested which would reduce the total embodied energy for each of the huts. These changes focused on replacing highly manufactured materials such as steel, fibreglass insulation and plywood with less processed, natural materials. The Coloursteel external wall cladding was replaced with a board and batten cladding system, the Coloursteel roofing

9

CONCLUSION

New Zealand is as beautiful as
beauty is in the world

10

BIBLIOGRAPHY

The natural environment is important to all New Zealanders, socially, culturally, spiritually and economically was replaced with a cedar shingle roofing system, the internal plywood flooring was replaced with pine tongue and groove flooring and any steel framing was replaced to timber framing. These changes produced significant results, with total embodied energy reductions ranging from 34% to 61%. The altered hut design results indicated that the hut with the highest embodied energy per metre squared was now the four bunk hut, however the twelve bunk hut retained the lowest embodied energy value per metre squared.

Although these embodied energy reductions are significant there were additional characteristics which needed to be considered. These included the durability of the altered materials, the transportability of the materials and the cost. The durability analysis determined that the use of a cedar shingle roof system could potentially increase the roofs life span, and decrease the required maintenance. By cladding the walls with a more environmentally conscious cladding the life expectancy of the material stays the same, however would require one extra dose of maintenance. The life expectancy of the insulation and internal flooring was unchanged. The transportability analysis concluded that the altered design was heavier than the original design; however (excluding the 10 bunk hut) this did not affect the number of loads which would be required in order to transport each of the huts to site. Therefore not posing any problems associated with fuel excessive fuel consumption and fly over disturbance. The final characteristic analysed was the cost. The results proved that the altered design was significantly more expensive than the original design, with price increases ranging from $17,448 to $25,302.

Through the embodied energy study conducted on The Department of Conservation huts, significant reductions in embodied energy values were achieved, thus reducing the negative impact these buildings could have on the environment. Due to the alterations suggested, the price of the materials to construct the huts has increased. However it must be highlighted that not all of the changes suggested would have to be implemented if it was not financially plausible. The information produced could not only be used to inform new hut builds, but could also be used to aid in material selection when individual alterations are being performed, or maintenance is being undertaken, therefore the price increase would not have such a significant impact, but environmentally conscious descisions could still be achieved.

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APPENDIX

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Material	MJ /	MJ / m³	g CO_2 / kg	kg CO_2	Imported	
					MJ/kg	g CO_2/kg
Copper, sheet	97.6	872924	7738	69173		
rod, wire	92.5	827316	7477	66844		
recycled, tube	2.4	21217	112	1002		
Glass, float, tint	15.9	40039	1735	3904	12.7	1500
laminated	16.3	41112	1743	4391	12.7	1500
toughened	26.4	66605	1918	4834	12.7	1500
Gypsum plaster	3.6		218		3.6	218
plaster board	7.4	7080	421	404	3.6	218
HDPE	51	48166	3447	3257	45.6	3440
Insulation, cellulose	4.3	146	140	4.7		
fibreglass	32.1	1026	770	24.6		
polystyrene	44.3	1064	2495	59.9	52.9	2495
LDPE	38.1	114	3540	3186	37.7	3533
MDF	11.9	8213	-1286	-392	0.6	42.1
Polystyrene, expanded	44.3	1419	2495	79.8	52.9	2495
PVC, extruded	60.9	80944	4349	5784	60.9	4349
Sand	0.1	232	6.9	15.9		
Steel, virgin, structural	31.3	245757	1242	9749	30	1148
recycled, reinf, sections	8.6	67144	352	2766	1.6	87.5
recycled, wire	12.3	96544	526	4129	1.5	82.9
stainless	74.8	613535	5457	44747	68.3	5105
					MJ/m³	g CO_2/m³
Timber, pine, air dried, rough-sawn, untreated	2.8	1179	-1665	-699	0.6	43.5
pine, air dri, rough, treat	3.0	1252	-1657	-696	62.5	3288
pine, air dried, dressed	3.0	1273	-1662	-698	0.6	43.5
pine, gas dried, dressed	9.5	3998	-1349	-567	0.6	43.5
pine, bio dried, dressed	4.1	1732	-1644	-690	0.6	43.5
pine, gas dried, dressed	9.7	4060	-1342	-564	62.5	3288
glulam	13.6	5727	-1141	-479	954.6	50042

Embodied Energy and CO_2 Coefficients of New Zealand Building Materials

Material	MJ /	MJ / m^3	g CO_2 / kg	kg CO_2	Imported	
					MJ/kg	g CO_2/kg
Aggregate, general	0.04	65.0	2.3	3.5		
river	0.03	46.7	1.6	2.4		
virgin rock	0.06	83.3	3.1	4.6		
Aluminium, virgin	192	517185	8000	21600	57.9	4294
extruded	202	544685	8346	22533	57.9	4294
extruded, anodised	226	611224	9359	25270	57.9	4294
extruded, powder coat	218	587940	9205	24855	57.9	4294
Aluminium, recycled	9	24397	622	1679		
extruded	14.6	39318	721	1946		
extruded, anodised	23.8	64340	887	2393		
extruded, powder coat	15.2	40928	731	1975		
Asphalt (paving)	0.2	335	14.6	22.7		
Bitumen (feedstock)	2.4	2475	171	176		
Bitumen (fuel)	44.3	45632	3020	3110		
Cellulose pulp	19.6	1057	612	33		
Cement, average	6.2	12005	994	1939	0.2	14.5
dry	5.8	11393	967	1885	0.2	10.9
wet	6.5	12594	1021	1990	0.3	17.9
Cement fibre board	9.4	13286	629	894		
Ceramic brick, new tech.	2.7	5310	138	271		
brick, old tech, av.	6.7	13188	518	1021		
brick, old tech, coal	7.6	14885	684	1348		
brick, old tech, gas	5.8	11491	353	695		
Clay	0.07	69	4.7	4.7		
Concrete, block	0.9	13.9/unit	106	1.6/unit		
block fill	1.2	2728	162	357.2		
precast double T	1.9	4546	214	526		
17.5 MPa	1	2242	120	282		
30 MPa	1.3	2988	164.7	390		
40 MPa	1.5	3512	195	466		

TWO BUNK HUT ALTERED DESIGN RESULTS

	Quantity	Weight	Coefficient	EE	
SUBSTRUCTURE - FLOOR					
Framing					
Ezi Yaka Lightfoot	8 no		N/A		
125x125 H5 pile - based on 900mm	8 no	42.69	3	128.07	pine, air dried, rough, treated
150x100 H5 bearers	9.0 m	68.31	3	204.93	pine, air dried, rough, treated
100 x 75 floor joists	32.00 m	121.44	3	364.32	pine, air dried, rough, treated
100x50 H3.2 blocks	5.00 m	12.65	3	37.95	pine, air dried, rough, treated
Flooring					
150 x 25mm Pine 180 flooring	7.0 m2	11.07	3	33.21	pine, air dried, dressed
Insulation					
55mm Expol expanded polystyrene insulation	7.00m2	6.16	44.3	272.888	Polystyrene expanded
Fixings					
12dia x 350mm proprietary stainless steel pin	6.00 no	0.006	74.8	0.4488	Stainless steel
50 dia stainless steel washer	6.00 no	0.252	74.8	18.8496	Stainless steel
PB2 timberlink conectors	28.00 no	3.416	N/A		
Jolthead nails	500.00 no	5.0	34.8	174	galvanised steel
M12x160 galv eng bolts	6.0 no	1.0668	34.8	37.12464	galvanised steel
M12x120 galv eng bolts	12.00 no	1.3776	34.8	47.94048	galvanised steel
M12x25 galv eng bolts	12.00 no	0.4032	34.8	14.03136	galvanised steel
50x50x3 galv washers	60.00 no	3.156	34.8	109.8288	galvanised steel
100 dpc	1.4m		N/A		galvanised steel
12g tek screws	460.00 no	2.43	34.8	84.564	galvanised steel
proprietary expol fixing clips	108.00 no	0.11	N/A		
100x100x6 steel angle 200mm long	8.00 no		N/A		
				1528.156	
EXTERNAL WALLS					
Framing					
100x50 H3.2 wall framing	117.00m	296.01	3	888.03	pine, air dried, rough, treated
External Cladding/Flashings					
200x25 board/batten cladding	21.00m2	53.13	3	159.39	pine, air dried, rough, treated
200x75x0.55 BMT colourstee1 eaves flashing	12.0m	10.85	34.8	377.58	galvanised steel
90x90x0.55 BMT colourstee1 external corner flashing	6.00m	3.25	34.8	113.1	galvanised steel
130x0.55 BMT colourstee1 window/door head flashing	3.00m	1.76	34.8	61.248	galvanised steel
Insulation					
Bitumous 660 building wrap	20.00m2	4.83	2	9.66	kraft
R2.2 Terra Lana Wool Insul	18.00m2	20.16	14.6	294.336	woolen insulation
Internal Linings/Trim					
9mm Ecoply untreated CD grad lining	18.00m2	90	10.4	936	plywood
30x12 untreated single bevelled skirting	10.00m	2.43	3	7.29	pine, air dried, dressed
Fixings					
12g tek screws	500.00 no	2.53	34.8	88.044	galvanised steel
8g tek screws	710.00 no	2.84	34.8	98.832	galvanised steel
Strapping tape	95.90 m		N/A		
				3033.51	
ROOF					
Framing					
150x75mm rafters	18.00 m	102.47	3	307.41	pine, air dried, rough, treated
Roof Cladding/Flashings					
12mm H3.2 ply sarking	10.00 m2	67	10.4	696.8	plywood
Pine shingle roofing	10.00 m2	50.6	9	455.4	Timber, shingles
50x50x0.75 m.a end flashing	6.00 m	5.69	3	17.07	pine, air dried, rough, treated
Insulation					
Flamestop 660 building paper	10.00 m2	2.1	2	4.2	kraft
R3.4 Terra Lana Wool Insul	9.00 m2	10.08	14.6	147.168	woolen insul
Internal Linings/Trim					
9mm Ecoply untreated CD grade lining	6.00 m2	40	10.4	416	plywood
50x50x0.75 m.a roof/wall flashing	14.00 m	13.28	3	39.84	pine, air dried, rough, treated
30x12 untreated bevel cornice	12.00 m	2.91	3	8.73	pine, air dried, dressed
Fixings					
Roofing nails 75mm	178.00 no	1.008	34.8	35.0784	galvanised steel
12g tek screws	110.00 no	0.55	34.8	19.14	galvanised steel
8g tek screws	400.00 no	1.6	34.8	55.68	galvanised steel
Rivet fixings	40.00 no	0.048	34.8	1.6704	galvanised steel
Strapping Tape	18.00 m		N/A		
				2204.187	
WINDOWS AND EXTERIOR DOORS					
Windows - 40mm Commercial Series					
Window 620x620 with one opening sash and 20mm H3.2 reveals	1.0 no	8.891	15.9	141.3669	glass, float
Window 640x470 with one opening sash and 20mm H3.2 reveals	1.00 no	8.745	15.9	139.0455	glass, float
Doors - 50mm Commercial Series					
Single door 810x1980 with 20mm H3.2 reveals	1.00 no	26.553	15.9	422.1927	glass, float
Flashing/Trim					
155x0.55BMT colourstee1 head flashing	2.10 m	1.47	34.8	51.156	galvanised steel
195x0.55 BMT colourstee1 sill flashing	1.40 m	1.23	34.8	42.804	galvanised steel
125x0.55 BMT colourstee1 jamb flashing	6.10 m	3.45	34.8	120.06	galvanised steel
75x50x6mm galv angle door threshold	0.60 m		34.8	0	galvanised steel
30x12 untreated bevelled timber architrave	6.90 m	2.16	2.8	6.048	pine, air dried, dressed
Fixings					
12g tek screws	45.00 no	0.225	34.8	7.83	galvanised steel
Rivet fixings	76.00 no	0.09	34.8	3.132	galvanised steel
200mm wide Protecto flashing tape	11.00 m		N/A		
Fosroc foamtak SB air seal	10.00 m		N/A		
PEF backing rod	10.00 m		N/A		
				933.6351	
DECK AND STEPS					
Framing					
Step pad	2.00 no		N/A		
Ezi Yaka Lightfoot	2.00 no		N/A		
125x125 H5 pile - based on 900mm	2.00 no	14.23	3	42.69	Pine, air dried, rough, treated
100x75 H3.2 bearers	3.00 m	11.39	3	34.17	Pine, air dried, rough, treated
100x50 H3.2 deck joists	6.00 m	15.18	3	45.54	Pine, air dried, rough, treated
100x50 H3.2 stringer	3.00 m	7.59	3	22.77	Pine, air dried, rough, treated
250x50 H3.2 step stringer	3.00 m	18.98	3	56.94	Pine, air dried, rough, treated
Decking/Steps/Trim					
100x40 H3.2 griptread decking	2.00 no	4.05	3	12.15	Pine, airdried, rough, treated
Webforge 1200 TA/A406MSG treads	2.00 no		N/A		
Fixings					
12dia x 350mm proprietary stainless steel pin	2.00 no	0.62	74.8	46.376	Stainless steel
50 dia stainless steel washer	2.00 no	0.103	74.8	7.7044	Stainless steel
PB2 timberlink conectors	4.00 no	0.488	N/A		
Jolthead nails	92.00 no	0.92	34.8	32.016	galvanised steel
Deck screws	48.00 no	0.2688	34.8	9.35424	galvanised steel
3195 step/pad bracket	2.00 no	6	34.8	208.8	galvanised steel
3175 step/joist bracket	2.00 no	5	34.8	174	galvanised steel
M12x190 galv eng bolts	3.00 no	0.5334	34.8	18.56232	galvanised steel
M12x 120 galv eng bolts	12.00 no	1.3776	34.8	47.94048	galvanised steel
50x50x3 galv washers	18.00 no	0.9468	34.8	32.94864	galvanised steel
stainless steel joist hangers	8.00 no	0.678	74.8	50.7144	Stainless steel
				842.6765	
TOTAL				8542.164	

TWO BUNK HUT ORIGINAL RESULTS

	Quantity	Weight	Coefficient	EE	
SUBSTRUCTURE - FLOOR					
Framing					
Ezi Yaka Lightfoot	8.00 no		N/A		
125x125 H5 pile - based on 900mm	6.00 no	42.69	3	128.07	pine, air dried, rough, treated
150x100 H5 bearers	9.00 m	68.31	3	204.93	pine, air dried, rough, treated
100 steel floor joists	32.00 m	251.2	31.3	7862.56	steel, virgin, structural
100x50 H3.2 blocks	5.00 m	12.65	3	37.95	pine, air dried, rough, treated
Flooring					
12mm H3 Ecoply plywood flooring	7.00m²	46.9	10.4	487.76	plywood
Insulation					
55mm Expol expanded polstyrene insulation	7.00m²	6.16	44.3	272.888	polystyrene
Fixings					
12dia x 350mm proprietary stainless steel pin	8.00 no	1.86	74.8	139.128	stainless steel
50 dia stainless steel washer	8.00 no	0.31	74.8	23.188	stainless steel
PB2 timberlink connectors	28.00 no	3.416	N/A		
Jolthead nails	392.00 no	3.92	34.8	136.416	galvanised steel
M12x160 galv eng bolts	6.00 no	1.02	34.8	35.496	galvanised steel
M12x120 galv eng bolts	12.00 no	1.4	34.8	48.72	galvanised steel
M12x25 galv eng bolts	12.00 no	0.4	34.8	13.92	galvanised steel
50x50x3 galv washers	60.00 no	3.156	34.8	109.8288	galvanised steel
100 dpc	1.40 m		N/A		
12g tek screws	315.00 no	1.575	34.8	54.81	galvanised steel
proprietary expol fixing clips	106.00 no	0.11	N/A		
100x100x9 steel angle 200mm long	6.00 no	1.83	31.3	57.279	steel, virgin, structural
				9612.9438	
EXTERNAL WALLS					
Framing					
90x40 0.55 steel studs	117.00 m	80.8	31.3	2529.04	steel, virgin, structural
External Cladding/Flashings					
Coloursteel corrugated vertical wall cladding	21.00 m²	94.92	34.8	3303.216	galvanised steel
150x20x0.55 BMT coloursteel base closure flashing	10.00 m	6.78	34.8	235.944	galvanised steel
200x76x0.55 BMT coloursteel eaves flashing	12.00 m	10.85	34.8	377.58	galvanised steel
90x90x0.55 BMT coloursteel external corner flashing	6.00 m	3.25	34.8	113.1	galvanised steel
150x150x0.55 BMT coloursteel external corner flashing	6.00 m	5.42	34.8	188.616	galvanised steel
76x100x0.55 BMT coloursteel cover flashing	1.00 m	0.45	34.8	15.66	galvanised steel
130x0.55 BMT coloursteel J flashing	2.00 m	1.18	34.8	41.064	galvanised steel
Insulation					
Sisalmus 680 building wrap	23.00 m²	4.83	2	9.66	kraft
R2.2 fibreglass insulation	18.00 m²	20.16	32.1	647.136	insulation, fibreglass
Internal Linings/Trim					
9mm Ecoply untreated CD grade lining	18.00 m²	90	10.4	936	plywood
19x12 untreated single bevelled skirting	10.00 m	2.43	3	7.29	pine, air dried, dressed
Fixings					
12g tek screws	509.00 no	2.53	34.8	88.044	galvanised steel
9g tek screws	324.00 no	1.296	34.8	45.1008	galvanised steel
Rivet fixings	118.00 no	0.1416	34.8	4.92768	galvanised steel
5mm Thermal B	76.90 m		N/A		
Strapping tape	95.90 m		N/A		
				6017.33848	
ROOF					
Framing					
150x0.95mm steel top hat rafters	16.00 m	20.14	31.3	630.382	steel, virgin, structural
Roof Cladding/Flashings					
Coloursteel corrugated roof cladding	10.00m²	45.2	34.8	1572.96	galvanised steel
200x150x0.55 BMT coloursteel barge flashing	7.00 m	6.33	34.8	220.284	galvanised steel
0.55 BMT coloursteel ridge ridge flashing	3.00 m	0.68	34.8	23.664	galvanised steel
50x50x0.75 m.s end flashing	6.00 m	1.36	34.8	47.328	galvanised steel
Insulation					
Flamestop 680 building paper	10.00 m²	2.1	2	4.2	kraft
R2.6 fibreglass ceiling insulation	9.00 m²	10.08	32.1	323.568	insulation, fibreglass
Internal Linings/Trim					
9mm Ecoply untreated CD grade lining	8.00m²	40	10.4	416	plywood
75x50x0.75 m.s [illegible] flashing	14.00 m	3.16	34.8	109.968	galvanised steel
40x12 untreated bevel cornice	12.00 m	2.91	2.8	8.148	pine, air dried, dressed
Fixings					
Nuway nails	126.00 no	0.882	34.8	30.6936	galvanised steel
12g tek screws	110.00 no	0.55	34.8	19.14	galvanised steel
9g tek screws	274.00 no	1.096	34.8	38.1408	galvanised steel
Rivet fixings	40.00 no	0.048	34.8	1.6704	galvanised steel
5mm Thermal B	18.00 m		N/A		
Proprietary foam baffle	8.00 m		N/A		
Strapping Tape	16.00 m		N/A		
				3446.1468	
WINDOWS AND EXTERIOR DOORS					
Windows - 40mm Commercial Series					
Window 820x520 with one opening sash and 20mm H3.2 reveals	1.00 no	8.891	15.9	141.3669	glass, float
Window 840x470 with one opening sash and 20mm H3.2 reveals	1.00 no	8.745	15.9	139.0455	glass, float
Doors - 60mm Commercial Series					
Single door 810x1965 with 20mm H3.2 reveals	1.00 no	26.553	15.9	422.1927	glass, float
Flashing/Trim					
150x0.55 BMT coloursteel head flashing	2.10 m	1.47	34.8	51.156	galvanised steel
195x0.55 BMT coloursteel sill flashing	1.40 m	1.23	34.8	42.804	galvanised steel
125x0.55 BMT coloursteel jamb flashing	8.10 m	3.45	34.8	120.06	galvanised steel
75x50x5mm galv angle door threshold	0.60 m		N/A		
40x12 untreated bevelled timber architrave	8.90 m	2.16	2.8	6.048	pine, air dried, dressed
Fixings					
12g tek screws	45.00 no	0.225	34.8	7.83	
Rivet fixings	75.00 no	0.09	34.8	3.132	galvanised steel
200mm wide Protecto flashing tape	11.00 m		N/A		
Fosroc fozstak SB air seal	10.00 m		N/A		
PEF backing rod	10.00 m		N/A		
				933.6151	
DECK AND STEPS					
Framing					
Step pad	2.00 no		N/A		
Ezi Yaka Lightfoot	2.00 no		N/A		
125x125 H5 pile - based on 900mm	2.00 no	14.23	3	42.69	pine, air dried, rough, treated
100x75 H3.2 bearers	3.00 m	11.39	3	34.17	pine, air dried, rough, treated
100x50 H3.2 deck joists	8.00 m	15.18	3	45.54	pine, air dried, rough, treated
100x50 H3.2 stringer	3.00 m	7.59	3	22.77	pine, air dried, rough, treated
250x50 H3.2 step stringer	3.00 m	18.98	3	56.94	pine, air dried, rough, treated
Decking/Steps/Trim					
100x40 H3.2 grooved decking	2.00 m²	4.05	3	12.15	pine air dried, rough, treated
Webforge 1200 TA/R405MSG treads	2.00 no		N/A		
Fixings					
12dia x 350mm proprietary stainless steel pin	2.00 no	0.62	74.8	46.376	stainless steel
50 dia stainless steel washer	2.00 no	0.103	74.8	7.7044	stainless steel
PB2 timberlink conectors	4.00 no	0.484	N/A		
Jolthead nails	92.00 no	0.92	34.8	32.016	galvanised steel
Deck screws	48.00 no	0.2688	34.8	9.35424	galvanised steel
6195 step/pad bracket	2.00 no	6	34.8	208.8	galvanised steel
3175 step/joist bracket	2.00 no	5	34.8	174	galvanised steel
M12x190 galv eng bolts	3.00 no	0.5334	34.8	18.56232	galvanised steel
M12x120 galv eng bolts	12.00 no	1.3776	34.8	47.94048	galvanised steel
50x50x3 galv washers	18.00 no	0.9468	34.8	32.94864	galvanised steel
stainless steel joist hangers	6.00 no	0.678	74.8	50.7144	stainless steel
				842.87646	
			TOTAL	29648.74	

FOUR BUNK HUT ALTERED DESIGN RESULTS

	Quantity	Weight	Coefficient	EE	
SUBSTRUCTURE - FLOOR					
Framing					
Ezi Yaka Lightfoot	9.00 no		N/A		
125x125 H5 pile - based on 900mm	9.00 no	64.04	3	192.12	pine, air dried, rough, treated
150x100 H3.2 bearers	9.00 m	68.31	3	204.93	pine, air dried, rough, treated
150x50 H3.2 floor joists	33.00 m	125.235	3	375.705	pine, air dried, rough, treated
100x50 H3.2 blocks	9.00 m	22.77	3	68.31	pine, air dried, rough, treated
Flooring					
150x25mm pine T&G flooring	11.00 m2	20.87	3	62.61	pine, air dried, dressed
Insulation					
55mm Expol expanded polystyrene insulation	11.00 m2	9.68	44.3	428.824	expanded polystyrene
Fixings					
12dia x 350mm proprietary stainless steel pin	9.00 no	2.79	74.6	208.692	stainless steel
50 dia stainless steel washer	9.00 no	0.378	74.6	28.2744	stainless steel
PB2 timberlink conectors	18.00 no	2.196	N/A		
Jolthead nails	476.00 no	4.76	34.8	165.648	galvanised steel
12g tek screws	262.00 no	1.31	34.8	45.588	galvanised steel
proprietary expol fixing clips	90.00 no	0.09	N/A		
EXTERNAL WALLS					
Framing					
100x50 H3.2 wall framing	248.00 m	627.44	3	1882.32	pine, air dried, rough, treated
External Cladding/Flashings					
200x50 board/batten cladding	51.00 m2	258.06	10.4	2683.824	plywood
90x90x0.55 BMT colourstreel external corner back flashing	13.00 m	5.29	34.8	184.092	galvanised steel
130x0.55 BMT colourstreel window/door flashing	3.00 m	1.76	34.8	61.248	galvanised steel
12mm H3.2 wood store wall linings	7.00 m2	42.5	3	127.5	pine, air driedn, rough, treated
Insulation					
Bitumus 869 building wrap	81.00 m2	12.81	2	25.62	kraft
R2.2 Terra Lana wool insul	31.00 m2	34.72	14.6	506.912	woolen insulation
Internal Linings/Trim					
9mm Ecoply untreated CD grad lining	31.00 m2	155	10.4	1612	plywood
10x12 untreated single bevelled skirting	13.00 m	3.16	3	9.48	pine, air dried, dressed
Fixings					
12g tek screws	909.00 no	4.545	34.8	158.166	galvanised steel
8g tek screws	1,018.00 no	4.072	34.8	141.7056	galvanised steel
Strapping tape	211.00 m		N/A		
ROOF					
Framing					
Prowod PLP GL8 H5 90x90 verandah post	3.00 m	12.3	3	36.9	pine, air dried,
150x100 H3.2 verandah beam	2.00 m	15.18	3	45.54	pine, air dried,
Mitek H1.2 covered roof truss	3.00 no				
Mitek H1.2 standard truss	2.00 no				
100x50 H3.2 end purlins	10.00 m	25.3	3	75.9	pine, air dried,
75x50 H3.2 purlins	46.00 m	91.08	3	273.24	pine, air dried,
75x50 H1.2 end plate	6.00 m	15.18	3	45.54	pine, air dried,
75x40 H1.2 ceiling battens	35.00 m	53.13	3	159.39	pine, air dried,
50x50 H3.2 eaves nog	10.00 m	12.65	3	37.95	pine, air dried,
Roof Cladding/Flashings					
12mm H3.2 ply sarking	24.00 m2	160.8	10.4	1672.32	plywood
Pine shingles roofing	24.00 m2	121.44	3	364.32	timber, shingles
150x25 H3.1 fascia/soffit	39.00 m	1.9	3	5.7	pine, air dried, rough, treated
Insulation					
Flamestop 693 building paper	24.00 m2	5.04	2	7.04	kraft
R3.4 Terra Lana wool insul	12.00 m2	13.44	14.6	28.04	woolen insulation
Internal Linings/Trim					
9mm Ecoply untreated CD grade lining	12.00 m2	60	10.4	20.4	plywood
40x12 untreated bevel cornice	14.00 m	3.4	3	6.4	pine, air dried, dressed
Fixings					
M12x220 galv eng bolts	2.00 no	0.3948	34.8	13.73904	galvanised steel
M12x220 stainless steel bolts	3.00 no	0.0591	74.8	4.42068	stainless steel
50x50x3 galv washers	4.00 no	0.2104	34.8	7.32192	galvanised steel
50x50x3 stainless steel washers	6.00 no	0.252	74.8	18.8496	galvanised steel
Roofing nails 75mm	332.00 no	2.656	34.8	92.4288	galvanised steel
Jolthead 100mm	180.00 no	1.8	34.8	62.64	galvanised steel
Jolthead	214.00 no	2.14	34.8	74.472	galvanised steel
12g tek screws	58.00 no	0.29	34.8	10.092	galvanised steel
8g tek screws	351.00 no	1.4	34.8	48.72	galvanised steel
Proprietary foam baffle	10.00 m		N/A		
Strapping tape	48.00 m		N/A		
Wire Dog	100.00 no		N/A		
Strap bracing	13.00 m		N/A		
Skn tensioners	4.00 no		N/A		
WINDOWS AND EXTERIOR DOORS					
Windows - 40mm Commercial Series					
Window 620x1350 with one opening sash and 20mm H3.2 reveals	1.00 no	21.645	15.9	344.1555	glass, float
Window 1250x1350 with one opening sash with screen and 20mm H3.2 reveals	1.00 no	44.675	15.9	710.3325	glass, float
Doors - 50mm Commercial Series					glass, float
Single door 910x1965 with 20mm H3.2 reveals	1.00 no	41.525	15.9	660.2475	
Flashings/Trim					
155x0.55BMT colourstell head flashing	3.00 m	2.1	34.8	73.08	galvanised steel
195x0.55 BMT colourstell sill flashing	2.00 m	1.78	34.8	61.248	galvanised steel
125x0.55 BMT colourstell jamb flashing	10.00 m	5.65	34.8	196.62	galvanised steel
75x50x6mm galv angle door threshold	1.00 m		34.8	0	galvanised steel
40x12 untreated bevelled timber architrave	14.00 m	3.4	2.8	9.52	galvanised steel
Fixings					
12g tek screws	53.00 no	0.265	34.8	9.222	galvanised steel
Rivet fixings	103.00 no	0.1236	34.8	4.30128	galvanised steel
200mm wide Protecto flashing tape	17.00 m		N/A		
Fosroc foamtex 50 air seal	14.00 m		N/A		
PEF backing rod	14.00 m		N/A		
DECK AND STEPS					
Framing					
Step pad	2.00 no		N/A		
Ezi Yaka Lightfoot	7.00 no		N/A		
125x125 H5 pile - based on 900mm	7.00 no	49.81	3	149.43	pine, air dried, rough, treated
150x100 H3.2 bearers	9.00 m	68.31	3	204.93	pine, air dried, rough, treated
150x50 H3.2 deck joists	46.00 m	174.57	3	523.71	pine, air dried, rough, treated
200x50 H3.2 stringer	9.00 m	45.54	3	136.62	pine, air dried, rough, treated
250x50 H3.2 step stringer	3.00 m	18.98	3	56.94	pine, air dried, rough, treated
Decking/Steps/Trim					
100x40 H3.2 griptread decking	12.00 m2	24.29	3	72.87	pine, air dried, rough, treated
Webforge A405MSG galv steel grating	2.00 m2		N/A		
Webforge 1200 TWA405MSG treads	2.00 no		N/A		
100x25 H3.2 rough sawn base boards	34.00 m	43.01	3	129.03	pine, air dried, rough, treated
Fixings					
12dia x 350mm proprietary stainless steel pin	7.00 no	2.17	74.8	162.316	stainless steel
50 dia stainless steel washer	7.00 no	0.3612	74.6	27.01776	stainless steel
PB2 timberlink conectors	14.00 no	1.708	N/A		
Jolheads nails	300.00 no	3	34.8	104.4	galvanised steel
Deck screws	765.00 no	4.2896	34.8	149.2781	galvanised steel
3195 step/pad bracket	2.00 no	6	34.8	208.8	galvanised steel
3175 step/joist bracket	2.00 no	5	34.8	174	galvanised steel
M12x100 galv eng bolts	7.00 no	1.2449	34.8	43.32206	galvanised steel
M12x 120 galv eng bolts	18.00 no	2.0694	34.8	72.01072	galvanised steel
50x50x3 galv washers	38.00 no	1.9988	34.8	69.55824	galvanised steel
Stainless steel joist hangers	25.00 no	3.325	74.8	248.71	galvanised steel
Acess hatch hinges/catch	1.00 no		N/A		

FOUR BUNK HUT ORIGINAL RESULTS

	Quantity	Weight Kg	Coefficient	EE	
SUBSTRUCTURE - FLOOR					
Framing					
Ezi Yaka Lightfoot	9.00 no		N/A		
125x125 H5 pile - based on 900mm	9.00 no	64	3	192	pine, air dried, rough, treated
150x100 H5 bearers	9.00 m	68.3	3	204.9	pine, air dried, rough, treated
100 steel floor joists	33.00 m	125.7	31.1	3918.76	pine, air dried, rough, treated
100x50 H3.2 blocks	9.00 m	22.8	3	68.4	pine, air dried, rough, treated
Flooring					
12mm H3 Ecoply plywood flooring	11.00 m²	73.7	10.4	766.48	plywood
Insulation					
55mm Expol expanded polystyrene insulation	11.00 m²	9.68	44.1	478.824	expanded polystyrene
Fixings					
12dia x 350mm proprietary stainless steel pin	9.00 no	2.79	74.8	208.692	stainless steel
50 dia stainless steel washer	9.00 no	0.378	74.8	28.2744	stainless steel
PB2 timberlink conectors	18.00 no	2.196	N/A		
Jotheads nails	478.00 no	7.46	34.8	259.608	galvanised steel
12g tek screws	220.00 no	1.1	34.8	38.28	galvanised steel
proprietary expol fixing clips	90.00 no	0.05	N/A		
EXTERNAL WALLS					
Framing					
100x50 H3.2 wall framing	248.00 m	627.4	3	1882.2	pine, air dried, rough, treated
External Cladding/Flashings					
Coloursteel corrugated vertical wall cladding	61.00 m²	230.52	34.8	8022.096	galvanised steel
150x20x0.55 BMT coloursteel base closure flashing	18.00 m	12.2	34.8	424.56	galvanised steel
90x90x0.55 BMT coloursteel external corner back flashing	13.00 m	4.29	34.8	149.292	galvanised steel
150x150x0.55 BMT coloursteel external corner flashing	13.00 m	8.81	34.8	306.588	galvanised steel
50x150x0.55 BMT coloursteel cover flashing	3.00 m	2.03	34.8	70.644	galvanised steel
130x0.55 BMT coloursteel J flashing	2.00 m	1.18	34.8	41.064	galvanised steel
Internal "W" corner flashing	3.00 m		N/A		galvanised steel
12mm H3.2 wood store wall lining	7.00 m²	42.5	3	127.5	pine, air dried, rough, treated
Insulation					
Sturnus 850 building wrap	61.00 m²	12.81	2	25.62	kraft
R2.2 fibreglass wall insulation	31.00 m²	34.72	32.1	1114.512	insulation, fibreglass
Internal Linings/Trim					
9mm Ecoply untreated CD grade lining	31.00 m²	155	10.4	1612	plywood
40x12 untreated single bevelled skirting	13.00 m	3.16	3	9.48	pine, air dried, dressed
Fixings					
Nuway nails	253.00 no	1.771	34.8	61.6308	galvanised steel
4g tek screws	1,018.00 no	4.072	34.8	141.7056	galvanised steel
Joltheads	1,250.00 no	12.5	34.8	435	galvanised steel
5mm Thermaz B	211.00 m		N/A		
Strapping tape	211.00 m		N/A		
ROOF					
Framing					
Prowood PLP GL8 H5 90x90 verandah post	3.00 m	12.3	3	36.9	pine, air dried, rough, treated
150x100 H3.2 verandah beam	2.00 m	18.18	3	54.54	pine, air dried, rough, treated
Mitek H1.2 covered roof truss	3.00 no				
Mitek H1.2 standard truss	2.00 no				
100x50 H3.2 end purlin	10.00 m	25.3	3	75.9	pine, air dried, rough, treated
75x50 H3.2 purlins	46.00 m	91.08	3	273.24	pine, air dried, rough, treated
75x50 H1.2 end plate	6.00 m	15.18	3	45.54	pine, air dried, rough, treated
75x40 H1.2 ceiling battens	35.00 m	53.13	3	159.39	pine, air dried, rough, treated
50x50 H3.2 eaves nog	19.00 m	12.65	3	37.95	pine, air dried, rough, treated
Roof Cladding/Flashings					
Coloursteel corrugated roof cladding	24.00 m²	146.4	34.8	5094.72	galvanised steel
200x150x0.55 BMT coloursteel barge flashing	10.00 m	9.04	34.8	314.592	galvanised steel
0.55 BMT coloursteel ridge/ridge flashing	5.00 m	1.24	34.8	43.152	galvanised steel
150x25 H3.1 fascia/soffit	39.00 m	3.4	3	10.2	pine, air dried, rough, treated
Insulation					
Flamestop 680 building paper	24.00 m²	6.24	2	12.48	kraft
R2.6 fibreglass ceiling insulation	12.00 m²	13.44	32.1	431.424	insulation, fibreglass
Internal Linings/Trim					
9mm Ecoply untreated CD grade lining	12.00 m²	80.4	10.4	836.16	plywood
40x12 untreated bevel cornice	14.00 m	3.4	2.8	9.52	pine, air dried, dressed
Fixings					
M12x220 galv eng bolt	2.00 no	0.3948	34.8	13.73904	galvanised steel
M12x220 stainless steel bolts	3.00 no	0.0591	74.8	4.42068	stainless steel
50x50x3 galv washers	4.00 no	0.2104	34.8	7.32192	galvanised steel
50x50x3 stainless steel washers	6.00 no	0.3096	74.8	23.15808	stainless steel
Nuway nails	172.00 no	1.204	34.8	41.8992	galvanised steel
Jolthead 100mm	160.00 no	1.8	34.8	62.64	galvanised steel
Jolthead	214.00 no	2.14	34.8	74.472	galvanised steel
12g tek screws	56.00 no	0.29	34.8	10.092	galvanised steel
4g tek screws	169.00 no	0.756	34.8	26.3088	galvanised steel
Proprietary foam baffle	10.00 m		N/A		
Strapping tape	48.00 m		N/A		
Wire dog	100.00 no		N/A		
Strap bracing	13.00 m		N/A		
Pin tensioners	4.00 no		N/A		
WINDOWS AND EXTERIOR DOORS					
Windows - 48mm Commercial Series					
Window 620x1360 with one opening sash and 20mm H3.2 reveals	1.00 no	21.645	15.9	344.1555	glass, float
Window 1240x1360 with one opening sash with screen and 20mm H3.2 m	1.00 no	44.675	15.9	710.3325	glass, float
Doors - 60mm Commercial Series					
Single door 810x1905 with 20mm H3.2 reveals	1.00 no	41.525	15.9	660.2475	glass, float
Flashing/Trim					
155x0.55BMT coloursteel head flashing	3.00 m	2.1	34.8	73.08	galvanised steel
195x0.55 BMT coloursteel sill flashing	2.00 m	1.76	34.8	61.248	galvanised steel
125x0.55 BMT coloursteel jamb flashing	10.00 m	5.65	34.8	196.62	galvanised steel
76x50x8mm galv angle door threshold	1.00 m		N/A		
40x12 untreated bevelled timber architrave	14.00 m	3.4	2.8	9.52	pine, air dried, dressed
Fixings					
12g tek screws	53.00 no	0.265	34.8	9.222	galvanised steel
Rivet fixings	103.00 no	0.1236	34.8	4.30128	galvanised steel
200mm wide Protecto flashing tape	17.00 m		N/A		
Fosroc foamtak SR air seal	14.00 m		N/A		
PEF backing rod	14.00 m		N/A		
DECK AND STEPS					
Framing					
Slab pad	2.00 no		N/A		
Ezi Yaka Lightfoot	7.00 no		N/A		
125x125 H5 pile - based on 900mm	7.00 no	49.81	3	149.43	pine, air dried, rough, treated
150x100 H3.2 bearers	9.00 m	68.31	3	204.93	pine, air dried, rough, treated
150x50 H3.2 deck joists	46.00 m	174.57	3	523.71	pine, air dried, rough, treated
200x50 H3.2 stringer	9.00 m	45.54	3	136.62	pine, air dried, rough, treated
250x50 H3.2 step stringer	3.00 m	18.98	3	56.94	pine, air dried, rough, treated
Decking/Steps/Trim					
100x40 H3.2 griptread decking	12.00 m²	24.29	3	72.87	pine, air dried, rough, treated
Webforge A405MSG galv steel grating	2.00 m²		N/A		
Webforge 1200 TA/A405MSG treads	2.00 no		N/A		
100x25 H3.2 rough sawn base boards	34.00 m	43.01	3	129.03	pine, air dried, rough, treated
Fixings					
12dia x 350mm proprietary stainless steel pin	7.00 no	2.17	74.8	162.316	stainless steel
50 dia stainless steel washer	7.00 no	0.2943	74.8	22.01176	stainless steel
PB2 timberlink conectors	14.00 no	1.708	N/A		
Jotheads nails	300.00 no	3	34.8	104.4	galvanised steel
Deck screws	788.00 no	4.2896	34.8	149.2781	galvanised steel
B195 step/pad bracket	2.00 no	6	34.8	208.8	galvanised steel
B175 step/post bracket	2.00 no	5	34.8	174	galvanised steel
M12x190 galv eng bolts	7.00 no	1.2445	34.8	43.3170	galvanised steel
M12x 120 galv eng bolts	16.00 no	2.0664	34.8	71.91072	galvanised steel
50x50x3 galv washers	36.00 no	1.9584	34.8	68.15232	galvanised steel
stainless steel joist hangers	25.00 no	3.325	74.8	248.71	galvanised steel
Access hatch hinges/catch	1.00 no		N/A		

SIX BUNK HUT ALTERED DESIGN RESULTS

	quantity	weight kg	coefficinet	EE	
SUBSTRUCTURE - FLOOR					
Framing					
Ezi Yaka Lightfoot	15.00 no		N/A		
125x125 H5 pile - based on 900mm	15.00 no	106.73	3	320.19	pine, air dried, rough, treated
150x100 H3.2 bearers	15.00 m	113.85	3	341.55	pine, air dried, rough, treated
150x50 H3.2 floor joists	44.00 m	166.98	3	500.94	pine, air dried, rough, treated
100x50 H3.2 blocks	15.00 m	37.95	3	113.85	pine, air dried, rough, treated
Flooring					
150x25 Pine T&G flooring	16.00 m2	34.16	3	102.48	pine, air dried, dressed
Insulation					
55mm Expol expanded polystyrene insulation	16.00 m2	15.84	44.3	701.712	expanded polystyrene
Fixings					
12dia x 350mm proprietary stainless steel pin	15.00 no	4.61	74.8	344.828	stainless steel
50 dia stainless steel washer	15.00 no	0.63	74.8	47.124	stainless steel
PB2 timberlink conectors	30.00 no	3.66	N/A		
Jotheads nails	420.00 no	4.2	34.8	146.16	galvanised steel
12g tek screws	378.00 no	1.88	34.8	65.424	galvanised steel
proprietary insrol fixing clips	144.00 no	0.144	34.8	5.0112	galvanised steel
EXTERNAL WALLS					
Framing					
100x50 H3.2 wall framing	319.00 m	807.07	3	2421.21	pine, air dried, rough, treated
External Cladding/Flashings					
200x25 board/batten cladding	82.00 m2	156.86	10.4	1631.344	plywood
90x90x0.55 BMT colourstel external corner back flashing	13.00 m	5.29	34.8	184.092	galvanised steel
130x0.55 BMT colourstel window/door flashing	4.00 m	2.35	34.8	81.78	galvanised steel
Internal "W" corner flashing	3.00 m		N/A		
12mm H3.2 wood store wall lining	7.00 m2	42.5	3	127.5	pine, air dried, rough, treated
Insulation					
Thermus 850 building wrap	73.00 m2	15.33	2	30.66	kraft
R2.2 Terra Lana wool insul	39.00 m2	43.68	14.6	637.728	woolen insulation
Internal Linings/Trim					
9mm Ecoply untreated CD grad lining	39.00 m2	195	10.4	2028	plywood
10x12 untreated single bevelled skirting	17.00 m	4.13	3	12.39	pine, air dried dressed
Fixings					
12g tek screws	909.00 no	4.545	34.8	158.166	galvanised steel
9g tek screws	1,209.00 no	4.837	34.8	168.1536	galvanised steel
Jotheads	1,490.00 no	14.9	34.8	518.52	galvanised steel
Strapping tape	245.00 m		N/A		
ROOF					
Framing					
Prowood PLP GL8 H5 90x90 verandah post	3.00 m	12.3	3	36.9	pine, air dried, rough, treated
150x100 H3.2 verandah beam	2.00 m	15.18	3	45.54	pine, air dried, rough, treated
Mitek H1.2 covered roof truss	5.00 no				
Mitek H1.2 standard truss	2.00 no				
100x50 H3.2 end purlin	10.00 m	25.3	3	75.9	pine, air dried, rough, treated
75x50 H3.2 purlins	64.00 m	121.44	3	364.32	pine, air dried, rough, treated
75x50 H1.2 end plate	8.00 m	15.18	3	45.54	pine, air dried, rough, treated
75x40 H1.2 ceiling battens	53.00 m	80.45	3	241.35	pine, air dried, rough, treated
50x50 H3.2 eaves nog	10.00 m	12.65	3	37.95	pine, air dried, rough, treated
Roof Cladding/Flashings					
12mm H3.2 ply sarking	33.00 m2	221.1	10.4	2299.44	plywood
Pine shingle roofing	33.00 m2	166.98	3	500.94	timber, shingles
150x25 H3.1 facia/soffit	47.00 m	89.18	3	267.54	pine, air dried, rough, treated
Insulation					
Flamestop 850 building paper	33.00 m2	6.93	2	13.86	kraft
R2.2 Terra Lana wool insul	19.00 m2	21.28	14.6	310.688	woolen insulation
Internal Linings/Trim					
9mm Ecoply untreated CD grade lining	19.00 m2	95	10.4	988	plywood
40x12 untreated bevel cornice	15.0 m	4.37	3	13.11	pine, air dried, dressed
Fixings					
M12x229 galv eng bolt	2.00 no	0.3948	34.8	13.73904	galvanised steel
M12x229 stainless steel bolts	3.00 no	0.0591	74.8	4.42068	stainless steel
50x50x3 galv washers	4.00 no	0.2104	34.8	7.32192	galvanised steel
50x50x3 stainless steel washers	6.00 no	0.252	74.8	18.8496	stainless steel
Roofing nails 75mm	439.00 no	3.512	34.8	122.2176	galvanised steel
Jothead 100mm	252.00 no	2.52	34.8	87.696	galvanised steel
Jothead	264.00 no	2.64	34.8	91.872	galvanised steel
12g tek screws	72.00 no	0.36	34.8	12.528	galvanised steel
9g tek screws	535.00 no	2.14	34.8	74.472	galvanised steel
Strapping tape	64.00 m		N/A		
Wire dog	140.00 no		N/A		
Strap bracing	16.00 m		N/A		
4m tensioners	4.00 no		N/A		
WINDOWS AND EXTERIOR DOORS					
Windows - 48mm Commercial Series					
Window 620x1383 with one opening sash and 20mm H3.2 reveals	1.00 no	21.645	15.9	344.1555	glass, float
Window 1240x1383 with one opening sash with screen and 20mm H3.2 reveals	1.00 no	44.675	15.9	710.3325	glass, float
Window 1240x900 with one opening sash with screen & 20mm H3.2 reveals	1.00 no	33.213	15.9	528.0867	glass, float
Doors - 50mm Commercial Series					
Single door 910x1905 with 20mm H3.2 reveals	1.00 no	41.525	15.9	660.2475	glass, float
Flashing/Trim					
150x0.55BMT coloursteel head flashing	4.00 m	2.8	34.8	97.44	galvanised steel
195x0.55 BMT coloursteel sill flashing	4.00 m	3.53	34.8	122.844	galvanised steel
125x0.55 BMT coloursteel jamb flashing	12.00 m	6.78	34.8	235.944	galvanised steel
76x50x5mm galv angle door threshold	1.00 m		N/A		
40x12 untreated bevelled timber architrave	19.00 m	5.6	2.8	15.68	galvanised steel
Fixings					
12g tek screws	73.00 no	0.365	34.8	12.702	galvanised steel
Rivet fixings	145.00 no	0.1752	34.8	6.09696	galvanised steel
200mm wide Protecto flashing tape	21.00 m		N/A		
Fosroc foamtak SB air seal	19.00 m		N/A		
PEF backing rod	19.00 m		N/A		
DECK AND STEPS					
Framing					
Step pad	4.00 no		N/A		
Ezi Yaka Lightfoot	9.00 no		N/A		
125x125 H5 pile - based on 900mm	9.00 no	64.04	3	192.12	pine, air dried, rough, treated
150x100 H3.2 bearers	11.00 m	83.49	3	250.47	pine, air dried, rough, treated
150x50 H3.2 deck joists	57.00 m	216.32	3	648.96	pine, air dried, rough, treated
200x50 H3.2 stringer	11.00 m	55.66	3	166.98	pine, air dried, rough, treated
250x50 H3.2 step stringer	5.00 m	31.63	3	94.89	pine, air dried, rough, treated
Decking/Steps/Trim					
100x40 H3.2 gripthread decking	15.00 m2	30.36	3	91.08	pine, air dried, rough, treated
Webforge A405MSG galv steel grating	2.00 m2			0	
Webforge 1200 TA/A405MSG treads	4.00 no			0	
100x25 H3.2 rough sawn base boards	42.00 m	53.13	3	159.39	pine, air dried, rough, treated
Fixings					
12dia x 350mm proprietary stainless steel pin	9.00 no	2.79	74.8	208.692	stainless steel
50 dia stainless steel washer	9.00 no	0.378	74.8	28.2744	stainless steel
PB2 timberlink conectors	16.00 no	2.196	N/A		
Jotheads nails	438.00 no	4.38	34.8	152.424	galvanised steel
Deck screws	935.00 no	5.2416	34.8	182.40768	galvanised steel
3195 step/pad bracket	4.00 no	12	34.8	417.6	galvanised steel
3176 step/joist bracket	4.00 no	10	34.8	348	galvanised steel
M12x190 galv eng bolts	9.00 no	1.6002	34.8	55.68696	galvanised steel
M12x120 galv eng bolts	33.00 no	3.444	34.8	119.8512	galvanised steel
50x50x3 galv washers	54.00 no	2.8404	34.8	98.84592	galvanised steel
Stainless steel joist hangers	33.00 no	3.39	74.8	253.572	stainless steel
Access hatch hinges/catch	1.00 no		N/A		

SIX BUNK HUT ORIGINAL DESIGN RESULTS

	quantity	weight kg	coeff	EE	
SUBSTRUCTURE - FLOOR					
Framing					
Ezi Yaka Lightfoot	9.00 no		N/A		
125x125 H5 pile - based on 900mm	9.00 no	106	3	318	pine, air dried, rough, treated
150x100 H3.2 bearers	9.00 m	113.85	3	341.55	pine, air dried, rough, treated
150x50 H3.2 floor joists	33.00 m	166.98	3	500.94	pine, air dried, rough, treated
100x50 H3.2 blocks	9.00 m	37.95	3	113.85	pine, air dried, rough, treated
Flooring					
12mm H3 Ecoply plywood flooring	18.00m²	120.6	10.4	1254.24	plywood
Insulation					
55mm Expol expanded polystyrene insulation	18.00m²	15.8	44.3	699.94	expanded polystyrene
Fixings					
12dia x 350mm proprietary stainless steel pin	16.00 no	4.65	74.8	347.82	stainless steel
50 dia stainless steel washer	16.00 no	0.63	74.8	47.124	stainless steel
PB12 timberlink conectors	30.00 no	3.66	N/A		
Joistheads nails	420.00 no	4.2	34.8	146.16	Galvanised steel
12g tek screws	348.00 no	1.73	34.8	60.204	Galvanised steel
proprietary expol fixing clips	144.00 no	0.144	34.8	5.0112	Galvanised steel
EXTERNAL WALLS					
Framing					
100x50 H3.2 wall framing	319.00 m	807.07	3	2421.21	pine, air dried, rough, treated
External Cladding/Flashings					
Colorsteel corrugated vertical wall cladding	82.00 m²	280.24	34.8	9752.352	galvanised steel
150x20x0.55 BMT colourstel base closure flashing	22.00 m	14.92	34.8	519.216	galvanised steel
90x90x0.55 BMT colourstel external corner back flashing	13.00 m	5.29	34.8	184.092	galvanised steel
150x160x0.55 BMT colourstel external corner flashing	13.00 m	8.81	34.8	306.588	galvanised steel
50x150x0.55 BMT colourstel cover flashing	3.00 m	2.03	34.8	70.644	galvanised steel
130x0.55 BMT colourstel J flashing	3.00 m	1.76	34.8	61.248	galvanised steel
Internal "W" corner flashing	3.00 m		N/A		
12mm H3.2 wood store wall lining	7.00 m²	42.5	34.8	1479	pine, air dried, rough, treated
Insulation					
Bitumus 650 building wrap	73.00 m²	18.9	2	37.8	kraft
R2.2 fibreglass wall insulation	39.00 m²	43.68	32.1	1402.128	insulation, fibreglass
Internal Linings/Trim					
9mm Ecoply untreated CD grad lining	39.00 m²	261.3	10.4	2717.52	plywood
40x12 untreated single bevelled skirting	17.00 m	4.13	3	12.39	pine, air dried, dressed
Fixings					
Nuway nails	243.00 no	1.981	34.8	68.9388	galvanised steel
8g tek screws	1,208.00 no	4.837	34.8	168.1536	galvanised steel
Joistheads	1,490.00 no	14.9	34.8	518.52	galvanised steel
5mm Thermax B	242.00 m		N/A		
Strapping tape	248.00 m		N/A		
ROOF					
Framing					
Prowood HLP GL8 H5 90x90 verandah post	3.00 m	12.3	3	36.9	pine, air dried, rough, treated
150x100 H3.2 verandah beam	2.00 m	15.18	3	45.54	pine, air dried, rough, treated
Mitek H1.2 covered roof truss	5.00 no				
Mitek H1.2 standard truss	2.00 no				
100x50 H3.2 end purlin	10.00 m	25.3	3	75.9	pine, air dried, rough, treated
76x50 H3.2 purlins	64.00 m	121.44	3	364.32	pine, air dried, rough, treated
76x50 H1.2 end plate	8.00 m	15.18	3	45.54	pine, air dried, rough, treated
76x40 H1.2 ceiling battens	53.00 m	80.45	3	241.35	pine, air dried, rough, treated
50x50 H3.2 eaves nog	10.00 m	12.65	3	37.95	pine, air dried, rough, treated
Roof Cladding/Flashings					
Colourstel corrugated roof cladding	33.00m²	149.16	34.8	5190.768	galvanised steel
200x150x0.55 BMT colourstel barge flashing	10.00 m	9.04	34.8	314.592	galvanised steel
0.55 BMT colourstel ridge flashing	7.00 m	1.74	34.8	60.552	galvanised steel
150x25 H3.1 fascia/soffit	47.00 m	89.18	3	267.54	pine, air dried, rough, treated
Insulation					
Flamestop 650 building paper	33.00 m²	8.58	2	17.16	kraft
R2.6 fibreglass ceiling insulation	19.00 m²	21.28	32.1	683.088	insulation, fibreglass
Internal Linings/Trim					
9mm Ecoply untreated CD grade lining	19.00m²	127.3	10.4	1323.92	plywood
40x12 untreated bevel cornice	18.00 m	4.37	2.8	12.236	pine, air dried, dressed
Fixings					
M12x220 galv eng bolt	2.00 no	0.3946	34.8	13.73208	galvanised steel
M12x220 stainless steel bolts	3.00 no	0.0591	74.8	4.42068	stainless steel
50x50x3 galv washers	4.00 no	0.2104	34.8	7.32192	galvanised steel
50x50x3 stainless steel washers	6.00 no	0.3096	74.8	23.15808	stainless steel
Nuway nails	225.00 no	1.582	34.8	55.0536	galvanised steel

Joisthead 100mm	252.00 no	2.52	34.8	87.696	galvanised steel
Joisthead	264.00 no	2.64	34.8	91.872	galvanised steel
12g tek screws	72.00 no	0.36	34.8	12.528	galvanised steel
8g tek screws	309.00 no	1.236	34.8	43.0128	galvanised steel
Proprietary foam baffle	14.00 m		N/A		
Strapping tape	64.00 m		N/A		
Wire dog	140.00 no		N/A		
Strap bracing	16.00 m		N/A		
5kN tensioners	4.00 no		N/A		
WINDOWS AND EXTERIOR DOORS					
Windows - 42mm Commercial Series					
Window 820x1380 with one opening sash and 20mm H3.2 reveals	1.00 no	21.645	15.9	344.1555	glass, float
Window 1240x1380 with one opening sash with screen and 20mm H3.2 reveals	1.00 no	44.675	15.9	710.3325	glass, float
Window 1240x900 with one opening sash with screen & 20mm H3.2 reveals	1.00 no	33.213	15.9	528.0867	glass, float
Doors - 60mm Commercial Series					
Single door 910x1965 with 20mm H3.2 reveals	1.00 no	41.525	15.9	660.2475	glass, float
Flashing/Trim					
156x0.55BMT colourstel head flashing	4.00 m	2.8	34.8	97.44	galvanised steel
196x0.55 BMT colourstel sill flashing	4.00 m	3.51	34.8	122.148	galvanised steel
125x0.55 BMT colourstel jamb flashing	12.00 m	6.78	34.8	235.944	galvanised steel
75x50x6mm galv angle door threshold	1.00 m		N/A		galvanised steel
40x12 untreated bevelled timber architrave	19.00 m	5.6	2.8	15.68	pine, air dried, dressed
Fixings					
12g tek screws	73.00 no	0.365	34.8	12.702	galvanised steel
Rivet fixings	146.00 no	0.1752	34.8	6.09696	galvanised steel
200mm wide Protecto flashing tape	21.00 m			0	
Forstoc foamtak SB air seal	19.00 m			0	
PEF backing rod	19.00 m			0	
DECK AND STEPS					
Framing					
Step pad	4.00 no			0	
Ezi Yaka Lightfoot	9.00 no			0	
125x125 H5 pile - based on 900mm	9.00 no	64.04	3	192.12	pine, air dried, rough, treated
150x100 H3.2 bearers	11.00 m	83.45	3	250.47	pine, air dried, rough, treated
150x50 H3.2 deck joists	67.00 m	216.32	3	648.96	pine, air dried, rough, treated
200x50 H3.2 stringer	11.00 m	55.66	3	166.98	pine, air dried, rough, treated
250x50 H3.2 step stringer	6.00 m	31.63	3	94.89	pine, air dried, rough, treated
Decking/Steps/Trim					
100x40 H3.2 griptread decking	15.00 m²	30.36	3	91.06	pine, air dried, rough, treated
Webforge AH05M5G galv steel grating	2.00 m²		N/A		
Webforge 1200 TA/A405M53 treads	4.00 no		N/A		
100x25 H3.2 rough sawn base boards	42.00 m	53.13	3	159.35	pine, air dried, rough, treated
Fixings					
12dia x 350mm proprietary stainless steel pin	9.00 no	2.79	74.8	208.692	stainless steel
50 dia stainless steel washer	9.00 no	0.378	74.8	28.2744	stainless steel
PB12 timberlink conectors	16.00 no	2.196		0	
Joistheads nails	436.00 no	4.38	34.8	152.424	galvanised steel
Deck screws	936.00 no	5.2416	34.8	182.4077	galvanised steel
B195 step/pad bracket	4.00 no	12	34.8	417.6	galvanised steel
B175 step/joist bracket	4.00 no	10	34.8	348	galvanised steel
M12x190 galv eng bolts	9.00 no	1.6002	34.8	55.68696	galvanised steel
M12x 120 galv eng bolts	30.00 no	3.444	34.8	119.8512	galvanised steel
50x50x3 galv washers	54.00 no	2.8404	34.8	98.84592	galvanised steel
stainless steel joist hangers	30.00 no	3.39	74.8	253.572	stainless steel
Access hatch hinges/catch	1.00 no		N/A		

TEN BUNK HUT ALTERED DESIGN RESULTS

	quantity	weight kg	coefficient	EE
SUBSTRUCTURE + FLOOR				
Framing				
Ezi Yaka Lightfoot	22.00 no		N/A	
125x125 H5 pile - based on 900mm	22.00 no	156.54	3	469.62
160x100 H3.2 bearers	24.00 m	182.16	3	546.48
160x50 H3.2 floor joists	114.00 m	432.63	3	1297.89
150x50 H3.2 blocks	4.00 m	15.18	3	45.54
100x50 H3.2 blocks	16.00 m	40.48	3	121.44
Flooring				
150x25 Pine T&G flooring	33.00 m2	62.62	3	187.86
Insulation				
55mm Expol expanded polystyrene insulation	33.00 m2	29.04	10.4	302.016
Fixings				
12dia x 350mm proprietary stainless steel pin	22.00 no	6.82	74.8	510.136
50 dia stainless steel washer	22.00 no	0.924	74.8	69.1152
PB2 timberlink conectors	36.00 no	4.35	N/A	
M12x220 galv eng bolt	8.00 no	1.5792	34.8	54.95616
50x50x3 galv washers	16.00 no	0.8416	34.8	29.28768
Jolthead nails	800.00 no	6	34.8	208.8
12g tek screws	2,046.00 no	10.23	34.8	356.004
proprietary expol fixing clips	480.00 no	0.48	N/A	
Corner angle fixings - BJ2	15.00 no		N/A	
EXTERNAL WALLS				
Framing				
100x50 H3.2 wall framing	473.00 m	1,196.69	3	3590.07
External Cladding/Flashings				
200x25 board/batten cladding	70.00 m2	177.1	10.4	1841.84
90x90x0.55 BMT coloursteel external corner back flashing	13.00 m	5.29	34.8	184.092
130x0.55 BMT coloursteel window/door flashing	12.00 m	7.05	34.8	245.34
Insulation				
Thermex 660 building wrap	80.00 m2	16.8	2	33.6
R2.2 Terra Lana wool insul	50.00 m2	56	14.6	817.6
Internal Linings/Trim				
9mm Ecoply untreated CD grad lining	51.00 m2	255	10.4	2652
10x12 untreated single bevelled skirting	24.00 m	5.83	3	17.49
Fixings				
8g tek screws	1,602.00 no	6.408	34.8	222.9984
12g tek screws	1,435.00 no	7.15	34.8	250.212
Jolthead	2,456.00 no	24.56	34.8	854.688
Strapping tape	289.00 m		N/A	
ROOF				
Framing				
Prowood PLP GL8 H5 90x90 verandah post	33.00 m	122.96	3	368.88
150x100 H3.2 verandah beam	16.00 m	121.44	3	364.32
Mitek H1.2 covered roof truss	8.00 no			
100x50 H3.2 end purlin	5.00 m	12.65	3	37.95
75x50 H3.2 purlins	66.00 m	166.98	3	500.94
75x50 H1.2 end plate	9.00 m	17.08	3	51.24
75x40 H1.2 ceiling battens	87.00 m	132.07	3	396.21
50x50 H3.2 eaves nog	10.00 m	12.65	3	37.95
200x50 H3.2 wall plate	12.00 m	60.72	3	182.16
150x50 H3.2 verandah rafters	71.00 m	268.45	3	805.35
150x50 H3.2 noga	63.00 m	239.06	3	717.27
Roof Cladding/Flashings				
12mm H3.2 ply sarking	82.00 m2	415.4	10.4	4320.16
Pine shingle roofing	82.00 m2	313.72	3	941.16
Laserlite translucent roofing	9.00 m2	8	34.8	278.4
250x150x0.55 BMT coloursteel apron flashing	12.00 m	13.56	34.8	471.888
150x25 H3.1 fascia/soffit	45.00 m	87.29	3	261.87
Insulation				
Flamestop 030 building paper	36.00 m2	7.98	2	15.96
R3.4 Terra Lana wool insul	33.00 m2	36.96	14.6	539.616
Internal Linings/Trim				
9mm Ecoply untreated CD grade lining	34.00 m2	170	10.4	1768
10x12 untreated bevel cornice	24.00 m	5.83	3	17.49
Fixings				
M12x220 galv eng bolt	22.00 no	4.3428	34.8	151.1294
M12x220 stainless steel bolts	33.00 no	0.6501	74.8	48.62748
50x50x3 galv washers	44.00 no	2.3144	34.8	80.54112
50x50x3 stainless steel washers	85.00 no	3.4056	74.8	254.7389
M12x75 galv coach screws	12.00 no	0.7488	34.8	26.05824
Stainless steel multi grips	58.00 no	6.554	74.8	490.2392
Roofing nails 75mm	1,097.00 no	8.776	34.8	305.4048
Jolthead 100mm	432.00 no	4.32	34.8	150.336
Jolthead	704.00 no	7.04	34.8	244.992
12g tek screws	90.00 no	0.45	34.8	15.66
8g tek screws	1,047.00 no	5.235	34.8	182.178
Strapping tape	68.00 m		N/A	
Wire dog	232.00 no		N/A	
Strap bracing	30.00 m		N/A	
6kn tensioners	8.00 no		N/A	
WINDOWS AND EXTERIOR DOORS				
Windows - 40mm Commercial Series				
Two light window 1240x400 with one opening sash with screen & 20mm H3.2 reveals	4.00 no	64.068	15.9	1018.999
Window 620x1240 with fixed sash & 20mm H3.2 reveals	1.00 no	17.983	15.9	285.9297
Two light window 1800x900 with one opening sash with screen & 20mm H3.2 reveals	1.00 no	43.377	15.9	689.6943
Two light window 1800x1300 with one opening sash with screen & 20mm H3.2 reveals	2.00 no	119.276	15.9	1896.488
Doors - 60mm Commercial Series				
Single door 910x1965 with 20mm H3.2 reveals	1.00 no	41.525	15.9	660.2475
Flashing/Trim				
155x0.55BMT coloursteel head flashing	12.00 m	8.41	34.8	292.668
195x0.55 BMT coloursteel sill flashing	11.00 m	9.7	34.8	337.56
125x0.55 BMT coloursteel jamb flashing	17.00 m	9.61	34.8	334.428
75x50x5mm galv angle door threshold	1.00 m		N/A	
40x12 untreated bevelled timber architrave	40.00 m	9.72	2.8	27.216
Fixings				
12g tek screws	180.00 no	0.93	34.8	32.364
Rivet fixings	294.00 no	0.3528	34.8	12.27744
200mm wide Protecto flashing tape	43.00 m		N/A	
Fosroc foamtax SB air seal	40.00 m		N/A	
PEF backing rod	40.00 m		N/A	
DECK AND STEPS				
Framing				
Step pad	4.00 no		N/A	
Ezi Yaka Lightfoot	12.00 no		N/A	
125x125 H5 pile - based on 900mm	12.00 no	85.39	3	256.17
150x100 H3.2 bearers	15.00 m	113.85	3	341.55
150x50 H3.2 deck joists	103.00 m	390.89	3	1172.67
200x50 H3.2 stringer	12.00 m	60.72	3	182.16
250x50 H3.2 step stringer	5.00 m	31.63	3	94.89
Decking/Steps/Trim				
100x40 H3.2 grooved decking	33.00 m2	66.79	3	200.37
Webforge A40SMSG galv steel grating	2.00 m2		N/A	
Webforge 1200 TA/A405MSG treads	4.00 no		N/A	
100x25 H3.2 rough sawn base boards	67.00 m	84.76	3	254.28
Fixings				
12dia x 350mm proprietary stainless steel pin	12.00 no	3.72	74.8	278.256
50 dia stainless steel washer	12.00 no	0.504	74.8	37.6992
PB2 timberlink conectors	24.00 no	2.928	N/A	
Jolthead nails	602.00 no	6.02	34.8	209.496
Deck screws	1,722.00	9.6	34.8	334.08
B195 step/pad bracket	4.00 no	12	34.8	417.6
B175 step/post bracket	4.00 no	10	34.8	348
M12x190 galv eng bolts	14.00 no	2.4892	34.8	86.62416
M12x 120 galv eng bolts	30.00 no	3.444	34.8	119.8512
50x50x3 galv washers	64.00 no	3.3664	34.8	117.1507
stainless steel joist hangers	41.00 no	4.633	74.8	346.5484
Access hatch hinges/catch	1.00 no		N/A	

TEN BUNK HUT ORIGINAL DESIGN RESULTS

	quantity	weight kg	coefficient	EE
SUBSTRUCTURE - FLOOR				
Framing				
Ezi Yaka Lightfoot	22.00 no		N/A	
125x125 H5 pile - based on 900mm	22.00 no	173.94	3	176.94
150x100 H3.2 bearers	24.00 m	182.16	3	185.16
150x50 H3.2 floor joists	114.00 m	432.63	3	435.63
150x50 H3.2 blocks	4.00 m	15.18	3	18.18
100x50 H3.2 blocks	16.00 m	40.48	3	43.48
Flooring				
12mm H3 Ecoply plywood flooring	33.00m²	271.1	10.4	2799.44
Insulation				
55mm Expol expanded polystyrene insulation	33.00m²	29.04	44.3	1786.472
Fixings				
12dia x 350mm proprietary stainless steel pin	22.00 no	6.82	74.8	510.136
50 dia stainless steel washer	22.00 no	0.924	74.8	69.1152
PB21 timberlink connectors	38.00 no	4.392	N/A	
M12x220 galv eng bolt	8.00 no	1.5792	34.8	54.95616
50x50x3 galv washers	16.00 no	0.8416	34.8	29.28768
Jolthead nails	600.00 no	6	34.8	208.8
12g tek screws	600.00 no	4.15	34.8	144.42
proprietary expol fixing clips	480.00 no		N/A	
Corner angle fixings - B32	16.00 no		N/A	
EXTERNAL WALLS				
Framing				
100x50 H3.2 wall framing	473.00 m	1,196.69	3	3590.07
External Cladding/Flashings				
Colorsteel corrugated vertical wall cladding	70.00 m²	316.4	34.8	11010.72
150x20x0.55 BMT colorsteel base closure flashing	24.00 m	16.27	34.8	566.196
90x90x0.55 BMT colorsteel external corner back flashing	13.00 m	5.29	34.8	184.092
150x150x0.55 BMT colorsteel external corner flashing	13.00 m	8.81	34.8	306.588
130x0.55 BMT colorsteel J flashing	11.00 m	6.44	34.8	224.808
Insulation				
Bitumus 650 building wrap	60.00 m²	20.8	2	41.6
R2.2 fibreglass wall insulation	60.00 m²	56	32.1	1797.6
Internal Linings/Trim				
9mm Ecoply untreated CD grad lining	51.00 m²	341.7	10.4	3553.68
40x12 untreated single bevelled skirting	24.00 m	5.83	2.8	16.324
Fixings				
Nuway nails	306.00 no	2.156	34.8	75.0288
8g tek screws	1,602.00 no	6.406	34.8	222.9984
Jolt heads	2,456.00 no	24.56	34.8	854.688
5mm Thermal B	375.00 m		N/A	
Strapping tape	269.00 m		N/A	
ROOF				
Framing				
Prowood PLP GL8 H5 90x90 verandah post	30.00 m	122.96	3	368.88
150x100 H3.2 verandah beam	18.00 m	121.44	3	364.32
Mitek H1.2 covered roof truss	6.00 no			
100x50 H3.2 end purlin	5.00 m	12.65	3	37.95
75x50 H3.2 purlins	66.00 m	166.98	3	500.94
75x50 H1.2 end plate	9.00 m	7.06	3	21.24
75x40 H1.2 ceiling battens	67.00 m	132.07	3	396.21
50x50 H1.2 eaves nogs	10.00 m	12.65	3	37.95
200x50 H3.2 wall plate	12.00 m	60.72	3	182.16
150x50 H3.2 verandah rafters	71.00 m	269.45	3	808.35
150x50 H3.2 nogs	63.00 m	239.09	3	717.27
Roof Cladding/Flashings				
Colorsteel corrugated roof cladding	62.00m²	280.24	34.8	9752.352
Lasertite translucent roofing	9.00 m²	8	34.8	278.4
200x150x0.55 BMT colorsteel barge flashing	10.00 m	9.04	34.8	314.592
200x200x0.55 BMT colorsteel barge flashing	5.00 m	4.52	34.8	157.296
250x150x0.55 BMT colorsteel apron flashing	12.00 m	13.56	34.8	471.888
0.55 BMT colorsteel ridge edge flashing	11.00 m	2.73	34.8	95.004
160x25 H3.1 facia/soffit	48.00 m	87.29	3	261.87
Insulation				
Flamestop 660 building paper	36.00 m²	9.88	2	19.76
R2.6 fibreglass ceiling insulation	33.00 m²	36.94	32.1	1186.416
Internal Linings/Trim				
9mm Ecoply untreated CD grade lining	34.00m²	227.8	10.4	2369.12
40x12 untreated bevel cornice	24.00 m	5.83	2.8	16.324
Fixings				
M12x220 galv eng bolt	22.00 no	4.3478	34.8	151.1294
M12x220 stainless steel bolts	33.00 no	0.6501	74.8	48.62748
50x50x3 galv washers	44.00 no	2.3144	34.8	80.54112
50x50x3 stainless steel washers	66.00 no	3.4056	74.8	254.7389
M12x75 galv coach screws	12.00 m	0.7488	34.8	26.05824
Stainless steel multi grips	66.00 no	6.553	74.8	490.1644
Nuway nails	570.00 no	3.99	34.8	138.852
Jolthead 100mm	432.00 no	4.32	34.8	150.336
Jolthead	704.00 no	7.04	34.8	244.992
12g tek screws	90.00 no	0.45	34.8	15.66
8g tek screws	477.00 no	1.908	34.8	66.3984
Proprietary foam baffle	18.00 m		N/A	
Strapping tape	68.00 m		N/A	
Wire dog	232.00 no		N/A	
Strap bracing	30.00 m		N/A	
6kN tensioners	6.00 no		N/A	
WINDOWS AND EXTERIOR DOORS				
Windows - 40mm Commercial Series				
Two light window 1240x400 with one opening sash with screen & 20mm H3.2 reveals	4.00 no	64.068	15.9	1018.999
Window 620x1240 with fixed sash & 20mm H3.2 reveals	1.00 no	17.981	15.9	285.9297
Two light window 1600x900 with one opening sash with screen & 20mm H3.2 reveals	1.00 no	43.377	15.9	689.6943
Two light window 1800x1300 with one opening sash with screen & 20mm H3.2 reveals	2.00 no	119.276	15.9	1896.488
Doors - 60mm Commercial Series				
Single door 910x1965 with 20mm H3.2 reveals	1.00 no	41.525	15.9	660.2475
Flashing/Trim				
155x0.55BMT colorsteel head flashing	12.00 m	8.41	34.8	292.668
195x0.55 BMT colorsteel sill flashing	11.00 m	9.7	34.8	337.56
125x0.55 BMT colorsteel jamb flashing	17.00 m	9.61	34.8	334.428
75x50x5mm galv angle door threshold	1.00 m		N/A	
40x12 untreated bevelled timber architrave	40.00 m	9.72	2.8	27.216
Fixings				
12g tek screws	186.00 no	0.93	34.8	32.364
Rivet fixings	294.00 no	0.3528	34.8	12.27744
200mm wide Protecto flashing tape	43.00 m		N/A	
Fosroc foamfill 520 air seal	40.00 m		N/A	
PEF backing rod	40.00 m		N/A	
DECK AND STEPS				
Framing				
Step pad	4.00 no		N/A	
Ezi Yaka Lightfoot	12.00 no		N/A	
125x125 H5 pile - based on 900mm	12.00 no	85.39	3	256.17
150x100 H3.2 bearers	16.00 m	113.85	3	341.55
150x50 H3.2 deck joists	103.00 m	390.89	3	1172.67
200x50 H3.2 stringer	12.00 m	60.72	3	182.16
250x50 H3.2 step stringer	5.00 m	31.63	3	94.89
Decking/Steps/Trim				
100x40 H3.2 grooved decking	33.00 m²	66.79	3	200.37
Webforge A405MSG galv steel grating	2.00 m²		N/A	
Webforge 1200 TA/A405MSG treads	4.00 no		N/A	
100x25 H3.2 rough sawn base boards	87.00 m	84.76	3	254.28
Fixings				
12dia x 350mm proprietary stainless steel pin	12.00 no	3.72	74.8	278.256
50 dia stainless steel washer	12.00 no	0.504	74.8	37.6992
PB2 timberlink connectors	24.00 no	2.928	N/A	
Jolthead nails	603.00 no	6.02	34.8	209.496
Deck screws	1,722.00 no	9.6	34.8	334.08
B196 step/pad bracket	4.00 no	12	34.8	417.6
B175 step/post bracket	4.00 no	10	34.8	348
M12x190 galv eng bolts	14.00 no	2.4882	34.8	86.58936
M12x 120 galv eng bolts	30.00 no	3.444	34.8	119.8512
50x50x3 galv washers	64.00 no	3.3664	34.8	117.1507
stainless steel joist hangers	41.00 no	4.633	74.8	346.5484
Access hatch hinges/catch	1.00 no		N/A	

TWELVE BUNK HUT ALTERED DESIGN RESULTS

	quantity	weight kg	coefficient	kt
SUBSTRUCTURE - FLOOR				
Framing				
Ezi Yaka Lightfoot	22.00 no		N/A	
125x125 H5 pile - based on 900mm	22.00 no	15.65	3	3
150x100 H3.2 bearers	24.00 m	182.16	3	3
150x50 H3.2 floor joists	130.00 m	493.35	3	3
150x50 H3.2 blocks	4.00 m	15.18	3	3
100x50 H3.2 blocks	16.00 m	40.48	3	3
Flooring				
150x25 Pine T&G flooring	39.00 m2	72.11	3	216.33
Insulation				
55mm Expol expanded polystyrene insulation	39.00 m2	33.44	44.3	1481.392
Fixings				
12dia x 350mm propietary stainless steel pin	22.00 no	6.82	74.8	510.136
50 dia stainless steel washer	22.00 no	0.924	74.8	69.1152
PB2 timberlink conectors	36.00 no	4.392	N/A	
M12x220 galv eng bolt	8.00 no	1.5792	34.8	54.95616
50x50x3 galv washers	16.00 no	0.8416	34.8	29.28768
Jolthead nails	830.00 no	6	34.8	208.8
12g tek screws	2312.00 no	11.71	34.8	407.508
propietary expol fixing clips	580.00 no	0.56	N/A	
Corner angle fixings - BJ7	16.00 no		N/A	
EXTERNAL WALLS				
Framing				
100x50 H3.2 wall framing	510.00 m	1,290.30	3	3870.9
External Cladding/Flashings				
200x25 board/batten cladding	75.00 m2	189.75	10.4	1973.4
90x90x0.55 BMT colorsteel external corner back flashing	13.00 m	5.29	34.8	184.092
130x0.55 BMT colorsteel window/door flashing	12.00 m	7.05	34.8	245.34
Insulation				
Stumus 660 building wrap	64.00 m2	17.64	2	35.28
R2.2 Terra Lanna wool insul	53.00 m2	59.36	14.6	878.528
Internal Linings/Trim				
9mm Ecoply untreated CD grad lining	64.00 m2	270	10.4	2808
10x12 untreated angle bevelled skirting	25.00 m	6.07	3	18.21
Fixings				
12g tek screws	1,518.00 no	7.58	34.8	263.784
Sika tek screws	1,708.00 no	6.832	34.8	237.7536
Jolthead	2,504.00 no	25.04	34.8	871.392
5mm Thermax B	275.00 m		N/A	
Strapping tape	275.00 m		N/A	
ROOF				
Framing				
Prowood PLP GL8 H5 90x90 verandah post	30.00 m	122.96	3	368.88
150x100 H3.2 verandah beam	17.00 m	129.03	3	387.09
Mitek H1.2 covered roof truss	6.00 no			
100x50 H3.2 end purlin	5.00 m	12.65	3	37.95
75x50 H3.2 purlins	66.00 m	166.98	3	500.94
75x50 H1.2 end plate	10.00 m	18.98	3	56.94
75x40 H1.2 ceiling battens	66.00 m	133.58	3	400.74
50x50 H3.2 eaves nog	10.00 m	12.65	3	37.95
200x50 H3.2 wall plate	12.00 m	60.72	3	182.16
150x50 H3.2 verandah rafters	73.00 m	277.04	3	831.12
150x50 H3.2 nogs	65.00 m	246.68	3	740.04
Roof Cladding/Flashings				
12mm H3.2 ply sarking	63.00 m2	422.1	10.4	4389.84
Pine shingle roofing	63.00 m2	318.78	3	956.34
Laserlite translucent roofing	9.00 m2	8	34.8	278.4
250x150x0.55 BMT colorsteel apron flashing	12.00 m	13.56	34.8	471.888
150x25 H3.1 facia/soffit	47.00 m	89.18	3	267.54
Insulation				
Flamestop 660 building paper	38.00 m2	7.98	2	15.96
R2.2 Terra Lanna wool insul	35.00 m2	42.56	14.6	621.376
Internal Linings/Trim				
9mm Ecoply untreated CD grade lining	38.00 m2	190	10.4	1976
40x12 untreated bevel cornice	20.00 m	6.31	3	18.93
Fixings				
M12x220 galv eng bolt	22.00 no	4.3428	34.8	151.1294
M12x220 stainless steel bolts	33.00 no	0.6501	74.8	48.62748
50x50x3 galv washers	44.00 no	2.3144	34.8	80.54112
50x50x3 stainless steel washers	66.00 no	2.772	74.8	207.3456
M12x75 galv coach screws	12.00 no	0.7468	34.8	26.05824
Stainless steel multi grips	60.00 no	6.78	74.8	507.144
roofing nails 75mm	1,114.00 no	8.912	34.8	310.1376
Jolthead 100mm	432.00 no	4.32	34.8	150.336
Jolthead	716.00 no	7.16	34.8	249.168
12g tek screws	90.00 no	0.45	34.8	15.66
8g tek screws	1,109.00 no	4.436	34.8	154.3728
Strapping tape	64.00 m		N/A	
Wire dog	232.00 no		N/A	
Strap bracing	31.00 m		N/A	
6kn tensioners	8.00 no		N/A	
WINDOWS AND EXTERIOR DOORS				
Windows - 40mm Commercial Series				
Two light window 1240x400 with one opening sash with screen & 20mm H3.2 reveals	4.00 no	64.088	15.9	1018.999
Window 620x1240 with fixed sash & 20mm H3.2 reveals	1.00 no	17.983	15.9	285.9797
Two light window 1600x900 with one opening sash with screen & 20mm H3.2 reveals	1.00 no	43.377	15.9	689.6943
Two light window 1800x1300 with one opening sash with screen & 20mm H3.2 reveals	2.00 no	119.27	15.9	1896.393
Doors - 60mm Commercial Series				
Single door 910x1965 with 20mm H3.2 reveals	1.00 no	41.525	15.9	660.2475
Flashing/Trim				
165x0.55BMT colorsteel head flashing	12.00 m	8.41	34.8	292.668
195x0.55 BMT colorsteel sill flashing	11.00 m	9.7	34.8	337.56
125x0.55 BMT colorsteel jamb flashing	17.00 m	9.61	34.8	334.428
75x50x5mm galv angle door threshold	1.00 m		N/A	
40x12 untreated bevelled timber architrave	40.00 m	9.77	2.8	27.216
Fixings				
12g tek screws	168.00 no	0.93	34.8	32.364
Rivet fixings	294.00 no	0.3528	34.8	12.27744
200mm wide Protecto flashing tape	43.00 m		N/A	
Fosroc foamtak SB air seal	40.00 m		N/A	
PEF backing rod	40.00 m		N/A	
DECK AND STEPS				
Framing				
Step pad	4.00 no		N/A	
Ezi Yaka Lightfoot	12.00 no		N/A	
125x125 H5 pile - based on 900mm	12.00 no	94.88	3	284.64
150x100 H3.2 bearers	15.00 m	113.85	3	341.55
150x50 H3.2 deck joists	104.00 m	409.86	3	1229.58
200x50 H3.2 stringer	13.00 m	65.78	3	197.34
250x50 H3.2 step stringer	6.00 m	31.61	3	94.83
Decking/Steps/Trim				
100x40 H3.2 griptread decking	35.00 m2	70.84	3	212.52
Webforge A405MSG galv steel grating	2.00 m2		34.8	0
Webforge 1250 TA/A405MSG treads	4.00 no		N/A	
100x25 H3.2 rough sawn base boards	69.00 m	87.29	3	261.87
Fixings				
12dia x 350mm propietary stainless steel pin	12.00 no	3.72	74.8	278.256
50 dia stainless steel washer	12.00 no	0.504	74.8	37.6992
PB2 timberlink conectors	24.00 no	2.928	N/A	
Jolthead nails	822.00 no	6.22	34.8	216.456
Deck screws	1,600.00 no	10.1136	34.8	351.9533
B195 step/pad bracket	4.00 no	12	34.8	417.6
B175 step/joist bracket	4.00 no	10	34.8	348
M12x190 galv eng bolts	15.00 no	2.667	34.8	92.8116
M12x120 galv eng bolts	30.00 no	3.444	34.8	119.8512
50x50x3 galv washers	65.00 no	3.4716	34.8	120.8117
stainless steel joist hangers	43.00 no	4.859	74.8	363.4537
Access hatch hinges/catch	1.00 no		N/A	

TWELVE BUNK HUT ORIGINAL DESIGN RESULTS

	quantity	weight kg	coefficient	EE	
SUBSTRUCTURE - FLOOR					
Framing					
Ezi Yaka Lightfoot	22.00 no		N/A		
125x125 H5 pile - based on 900mm	22.00 no	173.94	3	176.94	pine, air dried, rough, treated
150x100 H3.2 bearers	24.00 m	182.16	3	185.16	pine, air dried, rough, treated
150x50 H3.2 floor joists	130.00 m	493.35	3	496.35	pine, air dried, rough, treated
150x50 H3.2 blocks	4.00 m	15.18	3	18.18	pine, air dried, rough, treated
100x50 H3.2 blocks	18.00 m	40.46	3	43.46	pine, air dried, rough, treated
Flooring					
12mm H3 Ecoply plywood flooring	38.00m²	254	10.4	2641.6	plywood
Insulation					
55mm Expol expanded polystyrene insulation	38.00m²	33.44	44.3	1481.392	expanded polystyrene
Fixings					
12dia x 350mm proprietary stainless steel pin	22.00 no	6.82	74.8	510.136	stainless steel
50 dia stainless steel washer	22.00 no	0.924	74.8	69.1152	stainless steel
PB2 timberlok conectors	30.00 no	4.392	N/A		
M12x220 galv eng bolt	8.00 no	1.5792	34.8	54.95616	galvanised steel
50x50x3 galv washers	18.00 no	0.8416	34.8	29.28768	galvanised steel
Jointheads nails	600.00 no	6	34.8	208.8	galvanised steel
12g tek screws	910.00 no	4.55	34.8	158.34	
proprietary expol fixing clips	560.00 no		N/A		
Corner angle fixings - BJ2	18.00 no		N/A		
EXTERNAL WALLS					
Framing					
100x50 H3.2 wall framing	610.00 m	1,290.30	3	3870.9	pine, air dried, rough, treated
External Cladding/Flashings					
Colorsteel corrugated vertical wall cladding	75.00 m²	335	34.8	11797.2	galvanised steel
150x20x0.55 BMT coloursteel base closure flashing	25.00 m	16.95	34.8	589.86	galvanised steel
90x90x0.55 BMT coloursteel external corner back flashing	13.00 m	5.29	34.8	184.092	galvanised steel
150x150x0.55 BMT coloursteel external corner flashing	13.00 m	8.81	34.8	306.588	galvanised steel
130x0.55 BMT coloursteel J flashing	11.00 m	6.46	34.8	224.808	galvanised steel
Insulation					
Thermus 660 building wrap	64.00 m²	21.84	2	43.68	kraft
R2.2 fibreglass wall insulation	53.00 m²	59.36	32.1	1905.456	insulation, fibreglass
Internal Linings/Trim					
9mm Ecoply untreated CD grad lining	54.00 m²	361.8	10.4	3762.72	plywood
40x12 untreated single bevelled skirting	26.00 m	6.07	2.8	16.996	pine, air dried, dressed
Fixings					
Nuway nails	300.00 no	2.1	34.8	73.08	stainless steel
8g tek screws	1,708.00 no	6.832	34.8	237.7536	galvanised
Jointheads	2,504.00 no	25.04	34.8	871.392	galvanised
5mm Thermax B	410.00 m		N/A		
Strapping tape	275.00 m		N/A		
ROOF					
Framing					
Prowood PLP GL8 H5 90x90 verandah post	30.00 m	122.56	3	368.88	pine, air dried, rough, treated
150x100 H3.2 verandah beam	17.00 m	129.03	3	387.09	pine, air dried, rough, treated
Mark H1.2 covered roof truss	6.00 no				
100x50 H3.2 end purlin	5.00 m	12.65	3	37.95	pine, air dried, rough, treated
75x50 H3.2 purlins	68.00 m	166.98	3	500.94	pine, air dried, rough, treated
75x50 H1.2 end plate	10.00 m	18.98	3	56.94	pine, air dried, rough, treated
75x40 H1.2 ceiling battens	68.00 m	133.58	3	400.74	pine, air dried, rough, treated
50x50 H3.2 eaves nog	10.00 m	12.65	3	37.95	pine, air dried, rough, treated
200x50 H3.2 wall plate	12.00 m	60.72	3	182.16	pine, air dried, rough, treated
150x50 H3.2 verandah rafters	73.00 m	277.04	3	831.12	pine, air dried, rough, treated
150x50 H3.2 nogs	65.00 m	246.68	3	740.04	pine, air dried, rough, treated
Roof Cladding/Flashings					
Coloursteel corrugated roof cladding	63.00m²	284.76	34.8	9909.648	galvanised steel
Laserlite translucent roofing	9.00 m²	8	34.8	278.4	galvanised steel
200x150x0.55 BMT coloursteel barge flashing	10.00 m	9.04	34.8	314.592	galvanised steel
200x200x0.55 BMT coloursteel barge flashing	6.00 m	4.52	34.8	157.296	galvanised steel
250x150x0.55 BMT coloursteel apron flashing	12.00 m	13.56	34.8	471.888	galvanised steel
0.55 BMT coloursteel ridge roll flashing	11.00 m	2.73	34.8	95.004	galvanised steel
150x25 H3.1 facia/soffit	47.00 m	89.18	3	267.54	pine, air dried, rough, treated
Insulation					
Flamestop 660 building paper	36.00 m²	7.98	2	15.96	kraft
R2.8 fibreglass ceiling insulation	33.00 m²	42.56	32.1	1366.176	
Internal Linings/Trim					
9mm Ecoply untreated CD grade lining	38.00m²	254.6	10.4	2647.84	plywood
40x12 untreated bevel cornice	28.00 m	6.31	2.8	17.668	pine, air dried, dressed
Fixings					
M12x220 galv eng bolt	22.00 no	4.3428	34.8	151.1294	galvanised steel
M12x220 stainless steel bolts	33.00 no	0.6501	74.8	48.62748	stainless steel
50x50x3 galv washers	44.00 no	2.3144	34.8	80.54112	galvanised steel
50x50x3 stainless steel washers	68.00 no	2.772	74.8	207.3456	stainless steel
M12x75 galv coach screws	12.00 no	0.7488	34.8	26.05824	galvanised steel
Stainless steel multi grips	60.00 no	6.78	74.8	507.144	stainless steel
Nuway nails	679.00 no	4.053	34.8	141.0444	galvanised steel
Jointhead 100mm	432.00 no	4.32	34.8	150.336	galvanised steel
Jointhead	716.00 no	7.16	34.8	249.168	galvanised steel
12g tek screws	90.00 no	0.45	34.8	15.66	galvanised steel
8g tek screws	630.00 no	2.12	34.8	73.776	galvanised steel
Proprietary foam baffle	10.00 m		N/A		
Strapping tape	68.00 m		N/A		
Wire dog	232.00 no		N/A		
Strap bracing	31.00 m		N/A		
8kn tensioners	8.00 no		N/A		
WINDOWS AND EXTERIOR DOORS					
Windows - 40mm Commercial Series					
Two light window 1240x400 with one opening sash with screen & 20mm H3.2 reveals	4.00 no	64.088	15.9	1018.999	glass, float
Window 620x1240 with fixed sash & 20mm H3.2 reveals	1.00 no	17.983	15.9	285.9297	glass, float
Two light window 1600x900 with one opening sash with screen & 20mm H3.2 reveals	1.00 no	43.372	15.9	689.6941	glass, float
Two light window 1600x1300 with one opening sash with screen & 20mm H3.2 reveals	2.00 no	119.27	15.9	1896.393	glass, float
Doors - 50mm Commercial Series					
Single door 910x1965 with 20mm H3.2 reveals	1.00 no	41.525	15.9	660.2475	glass, float
Flashing/Trim					
150x0.55BMT coloursteel head flashing	12.00 m	8.41	34.8	292.668	galvanised steel
195x0.55 BMT coloursteel sill flashing	11.00 m	9.7	34.8	337.56	galvanised steel
125x0.55 BMT coloursteel jamb flashing	17.00 m	9.61	34.8	334.428	galvanised steel
75x50x6mm galv angle door threshold	1.00 m		N/A		
40x12 untreated bevelled timber architrave	40.00 m	9.72	2.8	27.216	pine, aire dried dressed
Fixings					
12g tek screws	168.00 no	0.93	34.8	32.364	galvanised steel
Rivet fixings	294.00 no	0.3528	34.8	12.27744	galvanised steel
200mm wide Protecto flashing tape	43.00 m		N/A		
Fosroc foamtak SB air seal	40.00 m		N/A		
PEF backing rod	40.00 m		N/A		
DECK AND STEPS					
Framing					
Step pad	4.00 no		N/A		
Ezi Yaka Lightfoot	12.00 no		N/A		
125x125 H5 pile - based on 900mm	12.00 no	94.88	3	284.64	pine, air dried, rough, treated
150x100 H3.2 bearers	15.00 m	113.85	3	341.55	pine, air dried, rough, treated
150x50 H3.2 deck joists	108.00 m	409.86	3	1229.58	pine, air dried, rough, treated
200x50 H3.2 stringer	13.00 m	65.78	3	197.34	pine, air dried, rough, treated
250x50 H3.2 step stringer	6.00 m	31.63	3	94.89	pine, air dried, rough, treated
Decking/Steps/Trim					
100x40 H3.2 griptread decking	35.00 m²	70.84	3	212.52	pine, air dried, rough, treated
Webforge A405MSG galv steel grating	2.00 m²		N/A		
Webforge 1200 TA/A405MSG treads	4.00 no		N/A		
100x25 H3.2 rough sawn base boards	69.00 m	87.29	3	261.87	pine, air dried, rough, treated
Fixings					
12dia x 350mm proprietary stainless steel pin	12.00 no	3.72	74.8	278.256	stainless steel
50 dia stainless steel washer	12.00 no	0.504	74.8	37.6992	stainless steel
PB2 timberlok conectors	24.00 no	2.928	N/A		
Jointheads nails	822.00 no	6.22	34.8	216.456	galvanised steel
Deck screws	1,608.00 no	10.1136	34.8	351.9533	galvanised steel
S195 step/pad bracket	4.00 no	12	34.8	417.6	galvanised steel
S176 step/post bracket	4.00 no	10	34.8	348	galvanised steel
M12x190 galv eng bolts	15.00 no	2.667	34.8	92.8116	galvanised steel
M12x120 galv eng bolts	30.00 no	3.444	34.8	119.8512	galvanised steel
50x50x3 galv washers	68.00 no	3.4716	34.8	120.8117	galvanised steel
stainless steel joist hangers	43.00 no	4.859	74.8	363.4532	stainless steel
Access hatch hinges/catch	1.00 no		N/A		

Job Name :	DOC HUTS REVISED		**Job Description**
Client's Name:	DOC HUTS - 2 to12 BUNK	Alternative Materials	

Trade Description	Trade %	Cost/ m2	Labour Qty	Labour Rate	Labour Total	Material Total	Sub Total	Mark Up %	Trade Total
2 BUNK									
SUBSTRUCTURE - FLOOR	1.62					5,653	5,653		5,653
EXTERNAL WALLS	2.16					7,571	7,571		7,571
ROOF	1.03					3,601	3,601		3,601
WINDOWS & EXTERIOR DOORS	1.15					4,033	4,033		4,033
FITTINGS & FIXTURES	0.48					1,691	1,691		1,691
DECK & STEPS	0.51					1,796	1,796		1,796
4 BUNK									
SUBSTRUCTURE - FLOOR	1.53					5,356	5,356		5,356
EXTERNAL WALLS	5.23					18,302	18,302		18,302
ROOF	2.67					9,326	9,326		9,326
WINDOWS & EXTERIOR DOORS	1.48					5,171	5,171		5,171
FITTINGS & FIXTURES	1.61					5,615	5,615		5,615
DECK & STEPS	1.92					6,722	6,722		6,722
6 BUNK									
SUBSTRUCTURE - FLOOR	2.41					8,445	8,445		8,445
EXTERNAL WALLS	7.12					24,907	24,907		24,907
ROOF	3.56					12,440	12,440		12,440
WINDOWS & EXTERIOR DOORS	1.68					5,870	5,870		5,870
FITTINGS & FIXTURES	2.07					7,248	7,248		7,248
DECK & STEPS	2.50					8,755	8,755		8,755
10 BUNK									
SUBSTRUCTURE - FLOOR	4.05					14,168	14,168		14,168
EXTERNAL WALLS	8.98					31,418	31,418		31,418
ROOF	7.87					27,521	27,521		27,521
WINDOWS & EXTERIOR DOORS	3.13					10,957	10,957		10,957
FITTINGS & FIXTURES	3.05					10,672	10,672		10,672
DECK & STEPS	3.51					12,296	12,296		12,296
12 BUNK									
SUBSTRUCTURE - FLOOR	4.36					15,244	15,244		15,244
EXTERNAL WALLS	8.25					28,853	28,853		28,853
ROOF	6.13					21,427	21,427		21,427
WINDOWS & EXTERIOR DOORS	3.13					10,957	10,957		10,957
FITTINGS & FIXTURES	3.21					11,223	11,223		11,223
DECK & STEPS	3.60					12,588	12,588		12,588
	100.00					**349,826**	**349,826**		**349,826**

Job Name :	DOC HUTS	Job Description
Client's Name:	DOC HUTS - 2 to12 BUNK	

Trade Description	Trade %	Cost/ m2	Labour Qty	Labour Rate	Labour Total	Material Total	Sub Total	Mark Up %	Trade Total
2 BUNK									
SUBSTRUCTURE - FLOOR	2.96					8,167	8,167		8,167
EXTERNAL WALLS	1.60					4,412	4,412		4,412
ROOF	0.95					2,619	2,619		2,619
WINDOWS & EXTERIOR DOORS	1.46					4,033	4,033		4,033
FITTINGS & FIXTURES	0.61					1,691	1,691		1,691
DECK & STEPS	0.65					1,796	1,796		1,796
4 BUNK									
SUBSTRUCTURE - FLOOR	1.61					4,437	4,437		4,437
EXTERNAL WALLS	3.84					10,601	10,601		10,601
ROOF	2.17					5,989	5,989		5,989
WINDOWS & EXTERIOR DOORS	1.87					5,171	5,171		5,171
FITTINGS & FIXTURES	2.04					5,615	5,615		5,615
DECK & STEPS	2.44					6,722	6,722		6,722
6 BUNK									
SUBSTRUCTURE - FLOOR	2.52					6,954	6,954		6,954
EXTERNAL WALLS	4.93					13,595	13,595		13,595
ROOF	2.83					7,795	7,795		7,795
WINDOWS & EXTERIOR DOORS	2.13					5,870	5,870		5,870
FITTINGS & FIXTURES	2.63					7,248	7,248		7,248
DECK & STEPS	3.17					8,755	8,755		8,755
10 BUNK									
SUBSTRUCTURE - FLOOR	4.00					11,028	11,028		11,028
EXTERNAL WALLS	6.29					17,366	17,366		17,366
ROOF	6.70					18,480	18,480		18,480
WINDOWS & EXTERIOR DOORS	3.97					10,957	10,957		10,957
FITTINGS & FIXTURES	3.87					10,672	10,672		10,672
DECK & STEPS	4.46					12,296	12,296		12,296
12 BUNK									
SUBSTRUCTURE - FLOOR	4.21					11,617	11,617		11,617
EXTERNAL WALLS	6.64					18,327	18,327		18,327
ROOF	6.86					18,937	18,937		18,937
WINDOWS & EXTERIOR DOORS	3.97					10,957	10,957		10,957
FITTINGS & FIXTURES	4.07					11,223	11,223		11,223
DECK & STEPS	4.56					12,588	12,588		12,588
	100.00					**275,918**	**275,918**		**275,918**