Timber

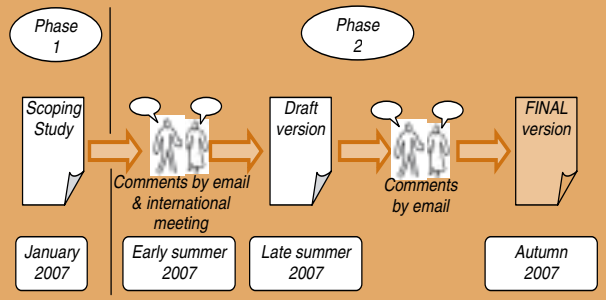
Scoping Study

This document is the output of phase 1 of a two-phase project to produce guidelines for timber in humanitarian emergencies.
See www.humanitariantimber.org for updates on the project process.

To make the final timber guidelines as practical as possible, it should include contributions from as many different agencies and individuals as possible.

Hundreds of thousands of cubic meters of timber costing millions of dollars are consumed in relief and reconstruction programmes worldwide. The timber is used in construction by those affected by disaster and external organizations offering assistance. Poorly planned timber procurement can result in significant delays in responses to people's needs, environmental degradation and organisational financial and operational inefficiency.

This document is the scoping study for a booklet that aims to consolidate published information and practical experiences on how humanitarian organisations go about procuring and using timber. This guideline will be useable in different contexts for any project involving the use of timber or bamboo as a construction material.



UNITED NATIONS

OFFICE FOR THE COORDINATION OF HUMANITARIAN AFFAIRS

Timber

A guide to the planning, use, procurement and logistics of timber as a construction material in humanitarian relief

Scoping Study

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Foreword

Hundreds of thousands of cubic meters of timber costing millions of dollars are consumed in relief and reconstruction programmes worldwide. The timber is used in construction by those affected by disaster and external organisations offering assistance. Poorly planned timber procurement can result in significant delays in responses to people's needs, environmental degradation and organisational financial and operational inefficiency.

This booklet aims to consolidate published information and practical experiences on how humanitarian organisations go about procuring and using timber. This guideline can be used in different contexts for any project involving the use of timber or bamboo as a construction material.

Practical information on this topic will save organisations time and money and improve the efficiency and effectiveness of emergency response.

Acknowledgements

This project was led by Joseph Ashmore and Jon Fowler. The co-ordinating editor for UN/OCHA was Isabelle de Muyser-Boucher.

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Individuals:

Adrian Porter, Anita van Breda, Antonella Vitale, Arian Ardie, Arshad Aziz, Barry Hearse, Bruno Dercon, Carsten Voelz, Charles Kelly, Dan Lewis, Ed Pepke, Elin Holmén, George Kuru, Goran Stojanovski, Göran Tannerfeldt, Gordon Browne, Graham Saunders, Ilan Kelman, Jean McCluskey, Julia Macro, Kazuko Puff, Kelly Wooster, Kristof Bevernage, Lionel Jayanetti, Maggie Stephenson, Manoucher Lolachi, Nabil Makki, Neil Noble, Nick Willson, Olivier Siegenthaler, Øyvind Nordlie, Pat Naidoo, Pete Manfield, Rachel Roseberry, Ralph Ashton, Regan Potangaroa, Rick Bauer, Simon Armstrong, Stepi Hakim, Tim Nolan, Toby Gould, Tom Bamforth, Tom Corsellis, Valentine Ndibalema.

Organisations:

- UN/OCHA: funded this draft.
- Norwegian Refugee Council: allowed its 'Internal Guideline - Timber Procurement and Specifications' to be used as a base for this draft.

CONTENTS

This booklet is divided into the following sections:

Are you happy with this structure?

Is the graphical style understandable?

i INTRODUCTION

Are you happy with this content?

i.1 What is in this book

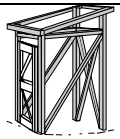
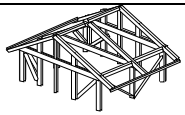
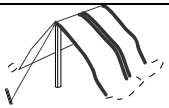
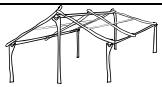
This book provides information on planning to use timber; using timber; procuring timber and the logistical considerations of timber in humanitarian emergencies.

This guideline is not sector-specific since timber can be used as a construction material in many different programmes and projects.

As with all guidelines the advice should be adjusted for the specific context.

The following materials are dealt with:

- Sawn wood
- Bush poles
- Bamboo

	*WATER & SANITATION: Timber used for a latrine frame*
	*WAREHOUSING: Timber used to build, for example, a food warehouse*
	*EDUCATION & HEALTH: Timber used to build school or clinic*
	*SHELTER: Timber used for temporary shelter with plastic sheeting roof*
	*SHELTER: Timber used for basic frame for family shelter*

i.2 What is not in this book

Timber is an environmentally friendly construction material when it is sourced sustainably. It is also strong and adaptable. However, this guideline does not advocate the use of timber over other materials in all situations. Timber is not always appropriate and legal or environmental degradation issues may prohibit its use.

This guideline is not an engineering guideline, though some basic design considerations are listed in section A. For detailed guides to construction see the annex ii.2 on Further Reading.

The following wood derivatives are not included in this guideline:

- Wood for fuel
- Pre-fabricated timber frames (doors, windows, roof trusses etc.)
- Other composite timber products such as plywood

Should composite products be included in this guideline?

i.3 Assumptions before using this book

This guideline assumes that whatever the sector of intervention a strategy of emergency response has been developed in coordination with others (NGOs, UN agencies, beneficiaries, government etc.).

Construction projects that are implemented without being part of a wider plan can have negative implications. Once a construction project starts it is hard to change it, so **the thinking should be carried out before the buying and the building**.

Key references to strategy documents are listed in the annex for further reading.

i.4 Key messages

A number of special considerations apply to the procurement, use and logistics of timber and bamboo. They include:

- Site appropriately
- Build appropriately
- Source timber legally and, preferably, sustainably
- Keep timber dry in the supply chain and in construction
- Check the quality of joints in construction

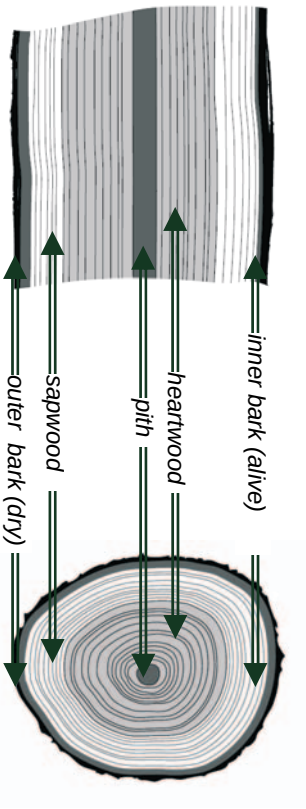
What sector guidelines would be most appropriate to reference here?

Do you agree with these key messages?

There is lots of information relating to the 2004 Asian Tsunami. Do you have any examples from other parts of the world?

i.5 What is timber?

Timber comes from trees while bamboo is the stem of a woody grass. In this document, sawn timber, bush poles and bamboo are included under the general term 'timber'. Specific considerations for each material are highlighted.



Wood

The trunk of a tree supports the foliage and fruits of the crown and resists tension, compression and bending.

The tree is made up of different cell tissues. Some cells deliver liquids, others store and distribute foods and others provide strength and elasticity.

Heartwood, pith and sapwood

The heartwood of a tree provides the structural strength of the tree, the pith being the very centre, while the sapwood, which is normally lighter in colour, delivers liquids to the crown. The sapwood is more susceptible to attack by insects and fungi than the heartwood.

Softwoods and hardwoods

Trees are divided into two types: softwoods and hardwoods. This does not correspond to the hardness of the wood.

Hardwoods are from broad-leaved trees which produce seeds in an enclosed case and are normally evergreen in the tropics and deciduous (lose their leaves once a year) in temperate zones.

Softwoods come from coniferous trees which produce cones and have leaves like needles. Hardwoods tend to be denser, stronger and grow slower than softwoods. Balsa wood, one of the lightest woods, is actually a hardwood.

Softwood *Hardwood*

Naming trees

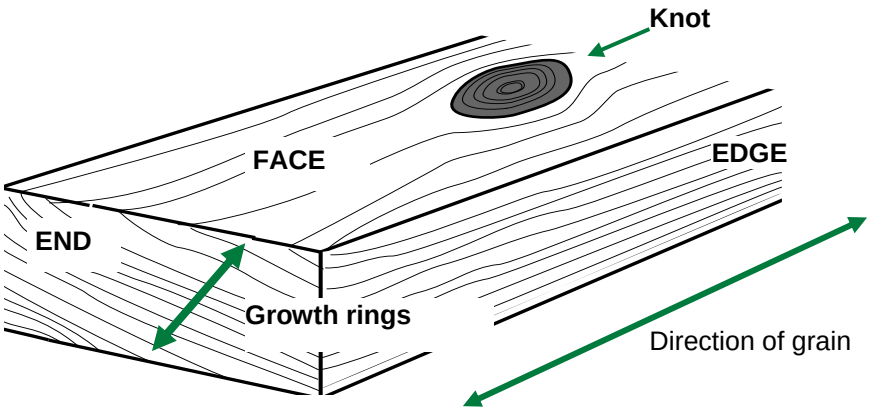
A tree has at least two names – a Latin (or 'botanical') name and, varying between countries, a common name. As common names are country-specific it is important to be sure of the Latin name of the species required.

Primary and secondary timbers

The timber construction industry uses the terms primary and secondary to classify woods. Primary timbers are mostly slow-growing hardwoods which are naturally durable and normally expensive and in short supply. Secondary timbers are fast-growing species whose low natural durability can be improved with seasoning and preservatives.

Sawn timber terminology

A glossary is included in the annex of this guideline. Some basic terms are shown in the diagram below:

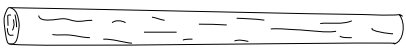


Timber poles

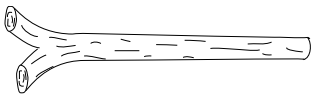
Timber poles can be stronger than equivalent sawn timber of the same cross section because the natural fibres of the timber are not interrupted by cutting through them. They can also be produced from younger trees than is required to make sawn timber, and do not require the costs of machining that sawn timber require.

Straight poles

In some cases local building practices prefer to use timber poles that have forks or other shapes. This guideline focuses on straight poles, although the legal and environmental issues remain the same for all construction timber.



Usually straight poles should be specified



In some cases, local construction practices use specially shaped poles

Bamboo

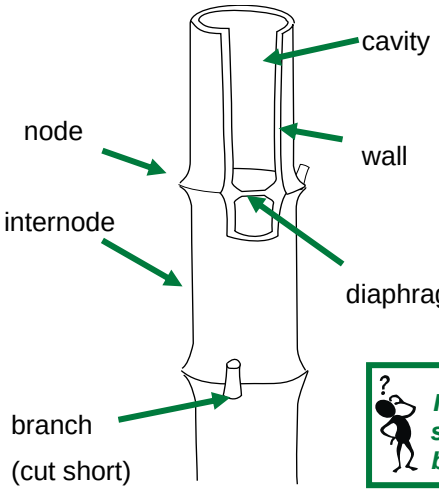
Bamboo is versatile and fast-growing, reproducing through its roots. It can be harvested in 3-5 years versus 10-50 years for most soft and hardwoods.

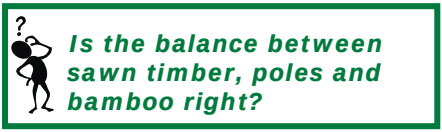
Culms, Growth and harvesting

A culm is the equivalent of a tree's trunk. Depending on the species, bamboo grows in patches (clumps type) or distributed over an area (running type). With the clump type, 50-100 culms might grow in a clump. Clump and running type bamboos are harvested differently to avoid damaging the roots.

Bamboo structure

A culm of bamboo is typically between 2.5 and 6m long. A bamboo culm is usually hollow and tapered towards the top and consists of several cavities separated by nodes. The nodes are the strongest part of the culm, and if used correctly, help to prevent the bamboo from splitting at the ends and at joints. When jointing bamboo, cuts, pegs and bindings must take into account of the position of the node.





Types of bamboo

There are about 600 different botanical species of bamboo around the world. Appropriate local bamboo species should be identified before being used for construction.

section

planning and use

A PLANNING and USE

A.1 Planning – think before you buy and build

is there a strategy? [a2]

Co-ordination and preparation – who else is involved?
Need – is the construction project necessary?
Siting – are the sites **appropriate** for the construction?
Maintenance – is there a plan for maintenance and handover?

primary considerations [a3]

Environment – impact of procurement & implementation? **[A.3.1]**
Phasing & lifetime – how long is the structure meant for? **[A.3.2]**
Legal – local, national and international legal conditions? **[A.3.3]**
Scale – how big is the construction project? **[A.3.4]**
Availability – local, national and international markets? **[A.3.5]**
Appropriateness of deign – what materials and techniques are commonly used? **[A.8]**
Logistics – what supply chain issues are there? **[C]**

These inform the following decisions:

what level of certification? [A.4]

minimum | nationally legal | internationally legal | certified sustainable | ideal

who will do the construction? [A.5]: direct: organisation | indirect: contractor | distribution: beneficiaries

what materials?[A.6]: bamboo | sawn wood | poles | other timber | alternatives [A.7]

how will they be used? [A.8]: construction: appropriate & reduced timber) | connections | joints

where to get them? [B]: local supplier / community | national supplier / government | international supplier

Is this diagram helpful?

A.2 Strategy

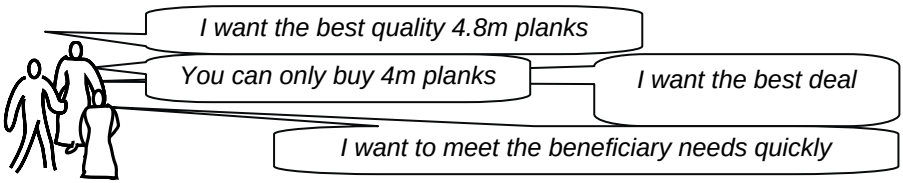
A.2.1 Co-ordination and preparation

Organisations should work together to support the needs of those that they wish to help. They should not work in competition with each other and should involve appropriate government departments.

We should be working together!

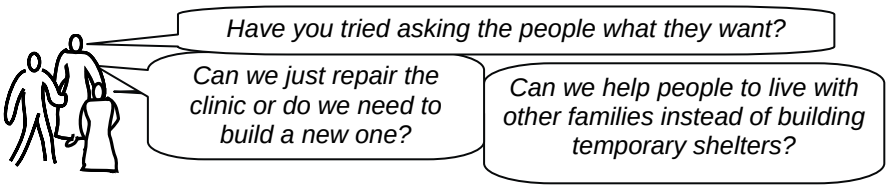
Procurement staff from different organisations can also coordinate to share legal and supplier information and establish block buying capacity.

Within organisations the logistics, procurement, programme and engineering staff must discuss the details of timber procurements.



A.2.2 Need

Before beginning any construction project consider if it is needed.



A.2.3 Siting

When making big decisions (such as selecting if, or where, to site a temporary settlement), or making smaller decisions (selecting where a latrine should be built), many factors, such as land ownership, landslide or flooding risk and impact on the environment should be considered.

A.2.4 Maintenance

Structures have maintenance costs, whilst public buildings have staffing costs. Before building, consider who is responsible for repairs to the structure (parts and labour) and who will look after it once the organisation has gone.

See annex ii.2 for further references on these issues.

A.3 Primary considerations

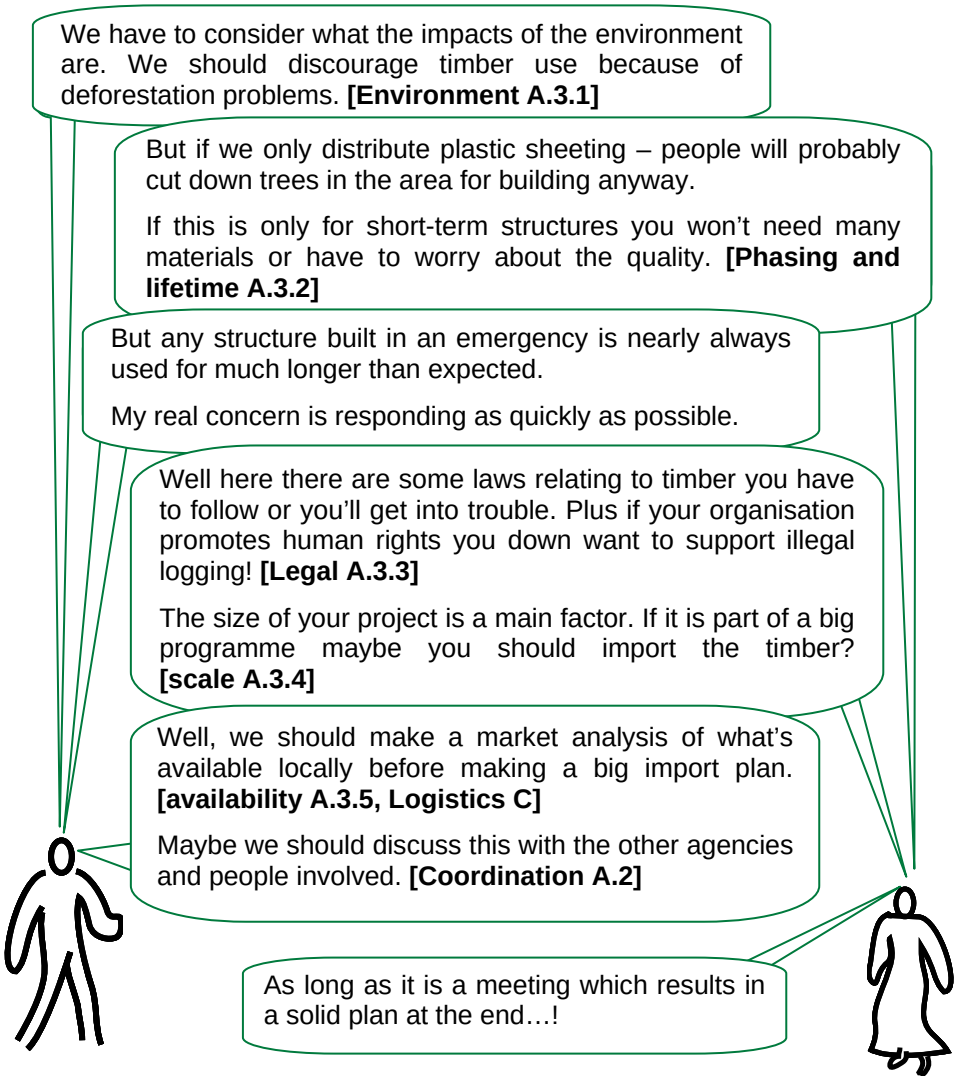


Illustration of a discussion that might be held when deciding whether or how to use timber in a construction programme.

A.3.1 Environment

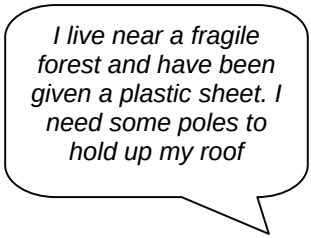
The main Sphere[1] standard relating to the environment and construction is:

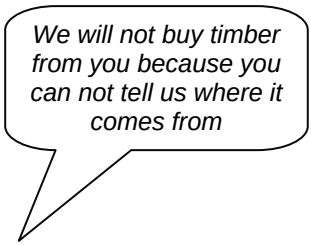
> Shelter, Settlement and NFIs – Standard 6: Environmental impact
>
> "The adverse impact on the environment is minimized by the settling of the disaster-affected households, the material sourcing and construction techniques used". (p.227)

Coordinate with other organisations to develop an environmental strategy for timber procurement. See UNHCR Environmental Guidelines (2005[2]) for guidelines on setting up an Environmental Taskforce.

The main environmental considerations for timber procurement are related to deforestation:

- Deforestation caused by siting large groups of people near unmanaged wood sources.
- Be wary of distributing emergency shelter materials such as plastic sheeting without considering frames for structures.
- Any programme involving timber for construction should also consider the effects of using of wood for fuel.
- Do not purchase timber from a supplier who does not have a natural resource strategy and damages forests.
- Replanting programmes will not automatically make up for uncontrolled felling of older trees.
- Implement recycling and salvaging programmes and wood waste management (section A.7).



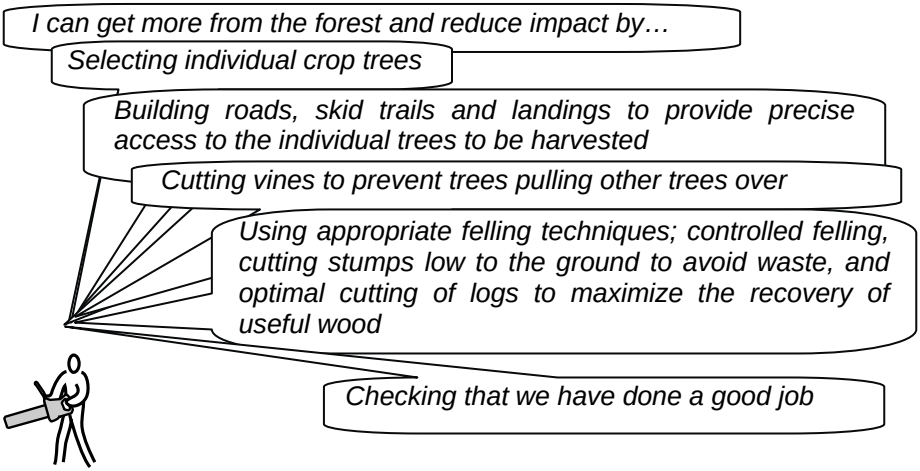


Are these the main environmental issues? What else would you recommend?

[1] www.sphereproject.org
[2] http://www.unhcr.org/protect/PROTECTION/3b03b2a04.pdf

Reduced impact logging (RIL)

Reduced impact logging (RIL) is a sustainable forestry management approach that reduces damage to trees, soil and forest hydrology. RIL usually needs to be part of a company's operations to meet certification standards for sustainability. It should be strongly encouraged from suppliers when certified timber is not available.



Some reduced impact logging techniques

Rapid Environmental Assessment (REA)

REA is a process to collect information on environmental impacts, provide tools to analyse the information and to review procurement decisions in order to reduce the potential negative environmental impacts of emergency assistance. REA was developed by the Benfield Hazard Research Centre and guidelines can be downloaded from: **http://www.benfieldhrc.org/rea_index.htm**

Life Cycle Analysis (LCA)

Life Cycle Analysis is a tool for determining a product's impact on the environment through the entire life cycle of its manufacture, transport, and disposal.

Procuring a steel bar made locally may initially appear to be more environmentally friendly than timber harvested in a fragile area but LCA may show that making the steel is relatively more damaging.

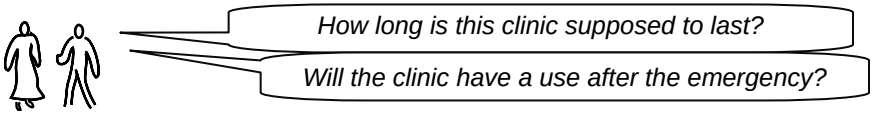
Which is more environmentally friendly, timber or steel?

LCA is complicated and there is no rapid analysis tool available as yet. More information available from UNEP: **http://www.unep.fr/pc/pc/tools/lca.htm** .

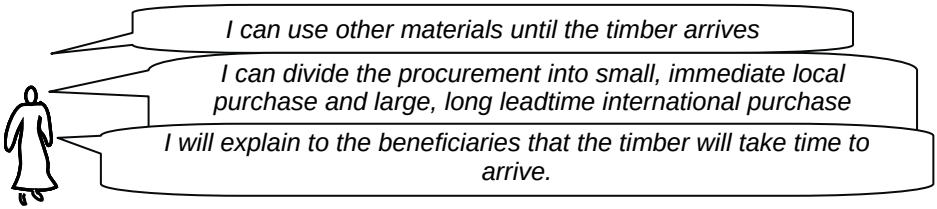
A.3.2 Phasing and lifetime

Timber may be used as a construction material immediately following a disaster and in any period through the reconstruction phase. This guideline is aimed at the emergency and early phases of reconstruction.

'Temporary' structures nearly always stay in the field far longer than planned.



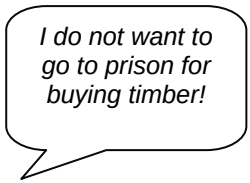
While leadtimes for importing timber appear to be prohibitively long, forward planning can mean that timber arrives in time for the very earliest phase of reconstruction.



A.3.3 Legality

Timber trade is controlled, primarily through CITES (The Convention on International Trade in Endangered Species of Wild Fauna and Flora) and the ITTA (International Tropical Timber Agreement). These agreements are implemented in national law by those countries signing the agreements.

An organisation must therefore ensure its timber supplies are, at the minimum, legal, in order to follow the law of the country of operation and to avoid any involvement in the conflict and corruption of the illegal trade in timber. Governments normally regulate forestry concessions (the right to harvest timber) and timber processing (e.g. licences for saw mills).



CITES

CITES is an international treaty that aims to protect certain plants and animals threatened by international trade. Trade in any trees on the CITES list must be accompanied by CITES certification, any trade without this documentation is considered illegal. See www.cites.org for more information and a list of species.

ITTA

The International Tropical Timber Agreement was updated in 2006. The first agreement was made in 1976 and the agreement focuses on forest conservation and development as much as establishing controls for the trade in tropical timber. National signatories to the agreement agree to follow and enforce its contents. The International Tropical Timber Organisation (ITTO - **www.itto.or.jp**) was set up as part of the ITTAs and develops internationally agreed policy documents to promote sustainable forest management and forest conservation.

Defining legality

There is no single definition of the legality of timber. The World Wildlife Foundation (WWF) defines timber involved in the following as illegal[3]:

- Illegal harvesting. Timber cut or removed without the required license or in breach of a harvesting license or law. This includes timber that is stolen.
- Illegal trading. Timber, or a product containing timber, bought, sold, exported, or imported and processed in breach of the laws, including laws implemented under CITES.
- Corruption. Authorization to harvest or trade logs or timber products is secured through corrupt application of laws or administrative procedures.

The UK's Central Point of Expertise for Timber Procurement (CPET[4]) has developed criteria for establishing legality and produced a matrix for evaluating the legality of timber products:

Criteria	How does the source comply?	Mechanism for verification	Evidence
The forest owner/manager holds legal use rights to the forest			
Compliance with national laws e.g. • Forest management • Environment • Labour and welfare • Health & safety • Other groups' land rights			
Royalties and taxes are paid			
Compliance with CITES.			

Does this summarise the main legal issues?

[3] **www.panda.org/gftn**
[4] **http://www.proforest.net/cpet**

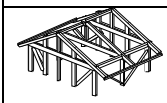
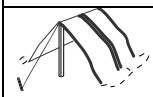
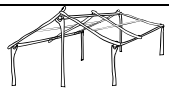
In the absence of a functioning national government forestry department if there are no official papers regarding land and forest ownership, every tree or forest will belong to a group or individual. Ownership of forests may be disputed and timber supply may be a source of conflict.

Section A.4 Chain of custody & certification deals with the question of legality in more detail by explaining the meaning of the 'chain of custody'.

A.3.4 Scale

Scale of the construction project will be one of the biggest determinates of whether procurement is made locally, nationally or internationally (or perhaps a mix of all three).

The scale of the project must be calculated in reference with other projects involving wood use (including wood used as fuel for cooking and other activities such as brick-making).

	*Latrine = 0.4 – 0.8 cubic meters*
	*8m x 6m timber framed shed = 3 cubic meters*
	*All timber house / small school / clinic = 2-4 cubic meters*
	*Basic shelter = <0.1 cubic meters*
	*Basic timber shelter frame = 0.3 cubic meters*

A.3.5 availability

What is available on the local and national markets may be one of the greatest determinates of what material to be used.

Carry out a market analysis for different construction materials including the following categories:

- Legality
- Quality
- Sustainability
- Price
- Timeliness

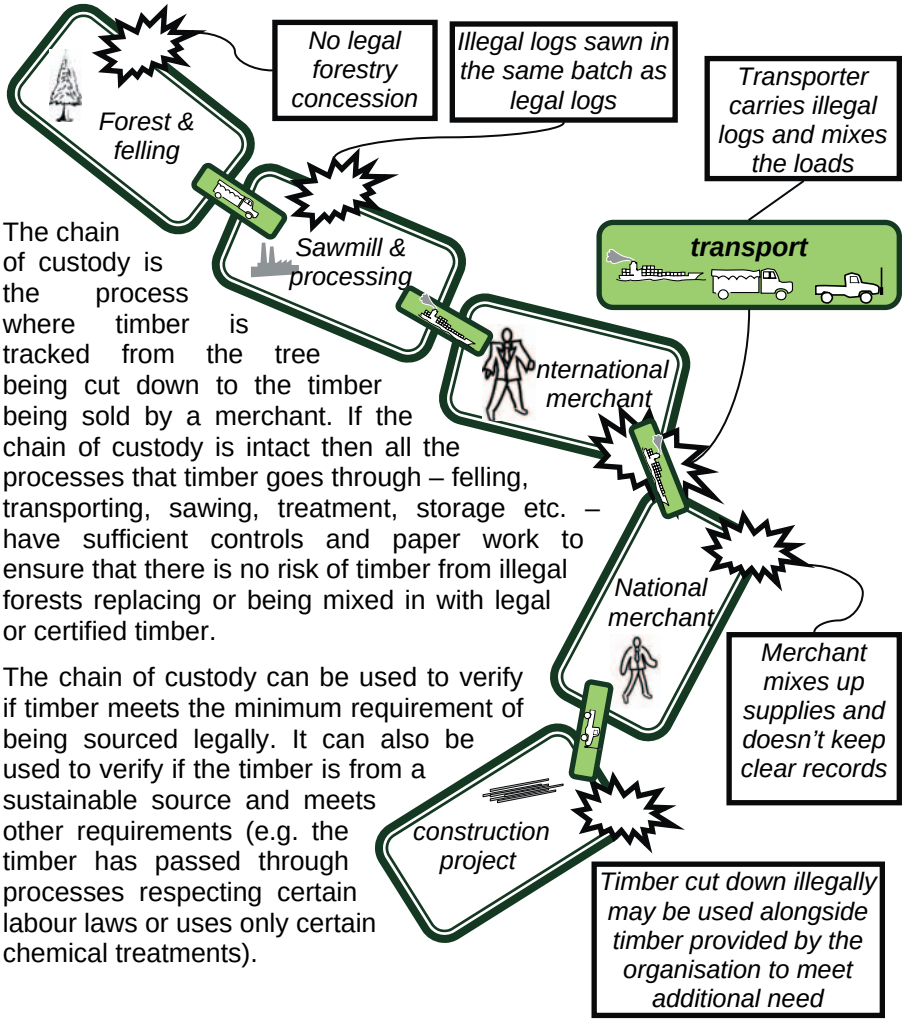
I do not want to price timber out of the range of people who need it!

This analysis should be conducted in a co-ordinated manner with other agencies where appropriate. When analysing the results consider:

- Other external demand for those materials
- Defining quotas for different markets
- The possibility of providing services to make better use of available materials (e.g. assisting with cutting tools)

A.4 Chain of custody & certification

As explained in section A.3.3 (Legality), timber is a product that is controlled by national and international law. But how can you tell if the plank you are buying in a timber yard has come from a tree that was cut down legally?



The chain of custody is the process where timber is tracked from the tree being cut down to the timber being sold by a merchant. If the chain of custody is intact then all the processes that timber goes through – felling, transporting, sawing, treatment, storage etc. – have sufficient controls and paper work to ensure that there is no risk of timber from illegal forests replacing or being mixed in with legal or certified timber.

The chain of custody can be used to verify if timber meets the minimum requirement of being sourced legally. It can also be used to verify if the timber is from a sustainable source and meets other requirements (e.g. the timber has passed through processes respecting certain labour laws or uses only certain chemical treatments).

As the chain can be broken at any point (see diagram above) it is important that the chain of custody can be verified. Ideally this is achieved by the timber being part of an internationally recognized certification system though it may be carried out by an independent auditor.

A.4.1 Certification systems

Is this arrow clear on certification levels?

Certification systems verify the chain of custody in order to be able to trace the origin of timber. Certification systems may have different grading levels to certify that timber not only meets minimum legal standards but also that wood products contain a certain percentage of recycled material or if the product is from a sustainably managed forest (moving further to the right of the arrow above). Some of the major certification bodies are listed below:

Organisation	Description	Legal?	Sustainable?
FSC Forest Stewardship Council www.fsc.org	FSC certification is carried out by FSC accredited certification bodies rather than directly. FSC issues updates on certificates awarded.	Yes	Yes
PEFC Programme for the Endorsement of Forest Certification schemes www.pefc.org	PEFC is a global umbrella organization for the assessment of and mutual recognition of national forest certification schemes.	Yes	Yes
SFI The Sustainable Forest Initiaive www.aboutsfi.org	SFI certifies different types of forest products.	Yes	Yes
CSA Canadian Standards Association www.csa.ca	The CSA SFM Mark is applied to wood products from a forest certified to Canada's National Standard for Sustainable Forest Management (CAN/CSA Z809).	Yes	Yes
MTCC Malaysian Timber Certification www.mtcc.com.my	The Malaysian Timber Certification Council (MTCC) is an independent organisation established to develop and operate a voluntary national timber certification scheme.	Yes	No

Are there other major certification schemes?

A.4.2 Other third-party verification methods

Agencies should consider co-ordinating to hire independent monitors to evaluate the legality of timber supplied or audit a supplier. This would also be necessary for verifying a construction contractor's commitment to using legal and sustainable timber.

We can work together to monitor legality and sustainability.

Organisation	Description	Legal?	Sustainable?
Tracing Services Consultant verification services, can track logs and identify them by DNA.	Certisource: **www.certisource.net** SGS: **www.sgs.com** TracElite: **www.tracelite.com** Track Record: **www.trackrecordglobal.com**	Yes	No

Independent Forest Monitoring

IFM involves an international, independent third party, which, with the agreement of state authorities, monitors the range of official processes relating to forest management.

IFM has thus far been undertaken in Cambodia, Cameroon, Canada, Ecuador, Indonesia and the Philippines, by both NGO and corporate sector organisations. See **http://www.illegal-logging.info/** for more information.

A.4.3 Problems with verification

Tracing back the history of a piece of timber can be extremely difficult in countries where national law is weak and timber is highly profitable (and sometimes illegal). Certificates can be faked and corruption in the timber industry may make relying on national government certification impossible while in some countries timber can be an extremely dangerous and violent industry to be involved in.

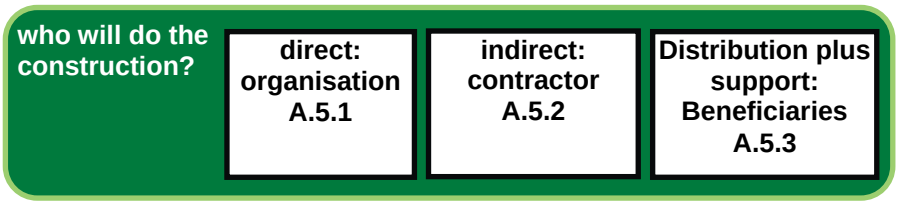
Identifying corrupt certification is not easy nor is it easy to appeal to national law if the government is part of the corruption process. Co-ordination of agencies to provide strength through numbers will help and advice can be sought from WWF or the ITTO (see annex).

What other verification is there?

A.5 Who will construct?

Deciding who will carry out the construction should be discussed with all of the actors involved. Generally it is good for beneficiaries to be responsible for aspects of the construction process as stated in Sphere Standard 5 in chapter 4 on Shelter, Settlement and NFIs:

> Shelter, Settlement and NFIs – Standard 5) Construction:
>
> "The construction approach is in accordance with safe local building practices and maximizes local livelihood opportunities". (p.224)



A.5.1 Direct – the organisation constructs

If the organisation implements the construction then it agrees to take on the 'risks' or responsibilities associated. These include:

- Ensuring the supply of timber is legal / sustainable
- Following legal requirements for construction such as Health and Safety law and national construction standards
- Being ultimately responsible to beneficiaries for the completion of construction on time and minimising delays

A.5.2 Indirect – construction is out-sourced to a contractor

If a contractor is engaged to construct then, in theory, the organisation passes over some of the 'risks' or responsibilities over to the private sector. However, this does not automatically solve procurement problems.

If a contractor is involved then either

- The organisation supplies the timber or
- The contractor is responsible for procurement.

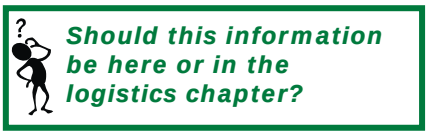
The second option appears to be attractive as all responsibility for ensuring timber is legal/sustainable is passed on to the contractor. However, the **organisation must monitor and verify** the legality/sustainability of the timber used by the contractor and a system of checks be established within the contract between the two parties.

A.5.3 Distribution – materials are given to beneficiaries to construct for themselves

Timber can be distributed for 'self-build' programmes. In some rebuilding programmes, community committees have been given cash accounts with which to procure their own timber (though the organisation may operate as a timber supplier to guarantee the quality and legality of supply). In other projects individuals are given vouchers to exchange for building materials from certain suppliers.

Consider:

- Timber is heavy – can beneficiaries transport it from a central distribution point and lift and cut it?
- Are other materials provided with the timber so it can be used effectively (fixings such as nails etc.).
- Timber is a valuable material (as are the fixings provided with it) and will have an impact on local markets, especially if re-sold.
- Monitoring and quality control on how the timber is used – provide technical support.
- Agencies may have quite sophisticated ideas about **Natural Resource Management** (NRM) which are not easily communicated to beneficiaries. NRM therefore needs to be realistic and simple.
- Shelter construction is a social process and not just a technical structure.



A.6 What materials?

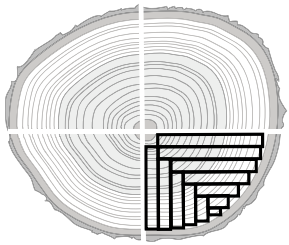
Timber can be used as a material with very little modification (e.g. dried logs) or after undergoing industrial-scale processing (e.g. the production of ply-wood). Here the main types of wood used in construction are considered: sawn wood, timber poles and bamboo. Also highlighted are other types of timber product that fall outside the scope of this document.

A.6.1 Sawn wood

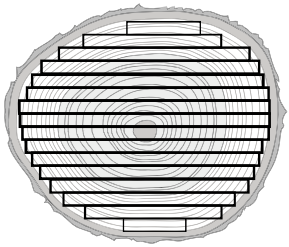
Sawing wood can be done simply, by two people in a sawing pit, or through mechanised saw mills. Timber is normally cut into standard lengths (see section B.5).

The way timber is sawn has an important effect on its strength. Timber that has the rings at angles of between 45° and 90° to the wide surface is called quartersawn. Timber with the rings at an angle between 0° and 45° to the wide surface is called plainsawn or backsawn timber. Quartersawn wood is more expensive as it involves turning the timber while sawing. However, quarter sawn wood shrinks and distorts less and is therefore stronger.

Most construction-grade sawn wood is chemically treated softwood (cheaper as it is faster growing).



Quartersawn



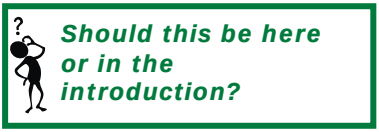
Backsawn

A.6.2 Poles

Timber poles can be used instead of sawn wood as they may be easier to obtain and more appropriate to local building practices. Poles may be cheaper due to fewer processing costs. Poles are normally procured by quantity and diameter (usually 100mm or 150mm) and are normally around 3-4 meters in length (the diameter may thin towards the end).

Poles that are 'peeled' or 'rounded' (i.e. have their bark stripped to produce an even size) lose 30% of their material and 40% of their strength. Rounded poles may have less strict import condition placed on them than poles with the bark still on.

A good guide to timber pole use is Timber Pole Construction by Jayanetti & Follett (2000).



A.6.3 Bamboo

Bamboo is a common construction material in parts of Asia, Africa and South America and may be particularly useful in the building of temporary structures. Its flexibility can make it a useful building material in earthquake areas. However, bamboo may have negative social connotations and it is important that people should be familiar with its application and skilled in its use.

There are many types of bamboo, so the correct local species should be identified prior to procurement and use.

Bamboo can be dried and treated to increase its durability (it degrades very quickly if it gets wet – see section B). A good guide to bamboo use is the ITDG publication 'Building with Bamboo' by Janssen (1995).

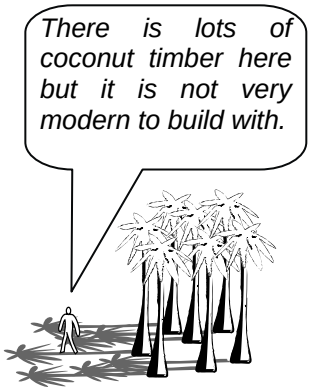
A.6.4 Other timber products

What else can be said about uncommon timbers?

Which species?

Some trees, such as coconut trees may not normally be used for construction. However these trees might be widely available or may have been felled by a storm or flooding. People will tend to have preferred types of wood for construction. Certain timber may not be used because:

- It is not durable or easily treated.
- It carries a social stigma; it is viewed as a "poor person's" material.
- It might take many years to encourage use of more appropriate timbers or the use of bamboo in local construction.



Other processed timber

As part of the construction project it is likely that other timber products will be used, particularly plywood for walls, ceilings and floors. This guideline does not deal with all timber products but the following should be considered:

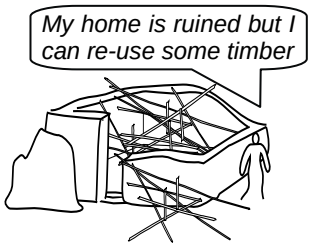
- Pre-fabricated frames (doors/windows) must use wood from legal sources and be organised to be delivered at the correct stage of construction.
- Plywood and timber composites must also use wood from legal sources.
- Plywood and timber composites contain glues and chemicals people may not be aware of so careful of people using composites in dangerous ways (chipped for animal bedding etc.).

Should other processed timber be included?

A.7 Alternatives to timber as a construction material

This section is not comprehensive but is intended to make some basic suggestions for alternatives to timber when using timber is inappropriate or impossible. In all cases, attention needs to be paid to the local style as unusual materials may not be well accepted.

A.7.1 Salvage



Frequently, following a natural disaster, significant amounts of construction material and timber is available from damaged or destroyed houses.

Following earthquakes, this material is usually on or near the site of buildings, whilst following flooding this material will be displaced.

The key challenges are: establishing ownership, collecting the timber and cleaning the timber.

Establishing ownership

- For timber that is on the site of an existing house this is usually simple.
- For timber that has been washed away, by water or landslides, local laws will have to be consulted or established.

Collecting the timber

- For timber that has clear ownership this is usually done by the owners.
- For timber that has been washed away, help might be required to retrieve it. This is especially the case for entire trees that might be usable but too heavy to move.

Cleaning the timber

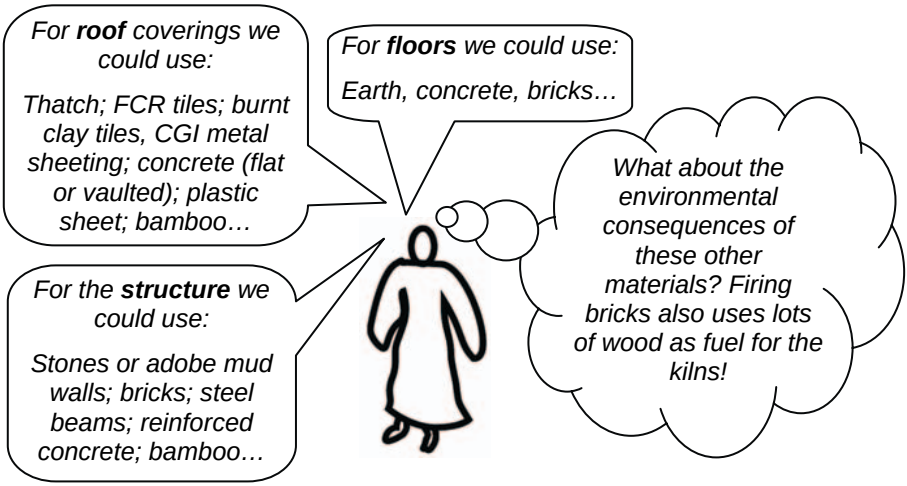
- The timber should be collected, cleaned with water and tools and then dried.
- Care should be taken if there is concern that it might be contaminated.

Using the timber

- The cleaned timber should be carefully sorted and checked for splitting and fractures before being used.

A.7.2 Other materials

In many cases, alternative materials to timber can be used. The decision on which materials to be used will be based on many factors including the design, the intended lifetime of the building, the available materials as well as the environmental impacts of the material to be used (see section A.3).



A.8 Design, joints and fixings

Designing a structure is not simply a technical exercise. Sphere states:

> Shelter, Settlement and NFIs – Standard 4: Design
>
> "The design of the shelter is acceptable to the affected population and provides sufficient thermal comfort, fresh air and protection from the climate to ensure their dignity, health, safety and well-being". (p.221)

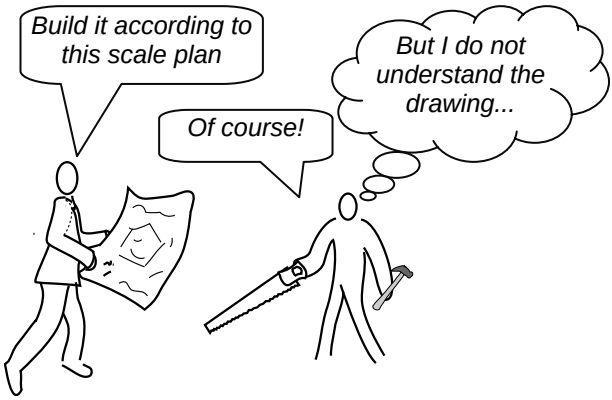
Wherever possible, design should be informed by what is available and what is quickly procurable.

At the most basic level, constructions using timber need to be:

- Acceptable – built with appropriate construction methods
- Stable and well fixed
- Designed to reduce the possibility of timber degenerating through rot and attack by insects (keep it dry!).

A.8.1 Appropriate construction methods

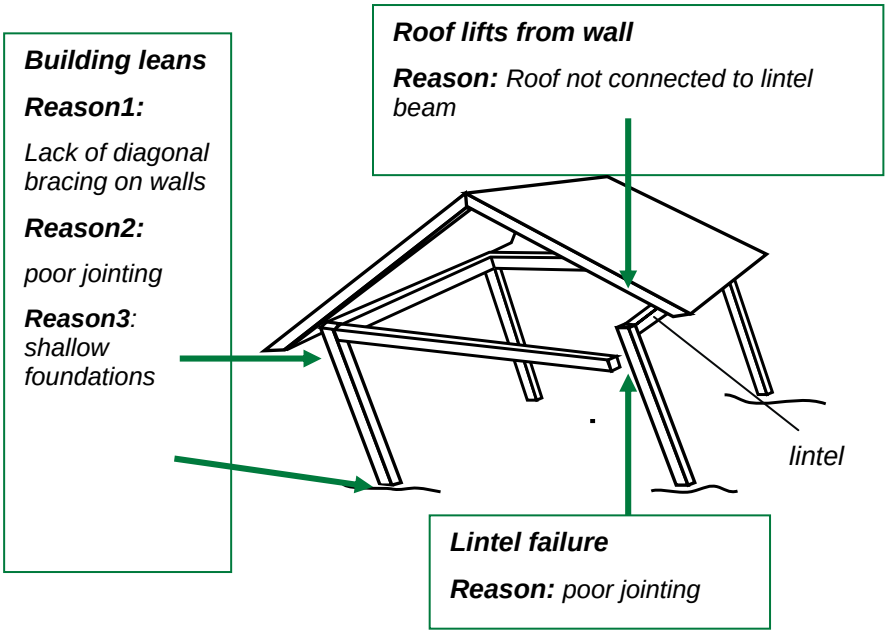
When designing a structure or locally employing someone to build a structure, the planned construction should be appropriate to needs and context. It should take into account:



- Beneficiary needs – do the construction details fit the needs of those for whom it is intended?
- Available skills and materials - can the carpenters build the demanded structure?
- Cultural acceptance – are people familiar and happy with the materials used?
- Local risks – build with earthquake, wind and flood risk in mind. Seismic resistant design is beyond the scope of this booklet, but pay attention to jointing and bracing.
- Can the other materials (fixings, roofing materials etc.) be supplied?
- Can the structure be adapted for longer term uses?

A.8.2 Designing for stability and protection

The key to any non-engineered structure is the bracing and jointing used.



Building collapse due to poor foundation, walls or roof

Buildings must:

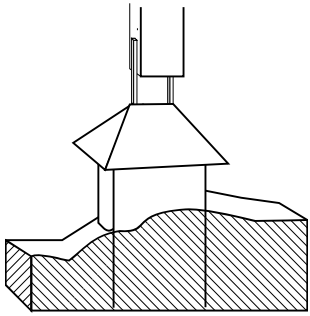
- Be securely anchored to the ground (foundations)
- Have strongly braced walls to both bear the weight of the roof and support wind (or earthquake loads)
- Have a roof securely connected to the roof
- Have a strong roof – using bracing

Ground preparation

A site away from landslide or flooding risks should be identified. It should be prepared with drainage, and levelled if required.

Foundations

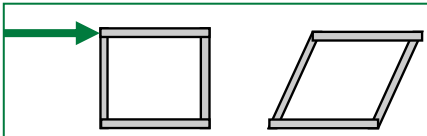
- If the walls are to be made of timber or bamboo, the point where the timber or bamboo meets the ground is one of the key weak points of the structure. Active design steps should be taken to reduce risk of rot caused by moisture and termite / insect risk
- The simplest type of foundation is a basic pad foundation, with the timber dug straight into the ground. Although timber or bamboo is likely to rot or be attacked by insects in such foundations, there may be circumstances when they must be used. Generally they should be a minimum of 50cm deep (allow extra timber for foundation poles.)
- Prevent termite attack by using mesh or plates at the base of the foundation



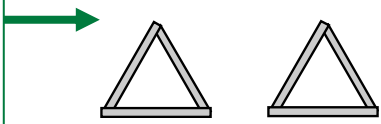
Timber frames raised from the ground on solid foundations to prevent insect attack and decay

Walls

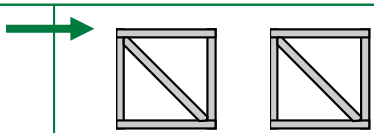
- Walls must both bear vertical loads – the weight of the roof - and horizontal loads from wind or earthquakes. In all designs walls should be braced.
- Walls must be built with a plan to connect the roof.



A rectangular structure (such as a wall frame) can deform without bracing



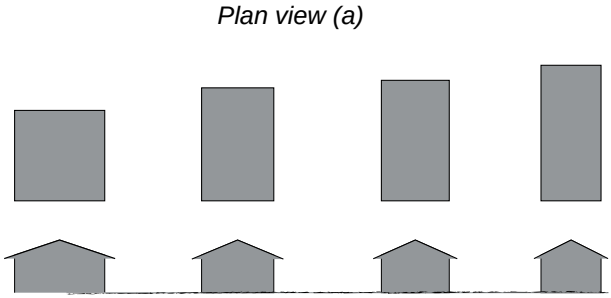
A triangular structure is stronger than a rectangular structure



By bracing a wall diagonally, triangles are made, making the wall stronger

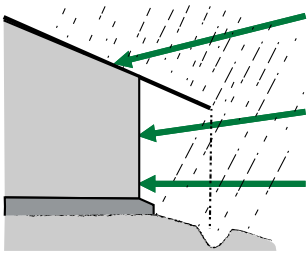
Roof

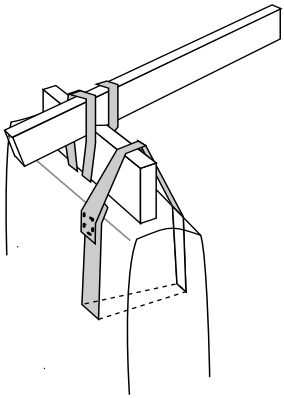
The roof can be made of timber or timber can be used to make the structure that supports another roofing material. Roof frames must be designed to bear the weight of the roofing material, wind load, the weight of those that repair them, and in some cases snow loads. Note that narrower span roofs are stronger than wider span roofs. There are many possible designs for the roof e.g. gable, pitched, saddle, hipped. An excellent guide to roof design is the roof structure guide from SKAT (see references in annex).



Buildings with the same covered area are shown in the plan views (a). these buildings have different lengths of roof span (b)

Roofs of timber walled buildings should have significant overhangs to protect the walls. Roofs must be connected to the walls. Their pitch should be designed appropriate to the wind load expected.

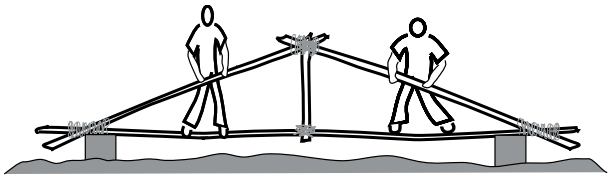




Connecting a roof to a wall

Strength testing

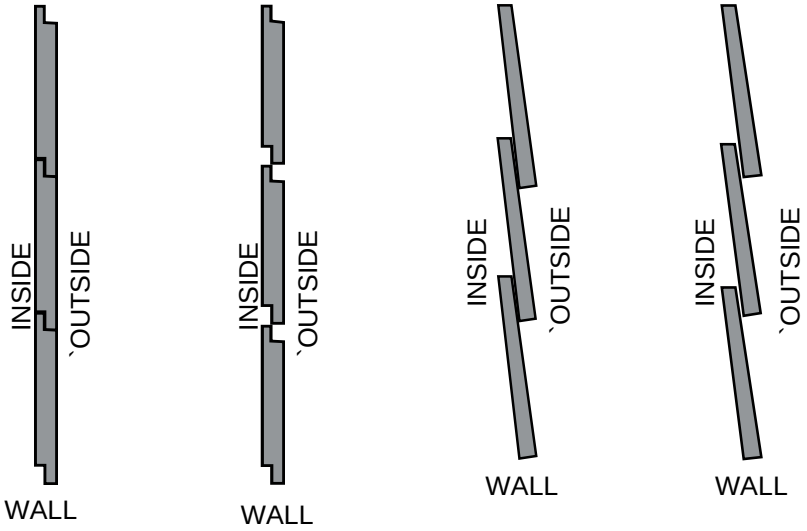
If all of the available timber is of an unknown strength, strength tests are better conducted on sample components rather than individual beams.



Sometimes the only way to know the strength properties of timber is to test a whole design element

Constructing with green timber

Ideally timber should be dried, however in some cases it will be necessary to build with green timber (requiring engineering expertise). When this occurs, design and fabrication should take into account the expected contraction and warping of the wood.



Timber walling as anticipated (with green timber)

Green timber shrinks causing wall to leak

Timber walling designed for shrinkage. (NB: uses more timber)

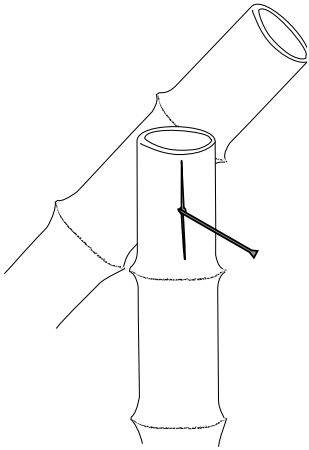
Timber shrinks and wall remains water-tight

Example of how design might make allowance for green timber that will shrink

A.8.3 Jointing timber and bamboo

Jointing of timber is by glue, nails, pegs, screws or bolts. Joints can be strengthened with gang plates or metal strapping. Timber is frequently cut to improve the contact surface between

All joints should be designed so that the joint is strongest in the direction of the load bearing forces.

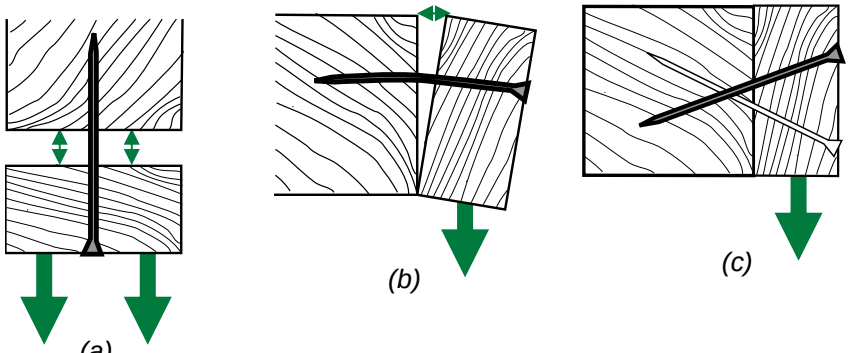


Bamboo is harder to nail than wood because it splits more easily

Nails / screws / bolts

- Nailed joints are strongest across their length rather than the direction of the nailed joint.
- Do not procure nails that are too large as they will split the timber.
- Avoid nailing bamboo as it tends to split.
- Screws or bolts can be stronger than nails and allow the timber to be recycled at the end of the use of the anticipated lifetime of the building, but are slower and require drills and screwdrivers or spanners.

Wood treated with copper-based preservatives, such as ACQ, can corrode fasteners (nails, screws, bolts, brackets). Untreated nails can be dissolved almost entirely. To minimize losses, steel fasteners can be coated with chromate paint, plastic, ceramic and metal coatings (double galvanizing or hot-dipped), or made from copper or stainless steel.

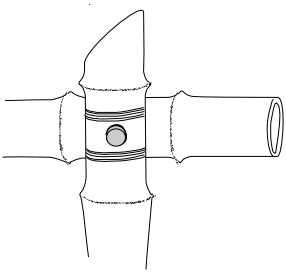


Nails have least grip lengthwise (a). Structures should be designed so that the forces do not "pull nails out".

In (b), a single horizontal nail is not enough to hold the load, whilst multiple angled nails (c) are.

Pegs

- Hardwood pegs can be used to fix pieces of timber. They can be strong if used correctly but require skilled carpenters to use. They should only be used if the local carpenters are accustomed to them.
- Pegs and rope are among the best ways of connecting bamboo as, if carefully drilled they do not cause the bamboo to split.



Joining bamboo with pegs

String / wire or thread

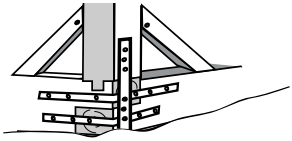
- Binding timber (especially bush poles) or bamboo joint is a very common way of building. If bound tightly, a strong joint can be formed

Glue

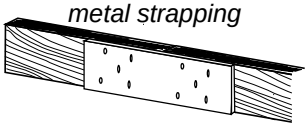
- The inner core of bamboo can be glued well, but the outer skin cannot be glued at all
- One of the strongest ways of fixing bamboo is to glue fitted timber into the ends. This can then be nailed as with timber.

Plates / Strapping

- Use of metal strapping is a simple way of increasing the strength of nailed joints. For example Distribution of metal strapping might be a simple way off increasing the resistance of timber buildings in an earthquake prone zone.
- Specialised metal plates are a simple way of jointing sections of timber. They might also be used with bolts



Note how the corner joint has been reinforced with metal strapping



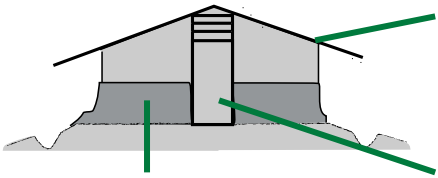
Use of metal plate to join timbers

How much wire is needed for a bound joint?

A.8.4 Reduced timber construction

By their very design, some structures use more timber than other structures with the same floor area. This is most critical when a basic design of structure is to be repeated on a large scale.

- Design for available sizes of timber available to reduce wastage.
- Understanding of components in tension as opposed to components under compression can help reduce cross sections of pieces of timber
- Consider semi-timbered rather than full height timber walls.



half wall made of masonry (not fully timbered wall)

Use of large roofing sheets rather than tiles reduces quantity of battening required

Door frame doubles as structural element

Reducing waste

Construction programs can produce many off-cuts. Off-cuts can primarily be used to improve connections and for strengthen jointing. They can also be used as fuel, chipped for animal bedding or, in the case of bamboo, used for animal feed. Identifying possibilities for recycling off-cuts in advance reduces wastage.

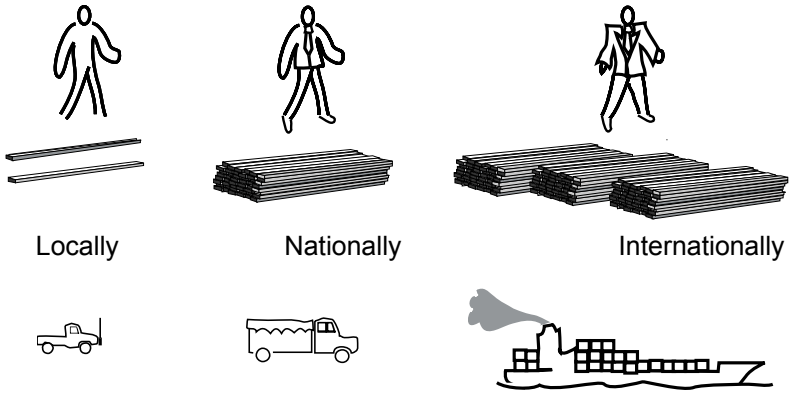
Have the major structural issues been addressed here?

section

procurement

B PROCUREMENT

As described in section A1, procurement may be made locally, nationally or internationally.



Small local purchases are unlikely to require as much detailed information or documentation as large national or international purchases. However, agreement between buyer and supplier on what specifications will be met is always necessary.

Putting together clear tender and procurement documents at the start of the process and identifying necessary national paperwork will save time at later stages of the procurement process. This section looks at what needs to be specified. It applies when contractors procure timber as part of a construction project as well as when organisations directly procure timber or bamboo.

SAMPLE SPECIFICATION SHEET [B.1]

Specifications for timber should include:

Documentation required (legal, sustainability certification **[B.2]**

Specifications of drying and treatment processes and treatments **[B.3]**

Quality specifications **[B.4]**

Quantities **[B.5]**

Delivery conditions **[B.6]**

Responsibilities & payment **[B.7]**

B.1 Specification sheet

Below is an **EXAMPLE** specification sheet with some suggestions for what might be included (developed from FAO's Tsunami work[1]). The exact specifications depend on the context and should be developed by an engineer in consultation with the logistician.

Timber used for different parts of a structure will have different specifications. More than one specification document may be required for each order.

Documentation	**See section B.2 Documentation**
Legality	• Certificate of legality from national government • Guarantee that no timber from the CITES list is included • Timber travel document • Sawmill license • Customs and Excise documents
Certification	• Certificate of sustainability from a recognised system • Not from High Conservation Value Forests (proof of forest source)
Processes	**See section B.3 Processes**
Seasoning	• Dried to 15% Moisture Content • Specify drying method and time (e.g. kiln dried 2 weeks)
Treatment	• Pressure treated CCB with anti-termite topical application • Treatment allowed by nationally law for timber not in contact with the ground • Treatment (creosote) must be made along the entire length of the timbers to a depth of 5mm.
Quality	**See section B.4 Quality (grading)**
Grading system	• Internationally recognized grading system (specify which in relation with which standard e.g. ISO) • National grading system (specify how grades are defined and in relation to which standard) • Informal local grading system (specify how the grades are defined e.g. 'external construction' or 'non-structural')
Grade required	• Class I, II, III etc as defined by the grading system above
Durability	• Timber must have a natural durability of X years and a seasoned/treated durability of Y years.
Visual grading – timber	• See section B.4.3
Decay	• Timber is free from pests and rot • None, except in an unsound Knot
Sloping grain	• 1 in 8

[1] www.fao.org/forestry/webview/media?mediaId=10473&langId=1

Knots	• Solid: 1/3 dimension of face, to max of 10cm diameter. 1 per meter in length • Unsound: 1/4 dimension of face, to max of 7cm diameter. 1 per 3 meter in length
Wane & want	• 1/3 sum of width and thickness
Checks	•
Split	• Longest split, 15cm at each end
Shake	• 1/2 thickness
Compression failure	• None
Warp	• BOW: 1 cm in 3m; CUP: 1 cm in 3m; SPRING: 1 cm in 3m; TWIST: 1 cm in 3m
Sapwood	• Sapwood as for wane
Visual grading – poles	• See section B.4.4 Visual grading – timber poles
Sweep/crook	• Pole does not deviate from middle axis
Taper	• Not exceed 5-10mm per meter
Spiral grain	• No 'twisted' trees
End splitting	• Splits should not extend more than 100mm along the length of the pole from end to end
Splits from handling	• Serious damage to outer fibers caused by storing, transporting etc. will result in rejection of pole.
Visual grading – bamboo	• See section B.4.5 Visual grading – bamboo
Quantity	**See section B.5 Quantity**
Dimensions	• Sizes required and total volume required stated
Deviation or Tolerances	• No more than 5% of length, width height • Max 5mm in lengths up to 75mm, 10mm in longer lengths
Delivery	**See section B.6 Delivery**
	• Description of packaging • Description of carrying volume of containers INCLUDING packaging
Responsibility & payment	**See section B.7 Responsibilities and payment**
	• 5% reduction in price for each 3% of timber that does not meet standards • Responsibility for cost of transport falls on supplier for rejection of timber

Are these specs useful or correct? What about bamboo & poles?

B.2 Documentation

Each agency has its own tendering and procurement procedures and each situation will have different requirements in terms of documentation to be provided. However, some level documentation will be required from a supplier in all situations.

Document	Supplier		
	Local	National	International
Proof of legality (identification of forest source etc.) [B.2.1]	YES	YES	YES
Proof of sustainability [B.2.1]	Unlikely	Preferable	Preferable
Phytosanitary certificate (for packing as well) [B.2.2]	NO	NO	YES
Customs clearance documentation	NO	NO	YES
Documents relating to other **national law** (e.g. tax and royalties paid; health and safety law followed in relation to timber treatments etc.)	Preferable	YES	YES
Description of **harvesting/logging process**	YES	YES	YES
Description of **seasoning and treatments** used (operating procedures)	YES	YES	YES
Certification of quality by a national or international grading system	Unlikely	Preferable	YES
Delivery note and **invoice**	YES	YES	YES

B.2.1 Proof of legality and sustainability

Deciding conditions on what is and is not acceptable evidence of legality or sustainability is essential before issuing the tender and would be best agreed in agency co-ordination meetings if many agencies are going through the same process.

Local legal documents

Small local procurements are unlikely to require a tender. Where possible, a government licence/certificate should be produced to determine the legality of timber.

Would samples of some of the documents be useful?

In the absence of a functional government body, establish who owns the forest and whether harvesting is considered to be legal under national law, or in its absence customary or traditional law.

A signed agreement to use timber from a collectively managed forest or a forest owned by local government should be obtained to prevent disputes in the future.

National and international legal documents

The following is sample text for use in a tender for national and international suppliers:

> The supplier should note that timber must come from legal sources and, preferably, sustainable sources. Suppliers can provide:
>
> (a) – Timber that is legal (this is a condition of contract an absolute minimum requirement); or
>
> (b) – A standard tender as in (a) above plus a separate tender for timber that is both legal AND from a sustainable source.
>
> The Agency prefers to award the contract to an offer to supply both legal and sustainable timber and will do so if it represents value for money.

Verifying the legality of timber normally involves the supplier being able to produce a national legal certificate of some sort.

Documentation to support the legality or sustainability of timber can be:

- 1st party checks – a company's own documents
- 2nd party verification – another agency's assessment or a second supplier's assessment as part of that second supplier's audit
- 3rd party audit – an official certification scheme or national certificate of legality

The easiest way to verify timber's legality and sustainability is through 3rd party audit - a certification system (see section A.4).

In the absence of a 3rd party certification scheme other documentation could be used to evaluate the legality and sustainability of a source. This could include waybills, invoices, independent review by other suppliers etc.

These documents should be attached to the tender and a cover sheet following the CPET format below could be provided to the supplier to assist in clarifying the process of verification:

How should this section link to A.4: Chain of custody?

How else can you verify without a certification system?

Supply chain stage	Supply chain description		Controls for preventing mixing or substitution	Mechanism for verification	Evidence available or provided
	Description	Location			
Forest					
Stage 1					
Stage 2 etc.					

The World Wildlife Foundation has published a useful guide to legal timber procurement which gives more detailed advice[2] while CPET has published some useful guides to assist the verification process[3].

B.2.2 Phytosanitary certificates

A phytosanitary certificate is necessary for all imports and is usually issued by quarantine authorities / ministry of agriculture in country of departure. This normally includes:

- Details of packing
- Botanical names of tree species and whether wood is softwood or hardwood
- Country where tree came from
- Serial numbers of phytosanitary certificates issued in the country of origin (import if timber is re-exported)
- Dimensions/weight of packaging articles plus volume of wood in cubic metres
- Name/number of boat or plane
- Wood treatment type (e.g. Chemical Pressure Impregnation)
- Name of chemical used
- Duration of treatment applied for effective treatment
- Dosage rate of chemical (number of grams per cubic meter)
- Date of treatment

[2] 'Keep It Legal' http://assets.panda.org/downloads/keep_it_legal_final_no_fsc.pdf
[3] http://www.proforest.net/cpet

B.3 Processes and treatments

Timber's durability is measured by its resistance to attack by insects or fungi. Protect timber and improve its durability by:

- Drying timber (seasoning) and keeping it dry (B.3.1 Seasoning)
- Treating timber with a preservative (B.3.2 Treatments)

Timber's durability is largely affected by its exposure to water. A timber's 'hazard class' (HC) is a description of what hazard it is exposed to once it has been used to build something. Different countries have different classification systems, but many look more or less like this:

Hazard Class	Description
1	Timber not exposed to weather – frames / internal e.g. doors, roof trusses, floor boards
2	As above and protected from termites
3	Timber exposed to the weather but not in contact with the ground e.g. cladding, log-homes
4	In contact with the ground – fence posts etc.
5	Timber exposed to 'continual wetting'
6	Marine use – jetties etc.

Most construction timber is Hazard Class 2 or 3, and it is important to make sure the design of the structure keeps this grade of timber out of the ground. Suppliers should state what treatments timber has undergone (this is required on a phytosanitary certificate in the case of imports).

B.3.1 Seasoning

Seasoning is the drying of wood in a controlled way to avoid distortion. Seasoned wood is lighter, stronger and less likely to split, warp or rot. Wood is seasoned by: air-drying or kiln-drying (or 'forced-air' drying).

Moisture content

Seasoning changes the moisture content (MC) of wood. Moisture content (MC) is a percentage:

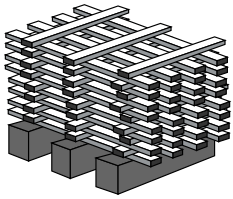
$$MC = \frac{\textit{Weight of the moisture timber contains (i.e. original weight of the timber minus its oven-dry weight)}}{\textit{Oven-dry weight (when all possible moisture is lost)}} \times 100$$

The moisture present in wood can weigh more than the dry weight of the wood and therefore it is possible to have a MC of over 100% when timber is green. The MC required for construction grade timber is normally around 15-18% and can be measured with a moisture meter (an electronic meter with two metal pins that are inserted into the timber. These can normally be purchased for around $150).

No moisture meter? Take a sample of timber (1kg should be enough) and record its weight. Put it in an oven at 100°C and weigh it every hour until the weight no longer changes. Then use the formula to calculate the MC. If available, this can be done with a microwave oven.

Air-Drying

Air-drying reduces moisture content to between 15 and 20%. Air drying takes around one year per inch (2.5cm) of thickness of timber for hardwoods and about six months per inch (2.5cm) for softwoods. This method is often used for timber poles.



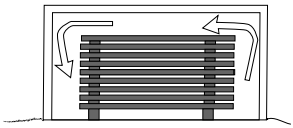
air drying by stacking timber so that air can circulate around it

Kiln-drying

Kiln-drying can bring timber moisture content to any desired specification in just a few weeks or less.

Bamboo

Bamboo shrinks more than wood when it loses water. The canes can tear apart at the nodes. Bamboo shrinks in the cross section by around 10-16% and in the wall thickness by 15-17 %.



kiln drying in controlled temperature and humidity

Both the season (bamboo should be harvested in the autumn and winter in the sub-tropics and the dry season in the tropics) and the species type are important when procuring bamboo. Bamboo intended for structural works needs to be dried for two–three months after harvest, until about 90 per cent of the water content has dried out. It should be harvested at dawn, when the plant is at its most dry.

Bamboo can be air-dried in stacked frames with good air circulation for 6 - 12 weeks. Kiln-drying of bamboo takes 2 - 3 weeks but some species may not tolerate quick drying.

Other treatments are applied to reduce water content and remove starch / sugars in order to reduce the likelihood of attack by insects:

- Clump curing – cured in locations they are cut
- Smoking – cured by smoking (can lead to cracking)

- Soaking – soaked in mud/water for 4-12 weeks (removes starch and sugar) then dried in the shade.

B.3.2 Treatments

There are 3 main types of preservatives to protect timber against rot and pests:

Oil-based

The most common is creosote (obtained by the distillation of coal tar and used externally for Hazard Class 3,4 & 5), often diluted with cheap petrol oil. Other treatments include pentachlorophenol and copper naphthenate and may be applied as a 'paint' or under pressure. All of them are toxic to humans. Linseed oil has been used as an 'envelope' treatment (not penetrating timber more than 5mm) and is cheaper than other treatments (though not as effective).

Water-borne

Water-borne treatments can be low-pressure or high-pressure and fixed (do not wash out with water) or non-fixed (generally boron compounds). They are made up of small amounts of fungicide/insecticide dissolved in water, to which a dye is sometimes added. Low-pressure treatments are quick-drying and in general construction meeting Hazard Classes 1, 2 and 3. High pressure treatments maximize the penetration of timber and are suitable for all hazard classes.

Water-borne treatments include: copper compounds such as Chromated copper arsenate (CCA) which is highly toxic, often banned and not recommended. Alkaline copper quaternary (ACQ) is a safer alternative and can protect timber for around 25 years; borate preservatives (non toxic to humans but can be washed out of timber); Bifenthrin spray preservatives which only penetrate timber 2mm (not clear how well they protect against insects.)

Light Organic Solvent Preservatives (LOSP)

Light Organic Solvent Preservatives are similar to low-pressure water-borne treatments but replace water with white spirit as a solvent. They are normally used for Hazard Classes 1, 2 and 3. As they do not affect the surface of timber, they are often used to protect timber used in joinery.

LOSP treatment is normally expensive but it protects timber for up to 40 years. Attempts to use water as a solvent have resulted in similar welling effects as Water-bourne treatments. LOSP treated wood should not be used where it may come into contact with public drinking water.

Bamboo chemical treatments

To preserve the bamboo inside of the pole, all diaphragms have to be perforated or all segments drilled.

- CCB, copper, chrome, +boron better treatment
- Coatings with borax are ecological and widely used. In addition, lime slurries, rangoo oil or slurries from lime or cow dung are also used.
- Kerosene, DDT, PCP, CCA- (3:1:4 mixture of copper, chrome, arsenic) are all toxic and not advised

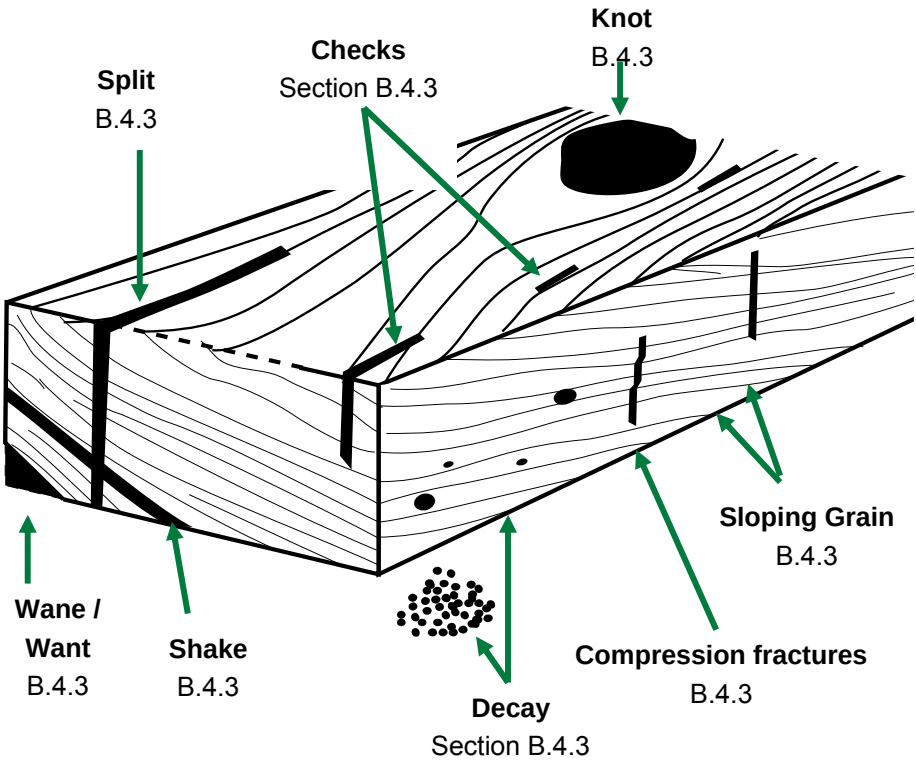
Treatment processes include: the open tank method, butt treatment method or the Boucherie method (see Janssen (1995) Building with Bamboo: An Introduction).

What other information on treatments is there? Especially on treatments in the field when expensive chemicals are not available...

B.4 Quality (grading)

As Timber is a natural material, there is significant variation between types of timber and between individual planks. Ideally timber should be classified according to the loads it should bear (using national or international formal structural grading systems) and the level of moisture and the weather to which it should be exposed (using a system of "hazard class"). In practice, such Graded timber may not be possible to obtain outside of capital cites.

When tendering, ordering or receiving a delivery of timber, and when choosing timbers in a local timber yard, some of these natural features must be defined to ensure that the timber is of suitable quality. Below is a diagram of a low quality piece of timber showing some of the flaws that might be found.



B.4.1 Strength/Density/Stress Class

Strength grading classification differs between countries and may be termed 'strength' or 'stress' grades. Official strength classification is normally made on a combination of machine-tested measurements and visual grading. Strength grading is not necessarily related to visual grading. A summary of country-specific grades can be found in FAO's Tsunami information guides guide (see annex for reference).

Machine strength grading exploits the relationship of stiffness to strength by measuring the resistance of each piece of timber to flexing. Certificates can be provided by independent grading bodies (e.g.TRADA: www.trada.co.uk) to verify whether quality controls are being met by a supplier.

Visual strength grading assesses the size, frequency and positions of characteristics such as knots, wane, sloping grain and other factors which affect strength. Grading rules lay down the allowable limits for each grade.

In the absence of an established national grading system, procurement from a local supplier can establish a strength specification by agreeing on:

- Species
- Visual grading specifications (see section B.4.3)
- Density (common density for softwoods used in construction is between 450 and 550 kg/ ḿ).

B.4.2 Durability

Durability varies by species. Heartwood is naturally more durable than sapwood. There is no internationally agreed specification for durability. However, the Australian classification[4] gives a good guide to what might be demanded. Their classification is based on trials of resistance to pests and decay of untreated heartwood in the ground.

Class	Description	No. of years durability in the ground	No. of years durability above the ground
1	Highest durability	25 years +	40 years +
2	High durability	15-25 years	15-40 years
3	Moderate durability	5-15 years	7-15 years
4	Low durability	0-5 years	0-7 years

[4] http://oak.arch.utas.edu.au/glossary/view_glossarylist.asp?term=D

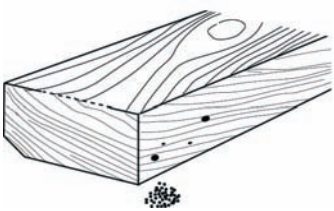
B.4.3 Visual grading – sawn wood

Visual grading can be used in situations where the supplier is unable to grade their timber mechanically as well as for specifying and checking timber quality in deliveries from suppliers using machinery.

Visual grading is a complex and difficult procedure and professionals undergo considerable training to become qualified. However, in circumstances where small quantities of timber are being purchased and logisticians are involved in evaluating deliveries, some of the following basic guidelines may be of use.

When visually grading timber, all surfaces should be checked and the timber is normally rolled along its length to reveal any obvious warping. Timber that is though not to meet the required specifications should be placed in a separate pile for double-checking and it would be advisable to have a representative of the supplier (e.g. the delivery driver) to acknowledge and sign for defective timber.

Decay

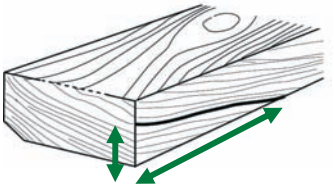


Decay is caused by fungus, bacteria or pests.

Specify: Free of fungus, bacteria or pests

Look for: Signs of fungus or insects, such as fine sawdust or holes. Reject timber with any signs of decay.

Sloping grain

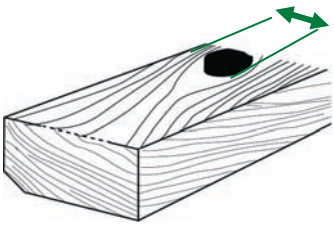


The slope of the grain on timber is the direction of the grain in relation to the length of the timber.

Specify: Allowable slope of the grain. (e.g 1in 8)

Measure: Measure the distances marked by the arrows in thee diagram to the right. The slope is the height divided by the length

Knots



A Knot is formed where branchs grow out of the main tree trunk. Knots weaken the strength of timber. A **sound knot** is one which is as strong as the surrounding wood and shows no sign of decay. An **unsound knot** is a weakness in the wood and is softer, chipped or shows other signs

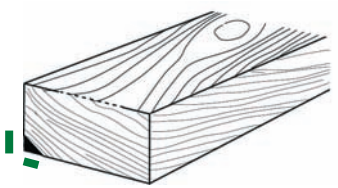
of decay.

Specify: Limits on knot sizes for sound and unsound knots.

Measure: Measure the width of the knot and divide it by the width of the timber. Also measure the number of knots per metre along the timber.

Wane and want

Wane is the absence of wood from the face or edge of timber due to the board being cut near the edge of a log.



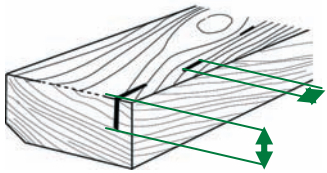
Want is the absence of wood due to some of the timber being split off in processing

Specify: maximum wane or want allowed

Measure: This is normally expressed as a percentage or fraction of the width or thickness of timber.

Checks

A **check** is a separation of fibre bonds accross the annual rings that **does not** carry all the way through an edge or face of a timber board.

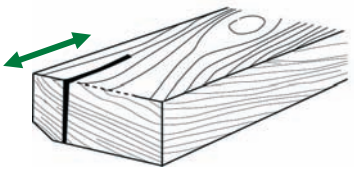


Specify: A limit on the absolute length of checks or as a maximum width of the board

Measure: the length of the checks and divide by the board thickness

Split

A **split** is a separation of fibre bonds across the annual rings that **does continue** all the way through to an adjacent or opposite side of the timber.

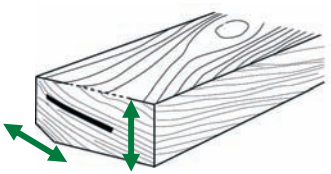


Specify: total length of the split, e.g. 15cm

Measure: the absolute length of the split from the end of the board

Shake

A shake is a separation or a weakness of fibre bond between the annual rings. Shake affects shear strength more than compression strength so specifications for the amount of allowable shake may vary depending on the timber's purpose. It can also allow water to enter the timber leading to rot

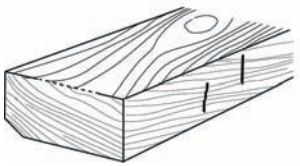


Specify: Maximum length of open shakes (cracks) as a fraction of timber end width. Eg less than ½ of end width

Measure: Length of open shakes (cracks) divided by plank thickness

Compression failure

A compression failure is visible as cracks across the grain, and is due to excessive compression.

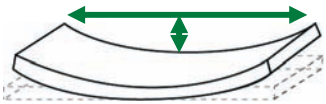


Specify: Timber should be free of all such fractures.

Measure: visual inspection

Warp

'Warping' is any variation from a true, flat surface. It includes



a) Bow warp: curve along the length of a board (along the grain)

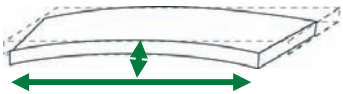
Specify: Deviation per unit length.

eg. Maximum 1cm per 3m length

b) Spring warp: curve along width of board (across the grain)

Specify: deviation per unit width.

eg 1mm/100mm width



c) Cup warp: curve along edge of a board but not affecting the face (along the grain)

Specify: deviation per unit length

eg Maximum 1cm per 3m length

d) Twist or curve warp: twisted distortion along the length of the timber (along the grain and across the grain)

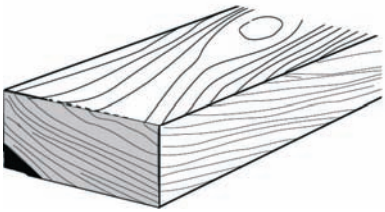
Specify: deviation per unit length

eg Maximum 1cm per 3m length

Sapwood

Sapwood (section i.5) is less strong than the heartwood. In softwoods it is treated to improve its durability.

Specify: If a hardwood is being ordered then should be considered as 'wane' (see B.4.6).

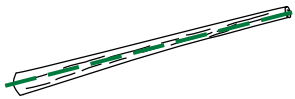


B.4.4 Visual grading – timber poles

Taper

Taper is the natural thinning of a pole towards its tip.

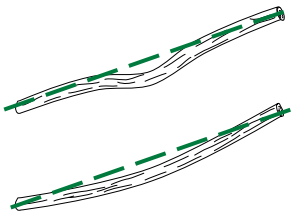
Specify: The change in diameter should not be more than 5-10mm per meter of pole length.



Sweep and crook

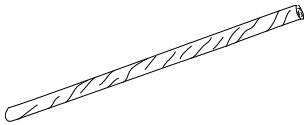
Sweep and crook measure straightness. 'Sweep', is where a pole bends like a banana, and 'crook' where a pole is crooked.

Specify: (draw an imaginary line from end to end of the pole and there should always be a part of the pole in the axis).Poles are usable if the sweep or crook deviation never falls beyond the central axis of the pole



Are there more grading tips for poles?

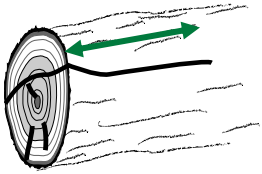
Spiral grain



poles from trees that have grown in a twisted manner.

Specify: rejected poles with spiral grain

Splitting



Poles might split at the ends

Specify: No splits larger than 100mm should be present at the ends of the poles.

Degradation

Specify: Poles showing insect or fungal attack should be rejected

Damage from felling

Specify: Poles that show severe damage from the logging process should be rejected.

B.4.5 Visual grading – bamboo

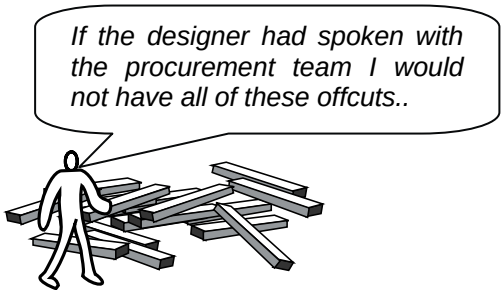
- Bamboo should ideally be dried for two months prior to use
- Bamboo should be straight (see sweep and crook in B.4.4) and free from defects.
- Bamboo should be clean from leaves and side branches.
- Bamboo should be free of cracks or splits (caused by mishandling or curing too quickly)
- The bamboo skin should be intact
- The nodes should not be cut so as to damage the skin integrity where the branches have been removed.
- Bamboo should be specified by minimum diameter or circumference

Are there more grading tips for bamboo?

B.5 Quantity

Depending on the scale of procurement, timber is procured by volume or by length. Within each order, individual planks or poles are specified by **length** and **cross section** or in the case of poles or bamboo, **diameter**. Sizes may be affected by finishing and shrinking.

Add 5% to order for wastage in transport.



Example - FAO[5] of a bill of quantities for Roofing Timber in Indonesia.			
Product	Dimension	No. Pieces	Volume (m3)
Roofing beams	5cmx10cmx4m	16	0.320
Roofing cross beams	5cmx5cmx4m	18	0.180
Corner wall beams	10cmx10cmx2.5m	4	0.100
External wall supporting beams	5cmx10cmx2.5m	18	0.225
Allowable species: Ampupu, Bangkirai, Bayur, Berumbung, Bintangur, Bungo, Cemara Laut, Cengal, Kapur, Keruing, Meranti batu, Merawan, Nangka, Resak, Semantok, Sentang, Sungkai, Tanjung.			
Durability Class: Class I-III, under the roof, no ground contact and well ventilated.			
Legality status: Must be purchased from a timber merchant licensed by the Dinas Trade and Industries Service.			
Treatment Required: Pressure treated CCB with topical application on ends during construction for termite resistance. Must attain hazard class II.			
Grading system/Grade: Local grading system, Class II			

[5] http://www.fao.org/forestry/site/tsunami/en Information Note 1: Procurement of Timber for Tsunami reconstruction in Indonesia

B.5.1 Dimensions

Cross section

When ordering, check what is considered to be 'standard' first, and procure according to those standards. There might be national variation in standard cross-sections as is illustrated in the table below.

Standard sawn timber sizes – metric & imperial and examples			
Inches	Metric equivalent	Swedish	Australian
2 × 4	50 x 100 mm	45 × 95 mm	45 x 90 mm
2 x 2	50 x 50 mm		
4 x 4	100 x 100 mm		
1 × 3	25 × 75 mm	22 × 70 mm	19 x 70 mm
3 × 3	75 × 75 mm	70 × 70 mm	70 x 70 mm
1 × 4	25 × 100 mm	22 × 95 mm	19 x 90 mm
1 × 5	25 × 125 mm	22 × 120 mm	19 x 120 mm
2 × 5	50 × 125 mm	45 × 120 mm	45 x 120 mm

Length

Lengths available may vary considerably. Checking the availability of lengths and ensuring that the design takes account of this will save money and time.

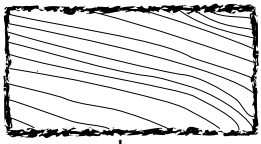
> In Indonesia, logs from one area were cut in 5 or 6 metre lengths to be transported by truck whereas in another area they were floated down a river in 8 metre lengths and cut in half to 4m at the sawmill. Standard lengths offered by different suppliers were therefore different.

B.5.2 Tolerances and deviation

Acceptable deviation, also known as 'tolerance' may be expressed as stating 'maximum of 5%' or detailing acceptable deviation in length. Deviation may be caused by finishing and shrinkage

Finishing and sawing

- Sizes are normally quoted as being 'rough sawn'. Finishing (planing and sanding the timber) can reduce timber sizes while timber that is cut green will shrink and deviate further from stated sizes.



rough sawn

finished

Would more case studies be useful (like the one on this page)? Do you have any suggestions?

- When ordering in volumes note that logs lose 30-40% of their volume in wastage simply due to be cut down to size.

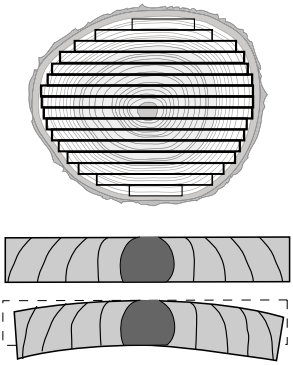
Shrinkage

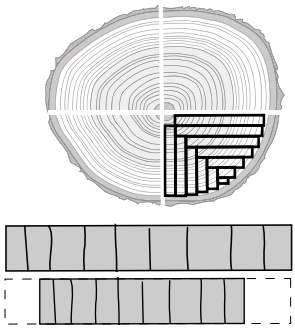
When timber dries it shrinks. Shrinkage occurs more across the width of a timber board than along its length. Timber that is sawn first and then dried will experience more distortion or shrinkage than timber that is dried and then sawn. Dried timber that is then used in conditions of higher humidity than the timber's moisture content (see section B.3.1 Seasoning) will gain moisture and distort.

When ordering timber it is important to be aware of humidity differences between the country of origin and the country of delivery. Ask the supplier about any potential problems with distortion of timber due to moisture changes.

Bamboo shrinks more than wood, shrinking 10-16% in cross section and 15-17% in wall thickness.

The amount and direction of the shrinkage of wood will depend on its species, treatment and, for sawn wood, in what way it is cut from the tree. Quartersawn wood bends less:





B.6 Delivery

As with all supplies, the delivery should be checked in terms of quality and quantity before being accepted. The visual grading section above gives some indication of how to verify quality in the absence of an accepted grading system.

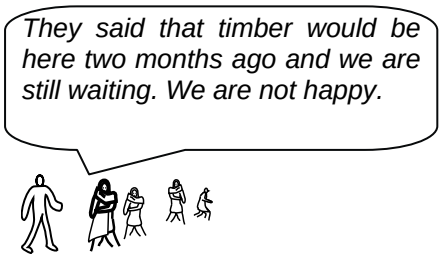
Delivery condtions

Delivery conditions should establish:

- Leadtime
- Where and how the timber will be delivered
- Cost and organisation of loading/unloading
- Cost and organisation of any on-going transport

Lead time

- The lead-time should **realistically be agreed** with the supplier and should be **communicated with** the beneficiaries who will have expectations as to when a construction project is to begin.



- Clarify the treatment processes with a supplier as short lead-times may look attractive but may involve the supply of untreated or un-dried timber.
- While it may seem to make sense to reduce the risk by contracting out the timber procurement process in order to avoid delays, many private companies seeking limited sources of timber will experience the same problems as many humanitarian agencies attempting the same thing.

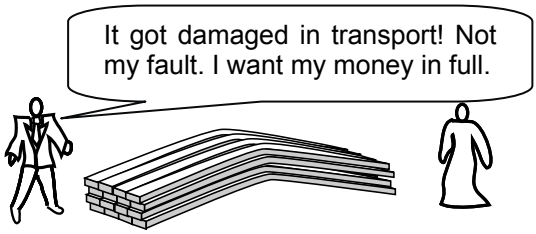
Handling

Internationally procured timber is normally shipped in bales in containers and therefore unloading machinery must be available at port.

B.7 Responsibilities and payment

Responsibilities

Clarify who is responsible for any problems in the procurement process in terms of insufficient documentation at port, responsibility for damage, any on-going transport or temporary storage costs (containers as temporary storage for timber are normally fine).



Note that international suppliers will not normally dispatch any order without a 'Letter of Credit' proving the agency's commitment and ability to pay. This has to be arranged with an international bank and should be arranged by head quarters as a disaster preparedness obligation.

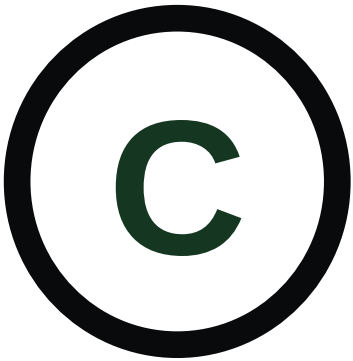
Clarify who is responsible for:

- Damages (and compensation rate for damaged goods)
- Cost of packing materials
- Costs of delays
- Import fees
- Payment process (is payment made with an invoice or automatically)

Payment

Payment should be made once the agency is happy with the goods received. If the agency discovers at a later date that the timber provided was not the timber stated in the specification sheet (e.g. it is illegal timber) then they should be able to refer to a clause in the tender for reparation/compensation.

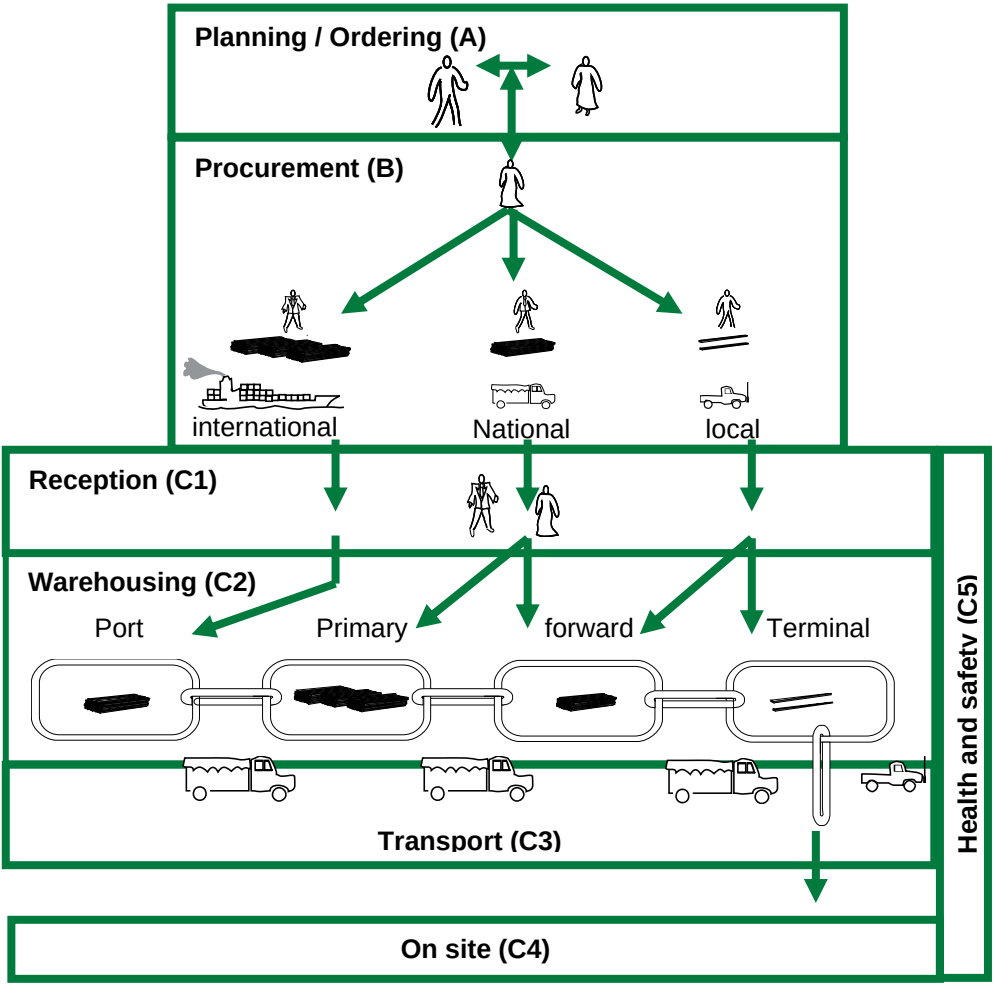
section



logistics

C LOGISTICS

Timber is often procured in bulk and needs to be checked for quality on delivery and stored with some care. For larger procurements, both the challenges of finding an appropriate timber supply and the potential transportation challenges can lead to significant delays in delivery. Programme staff and beneficiaries must be made aware of these expected delays.

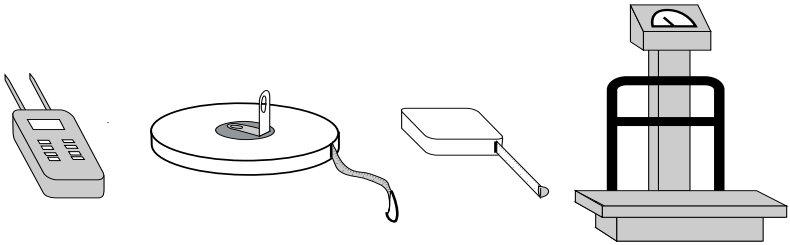


C.1 Reception

As with all deliveries, timber should be checked on delivery against the specification, and warehouse space should be prepared for the timber.

C.1.1 Reception of local delivery

For large deliveries a professional or a trusted inspection company might be used. For smaller deliveries, the grading in B.4 might be used.



To receive timber and check specifications of timber, you will need: (left to right) moisture meter, measuring tapes, weighing scales. Also take pen, paper and a camera!

Some simple tests on the receiving of timber or bamboo are:

- Measure moisture content (see B.3.1)
- Visually check for any signs of pests and damp (section B.4.2)
- Roll timber on the ground to check if it is straight

Depending on warehouse layout, additional dry temporary storage space might be required.

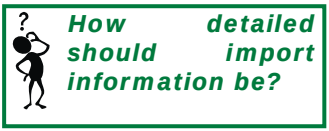
C.1.2 Importing

Where timber has been delivered internationally, check (either directly or through a third party validation) at the port of departure. This will help to avoid having to resolve disputes over quality once the timber has been imported.

Prepare customs paperwork and all other paperwork in advance of arrival (B.2) being aware that this may take several days. Re-check all paperwork

Prepare transport for loading and storage space beforehand.

Check and photograph stamps on timber. The timber should be stamped if certified.



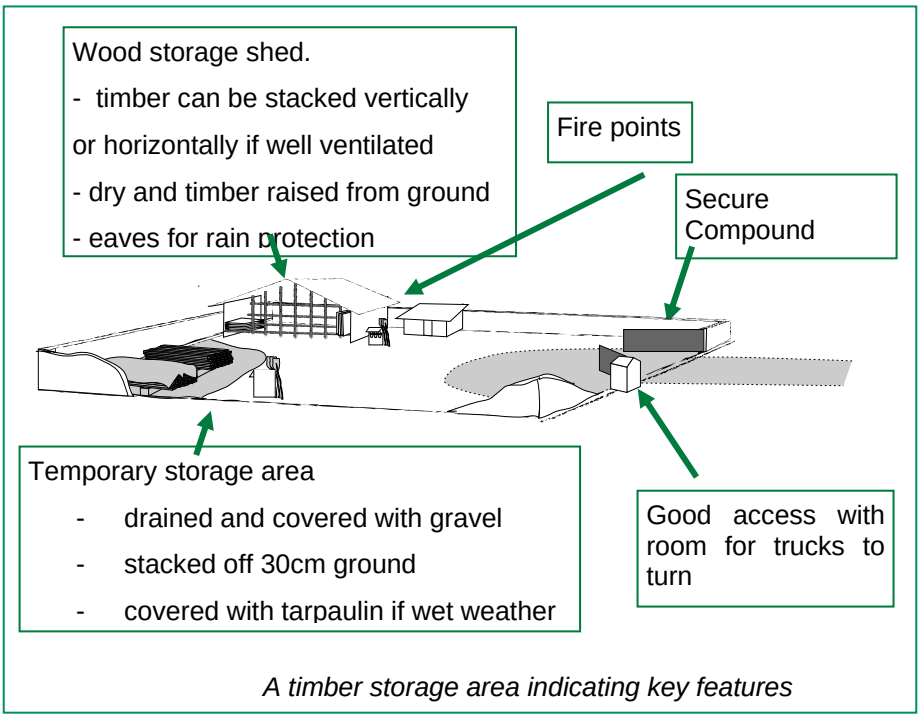
C.2 Storage

Keep timber dry

The main reason for timber spoiling is it getting damp or wet. Timber should always be kept dry. It should be stored under cover (at minimum under a tarpaulin, though not pulled tight so air can ventilate) and a minimum of 30 cm off the ground to prevent moisture and insect attack.

Check regularly

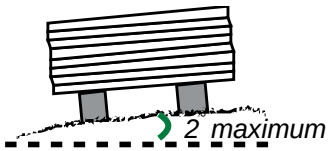
As timber and bamboo are perishable items, they should be regularly checked. Checking should include at minimum checks visual checks and ideally checks with a moisture metre.



A timber storage area indicating key features

Site

Ideally the site for storage should be solid and have a slope of less than 2°. The land should be strong enough to withstand the load of timber and trucks. It should be secured and have good road access.

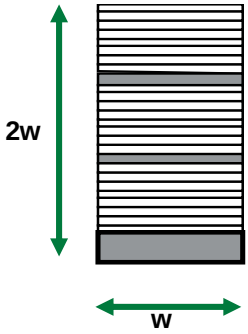


Stacking

Sawn wood, poles and bamboo should be stacked flat and off the ground in easily countable stacks. There should be a gap between the stacks, to provide access and fire safety. Stacks should be secured and carefully set up so that they cannot topple over.

Where there are smaller amounts of sawn wood of different sizes, it can be securely stacked vertically to save space.

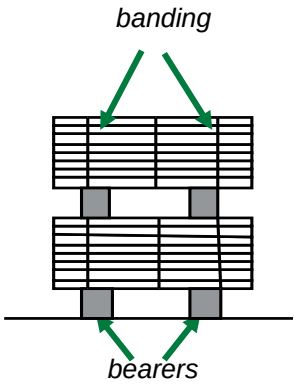
When stored indoors and lifting machinery is available, stacks of sawn timber should not be more than four times the shortest width of the pack (a ration of 4:1), whilst indoors, the ratio should not be more that 3:1 or 2:1 if on a slope or there is public access. Stacks should be checked after high winds.



In public places, timber should be stacked no more than twice its width high

Bearers

Bearers support packs of timber keeping them of the ground and allow access for forklift trucks (if available). Bearers should be straight and identical in length and cross section. They should be shorter than the width of the timber to prevent people from climbing the stack. They should be carefully positioned across the stack (not lengthways) to prevent risk of stacks from toppling.



Banding

Metal bands are frequently used to ensure that packs of timber stick together. Bands should be regularly inspected and replaced if they look likely to fail. If timber swells with humidity, they might become too tight and snap.

Eye protection should be worn when removing bands.

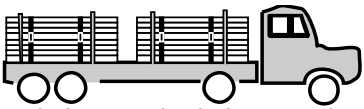
C.2.1 Container storage

If agreed in advance with the suppliers, the shipping containers can be used for storing wood. As for warehouses, containers should be carefully sited in a secure location and away from flooding.

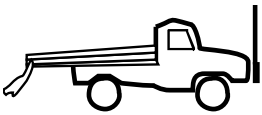
C.3 Transport

C.3.1 Transport by truck

Trucks should be loaded carefully. The diagrams below show how timber should be laid lengthways along a truck bed rather than across it. This is firstly so that it does not stick over the sides, but also to reduce risk of it tipping.



Timber stacked along truck



DO NOT stack timber across a truck – it is likely to fall

If large loads are to be carried, ensure that they are clearly marked at the end.

Loading / Unloading

Timber and bamboo is commonly split and damaged in handling. When unloading, staff should be under strict instructions to handle the timber carefully, placing rather than throwing it on the truck or in ordered piles. Staff should be issued with protective clothing (gloves / boots) to prevent splinters and injuries (C5 health and safety).

DO NOT THROW THE TIMBER FROM THE TRUCK!!!

Paperwork

The transportation of timber is frequently tightly controlled. Identify and ensure that the correct paperwork is in place before transporting timber by road.

Access

As timber is bulky, large trucks are frequently required to transport timber by road. Ensure that that the roads will be able to accommodate them, and if necessary, send smaller trucks with reduced loads.

C.3.2 Transport by other means

Floating poles down river

Logs are frequently floated by river as a means of transport. This is not advisable for lighter poles and certainly not for dried sawn timber as it will get wet and will risk warping.

By boat

Shipping of timber should generally be the responsibility of the supplier or a freight company. Ensure the correct documentation is in place prior to shipping.

By plane

It is rarely economic to fly timber by air.

C.4 Distribution to site

Distribution to site can be to a working construction site or to a site where beneficiaries collect timber and take it back to their land for reconstruction.

Any site has the challenge of access, and arrangements should be made if trucks are to be used. (C.3.1)

Receipt of timber

Like any item in emergency relief, verification of reception of timber by beneficiaries must be obtained.

Distribution to individuals

When timber or bamboo is being distributed, support will be needed by individuals with transport as timber is heavy and bulky.

As timber requires strength and skill to use, additional technical and possibly physical construction support will be needed by individuals to whom it is given.

Wood waste

When significant construction is underway at one site, have a wood-cut waste strategy in place

- **Store:** keep wood dry and off the ground;
- **Centralise:** have a centralised cutting area to make finding useable off-cuts easier;
- **Reuse:** Use offcuts for jointing, animal bedding, fodder etc. however, be careful of the dust and the waste plywood and glued wood products.

C.4.1 Delivery to construction site

The delivery of timber should be timed with the delivery of other materials so as not to hold up construction or not to spoil or risk theft before it is used.

On larger sites, it might be necessary to set up temporary dry storage to hold timber until required

When delivered, timber should also be accompanied by fixing materials, tools and people who know how to use them.

C.4.2 Distribution of un-cut wood

Where projects include uncut logs (such as reclaim of fallen trees) or timber are used, cutting tools may need to be provided onsite. In many areas these tools might need to be controlled to ensure that they are not used for illegal logging activities.

Bamboo has a hard outer shell that can blunt tools. When working with or cutting bamboo, ensure that sharpening tools are available.

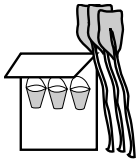
C.5 Health and Safety

Transporting, loading and moving

As for all heavy objects, workers must be trained in lifting of heavy weights. Gloves should be provided to prevent splinters, and workers encouraged to use them.

Staff working in warehouses need to know stacking patterns limits and appropriate signs warning against the dangers of climbing on stacks should be put up.

Fire safety



Usual fire safety procedures in warehousing and storage should be followed. Check that fire fighting equipment is at hand and that staff are trained to prevent and deal with fires. Ensure that sufficient firebreaks are present between stacks when storing large volumes of timber.

Dust

Some timbers and some glued wood products produce toxic dust. Wherever possible these timbers should be avoided. If these timbers are used, protective clothing to reduce exposure to skin might have to be provided

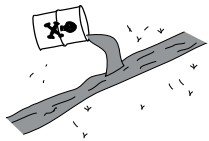
If production lines for prefabricated components are being set up, or significant amounts of work are taking place indoors, an effective dust extraction system should be installed. If this is not sufficient, masks should be provided and workers should be encouraged and trained to use them.

Good personal hygiene for workers include thorough washing should be encouraged. Washing facilities may need to be provided.

Chemicals

In some cases it will be necessary to treat timber or bamboo with chemicals. Organisations might also wish to monitor working standards of treatment plants of their suppliers. Where chemical treatment is being conducted,

- Ensure the legality and safety of chemicals purchased.
- Workers should be trained in the use of handling of chemicals, safety equipment (including gloves and goggles), hand washing and hygiene.
- Do not burn off-cuts as fuel. Carefully dispose of other waste.
- Ventilate work space.



take care with disposal of chemical waste

- Dry treated timber before use

Be aware of the environmental impact of chemicals washed into surface or ground water during treatment processes. Waste water should be appropriately managed in accordance with the treatment instructions.

Would a list of chemicals and the risks associated be useful?

section

annexes

Should there be information on tree species? How could this be summarised?

ii ANNEXES

ii.1 Glossary

Term	Meaning
Board	A term used for a piece of timber which is wider than it is thick.
Cellulose	Complex sugar-based chemicals in a tree providing strength and elasticity to timber.
Chain of custody	Process through which wood passes from tree to finished wood product and can be traced back to its origin through inspection.
Check	Separation of fibers along the grain and across the growth rings. The crack formed does not run from face to face.
Compression failure	Fracture of wood fibers across the grain resulting from compression along the grain.
Crook	Deviation of a timber pole from a straight axis involving more than one bend.
Culm	Stem of a bamboo plant. Equivalent of the trunk of a tree
Degradation	Anything that lowers the value of wood e.g. rot/decay (from fungus or bacteria), damage by insects or damage in felling/transport.
Durability class	Classification determined by how many years timber will last above ground with and without treatment (seasoned or natural durability) at a constant moisture content.
Figure	The markings on the surface of sawn timber formed by the structural features of the wood.
Grain	Direction of the wood fibers relative to the main length axis of the timber.
Grain, sloping	Deviation of grain from being parallel to the longitudinal axis of a board.
Hazard class	The classification of timber by what 'hazard' it will be exposed to – e.g. whether it is to be used internally or externally or if it will be in contact with the ground or not.
Heartwood	The centre of a tree, darker in color, providing the structural strength.
Knot	Remains of a branch embedded in the tree trunk which appears as a dark round circular shape on timber board.
Knot, sound	A solid knot that is as hard as the surrounding wood, and shows no sign of decay.
Lignin	Bonding agent in the cellular structure of timber.
Moisture Content	Weight of moisture in timber expressed as a percentage of its oven-dry weight (MC).
Name, Latin / common	Tree species have two names. The common name varies around the world while the Latin, or botanical, name is

	universally accepted.
Penetration class	The classification of treatments by how far it will penetrate timber. Note the penetration properties of timber vary between species.
Pole, peeled / rounded	Timber poles are un-swan logs. Rounded or peeled poles are poles with the bark removed, stripped to a regular size. Also known as ROUND TIMBER.
Primary wood	Timber from slow-growing forests, usually hardwood. Used mostly in joinery/furniture.
Rings, growth/annual	The rings marking the growth of the tree seen in a transverse tree section.
Sapwood	Surrounding the heartwood, contains the living cells and is lighter in color and more penetrative and vulnerable to insect attack and rot than heartwood.
Sawn, back / quarter	A division of timber by the angle of the rings to the wide face age. Quartersawn is where the rings are at an angle of not less than 45 degrees to the face.
Seasoning (also air/kiln drying)	Drying of wood, by stacking and allowing it to dry in the air (unforced) or drying in an oven (forced), to reduce moisture content and improve durability.
Secondary wood	Timber from fast-growing forests, usually softwoods, that will require seasoning and treatment. Used mostly in construction.
Shake	Fracture of the wood fibers between the growth rings caused by stresses caused by factors other than shrinkage.
Shrinkage	Linear shrinkage is caused by reduction of moisture content below fiber saturation point and expressed as a percentage of the original dimensions or volume of timber.
Strength/ stress grade	Classification of timber's ability to bear stress without breaking/weakening.
Sweep	Deviation of a timber pole from a straight axis involving one bend, like a banana.
Taper	When a pole this towards one end.
Wane	The absence of wood on any face or edge of a piece of timber.
Warp	Variation of a surface from a straight axis. It includes bow, spring, cup and twist and may be due to irregular seasoning.

Is this glossary missing anything?
Are the definitions good?

ii.2 Brief further references

It has been suggested to provide a CD with this guideline to hold useful references suggested by people during this project. This would allow the pdf document to directly link to references on the CD and provide some of the more detailed references for logisticians, engineers and programme managers that are not listed below for the sake of space.

Suggestions for documents that should be included on this CD should be sent to: **contact@humanitariantimber.org**

The website **www.humanitariantimber.org** has a long list of references which will be updated over 2007.

Planning: standards and strategic planning

- Humanitarian Charter and Minimum Standards in Disaster Response (SPHERE) www.sphereproject.org
- Oxfam/shelterproject Transitional Settlement: Displaced Populations www.sheltercentre.org/shelterlibrary/items/pdf/Transitional_Settlement_Displaced_Populations_2005.pdf
- UNHCR Handbook www.the-ecentre.net/resources/e_library/doc/han_Em.pdf

Environment

- UNHCR Environmental Guidelines www.unhcr.org/protect/PROTECTION/3b03b2a04.pdf
- UNHCR/CARE: Environmental Assessment www.benfieldhrc.org/disaster_studies/rea/frame/ea_hand_final.pdf
- Guidelines for Rapid Environmental Assessment in Emergencies (v4.4) www.benfieldhrc.org/disaster_studies/rea/rea_guidelines.v4.4.pdf
- FAO: Reduced Impact Logging in Tropical Forests www.fao.org/docrep/007/j4290e/j4290e00.htm

Use (design and engineering)

All hard-copy books (📖) from: www.developmentbookshop.com

- 📖 Mukerji and Stulz (1993) Appropriate Building Materials
- 📖 Lambert and Davies (2003) Engineering in Emergencies
- 📖 Janssen (1995) Building with Bamboo: An Introduction, ITDG
- 📖 Follett & Jayanetti (2000) Timber Pole Construction: An Introduction, ITDG
- 📖 SKAT: TK 24 Roof Structure Guide http://www.skat.ch/
- Heini Müller (2004) Basic Construction Training Manual for Trainers www.redcross.ch/data/activities/pdf/Basic_Construction_Training_Manual.pdf

- Inter-Agency Network for Education in Emergencies (INNE): Shelter and School Construction http://ineeserver.org/page.asp?pid=1322

Timber properties

- Wood Handbook: Wood as an Engineering Material (1999) U.S. Department of Agriculture, Forest Service, Forest Products Laboratory www.fpl.fs.fed.us/documnts/fplgtr/fplgtr113/fplgtr113.pdf
- Timber Species summary reports: www.timber.net.au/documents/
- Bamboo: www.bamboocentral.org (includes treatment handbook)
- RWTH Aachen University: "Bamboo As A Building Material" http://bambus.rwth-aachen.de/eng/PDF-Files/Bamboo%20as%20a%20building%20material.pdf

Procurement

- FAO: Guidance notes for Indonesia www.fao.org/forestry/site/tsunami/en
- WWF: Keep it Legal http://assets.panda.org/downloads/keep_it_legal_final_no_fsc.pdf
- UNEP: CITES and the Wood Products Trade - What You Should Know www.fao.org/DOCREP/004/Y3609E/y3609e00.htm
- CPET: www.proforest.net/cpet (instructions for checking legality without certification – includes checklist sheets etc.)
- TTF Scoping Study: Sourcing Legal Timber from Indonesia www.illegal-logging.info/papers/Sourcing_Legal_Timber_from_Indonesia.pdf
- FAO - Development and Implementation of a Wood Procurement Plan for Post-Tsunami Reconstruction in Indonesia www.fao.org/forestry/webview/media?mediaId=10473&langId=1

Logistics

- FAO: Guidance notes for Indonesia www.fao.org/forestry/site/tsunami/en
- Health and Safety Executive UK: Safe stacking of sawn timber and board materials http://213.212.77.20/pubns/wis2.pdf
- The Roundwood Haulage Working Party: Road Haulage of Round Timber www.ukfpa.co.uk/pdfs/CODE_OF_PRACTICE_2003.pdf

Websites

- TRADA Timber species database: www.trada.co.uk/techinfo/tsg/
- FAO: www.fao.org/forestry/en & www.fao.org/forestry/site/tsunami/en
- ITTO: www.itto.or.jp
- WWF: www.panda.org/gftn/ & http://wwf.org.au/publications/WWFTimberForAceh/
- Educational Resources – Materials: www.Timber.org.au
- Practical Action: http://practicalaction.org

ii.3 Assessing possible impacts of forestry activities

[UNHCR/CARE "Environmental Assessment in Refugee-Related Operations"]

Sector Activity	Potential impacts	Causes	Mitigation Measures
Reforestation Tree-planting and forest product production Maintenance of young plantations and trees Forestry extension Wood supply and harvesting	**Will the activity lead to:** Lowering of the water table and/or interception of rainfall, which may be detrimental to other species or users of ground water? Conversion of agricultural land and reduction on food production? Exploitation or conversion of forested areas that support valuable ecosystems (e. g., protected areas, critical habitats, endangered species); or containing important historical/cultural sites? Conflict with existing uses for forested areas (e.g. fuelwood forest products, wildlife, wildlife habitats)? Altering livelihood support activities of local populations, leading to increased pressure on natural resources (e.g. soil, wildlife, potable water supplies)? Induced development through the construction of access or feeder roads and subsequent environmental impacts?	Forest dependent women and men not fully consulted in the planning process Special measures not targeted to vulnerable groups, for example the provision of secure tenure on demarcated reserved areas Harvesting of timber and non-wood products is not controlled by a management or working plan that is based on clear "ownership" of trees and non- timber forest productions Some forest, rich in biodiversity, is not set aside for complete protection from exploitation Inadequate institutional capacity to control and supervise the logging process at all stages	Resolve conflicts in local tenure systems Avoid new species or new technologies for which local knowledge is weak Match species to local needs and site conditions Control planting, cutting and spacing Limit the establishment of new roads Protect water resources and unstable slopes Adopt closure natural regeneration techniques when feasible Ensure that logging damage to the residual stand is minimized Ensure long-term viability by adopting only economically viable forestry operations Ensure that incentives are sufficient to allow for longer-term protection and maintenance Encourage sustainable forest management practices Establish long-term use/benefit-sharing contracts for community groups based in national or local land tenure systems Ensure traditional ownership rights and responsibilities are integrated into management and harvesting actions

Is this the sort of document that is useful in an annex? What else should be here?