PCR TOOL 11

Defining Standards for People-Centred Reconstruction

Introduction

On January 12th 2010, an earthquake measuring 7.0 on the Richter scale struck Haïti, killing 222,570 people. Less than two months later, on February 28th, a quake measuring a massive 8.8 hit the Concepción region of Chile but killed 562 people. Both earthquakes affected heavily populated areas so how was it possible that an earthquake nearly a hundred times stronger led to 400 times less casualties. A major factor in this was Chile's adoption of high quality building standards that incorporate requirements for disaster-resistance. These are both applied properly, and affordable for the Chilean people to comply with.

Haïti also has standards, but they are more lenient than those in Chile. Furthermore, these standards are often poorly implemented, (with inspection turning a blind eye) and most importantly unaffordable for the large proportion of the population to comply with. The lesson from these two disastrous events is that good building standards can save lives, but they need to be properly implemented and inspected, and above all, affordable.

Poverty is still widespread in the developing world and there is ample evidence that with disasters of a similar size, poor countries suffer more than rich countries. Similarly, the poor in any country tend to suffer more than the rich (see **PCR Tool 10: Quality Control**). Poverty is a key factor in determining what level of building quality people can afford. Countries define that level of quality through a regulatory framework that includes acts, regulations, standards etc. (see the section on Definitions for details on the various components). Within those frameworks, standards are the most important component to define disaster resistance. Unfortunately, many of the regulatory frameworks in place in the developing world borrow heavily from the developed world, making them inappropriate and unaffordable for the poor. Furthermore, disaster resistance can be inadequately covered by the frameworks, but including additional requirements would reduce affordability further.

Unaffordable standards are a likely factor to add to the loss of life from disasters. In many countries, sub-standard housing is considered illegal and can be demolished by the authorities. Therefore, home owners who know they will never be able to meet the standards are often inclined to under-invest in housing, as they risk losing such investments. They may not even make the small improvements or carry out the proper maintenance that could help to reduce their risks.

Donations of aid for reconstruction are high following large-scale disasters. This influx of money can help to overcome affordability problems and enable the reconstruction of housing that meets disaster-resistant building standards. Out of hundreds of people interviewed after the tsunami in Sri Lanka, 41% answered that housing built afterwards had much better walls and 58% said it had a much better roof than the house they owned before the disaster; it often was larger too. The question, however, is whether people can maintain the standard of building if they expand their house in the future, or build a house for their children. How sustainable are standards that need to be heavily subsidised?

After observing the impact of disasters on buildings (see **PCR Tool 3: Learning from Disasters**), we know that some of the traditional ways of building in many countries do stand up relatively well to disasters. Also, with limited improvements such vernacular technologies can become even more disaster-resistant. Thus, the timber frame (dhajji dewari) houses of rural Pakistan, which were on the decline before a

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Improved *quincha*, used here in reconstruction after an earthquake in Chincha, Peru, is proven to have good earthquake resistance.

recent earthquake, became a popular option for reconstruction. The advantage of using vernacular technologies is that they use local knowledge, skills and materials, and tend to be affordable. But in many countries no standards exist for them which limits their acceptability, (for example because the regulatory framework does not accommodate them, or because building professionals, whose studies focused on modern materials and technologies are reluctant to venture into unknown territory).

Disaster-resistant building standards can certainly help reduce the loss of life and property when natural hazards strike. However, the standards currently in place in many countries do not reduce risk for their poor. To achieve this, they need to be changed, primarily to be made more affordable. If they are not, they could do more harm than good.

There is a lot of variety in how people in different countries build, and what disasters they are vulnerable to. Describing in detail the technical standards that provide disaster-resistance in all those different contexts would require a book, not a simple tool. Besides, there is a growing amount of literature, (some of which is included in the Resources section), that describes how particular ways of building can be made more resistant to a range of disasters. This tool therefore focuses on the possible approaches to setting and achieving an adequate standard of disaster-resistant construction.

What makes construction vulnerable to disasters in developing countries?

From assessments of disaster damage in many countries, we know that the absence of a proper regulatory framework, its improper implementation or incomplete use (as highlighted above), is only one of the factors having an impact on the scale of damage. Others include:

- Poorly defined knowledge and mapping of disaster hazards and risks;
- Insufficient awareness of disaster hazards and risks;
- Lack of preparedness planning or early warning of impending events;
- Lack of protective infrastructure such as flood barriers or slope stabilisation;
- Poor quality and unreliability of infrastructure services;
- Poor quality materials and insufficient quality control of building techniques;
- Low priority for emergency evacuation and safe public shelters.

These and other deficiencies in mitigating the impact of disasters have a number of underlying causes:

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The rapid urbanisation of Lima forced some people to build their houses on very unstable slopes.

- Widespread poverty;
- Lack of education;
- The need for many poor people to prioritise immediate needs (ie day to day survival) over disaster risk
- Rapid urbanisation - including a tendency to concentrate large populations in vulnerable locations such as steep slopes or flood plains;
- Lack of secure tenure;
- Landlords placing profit before the safety of tenants;
- Lack of capacity and resources of local and central authorities;
- Poor governance, including complex bureaucracies, a lack of popular voice and corruption.

Getting the standards right is therefore not necessarily enough to guarantee reduced disaster impact. Furthermore, the above factors may actually hinder both the development and implementation of appropriate standards.

PCR Tool 3: Learning from Disasters provides the most common structural factors that lead to disaster damage to buildings for example a lack of disaster-resistant features, poor quality work or materials, or a lack of maintenance. These are the issues that standards and regulations can improve. **PCR Tool 8: Participatory Design** gives some of the design principles for withstanding major disasters, which should be considered too.

What difference can standards make?

After almost every major disaster in a developing country, people have called for building standards to be tightened and enforced more strictly. After all, this has worked to reduce the impact of natural disasters in more developed countries. But can the same approach work in the developing world? The above section has already argued that

Building in developing countries	Building in developed countries
Between 40 and 90% of housing and private commercial buildings are constructed without former title of land or property, i.e. considered informal.	The vast majority of buildings are formally registered.
A lot of building work is carried out by owners with the help of family or friends and sometimes building artisans	Most building work is executed by contractors.
A lot of housing is incremental, starting small, but expanding and/or improving in quality over time, as resources allow.	Most housing is a one-off final product that meets quality standards from the onset.
Vernacular construction is still significant, based on traditions that can date back a long time. It is important in rural locations, but diminishing where urbanisation occurs	Vernacular buildings are mainly of historical interest. Nearly all current construction uses standardised so-called modern materials and products.
Many countries are still predominantly rural, though urbanising rapidly, with a high concentration of people in and around one large city. In most rural areas, building standards and regulations do not apply; quality is defined by tradition.	Nearly all countries are highly urbanised, with a good balance between large and middle size cities.
In urban areas, a significant proportion of housing is in slums, usually far below prevailing standards. Close to 1 billion people live in slums; they tend to be very vulnerable.	Very little of the housing stock can be considered slums in most countries.
For many people, their home is also their workplace.	Strict zoning regulations mean that few commercial activities can be undertaken from home.
Few building artisans have had formal education or training in building skills. Most learnt their craft from other builders. Many countries do not have a formal register of builders.	Builders need formal education and a qualification in building to be considered skilled. Trade associations for builders and contractors usually exist as well.
There is unlikely to be a formal certification process for new materials, products and techniques.	There usually is a formal approval and certification process for new materials, products and techniques that also provides quality and performance specifications.
Many buildings are not built to conform to standards, either because they are in locations where standards do not apply, or because they are in informal settlements where standards get ignored. For buildings that do comply, inspection may be lax or corrupt; thus bad practice is overlooked.	The systems for checking, approval and issue of building permits and completion are usually thorough. Almost all construction requires approval, except for small temporary buildings. Compliance with building standards and regulations is therefore high.
Many countries do not have their own systems of building regulations and standards. They often use the standards of their former colonial power or other developed country without significant revision to reflect their own context. Consideration of country-specific disaster risks might also be absent.	Building regulations and standards are often country-specific, but some are internationally or regionally agreed (e.g. by ISO). They are regularly updated to reflect new knowledge and legislation or to overcome specific problems that have emerged with aspects. They incorporate measures to mitigate disaster risks of the country.
As many buildings are owner-built, the owner is often present for much of the construction and so ensures that the work is completed to his or her requirements. Where no formal building codes or standards are followed, diligent supervision by an owner can still help to ensure that the outcome is a good and disaster resilient building.	Ensuring quality of construction is usually the responsibility of the architect (if one is employed), building contractor and building inspector. Users or owners are far less involved in day to day construction. There is then some risk that the final building is not entirely to their satisfaction.

improving standards alone does not guarantee safer construction. There are some important differences between building housing in developed and developing countries which would have to be considered when deciding how to make post-disaster reconstruction safer. These differences are summarised on page 3.

When there is a lack of capacity in a developing country to devise standards in specialist areas, such as disaster resistant structures, it becomes tempting to adopt the standards of developed countries that have proven to withstand disasters. Thus, several Latin American countries have adopted standards for earthquake resistance from the USA, and Asian countries have derived standards from Japan or New Zealand. This often only had a limited positive impact, because:

- The standards are set at a very high level which makes them unaffordable to a majority in developing countries.
- The standards over-emphasize engineering solutions, encouraging the use of modern materials and techniques by building contractors, rather than allowing for informal construction. They overlook vernacular construction and its own disaster-resistant elements.
- The capacity for adequate implementation and inspection is often lacking.

The adoption of such 'ideal' standards may have worked for some buildings, but generally has helped make low-income housing less vulnerable to disasters. That is not to say that having standards is wrong, just that they need to be fit for purpose. Having the best standards may only protect a small proportion of the population. Instead, moderate standards with simple processes of compliance might be able to protect a majority from all but the highest magnitude disasters.

Finally, some consideration needs to be given to retro-fitting as an option for strengthening existing dwellings, some of which may have suffered repairable damage. Rather than replacing such dwellings with entirely new ones of a high standard, retro-fitting is a much more cost-efficient solution for providing disaster resistance. Standards for reconstruction should therefore not just cover new buildings, but also the retro-fitting of existing ones.

A People-Centred view of standards

Historically, building regulations, codes and standards were developed to ensure protection of people from illness, injury and accidental death when they live, work-in or visit a building. However, this system of building control developed largely for the public good has often failed to deliver an adequate level of protection against natural disasters in developing countries. Past experience shows that regulatory frameworks derived from developed countries are often inappropriate for developing countries (see e.g. Yahya et al., 2001). Reform of regulations can take several decades because of the need to pay attention also to the processes of applying, decision making, appealing, communicating with applicants, record keeping and dealing with non-compliance. If those processes are too complex and costly, few property owners will bother to comply (see e.g. de Soto, 1989: chapter 2). It is important for reform to have a group of champions who manage to overcome the obstacles thrown in their way by stakeholders who have something to gain from maintaining the status quo.

In People-Centred Reconstruction, people are what matters most. In other Tools and a Position Paper on PCR, we have argued that the ultimate aim of PCR is more than just achieving safer housing; it is to make the people themselves more resilient. In the reconstruction process itself, this means empowering them by involving them much more in decision making. The process should not just aim to rebuild houses, but also livelihoods, local markets and social networks, as these all are crucial in generating resilience.

If people are what matters most, then standards should protect people first and foremost, and aim to substantially reduce the number of casualties that natural disasters cause. Lives cannot be replaced, but buildings and other assets can, and often are with the aid that is given following disasters. Applying this principle to building practice, means that a certain amount of damage to buildings could be acceptable, but their collapse on people inside should be prevented.

This thought can be translated into regulations and standards to define the weight and integrity of roofs and intermediate floors, the strength and technologies for supporting structures, and their connections. However, if for example walls have no structural contribution, they could be allowed to be relatively flimsy. For certain types of high-

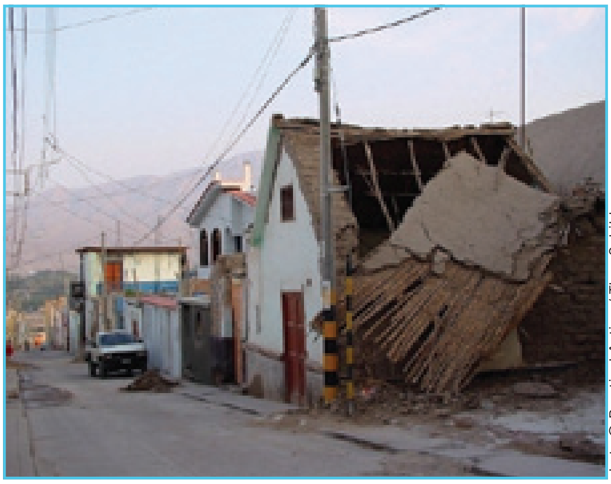

photo © Practical Action / Theo Schilderman

The inhabitants of this house in Moquegua, Peru had a narrow escape, because the failing roof slid sideways rather than falling in on them.

magnitude hazards, such as tropical storms or floods and tsunamis people can be warned of their approach. In these cases, lives could be saved through evacuation into disaster-resistant shelters or to safe locations such as high ground at community level. These shelters could have alternative uses when there are no imminent hazards, which would help to avoid the high cost involved in increasing the resistance level of a lot of housing from medium to high.

In PCR, it is important to involve the end users in thinking about the types and levels of standards, regulations and compliance processes required for disaster-resistant reconstruction. In considering how regulatory frameworks could be made to work better for housing the urban poor Payne and Majale (2004) outlined a series of guiding principles on which the conceptualisation of such frameworks would need to be based. These guiding principles, summarised in the table below, can also be useful for deciding on standards and regulations for post-disaster reconstruction.

Similarly, it is worth considering the newly revised minimum Sphere standards for Shelter and Settlement (The Sphere Project, 2011). Whilst these standards are focused on emergency and transitional shelter, the underlying principles are often also valid for permanent reconstruction.

Guiding principles for getting standards right

- Recognise and accept the realities on the ground
- Focus on key aspects of public concern
- Understand and acknowledge knowledge and information systems of people living in poverty
- Adopt an enabling role
- Invest in precedents drawn from targeted research and pilot projects
- Strengthen inclusiveness
- Promote partnerships between key stakeholders
- Facilitate local ownership of processes
- Identify champions of change and create a critical mass
- Apply rules consistently
- Integrate planning and development strategies
- Accept regulations as a process rather than a product
- Acknowledge the principles of incremental development
- Guarantee access to information
- Take advantage of windows of opportunity
- Build institutional capacity
- Cultivate political and professional will
- Consider enforcement still as important, although enforcement mechanisms may have to be modified from those conventionally used for the regulation of construction.

Minimum Sphere standards for shelter and settlement

1. Strategic planning: Shelter and settlement strategies contribute to the security, safety, health and well-being of both displaced and non-displaced affected populations and promote recovery and reconstruction where possible.
2. Settlement planning: The planning of return, host or temporary communal settlements enables the safe and secure use of accommodation and essential services by the affected population.
3. Covered living space: People have sufficient covered living space providing thermal comfort, fresh air and protection from the climate ensuring their privacy, safety and health and enabling essential household and livelihood activities to be undertaken.
4. Construction: Local safe building practices, materials, expertise and capacities are used where appropriate, maximising the involvement of the affected population and local livelihood opportunities.
5. Environmental impact: Shelter and settlement solutions and the material sourcing and construction techniques used minimise adverse impact on the local natural environment.

Approaches to determining the quality of reconstruction

When deciding how to set the level of construction quality in reconstruction after disasters (or for the mitigation of them), authorities and agencies have a number of options that include:

- adopting international standards
- adhering to a national framework
- setting regulations in the context of a specific reconstruction strategy
- Allowing users to decide on quality.

In People-Centred Reconstruction, it is important for the people affected by disasters to have a say not just in how houses are designed or constructed, but also in what level of quality should be adopted. If other stakeholders set quality at levels that appear unachievable or unreasonable to those people, it can subsequently become quite difficult to obtain their interest and participation in projects. What approach is most appropriate is very much dependent on the local context and needs to be decided on a case-by-case basis.

Adopting International standards

The Sphere project (2011) has developed a Humanitarian Charter and Minimum Standards for water supply, sanitation and hygiene promotion; food security and nutrition; shelter, settlement and non-food items; and health action. These standards, however, tend to focus more on emergency and transitional shelter than on reconstruction. Sphere standards may need revision where they are applied to permanent housing, for example, a minimum space of 3.5 m^2 per person may be sufficient for a temporary shelter but not for the long term. They could be applied to permanent core housing designed to grow over time.

The International Standards Organisation, ISO, has developed around 18,000 internationally agreed standards on a wide range of products and processes. It does so through over 200 international Technical Committees. The standards produced by these committees can be purchased on-line via the ISO web site: http://www.iso.org/iso/iso_catalogue. The table indicates where the ISO may have standards relevant to reconstruction.

Adopting a national regulatory framework already in place

All countries have regulatory regimes in place that determine the quality of construction; these frameworks and their components can vary considerably between countries, according to whether they are embedded in Roman Law, Napoleonic Law or other types of law. Their components may go under names such as laws, bylaws, regulations, codes, standards or specifications. For more detailed information, see Yahya et al. (2001), and the section on Definitions. In many countries these regimes include regulations and standards to make buildings disaster-resistant. In these cases, it would be possible to simply impose this regulatory framework on reconstruction after disasters. One should check, however, whether the regime does apply everywhere in the disaster area, and whether it is suitable for the poorest and most vulnerable population groups.

Establishing tailor-made regulation after individual disasters

Applying an existing regulatory framework to reconstruction after a disaster can sometimes be inappropriate. For example, if the framework does not cover all reconstruction, where it does not adequately cover disaster-resistance, or where it would be unaffordable to many. In such cases, agencies could establish their own regulations and standards based on experience they may have from elsewhere. Also, after large-scale disasters, it is often common for the national authorities to impose new regulations in the context of a reconstruction strategy, as Sri Lanka did after the tsunami of 2004 (NHDA, 2006). These typically apply in coastal areas, but not in others.

ISO technical committees of relevance

- TC 59: Building Construction
- TC 71: Concrete, Reinforced Concrete and Pre-stressed Concrete
- TC 74: Cement and Lime
- TC 162: Doors and Windows
- TC 165: Timber Structures
- TC 167: Steel and Aluminium Structures
- TC 176: Quality Management and Quality Assurance
- TC 196: Natural Stone
- TC 218: Timber

Leaving quality up to the people

Authorities and agencies alike may consider this a risky approach. After all, a disaster may have just caused a huge amount of damage, many casualties and injuries, with insufficient quality of construction a major contributing factor. One should not thus conclude however, that people are not concerned about the quality of their housing, nor that they always have insufficient knowledge about quality. There are plenty of examples where vernacular housing has withstood natural hazards. In such cases, although no formal standards were applied, people and local building artisans often use informal standards of their own that have evolved over many years(see, for example **PCR Tool 5, Learning from the Housing Sector**). However, people do not always have the resources required to build as they would like. They often have difficult choices to make, e.g. between the size and the quality of their housing, and where families are large they may be forced to opt for an extra room, over a stronger structure. Reconstruction, however, may provide an opportunity to overcome this with the additional resources made available.

Leaving decisions on quality to people does not have to mean a free-for all. Whilst it does mean that no authority or agency will force people to build their houses in a certain way, they can still raise their awareness of disaster risks, provide information about safer ways of building, demonstrate those, provide training and support people in their building processes (see **PCR Tool 8, Communicating Better Building**). Using encouragement rather than the force of regulation may be equally effective in ensuring safe housing. Furthermore, it may be the only approach remaining in situations where it does not make sense to apply an existing regulatory regime or time is too restricted to create tailor-made regulations.

Advantages and disadvantages of adopting international quality standards	
+ ISO or Sphere standards have been internationally agreed, and are especially suitable for contracts between parties of different nationalities + ISO standards in particular could be useful when ordering materials, such as timber or cement, on the international market or when engaging contractors who are not from the disaster-affected country	- ISO standards mostly employ modern materials and construction technologies, which may be unaffordable to a majority in the Third World - Sphere standards focus more on temporary shelter and do not cover reconstruction adequately - local building professionals, contractors and materials suppliers are often not familiar with international standards, and may therefore be at a disadvantage when competing for work - ordinary people have had little or no say in determining these standards, questioning their relevance. For example, there tends to be little attention for vernacular construction in international standards.

Advantages and disadvantages of applying existing regulatory regimes	
+ the regulatory regime is familiar to environment professionals in the country, as well as inspectors and contractors + it is largely based on modern construction technologies, with which professionals are familiar + the regime has often been developed and modified over time, including its disaster-resistant elements, and is presumably proven. In such cases, there is little need to rapidly develop additional elements + these regimes have proven to be able to deliver quality (e.g. during the Concepción earthquake), but often at a cost.	- the regime only works where it applies; in many countries, it does not cover rural areas - regimes are often formulated for blanket applications throughout a country, and not for areas affected by specific disasters - in the poorest countries, less than half the urban population can afford to build according to the regulations. Although following a disaster they might be aided to reconstruct according to the regime, they would struggle to maintain that standard in the future - ordinary people often have little or no say in the regulatory regime, in fact it may even be a colonial legacy and very inappropriate to popular housing - in some countries, the capacity to inspect the application of the regulations is inadequate even in normal circumstances. Besides, when disasters strike, institutions charged with inspection are often affected too, even further reducing that capacity. Regulations that cannot be controlled do not function well - there is ample evidence from disaster damage assessments in a range of countries that standards have not been properly implemented due to bribery and corruption.

Advantages and disadvantages of tailor-made regulations	
+ tailor-made regulations are often more appropriate to reconstruction after specific disasters than existing regulations that take a more general approach + they are better able to accommodate the housing culture, building traditions and vernacular technologies of specific disaster areas + more affordable than the previous two options + can be made to apply to the entire disaster area.	- takes time to develop appropriate regulations. After a disaster, there are many competing demands for time so regulations are sometimes published too late when people have already started rebuilding. This can cause complications, e.g. some people may not be entitled to reconstruction aid, or houses will require retrofitting - regulations are developed in a hurry, so there is insufficient consultation of affected populations, and they may not suit everybody - individual stakeholders may impose their own agendas, for example governments may require more than the minimum because there is abundant aid; or donor agencies may insist on expensive modern technologies - there is no time to pilot them, so if they turn out not to be unsuitable it can cause major problems - the regulations are new, so everybody involved in reconstruction will have to take time to adjust to them.

Advantages and disadvantages of leaving quality for the people to decide	
+ people themselves know best which construction technologies they are able to implement and can afford + leaving decisions on quality to the people allows them to accommodate what is important to them in terms of culture, tradition, skills and experience + quality standards that are locally decided often allow greater use of local materials and building artisans, which can boost livelihood recovery in the area; they may also be more environmentally friendly + there is more scope for recycling materials and components from the previous house, where people decide on quality.	- people sometimes have insufficient knowledge of construction, and particularly of what is needed to make houses disaster-resistant - people may not know how to control the quality of materials they buy - locally produced materials may not meet national standards - some agencies, particularly those adopting a cash for shelter approach and those concerned with keeping overheads low, provide inadequate information and support to their beneficiaries who are left to make decisions about quality on their own. This often leads to inadequate reconstruction quality - aid workers providing support to people's construction processes are educated in modern construction and may have inadequate knowledge of vernacular construction - retro-fitting is a largely unknown concept to informal builders.

How to decide what approach to take?

It is important not to make hasty decisions on standards for reconstruction, but to take sufficient time to consider all available data and get them right. These decisions need to involve all key stakeholders, and especially representatives of disaster victims and of affected local authorities. This may not be easy at a time where everybody is stretched, and many are urging to get reconstruction under way as quickly as possible.

Decision making will be made a lot easier after gathering relevant information in the following three ways:

- regulatory audit
- damage assessment
- scenario evaluation

Regulatory audit

This is a tool suggested by Payne and Majale (2004); they have applied it to land registration and the physical planning of settlements, but it could equally be used to take stock of and assess the performance of any standards or regulations to do with disaster resistance. Regulatory audits not only consider the technical aspects and how these diminished or contributed to collapse or damage in disasters, but also how such standards are implemented.

Undertaking a detailed regulatory audit after a disaster may be constrained by the destruction of key public buildings and records as well as the death of important stakeholders. However, it should be possible to build an adequate picture by not solely relying on documents but also using the memory of surviving stakeholders. It would, of course, be preferable to have such audits done in preparation for eventual disasters. They could, for instance, be undertaken by academic institutions as part of their curricula.

Main components of a regulatory audit

- Identification of direct and indirect stakeholders involved in regulating disaster resistance of buildings
- Compilation and review of relevant documents about regulation policy, what is regulated and how the regulation is carried out. This may include official documents, reviews or evaluations, academic studies or articles from the press.
- Interviews and discussions with stakeholders focusing on their awareness of standards and regulations, how they are implemented and affect them.
- Assessment and analysis of the information collected.
- Production of a matrix showing: the nature of the standard or regulation; the institution responsible for its implementation; a summary of its effect on both formal and informal housing and buildings; whether the regulation is a constraint or incentive to improved and more resistant buildings; and any issues emerging.
- Report considering the nature of the standards and regulations as well as the procedures involved.

See: Geoffrey Payne and Associates web site, Resources section: http://www.gpa.org.uk

What can disaster damage tell us about standards and regulations?

- Were the standards and regulations in place relevant to the disaster risks encountered in the area? For example, did they contain design and construction requirements related to the type of disaster that occurred?
- Were the standards ostensibly followed, but their application poor? For instance, was the quality of concrete construction deficient, because builders lacked the knowledge, or it was difficult to inspect? Was inspection too lax in general, for whatever reasons?
- How many buildings were constructed with little consideration of standards and regulations and could be considered as informal? Did such informal buildings perform better, worse or the same as formal buildings that complied with standards and regulations? For types of informal buildings that withstood the disaster well: what quality checks did builders use instead of official standards?
- Did the age of buildings have a bearing on how much damage they sustained? This might be relevant if standards or regulations were changed at a particular date: how did the buildings built after that date compare with the older ones?
- Can anything be learned from very old buildings, built before many of the standards and regulations were in place, especially if such buildings have withstood similar disasters in the past? Do local builders still know how these buildings were constructed and do they have the skills to do so now?
- What were the most common causes of building collapse and their frequency? Were they a result of non-provision in standards and regulations, poor application of the standards, or because they were common to informal construction, built outside standards and regulations?
- Were there any types of construction using particular materials or structural details that were especially prone to damage or collapse? Were these common to formal or informal construction? Were they found throughout the disaster-affected area or only in specific locations? Is there an explanation for this?
- What modern buildings coped well in the disaster? Could the builders be traced to check whether they did apply standards and regulations? Did they do anything differently or over and above prevailing standards? Could this help to improve reconstruction standards and regulations?

Damage assessment

A study of damage caused by a disaster can tell us a lot about how the performance and implementation of standards and regulations contribute to the survival or failure of buildings. Damage assessments are treated in more detail in **PCR Tool 3: Learning from Disasters**. To make such assessments useful for decision making on standards and regulations for reconstruction, they should be designed to help answer the following questions as far as possible:

Scenario evaluation

Once a regulatory audit and damage assessment have been undertaken, it is a good moment to bring together the key stakeholders in defining reconstruction standards and regulations. They jointly assess the current strengths and weaknesses of standards and regulations and their implementation. They then consider the best option(s) from a number of scenarios that can be developed to improve the way construction is regulated to make it safer and more disaster resistant. It is important for them to consider that the standards and regulations they put in place may later be applicable too. Regulators may be tempted to set high standards and regulations by the influx of aid money following disasters, but it is impossible for many people to maintain these once the aid flow dries up. In the interest of long term disaster risk reduction, long-term affordability must therefore be considered. The scenarios may differ across a disaster area, for example between rural and urban locations. Potential scenarios could include, but might not be limited to, the following:

Scenarios for regulation

1. Standards and regulations performed mostly satisfactory, but their application was limited.

This scenario can apply if it is observed that buildings that were constructed according to standards and regulations performed better than those that were not, but only a small proportion of buildings were found to actually fully comply. It may be that standards, regulations or procedures were too strict for many builders to adhere to. This could suggest a cause for relaxing them, but only so far as is safe, determined by engineers or architects Procedures could be improved by: establishing one-stop shops; cutting red tape; reducing the cost of permits etc.; setting limits to approval periods; and installing clear appeal and complaint processes. Access and understanding of standards and regulations might be another constraint. This could be overcome by: developing information materials tailored to informal builders and home owners (which would use simpler language, more visual information and examples of application), and perhaps providing technical support and/or a dedicated question and answer service. However, these measures often are still not enough to regulate all building. Land tenure can be an underlying factor that may need to be addressed simultaneously. Even if these measures improve affordability, it might not be to the extent that is adequate for the poorest. Some countries have partially overcome this by having a two-tier regulatory framework that includes minimum standards to apply to low-income housing. Others have established starter standards or incremental standards, both of which expect owners to reach full standards after a given period. If one applies this principle to disaster resistance, it could mean that owners would be allowed to build a house with only a single cross-braced room, in which residents could shelter when a cyclone threatens, but that other rooms could be cross-braced later. Thus meaning design for retrofitting over time, but providing a safe core that would allow survival.

2. Buildings constructed in compliance with standards and regulations did not perform significantly better than those that did not comply.

Such a scenario can happen if standards or regulations did not consider the disaster in question adequately, or the disaster exceeded the magnitude for which they were designed. It can also occur if there is incomplete knowledge of disaster risk, and disasters strike in areas that were considered relatively safe. In such cases, it is advisable to undertake more systematic hazard mapping, and to revise standards and regulations upwards, remembering that there are limits to what people can afford. This scenario, however, can also occur if standards and regulations are well designed to deliver disaster resistance, but implemented poorly. This may happen for example if standards demand technologies that local builders are insufficiently familiar with to execute well, something that could be overcome with more training, technical support and supervision. Failure to perform also happens as a result of inadequate inspection, when inspectors are inadequately trained, lack transport, are overloaded, or can be bribed to approve poor quality construction. Some of this can be addressed by better education and training of building inspectors. Furthermore, the building inspectorate may need additional resources, particularly at times of high demand (i.e.when a huge reconstruction programme gets under way) which aid agencies may need to invest in. It is the approval of poor quality construction, often involving bribery that is harder to combat. A bottom-up approach to this could be to involve the future owners more in quality control, provided they are not the builders themselves; however, this would involve capacity building on quality issues and how these could be checked. It would also require them to have access to a building site, which builders may oppose for safety reasons - and it does require owners to be known in advance – which is often not the case. A top-down approach would require the agencies that finance reconstruction to take a more active interest; using their architects or engineers to check on quality independently or to hire check consultants. For an example of the latter, see **PCR Tool 10: Quality Control**, case 4.

3. There has been almost no regulation of construction.

Such a scenario may occur in rural areas where regulatory frameworks do not always apply. The big question here is whether they ought to be regulated to enforce good quality construction or whether a different way of achieving quality could be allowed. The practical implementation of a regulatory framework could be very difficult and expensive in some countries with rural areas that have scattered populations and poor accessibility, whereas it may be easier in countries like Bangladesh that are much more densely populated. However even in Bangladesh the affordability of regulation would pose serious constraints, as rural people tend to have less monetary income than their urban counterparts. Furthermore, those in rural areas are less familiar with the technologies imposed by some regulations, increasing the risk of poor construction. It may therefore be preferable to look for and strengthen traditional ways of achieving quality. To pursue this, it is important to identify what people do traditionally to guarantee construction quality and disaster resistance, and how these traditional quality measures have worked for different prevailing construction types. It can often be noted that vernacular technologies have evolved over time, learning from disasters that have occurred. Traditional timber frame constructions (for example in Turkey, or the *dhajji dewari* in Pakistan and *quincha* in Peru) all have good earthquake resistant records and have been used successfully in reconstruction without having to be regulated. In such cases, the advice and guidance by architects and engineers working for aid agencies, or researchers and academics, often helped to overcome slight weaknesses and execute construction in the best possible way. Over time, standards, guidelines or manuals may emerge from this.

4. The impact of the disaster is disproportionately large compared to its magnitude.

An earthquake with magnitude 5.5 or less, a cyclone classified as a tropical storm rather than a hurricane or typhoon, or flooding that happens every few years rather than once every century can be expected to cause only minor damage to most buildings, and most of this damage should be repairable. Only rarely would a building collapse from such disasters. If a scenario emerges whereby medium magnitude events cause several buildings to collapse or be seriously damaged, it should serve as a wake-up call. Possible causes need to be investigated and actions taken to make buildings more resilient, even to potentially more powerful future events. It could be that particular buildings more prone to damage, take priority in retrofitting. Attention also needs to be given to producers of building materials and components to ensure their products are not poor quality. The regulatory framework can also be examined; for certain types of construction such as reinforced concrete, it can be very difficult for inspectors to identify problems or visit all construction sites frequently. Better quality at the building site remains important (see **PCR Tool 10: Quality Control**) - having appropriate standards and regulations can facilitate that.

5. Most buildings withstood the disaster well.

This is the ideal scenario and it is important to look into the reasons for it. What types of buildings turned out to be particularly resilient and what are their significant characteristics? What made people decide to select this particular type over other options? How have standards and regulations and the methods of building control contributed to this good performance? What do builders and materials producers do to control quality? Lessons from this can then be applied to other construction that performed less well, or to other potential disaster areas.

Applications

Relatively few countries have standards and regulations that cover the hazard resistance of non-engineered low-rise residential and commercial buildings, and most of these are developed countries. There is now growing recognition of the particular vulnerabilities to natural disasters of such buildings in developing countries. In many cases, this has led to the production of guidelines for strengthening simple buildings. However, convincing householders as well as local authorities that these can be effective remains problematic. There have been documented cases of builders not implementing standards even after extensive training and demonstration, and of householders removing timber or bamboo struts or cross-bracing to use as fuel or to sell. Development agencies, researchers and building inspectors alike tend to pay very little attention to the alterations owners make to buildings, or their eventual lack of maintenance, once they are in use.

There are also positive developments however. These have often combined appropriate regulation with a significant level of community-based decision making and involvement in quality control. They involve the merging of formal top-down official regulatory processes that in some developing countries only cover a small part of construction activities with some of the bottom-up ways found in informal housing and building. What follows are some examples that have aimed to extend building standards and regulations to a wider audience, including builders of non-engineered construction.

1. Moving towards more inclusive codes and standards for disaster reduction in India

India has been severely affected by natural disasters in the past few decades, including several major earthquakes and cyclones and the 2004 tsunami. These have caused a high toll of human casualties and physical destruction, and highlighted the vulnerability of non-engineered buildings, particularly low-income housing. The Bureau of Indian Standards has taken the initiative to produce codes and standards that incorporate disaster mitigation for non-engineered and traditional-type buildings. These have been developed by committees of technical experts based on contemporary research on these types of buildings. More recently, there also has been provision for NGOs and consumer groups to participate in the formulation and revision of standards, but it is unknown how far this has happened for construction standards yet.

The *National Building Code of India – 2005* has a greater focus on disaster mitigation and on low-income and rural housing than previous editions. Relevant Indian Standards for the protection of simple or traditional types of buildings now include:

- *IS 13827: 1993 Improving Earthquake Resistance of Earthen Buildings – Guidelines*
- *IS 13828: 1993 Improving Earthquake Resistance of Low Strength Masonry Buildings – Guidelines*
- *IS 13938: 1993 Repair and Seismic Strengthening of Buildings – Guidelines*
- *IS 15498: 2004 Guidelines for Improving the Cyclonic Resistance of Low Rise Houses and Other Buildings/Structures*
- *IS 14804: 2000 Guidelines for Siting, Design and Selection of Materials for Residential Buildings in Hilly Areas.*

The standards have been complemented by detailed mapping of risk and hazard zones in India so that their users can have confidence in choosing the right technology for the level of risk in an area. For further information or sales contact: *Bureau of Indian Standards, Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002, India* – Email: sales@bis.org.in – Web site: http://www.bis.org.in

Further information including brief summaries of standards and areas of focus for safer construction can be found in the *Status Report on Standardization Efforts in the Area of Mitigation of Natural Hazards* by the Bureau of Indian Standards and the National Disaster Management Division of the Ministry of Home Affairs (undated): http://www.ndimindia.nic.in/WCDRDOCS/BIS.pdf and on the principles and policies for codes, standards and regulation for land use planning and construction with respect to disaster mitigation in: *Building a New Techno-Legal Regime for Safer India*, by the National Disaster Management Division of the Ministry of Home Affairs, and the Building Materials and Technology Promotion Council (BMTPC), undated: http://www.ndmindia.nic.in/WCDRDOCS/Building%20a%20Techno%20Legal%20Regime.pdf

2. Regulation from the grassroots: Post-earthquake reconstruction supported by the Coffee Growers Federation in Colombia

In January 1999 an earthquake of magnitude 6.0 struck the coffee growing districts of Western Colombia. Although the quake was only moderate it nevertheless caused over 600 deaths and severely damaged or destroyed many thousands of homes and coffee processing facilities. The coffee growers had one advantage: they were well organised both locally and nationally, in the Coffee Growers Federation, a body used to provide them with livelihood support. It now took on relief and ultimately reconstruction, though it was not technically qualified for the latter, and hired a team of engineers to help. The federation operated a reconstruction fund (FORECAFE), established with foreign aid and national contributions. It decided to leave decisions on the design and technology - and standards applying to those - to the householders, but provided various types of support to the latter. The engineers helped residents to draw up individual house plans and specifications, and the federation provided a lot of information to its members, e.g. on earthquake resistant construction. People could then choose whether to build their house themselves, hire contractors, or have a combination of both; there even was an option to acquire prefabricated housing. The affected could obtain a reconstruction grant of $4,000 from FORECAFE, plus an additional loan of $1,000 for house reconstruction. These were paid in instalments, with the engineers checking the quality of each phase before a new instalment was released. The coffee growers were very resourceful in using their social networks for help, salvaging components from damaged houses, combining traditional with modern materials, and negotiating down building materials prices. They also combined the modest grants and loans with their own savings, and were thus able to rebuild nearly 7,000 houses. In 2004, a slightly weaker earthquake, of magnitude 5.2, hit the region again, causing very little damage, providing some proof that self-regulation can work.

See: Lizarralde, Gonzalo (2010) in the Resources section.

3. Towards regional disaster mitigation: The Caribbean Uniform Building Code (CUBiC)

CUBiC was originally developed with USAID funding as a set of codes and standards that could be used or adapted by the 15 member and five associate member states of the Caribbean Community (CARICOM) and was released in 1985. As most CARICOM states are small, utilising CUBiC avoid them having to develop their own codes. CUBiC provided for the design of buildings against wind load and earthquake load with different levels of intensity. However, there was only limited consideration of how winds and earthquakes had an impact on different types of buildings and details about protecting low-rise non-engineered buildings, in which most Caribbeans live and work, were not included. Only three states fully mandated the use of CUBiC for regulatory control of building; in others compliance remained voluntary, or they continued to use their own codes and standards. There also was not much of an effort to train and orient professionals and builders on CUBiC.

In 2003, the model codes for the Caribbean related to earthquake and wind loads were revised and extended by experts from the Caribbean and Italy. This time, they included provisions for one and two storey residential buildings. See: Faccioli, Ezio and Calvi, Gian Michele, Model Building Code for Earthquakes, 2003, for the Association of Caribbean States, Port of Spain, Trinidad and Tobago, http://www.acs-aec.org/Documents/Disasters/Projects/ACS_ND_001/SeismCod.pdf and Chin, Myron M. and Suite, Winston, Model Building Code for Wind Loads, 2003, for the Association of Caribbean States, Port au Prince, Trinidad and Tobago, http://www.unesco-ipred.org/gtfbc/WindCode.pdf

One Caribbean country that has been at the forefront of the development and application of codes and standards has been St. Lucia. Hurricanes are the principle hazard here, although low magnitude earthquakes also occur. St. Lucia has not fully adopted CUBiC, but uses a variant based on the codes specifically developed for the Eastern Caribbean States under a collaboration of the Organisation of Eastern Caribbean States (OECS) and UN-Habitat. Since 1996, the National Research and Development Foundation (NRDF) has been running a programme of retrofitting the houses of low-income earners to improve hurricane resistance. This has included awareness raising and training of builders and homeowners on the effects of storms on buildings and how to make them more wind resistant. NRDF has produced a set of minimum standards for retrofitting. These contain many photographs and drawings and are mostly written in an easy to understand way that both technical specialists and most lay builders can make use of: Minimum Building Standards and Environmental Standards for Housing, prepared by the Safer Housing & Retrofit Program, St. Lucia National Research and Development Foundation, May 1997 & updated May 2003, available for download in six parts:

http://www.oas.org/cdmp/hrhip/documents/minstds/MinimumStandards_Part1.pdf

http://www.oas.org/cdmp/hrhip/documents/minstds/MinimumStandards_Part2.pdf

http://www.oas.org/cdmp/hrhip/documents/minstds/MinimumStandards_Part3.pdf

http://www.oas.org/cdmp/hrhip/documents/minstds/MinimumStandards_Part4.pdf

http://www.oas.org/cdmp/hrhip/documents/minstds/MinimumStandards_Part5.pdf

http://www.oas.org/cdmp/hrhip/documents/minstds/MinimumStandards_Part6.pdf

4. Matching standards to reconstruction realities in Kashmir, Pakistan

The Kashmir earthquake of October 2005 was massively destructive and resulted in the need to reconstruct half a million houses, many of which were scattered rural settlements in remote mountainous areas. People in those areas are highly self-reliant due to the terrain and the climate. Nearly every family had built its own house, with occasional help from friends, neighbours or artisan builders. The Earthquake Reconstruction and Rehabilitation Agency (ERRA) of Pakistan, established to manage the reconstruction process, therefore adopted an owner-driven approach to reconstruction. This created a problem of how to maintain standards over the very large number of reconstruction projects taking place in a vast area.

Some people reconstructed their houses using modern techniques, most commonly reinforced concrete block masonry or reinforced concrete frames with infill. Others returned to more traditional ways of building, particularly those that had proven to withstand the earthquake better, such as the *dhajji dewari* timber frames, with timber battens and stone or earth infill. Each technique presented particular issues for achieving good earthquake resistance, but the modern ones proved much more problematic.

UN-Habitat collaborated with ERRA on supporting owner-driven reconstruction. It found that with the modern techniques builders had not followed ERRA guidelines and therefore had not met standards and introduced safety risks in future quakes. A system of repairing common defects was needed for those houses. There were fewer defects with the traditional types of construction, with which builders were more familiar, yet some still made significant errors. It was found that the following factors are important to match construction standards to needs:

- Introduce flexibility and do not make standards too rigid
- Set the standards at a level builders can achieve
- Explain to builders the principles on which standards are based. Illustrate this with diagrams or models that people can check out for themselves
- Focus on training a small number of builders very well rather than a large number of builders superficially. Rely on these well-trained builders to disseminate information and train other local builders and support them to do this.

More on the difficulties and possibilities for implementing standards in owner driven reconstruction using either traditional or modern techniques can be found in: Maggie Stephenson, *Notes from Experience in Post-earthquake Rural Housing Reconstruction in Pakistan*, presented at the Building Back Better Workshop, Beijing, China, July 2008, http://www.un.org.cn/public/resource/9330387be56a506bac9cae9aef6d5400.pdf

A manual was produced on *dhajji dewari* construction, including high quality drawings and photographs and paying particular attention to showing potential mistakes and how to avoid them, see: Stephenson M. and Schacher, T. *Basic Training on Dhajji Construction*, 13/12/2006, http://www.traditional-is-modern.net/LIBRARY/SCHACHER-lessons/Schacher-DhajjiLesson(8.3.07)(s).pdf

Definitions

The terms building codes, specifications, standards, regulations, by-laws are sometimes used interchangeably. They do, however, have different meanings and may be understood in a number of ways by different people. Their definitions, however, are by no means clear-cut. Some details on the key terms are given below, mainly drawing from Yahya et al (2001: Appendix 1). Other interpretations may also be given in the literature:

Act (or **Ordinance**)

An act is a statutory governmental enactment, authoritative decree or law to control the physical development of the built environment. It can only be amended by further legislature. Acts can mandate specific organisations to produce or amend building codes, standards and regulations, and may also contain measures on how these would be enforced.

By-law

A by-law is statutory and similar to an act, but is enacted by a subsidiary legislative authority, such as a municipal council. The term 'building by-laws' means local, not national building regulations.

Building Regulation (or Rule)

Building Regulations describe requirements for buildings laid down by a responsible authority to ensure the safety, hygiene, structural stability and level of amenity compatible with environmental and social requirements during the construction and throughout the lifetime of a building. They expand on Acts, but are statutory on their own. These detailed rules may therefore address such elements as site conditions and use, means of access, lighting, ventilation, and disaster resistance of buildings. Regulations are taken as mandatory with transgressors required to put right any violations, or face fines or even imprisonment. Building inspectors check for compliance with the regulations and usually have the powers to order building works to be stopped, remedial measures to be put in place to rectify minor transgressions or complete demolition for serious breaches.

Building Code

Such codes provide practical, technical and administrative rules and requirements for the construction of buildings. Contrary to regulations, they are advisory rather than statutory. In most cases, mandatory issues are dealt with in regulations, whereas the codes support regulations with technical requirements and details. Within building regulations, the process for approving new or vernacular technologies can be very lengthy and complicated. But codes tend to be much more flexible and offer more scope to incorporate vernacular or innovative technology as well as non-engineered housing.

Building Permit

Such a permit allows an owner or developer to construct a building. For it to be issued, a relevant inspection body needs to be satisfied that the planned building is intended to conform to existing standards and regulations, and on a plot that is allocated to building.

Certificate of completion

This is issued on completion of a building deemed satisfactory by inspectors. Where a building is constructed in phases, and further funding depends on a previous phase being completed, **interim acceptance forms** may be provided by inspectors to show that construction has been completed satisfactorily up to that stage.

Code of practice

This is a technical guide for good design or construction that is not statutory. A code of practice is either published separately, or as part of a building code. A code of practice for design will typically deal with loads (dead, live, wind), materials (masonry, timber, concrete, steel etc.), elements (foundations, walls, roofs etc.), and special structures.

Decree

In the absence of a parliamentary system of government, laws are made through decrees. In some African countries building and planning decrees made in colonial days are still in force and have not been updated.

Legislation

Building legislation encompasses all legal instruments for controlling building operations. It normally takes the form of one or more acts of parliament or legislature, e.g. a Building Act or a Housing and Urban Development Act.

Norm

Building norm is a term used in francophone countries and sometimes in India. Norms can be of either the codes or regulations model.

Specification

This is a target that a material, component, building or part thereof is required to meet to be deemed to perform satisfactorily. They cover a large range of physical and user-related characteristics, such as strength and deformation of materials or components, weather-tightness, safety, hygiene and comfort. Specifications are statutory and published separately from regulations or codes.

Standard

A standard is a document stating the essential properties of buildings, building components and building products, including their dimensions, characteristics and performance. The also often contain information on how such properties can be verified. In general, standards are related to building regulations by virtue of the fact that the properties stated satisfy requirements in the regulations, and it is for this reason that reference is often made to standards in the regulations. Standards regulate design by specifying such items as room size, distance from adjacent buildings, types of material and construction techniques. There are also standards for specific materials such as cement, steel, aggregate, timber and bricks. Standards can be **prescriptive**, e.g. that parts of a building need to have certain dimensions, be of a particular shape, or built in a specific way. They can also be **performance** standards, defining characteristics such as load-bearing capacity, weather tightness, or wind resistance, but leaving owners and builders much more scope to decide for themselves what designs, materials and technologies (including vernacular ones) they are going to use to comply with performance criteria. Performance standards are more appropriate for people-centred reconstruction than prescriptive standards. **Minimum standards** are sometimes applied to low-income housing, to increase the potential of poor people to build within the law. **Starter standards** are a form of minimum standards which builders have to comply with initially, but have to improve on over time. **Incremental standards** are standards that begin with the minimum standards but indicate a process for reaching full standards over time.

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Resources

1. Aysan, Yasemin et al. (1995) *Developing Building for Safety Programmes: Guidelines for organizing safe building improvement programmes in disaster-prone areas*, Intermediate Technology Publications, London (now Practical Action Publishing, Rugby)

2. Coburn, Andrew et al. (1995) *Technical Principles of Building for Safety*, Intermediate Technology Publications, London (now Practical Action Publishing, Rugby)-
3. de Soto, Hernando (1989) *The Other Path: The invisible revolution in the Third World*, I.B. Tauris & Co, London.
4. Earthquake Engineering Research Institute (EERI) and the International Association for Earthquake Engineering (IAEE) *World Housing Encyclopedia*, a web-based compendium of housing types from around the world considered to offer advantages in earthquake resistance: http://www.world-housing.net
5. Global Facility for Disaster Reduction and Recovery (GFDRR) (2009) *Guidance Notes on Safer School Construction*, The World bank, Washington DC, USA. http://www.gfdrr.org/docs/Guidance_Notes_Safe_Schools.pdf
6. IFRC (2011) *Shelter Safety Handbook – Some important information to build safer*, IFRC Geneva.
7. International Strategy for Disaster Reduction (ISDR) and United Nations Development Programme – Regional Centre in Bangkok (2007) *Handbook on Good Building Design and Construction*, Aceh and Nias Islands, Geneva, http://www.unisdr.org/eng/about_isdr/isdr-publications/joint-pub/Handbook26-03-07.pdf
8. Key, David (ed.) *Structures to Withstand Disaster*, Thomas Telford Publications for the Institution of Civil Engineers, London
9. Lizarralde, Gonzalo (2010) *Decentralizing (Re) construction: Agriculture co-operatives as a vehicle for reconstruction in Colombia*, in Lyons and Schilderman (eds.) Building Back Better: Delivering people-centred housing reconstruction at scale, Practical Action Publishing, Rugby, UK, pp. 191-213.
10. Minke, Gernot (2001) *Construction Manual for Earthquake-Resistant Houses Built of Earth*, GATE-BASIN at GTZ, Eschborn, Germany, http://www2.gtz.de/dokumente/bib/04-5789.pdf
11. NHDA (2006) *Guidelines for Housing development in Coastal Sri Lanka*, Colombo
12. Parker, Jinx (1994) *Building Codes: The failure of public policy to institutionalize good practice*, Caribbean Disaster Mitigation Project (CDMP), http://www.oas.org/cdmp/document/papers/parker94.htm (also published in Environmental and Urban Issues, Vol. XXI, No. 4, Summer 1994)
13. Payne, Geoffrey and Majale, Michael (2004) *The Urban Housing Manual: Making regulatory frameworks work for the poor*, Earthscan, London.
14. Rossetto, Tiziana (2007) *Construction Design, Building Standards and Site Selection, Guidance Note 12 in Tools for Mainstreaming Disaster Risk Reduction: Guidance Notes for Development Organisations*, by Charlotte Benson and John Twigg, ProVention Consortium Secretariat, Geneva, pp. 141-152, http://www.proventionconsortium.org/themes/default/pdfs/tools_for_mainstreaming_GN12.pdf
15. Shelter Centre (undated) *Disaster Resistant Construction Practices, A Reference Manual* http://www.sheltercentre.org/library/disaster+resistant+construction+practices+reference+manual
16. The Sphere Project (2011) *Humanitarian Charter and Minimum Standards in Humanitarian Response* (especially pp.242-267 Minimum Standards for Shelter and Settlement), Practical Action Publishing, Rugby and www.sphereproject.org.
17. United Nations Centre for Regional Development, Disaster Management Planning, Hyogo Office (UNCRD) (2009) *From Code to Practice: Challenges for building code implementation and the further direction of housing earthquake safety*, Records and Outcomes of an International Symposium on Earthquake Safe Housing, 28-29 November, 2008, UNRCD, Tokyo, Japan
18. Yahya, Saad et al. (2001) *Double Standards, Single Purpose: Reforming Housing Regulations to Reduce Poverty*, ITDG Publishing, London (now: Practical Action Publishing, Rugby).

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