Design of a Transitional Community Center as an Urban Base for Relief.
Design of a Transitional Community Center as an Urban Base for Relief.
Research Report

as a template for the design,
created to obtain the degree of Engineer (Ir.)
i.e. the title ‘Master of Science’

Delft University of Technology, Netherlands
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on the authority of:
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Title: Architecture in Crisis | Urban Shelter Proposal
Design of a Transitional Community Centre as an Base for Relief

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Making plans for one year,
we plant rice.

making plans for ten years,
we plant trees.

making plans for one hundred years,
we prepare people.

- old Chinese saying
“Everyone has the right to a standard of living for health and well-being of himself and his family, including food, clothing, housing and medical care and necessary social services, and the right to security in the event of unemployment, sickness, disability, widowhood, old age or other lack of livelihood in circumstances beyond his control.”

Universal Declaration of Human rights (Article 25.1)
To conclude my masters’ degree at the Faculty of Architecture of the Delft University of Technology I choose to graduate in the Explore Lab. This graduation studio makes it possible to do an individual research and design by a personal fascination.

In the beginning of my studies, almost seven years ago already, I developed an interest for new cultures, countries and especially for the long-distance traveling that is associated with it. During my bachelors’ in Groningen I have had the opportunity to visit various parts of the world where, at the same time, I was confronted with the big differences that exist in the world. Visiting slums in South-America, small developing communities in Africa and graduating in a very small village on the island of Sulawesi, Indonesia, has taught me a lot about the strong differences between my ‘western’ world and the rest of the ‘developing’ world and made me realize that we are blessed with our safe and cared life in the Netherlands.

Starting in Explore Lab, the only thing for sure was my fascination: ‘architecture after disaster’. During the first months of graduation it slowly started to turn into an idea that combined the complex world of humanitarian relief aid and the future increase of natural disasters and urbanization of the poor. Searching for ‘the solution’ for all these problems didn’t actually succeed but taught me a lot in the first place and finally brought me to the idea of a transitional community center as an urban base for relief. Although the idea in itself might not ‘solve everything’ and doesn’t seem to be realistic for every professional involved in the field, it is an attempt to bring new insights into the debate on the problems of ongoing urbanization of poverty and the increase in natural disasters.

This essay is a reflection on the research period I did about the transition of a community building. Designing in a pre-disaster phase forces to design for preparing which is translated into a design manual (chapter 4) that can function as ‘the rule of thumb’ for the design of building that has to withstand earthquakes, floods and typhoons. Designing transition within several other phases that offer education, facilitation, sheltering and relief aid in both periods before, during and post-disaster, forces to focus on functionality and flexibility of the design. Guidelines for such a design project are developed during the research and design project and are translated into guidelines or ‘points of consideration’ (chapter 5). Coherent to this research, an architectural translation, located in the slums of Manila, the Philippines, was developed in the final phase of graduation and is discussed further in the subsequent chapters.

This process that eventually led to developing this report is, of course, not passed through alone. Due to the input and encouragement of John Heintz and Robert Nottrot in the early beginning of graduation, the ideas started to develop slowly but progress remained when Alexander Vollebregt made sure I searched further, to the core of the assumed problem. During the struggle with the endless stream of information that is available on humanitarian aid, urbanization, housing emergency and natural disasters, Alexander helped me with the interpretation and perspective of this input. The comments of Jim Kennedy, shelter coordinator at CARE, during several Skype sessions, in response to our encounter at a seminar in Delft, made me realize that the world of humanitarian aid and development is so complex that an actual solution doesn’t exist. Practical narratives by Henk Meijerink, shelter coordinator at Cordaid and an interview with Roel Gisbers, researcher at the Technical University in Eindhoven, have helped me during the overall process. In the end, during the concluding design process, the enthusiastic and encouraging comments of both Elise van Dooren and Robert Nottrot helped me to visualize the proposed idea of a transitional community building.

Besides all these professionals that shared their knowledge from practice, I am very grateful to my parents who supported me in various ways, always encouraging to continue, even if my doubts expressed. In addition, of course, my two sisters, girlfriend and some close friends, they know who they are, supported me in various ways during my whole studies.

Diederik de Jonge

April 2013
Global disaster risk is on the rise because of unsafe cities, environmental destruction and climate change—factors that jeopardize the lives of hundreds of millions of people worldwide.\footnote{UN International Strategy for Disaster Reduction (ISDR)} Growing urbanization in combination with these changing climate conditions will cause more and especially bigger natural disasters in the nearby future. Urbanization is in such a rapid development that city authorities in many developing countries have difficulties with providing basic infrastructure and services for the tremendous influx of new city dwellers. Besides, many of the world’s mega-cities - those with populations exceeding 10 million, are in locations prone to major earthquakes and severe droughts, or are along flood-prone coastlines. And the growth continues, by 2050, 70 per cent of all people on the globe are called urbanite. Already these days, nearly 2.6 billion city dwellers are living in poorer countries, and around one billion of them live illegally in slums.\footnote{World Disasters Report 2010, Red Cross, 2012} This means that 30-60\% of people in the largest cities of the developing world live in densely populated squatter settlements. Demand for new land in cities has led to use of unsuitable terrain (floodplains, unstable slopes, reclaimed land) prone to natural hazards and urban development increases the flood risk by disrupting natural drainage channels. The cities’ poorest dwellers live in areas most vulnerable to hazards. Therefore fast-growing cities contain increasing numbers of poorly constructed or badly maintained buildings, leading to unnecessary deaths, and makes more people vulnerable to future disasters.\footnote{Cities at risk – Making Cities Safer…. Before Disaster Strikes, IDNDR Report} More than ever, there is the need for decision makers to adopt holistic approaches and new solutions in dealing with displacement, urbanization of the poor and the increase of natural disasters.

Urban acupuncture: focus on community level

How on earth can we ever solve all these problems with regard to urbanization of the poor and the increase of natural disasters? To be short, it is impossible and therefore no specific solution will be given in this report since there is no ‘real’ solution that solves all the problems and minimizes all the risks that are attached to them. The solution given by this research and design report focuses on upgrading and protecting lives of poor slum dwellers. Upgrading by offering facilities and minimum living conditions and protecting by offering a shelter in case of disaster to strike. Upgrading living conditions and preparing for disaster automatically offer a partial ‘solution’ to the problem of giving proper relief aid that should be provided in high dense urban areas by emergency agencies after disaster has struck. The focus on preparing for disaster on community level leaded to the development of a transitional community centre as a urban base for upgrading slum life conditions and urban relief.

\begin{itemize}
\item \textbf{ABSTRACT}

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Global disaster risk is on the rise because of unsafe cities, environmental destruction and climate change—factors that jeopardize the lives of hundreds of millions of people worldwide.\footnote{UN International Strategy for Disaster Reduction (ISDR)} Growing urbanization in combination with these changing climate conditions will cause more and especially bigger natural disasters in the nearby future. Urbanization is in such a rapid development that city authorities in many developing countries have difficulties with providing basic infrastructure and services for the tremendous influx of new city dwellers. Besides, many of the world’s mega-cities - those with populations exceeding 10 million, are in locations prone to major earthquakes and severe droughts, or are along flood-prone coastlines. And the growth continues, by 2050, 70 per cent of all people on the globe are called urbanite. Already these days, nearly 2.6 billion city dwellers are living in poorer countries, and around one billion of them live illegally in slums.\footnote{World Disasters Report 2010, Red Cross, 2012} This means that 30-60\% of people in the largest cities of the developing world live in densely populated squatter settlements. Demand for new land in cities has led to use of unsuitable terrain (floodplains, unstable slopes, reclaimed land) prone to natural hazards and urban development increases the flood risk by disrupting natural drainage channels. The cities’ poorest dwellers live in areas most vulnerable to hazards. Therefore fast-growing cities contain increasing numbers of poorly constructed or badly maintained buildings, leading to unnecessary deaths, and makes more people vulnerable to future disasters.\footnote{Cities at risk – Making Cities Safer…. Before Disaster Strikes, IDNDR Report} More than ever, there is the need for decision makers to adopt holistic approaches and new solutions in dealing with displacement, urbanization of the poor and the increase of natural disasters.
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\end{itemize}
high density urban slum

what if disaster strikes?

current situation

utopian solution?

Figure 0.1: Abstract research model: the intention of designing a transitional community center.
Guidelines for a transitional community centre

The research focuses on the transition of this so-called community centre since it has to adapt to several conditions in many different phases. Since the transitional community shelter is an entire separate structure that should function as an education and community centre, and is designed and constructed to protect its occupants and nearby residents from specific natural disasters as well, means there a many things to take care of within the design process.

Transitional community centres can be built in disaster prone areas, in this research there is a focus on typhoons, floods and earthquakes, especially in slum areas, which are mainly underdeveloped and have poorly constructed houses and often lack proper sanitation. The proposed centre accommodates educational, community and sanitation facilities to upgrade standard living conditions and hygiene and offer new opportunities to boost new developments by means of a strong connection with a market place, modern communication networks and proper accessibility. Communities should not be passive recipients of information but should be encouraged to help themselves and the centre must be provided with the mechanisms and tools to do so. There is a need to acknowledge that facilities for information, education, sanitation and communication could actually help to develop urban slums. When disaster strikes, the community is supposed to know how to handle and the centre itself can transit into a safe house to provide proper protection against high wind forces, the impact of windborne debris, monsoons and high water levels caused by typhoons and floods. In case of heavy earth shocks caused by earthquakes, the building should withstand these and immediately be able to transform into a centre of emergency relief.

The guidelines provided in this research are oriented to the needs of the designers and engineers that have to bring these kind of constructions into practice and provide a description of the range of design guidelines that need to be considered when making design that have to be able to withstand natural disasters like earthquakes, typhoons and floods. The guidelines are divided in standards and transitional guidelines. The standards will provide an introduction to the general structural requirements and various measures to mitigate the impacts associated with natural disasters. The transitional guidelines will further elaborate on the different phases that are identified: education and facilitation in the pre-disaster period, alarming and sheltering during disaster and relief aid and re-building in the post-disaster period.
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How does architecture arise after disaster has struck? Where does design start when nothing is left and creation has to start fast and cheap? After seeing the plans of the Japanese architect Shigeru Ban for a 25-meter high cathedral built up with 104 cardboard tubes in the New Zealand city of Christchurch I was inspired by the simplicity of this idea for a temporary replacement for the iconic stone cathedral that was partly laid in ruins by the earthquake in 2011. During that natural disaster, 185 people died and a large part of the center of the city was destroyed.2 Shigeru Ban had processed cardboard previously in his design for new temporary buildings and was responsible for the beautiful paper church in Kobe after the earthquake in 1995 acted as a community center.

1.1 Fascination

Being intrigued by his buildings the search for other disaster related architecture started and brought many interesting examples of architecture for crisis. Several organizations and projects within the field of emergency architecture and slum upgrading initiatives brought me into the field of urbanization of the poor. During a seminar, organized within the TU Delft with some professionals out of the field, from non-governmental organizations like Cordaid, many things became clear for me. The immense and complex world of re-construction after disaster is to complex to fully understand, but one thing said by Henk Meijerink kept at me: “The Red Cross cites Haiti as a scenario many poor countries are likely to face. Haiti’s capital Port-au-Prince is designed to house some 250,000 people but numbered two million residents when the earthquake struck in January with some 90 percent of them living in slums, and many more cities in the world face the same problems.”3 It made me realize that many people in the world, especially in urbanized areas, are under the treat of huge risks without actually being able to protect and prepare for these risks. The combination of the predicted future increase of natural disasters, the ever expanding urbanization of poverty in coming decades and all the related problems that exist in todays slums, brought me to the first idea of designing a transitional community center as a urban base for relief. The research that followed in the months after this seminar brought me to an idea of this so-called transitional community center. An architectural intervention, placed as acupuncture in the urban fabric of high density slums, that is able to prepare people for a natural disaster by education, retrofit slums by facilitation and knowledge, protect by alarming and sheltering and finally can be transitioned into an urban base for relief and re-building.

INTRODUCTION

Where does fascination start and research start? An introduction into the search for a transitional community shelter as an urban base for relief.

1 Population Division of the Department of Economic and Social Affairs of the United Nations
2 www.nd.nl/artikelen/2012/april/16/een-kartonnen-kerk-voor-christchurch
3 Seminar with Henk Meijerink, Architect at Cordaid, October 2013

IN 2008 more of us lived in cities than in rural areas

Figure 1.1: Rapid urbanization of poverty is a major challenge for the future. Already in 2008 more than 50% of worldwide population lived in cities.1
1.2 Context

Global disaster risk is on the rise because of unsafe cities, population growth, environmental destruction, climate change and rapid urbanization — factors that jeopardize the lives of hundreds of millions of people worldwide. Growing urbanization in combination with these changing climate conditions will cause an increase of natural disasters both in terms of frequency and impact, in the near future. Several non-governmental organizations have warned for an increase in extreme weather conditions in the coming years, and already over the past decades, the frequency of so-called ‘natural’ disasters has grown significantly worldwide. In fact, their number has quadrupled during the last 30 years, resulting in escalating human and economic losses.

Urbanization of poverty

At the same time, urbanization is in such a rapid development that city authorities in many developing countries have difficulties with providing basic infrastructure and services for the tremendous influx of new city dwellers. Besides, many of the world’s mega-cities - those with populations exceeding 10 million, are in locations prone to major earthquakes and severe droughts, or are along flood-prone coastlines. And the growth continues, by 2050, 70 per cent of all people on the globe are called urbanite. By this time, there are about three billion people more are drawn to the city: the biggest migration in history. Already these days, nearly 2.6 billion city dwellers are living in poorer countries, and around one billion of them live illegally in slums. This means that already 30-60% of people in the largest cities of the developing world live in densely populated squatter settlements. A squatter is a person that occupies a piece of land or a building without legal permission. In the context of rapid urbanization the problems of squatters are increasingly difficult. More and more people come to (mega)cities for the hope of a job and a better life. Urban populations are growing fast and cities grow bigger than anyone ever imagined. Sixty years ago, only 75 cities had more than a million inhabitants. Now there are nearly 450 such cities. The ongoing demand for new land in cities has led to use of unsuitable terrain (floodplains, unstable slopes, reclaimed land) prone to natural hazards and urban development increases the flood risk by disrupting natural drainage channels. The cities’ poorest dwellers live in areas most vulnerable to hazards. Therefore fast-growing cities contain increasing numbers of poorly constructed or badly maintained buildings, leading to unnecessary deaths, and makes more

1 billion people call ‘slums’ home today

The UN defines a slum as a household that lacks access to one or more of the following:
- access to improved water
- access to improved sanitation
- security of tenure
- durability of housing
- sufficient living area

4 UN International Strategy for Disaster Reduction (ISDR)
5 Managing Urban Disaster: Risk Analysis for Integrated Settlement Development Programming for the Urban Poor, Christine Wamsler, Lund University, 2007, pIII
6 World Disasters Report 2010, Red Cross, 2012
7 Cities at risk – Making Cities Safer…. Before Disaster Strikes, IDNDR Report
8 Toilet tragedy, toilet treasury. Lanting 2011
9 Interview Cees Breederveld, CEO Dutch Red Cross
10 The Challenge of Slums: Global Report on Human Settlements 2003 - UN
people vulnerable to future disasters. More than ever, there is the need for decision makers to adopt holistic approaches and new solutions in dealing with displacement, urbanization of the poor and the increase of natural disasters.

The impact of natural disasters

These ‘natural’ disasters have devastating impacts on people, environments and economies. Every year over 200 million people are affected by natural disasters and hazards. Ninety-eight percent of these victims are in the developing world, although, those in the developed world are not immune, as extreme temperatures, intense heat waves, increased flooding and droughts expose vast numbers of people to the experience of the eco-refugee. Especially in terms of the human lives and proportion of gross domestic product lost as a result of disasters developing countries bear the highest burden.

Disasters are occurring more often and becoming more intense, so disaster risk reduction has become one of the most important components of sustainable development.

1.3 Problem statement

Particularly the urban poor are more vulnerable to ‘natural’ disasters, such as earthquakes, floods, landslides, and typhoons and in lesser extent to volcanic eruptions, wild fires, water surges, and droughts. Their settlements are often located on marginal land near rivers or on steep slopes and have substandard housing and infrastructure. Among other risk factors are leaking sewage pipes from better-off settlements that pass through slum areas; lack of water and waste management services; limited access to information; and overcrowding. While poverty reinforces people’s vulnerability to natural hazards, disasters make their already precarious living conditions worse, creating a vicious circle of poverty. As mentioned before, half of the world population lives in urban areas and more than one billion people worldwide live in slums. It is estimated that their number will double over the next 25 years, thus strongly increasing the

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11 Beyond Shelter: Architecture For Crisis, p7
12 Global Facility for Disaster Reduction and Recovery, Annual Report 2011, GFDRR, p18
Figure 1.2: Distribution of disasters by type between 1991-2005

Figure 1.3: Proportion of victims by type of disaster between 1991-2005
number of people forced to accept living conditions that are dangerous and beneath human dignity. The threat of climate change presents an even more worrying outlook in this context. To address these challenges, increasing attention has to be given to the need to reduce disaster risk through development work during pre-disaster periods in disaster prone areas. This could bring a further developed and more sustainable manner of poverty reduction in both rural and urban situations. Especially in urban slum areas new methods for re-development, education and options for easier and quicker relief responses have to be addressed to reduce the risks of living in these urban areas. One of the aims of the Millennium Declaration, to achieve a significant improvement in the lives of at least 100 million slum dwellers by 2020, alludes to this need. However, in practice little attention has been paid to urban settlement development in comparison with other development sectors. Consequently, urban development actors (including donor and implementing organizations) still struggle to effectively tackle disaster risk through their everyday work. The past decades, research on post-disaster relief aid and reconstruction, focused on the implementation of sustainable urban shelter programs and the support and active involvement of the local population, should contribute to improve living conditions of this recurring problem.
2.1 Problem definition

The on-going urbanization of poverty in slums, the future increase of natural disasters and the insufficient developing of emergency strategies within urban areas are the three cores in the forming the problem definition of this research. Having introduced some fact and figures in the introduction of this research the problem statement has put the major research components mentioned above in more detail. Further defining the problem will help to focus on the specific architectural solutions that were sought during the research period. Describing the situation can only be relevant if there is relevance within the related areas of research and the assumed patterns of concerned people and organizations. Defining the problem and its owner should make it conceivable that the proposed solution is more desirable than the present one: the research goal. Since the existing situation is already formulated in such a way that the problem arises, defining the problem will be mainly about the focus on the proposed solution, its relation with the problem and the final research goal.

Urbanisation of poverty

In the perspective of a growing urban world population and the expected increase of poverty in especially slum areas, it assumed that the development of new and more sustainable architectural solutions for achieving minimal living standards is necessary and useful. Not only for people living in urban poor conditions right now, as well as for those in the near future. By developing new and different ideas for the problems concerning slums, disasters and related relief aid, it could be possible to ensure and improve the minimum standard living conditions in future slums. In general, education and sanitation facilities are seen as the main solutions to increase standard living conditions. Besides these basic living conditions it is well known that proper infrastructure and related access to it, both in the physical and digital world, is seen as the main booster of economics and its associated prosperity. Access to modern communication networks will increase this economic boost and at the same time will improve education and information possibilities within these subordinated urban areas.

Increase of natural disasters

The definition of slums (UN Habitat) tells us that besides proper access to safe water and sanitation, the lack of durable housing with a permanent nature that protects against extreme climate conditions is one of the main problems in slum areas. Since urban poor are particularly more vulnerable to natural disasters and taking in account the future increase of these disasters and the rise of related risks that an urban environment brings anyway, these risks should be implemented and interwoven with the same proposed architectural solution. Logically, the proposed
architectural intervention should be prepared for these future increased risks and especially these of natural disasters. The solution should come up with shelter possibilities to prevent forced evictions by natural disasters and should be able to offer safety during disasters. Since many natural disasters are known and cause very varied numbers in casualties there will be a focus on specific disasters. As shown in figures ?? and ?? the distribution of floods and storm are the highest. The proportions of victims on the other hand show earthquakes as the most dangerous natural disaster. Therefore the architectural solution has to be able to withstand these three natural disasters and offer proper shelter to slum dwellers in case one of these will strike. This automatically means that the minimal standards of this architectural intervention are high.

**Urban emergency strategies**

Since the upcoming urban environments have many (maybe more) different requirements and solutions than the declining rural environmental in both pre- and post-disaster situations it will need different solutions on different levels as well. The most common architectural solution in rural areas after disaster has strike focuses on household level, which is completely developed and applied in many ways. Although it doesn’t apply in every situation and it doesn’t work in every area, it is still the most standard solution of non-governmental organizations after

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**Figure 2.2:** First set-up of research in different phases within in the context of slum-upgrading by minimum standards, education and facilitation, in the context of natural disasters by phases of preparing, alarming and sheltering and finally in the context of urban emergencies by relief aid and re-construction.
disaster has struck. In this research it is assumed that an approach on household level is not the appropriate level in order to intervene in an optimal way. To be able to interfere in a pre-disaster phase it is presumed necessary to intervene on the level of neighborhoods or communities. Choosing this level means another architectural scale, which makes it possible to facilitate education, sanitation and shelter possibilities on a bigger scale, factors that can improve the quality of many lives directly and more important, in a pre-disaster situation. The proposed level makes it possible to develop a structure that can be integrated in slum-upgrading programs that retrofit slum housing. Retrofitting by urban acupuncture could be more effective in both pre and post-disaster phases because of economies in scale and structure. Although it is well known that collective emergency centers are not a preferred displacement solution, there is a best-case scenario for the selection of a collective center in emergency situation: if a proper structure at an appropriate site is found, many future issues in collective center management can be addressed more easily. Since this best-case scenario does exist in this proposed situation, this idea of an urban transitional community center could be the base of a newly developed plan as an urban base for relief. It will improve and upgrade lives in pre-disaster situations, safe and protects lives during disaster situations and will offer quick relief aid and re-building possibilities in post-disaster situations.

### 2.2 Research question

The proposed idea of a transitional community center has of course a wide variety of issues to deal with. Besides architectural and constructional requirements it has to respond on community and society relevant issues like culture, religion, local habits and traditions but also on management and administration level a lot of questions rise. Who is responsible for what during ‘pre-disaster’ times? What actors, like non-governmental organizations, play a role in the phase before disaster happens and particularly the first phase after disaster has strike? How can you involve the local community into the design and construction of this community based architectural intervention and how do they respond on it when disaster is actually happening? This architectural intervention will not take care of all these questions in the first place. The goal is to create a building that can actual form the required backdrop during all these different phases and demands. Since the range of problems is too broad to grasp and the world of relief aid turned out to be a complicated one with to many actors and influences it is impossible to completely answer the problems that are indicated within the problem statement. The world of non-governmental organizations, many different disastrous scenarios, possible governments and of course the many rules and regulations that are required in relief aid turned out to be a tangle of

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1 United Nations High Commissioner for Refugees (UNHCR) and International Organization for Migration (IOM) and CCCM Cluster, Collective Centre Guidelines, 2010, p55
constraints making it impossible to find a solution that will and can satisfies all actors and conditions. Specific knowledge is required for different situations and locations. Specific knowledge about any culture can influence design in a positive way for sure but what if the reason of the design does not corresponds with the cultural identity of the local community? For example, in some cultures people built to withstand nature, in other cultures they build to undergo nature. Since this problem statement and the research goal are developed with a western view, with

Problem statement
(disaster prone urban area in need of risk reduction)

Figure 2.3: Research overview: from problem statement to guidelines and a design to generate recommendations for improvement of high densed slums, sheltering during disaster and recovery by emergency aid and rebuilding.
a western solution (withstanding nature) it is more adequate to design it in this way as well. Of course, it is not desirable to ignore local traditions and construction methods but the degree of efficiency should of course be judged differently in every situation. Since the proposed design location in Manila, the Philippines, will not be visited during the research period it will not be possible to fully implement the local knowledge and traditions. Literature studies and interviews should be helpful enough to adapt the design to the Philippines climatic and specific slum situations. The adaptation to this specific Philippines situation is in this case less important than the adaptability of the design itself. The focus of this research will be more specific on the generic principles of the transitional identity, or actually the adaptability, of the building than the cultural specific principles. In this way it is possible to stimulate a more thorough discussion on urban interventions in upgrading slum situations within the context of disaster issues as a key input during the design process. Therefore the research question is as follows:

‘What are the architectural requirements of an urban transitional community centre, in an disaster prone area, that has to become suitable and contributing to the neighbourhood in pre-disaster, during-disaster and post-disaster phases?’

This main research question has the final goal of recommending one (or multiple) strategies for the adaptable design of a transitional community centre in an urban area, but of course, more sub questions are necessary to achieve this goal. First of all the already mentioned complexity of the pre (slum-upgrading) and post-disaster (relief aid) context needs to become understood, which requires a short theoretical description of slum upgrading processes and post-disaster reconstruction. Secondary, the differences between rural and urban interventions will be mentioned and compared. Third, looking into already used methods and structures in former disaster areas and interviewing specialists in the emergency relief field should give enough information about do’s and don’ts in both pre- and post-disaster areas. The final design has to answer the main question by a specified design of a new transitional permanent community center/shelter. To summarize the research and design, a schematic overview is given to explain the principles of the research.

2.3 Research goal
The primary goal of this study is to understand whether it is possible to minimize the possible risks of living in a disaster prone slum (urban) area by using architectural elements in an adaptable design that can offer the perfect base in all the different phases that exist in pre- and post disaster context. This study takes

2 Interview with Alexander Vollebregt, November 2012
a scientific perception by using specific adaptable architectural elements in six different phases (chapter 5) that can be used in the context of disaster prone urban areas in developing countries or more specific, so-called ‘slum areas’. By incorporating different phases as a tool for research and design, indicators are created where architectural interventions are most needed. By literature studies, analyzing other slum-upgrading design, research by design and taking interviews, recommendations are presented in a range of guidelines and requirements that will present the results of research in such a way that both aid-workers, local people, designers and other vocational oriented people could use it in the process of slum-upgrading, disaster risk interventions, emergency relief and other urban community related development issues in (poor) urban oriented areas. It is thereby the assumption that the focus of research on generic architectural elements, instead of pure location/local culture based design, contributes and stimulates a more thorough discussion to policy for future trajectories in slum redevelopment.

Figure 2.4: Different phases in the design of a transitional community centre: to reach a certain ‘generic’ design that is adaptive to every phase, it is assumed that every user, every culture and thus every phase has its own specific identity within the same archetype. The search for a base, or the so-called archetype of a transitional community building, should deliver a basic design that can carry every identity as the tree can carry its leaves in every different season.
2.4 Design goal

The final design has to answer the main question by a specified design of a new transitional permanent community center/shelter in the context of a Philippines slum area in its capital Manila. It should be mentioned that during the design process there is a focus on the adaptability of the building in each phase. Local influences of culture and community on the design will be less important than climate related issues. Most important will be the adaptability to each proposed situation in both pre- and post disaster. In figure 3 it is made clear that the design should act as an open ended adaptable structure, which is completed by a designers view but is able to be re-finished by local inhabitants.

Figure 2.5: Research goal: the base of a transitional community center should be given by its designer and appearance by its identity which will be given by its user, environment and culture. The research results should be the base of a transitional community center, but climate issues and cultural influences will be able to adopt in the final design.
2.5 Research method

The proposed ‘solution’ in this research is not supposed to work solely as a displacement function, school or shelter. However, education and aid are needed directly in different phases, the proposal should rather act as a possible architectural structure that can house these ultimate requirements that are needed both in the pre-disaster phase (education/facilitation), during disaster ( alarming/sheltering and in post-disaster phase (relief-aid/ rebuilding). Each of these phases has of course it’s own programmatic, structural and architectural elements and requirements that have to be addressed in every possible situation the building is designed for. The main structural elements are described in the chapter about ‘standards’ (chapter 4). These guidelines will inform the designer of the proposed community center/shelter about the diverse structural requirements when designing a building that has to be able to resist natural disasters like earthquakes, typhoons and floods. The subsequent chapter will further analyse the aforementioned six different phases (education, facilitation, alarming, sheltering, relief-aid and rebuilding), which are the base of the research and are further developed and processed into specified guidelines for each phase. The subsequent six parts of the research project cover the method description of the research that has been done. These parts of research are „problem description & analysis“, „interviews“, „research by design“, „guidelines“, „design“ and „conclusion“. Each part of the research reflects on the previous gathered insights, which changes the tasks and content of each part.

1. „problem description & analysis”

This first part has been treated already for a large extent and will continue in the following chapter about definitions where further analyses of main questions have been done. Desk research into the world of post-disaster situations and the related development aid organizations was the main research method within this phase of the research. The academic field of post-disaster reconstruction has published a large range of books, articles and evaluation reports which where used extensively next to the knowledge brought in by specialists out of the field.

2. „interviews”

The second part of the research method is found within the practical experiences of people that are vocationally concerned with the implementation process of permanent transitional shelter / community centers in both pre- and post-disaster areas. These people are interviewed during the process of starting this research until this research was

Figure 2.6: Research by design; flood requirements to protect the building and minimize risks.
finished. The influences of professionals polished the existing principles that have been set up out of the desk research and can be found in the appendixes of this research report.

3. “research by designs”
The third part of the method is found within the practical experiences of research by design. The implementation process of practical sketches and desk research ended up being the base of the guidelines and requirements that are important within the six different phases. It clarified and transferred theoretical information into themes to be used in the efficacy of designing a transitional community center.

4. “guidelines”
The fourth part of the research project is found within the research and design experiences during the period of desk research, doing interviews and resulted in many design sketches that are transformed into specific guidelines. In chapter 4 the actual ‘standards’ can be found which describes the structural, and therefore minimum standards, guidelines for designing a community center that has to withstand earthquakes, typhoons and shelters. The subsequent chapter will have the same guideline structure with further input on every aforementioned main phase that was filtered out the research input.

5. “design”
Part five of the research project will provoke a design in which the developed research information is used to examine the effectiveness of and the difference with the existing context of post-disaster activities. Research by design has been the mayor input during this phase and the drawn sketches and program of the research will be the main source for the final design. The several phases and the corresponding architectural elements (specified in the main research question) will be used as indicators to specify conditions and success of the implementation of the research process. The building should be the icon of adaptation with protection as the key principle in each proposed phase.

6. “conclusion”
Final part of the project will conclude all preceding information. The themes that stood out in the research could lead to a new approach within the issues of risks caused by urbanity and natural disasters. Given recommendations could stimulate a more thorough discussion on urban intervention and in the adaptation of new slum-upgrading, sheltering and re-construction strategies for NGO’s and other governmental organizations.
3.1 Specific challenges in urban areas

Urban areas are much more complex than the rural areas that have been the focus areas of relief aid organizations in the last decades. Every urban context is different; a closer look at some stereotypical features of households, neighborhoods, cities and their wider connections will help to develop a certain ‘urban view’ on emergency related issues.

Households and families

First of all, urban households have to rely on very different strategies and assets for survival comparing to their rural counterparts. Instead of rural agriculture, taking a less prominent role in being dependent, informal employment in construction, services and trade become much more important in their urban
counterparts. Rural refugees arriving in urban areas may have to adjust to cash economies, unemployment, and types of violence associated with, or exacerbated by the urban environment. The history and economies, particular in urban areas, also affect decision-making particularly with respect to:

- The capacity of urban communities to absorb new arrivals without conflict erupting.
- The functionality and accessibility of housing and related facilities.
- The presence of other services such as water and sanitation systems and markets.

Locations and neighbourhoods

 Poor people often tend to want to live close to their income generating opportunities. This may mean that they have to settle on dangerous or illegal, though central sites, rather than on the fringes of cities where it takes a long time and is expensive to reach work. The immediate need of survival is often a more critical factor for the poor than the risk of an eventual disaster at some unpredictable time in the future. Land without services and infrastructure or that is prone to hazards may also be a lower-cost, informal option. The more privileged and deprived areas can be closely interwoven or split into distinct areas of cities. There may be multiple busy centres clustered around markets, clinics, schools or transport hubs; people may use different parts of the city by

Figure 3.1: Diagram of different stakeholders and environmental context of urban settlements.
day and by night. This clustered and wide spreading of urban slums within the city makes it hard to localize vulnerable people. Efforts to actually provide facilities and infrastructure within these informal settlements is almost impossible since developing housing and infrastructure in these dangerous only solves the problem temporary.

Urban linkages
A useful definition is one that views the urban, peri-urban and rural areas as a continuum held together by their degree of economic and social integration around the city. It is helpful to see that rural and urban areas are linked together by transport and road infrastructure, trade and flows of money and the daily, seasonal and migratory flow of people. Cities link in to national, regional and international systems. The risks of operating in an urban environment need to be considered with care, especially in a pre-disaster period. Government is responsible for infrastructure and facilitating proper living conditions within urban areas, in crisis or disaster situation this enforcement can be less limiting since all help, even if government is not directly involved, is welcome. The main option in pre-disaster urban areas for humanitarian organisations is engaging in, for example, participatory risk mapping of communities. Such processes not only help to identify physical and environmental risks - often perceived as a high priority immediately after a natural disaster - but also allow relative risks and the perception of risk to be understood by both relief organizations and communities itself, including risks associated with criminal or gang activity, police or state brutality. Risk mapping could then inform planned layouts or community neighbourhood improvements and could be the main reason to allow humanitarian organisations on a permanent base within the urban slum areas of cities. This approach of risk mapping can for example be useful when planning crowd control during distributions in post-disaster phases, which can create an atmosphere of fear and resentment.

3.2 Differences in rural and urban areas
Humanitarian response in urban areas is completely different than the assistance in rural areas since larger groups has to be served on smaller areas which causes an different complexity of relief assistance. The complexity of to enable the recovery of sustainable livelihoods, providing protection (sexual and gender based violence), offer privacy and dignity and support households with coping strategies to rebuild their lives is much higher in high density areas since the influx of people is extremely high and the space to offer relief aid is intense small. Defining triggers for humanitarian intervention in an urban context is difficult and especially shelter assistance is often expensive and highly politicized by factors of permanent building structures and often the situation.

1 Urban shelter guidelines, Norwegian Refugee Counsil, p10
2 Urban shelter guidelines, Norwegian Refugee Counsil, p12
3 Urban shelter guidelines, Norwegian Refugee Counsil, p11
4 Urban shelter guidelines, Norwegian Refugee Counsil, p12
on dangerous and illegal sites. The cash-based urban economies and markets mean that conventional material distributions, done in rural areas, will not be appropriate. Introducing a community shelter as the base for urban relief makes it easier for humanitarian organization to start with the relief phase since stocks of general items, tents, food and clean water are already in position. Community mapping in pre-disaster phases will help to start the relief phase even faster and the presence of a health care facility completes picture of what is need in urban emergency phase. It needs to be highlighted that assistance in urban areas can not be seen without considering the challenges in rural areas since they strongly influence each other by the migration between these areas caused by emergencies, conflicts and economic factors.

3.3 Stakeholders in urban areas

Humanitarian response in urban areas can be extremely complicated and has many actors involved. Local authorities and development NGO’s are main actors in both pre and post-disaster phases. These are active organizations and are likely to have institutional maps, specified documents and special briefings for their humanitarian responses. A cluster system of different humanitarian organizations strengthens the humanitarian response by divining organizations within the ‘shelter cluster’,

Figure 3.2: Overview of all the related urban stakeholders in Haiti

![Diagram of urban stakeholders in Haiti](image-url)
‘food cluster’, ‘education cluster’, etc. It activates the humanitarian response by demanding high standards of predictability, accountability and partnerships in all sectors of activity. It is about achieving more strategic responses and better prioritisation of available resources by clarifying the division of labour among organisations, better defining the roles and responsibilities of humanitarian organisations within the sectors, and providing the Humanitarian Coordinator with both a first point of call and a provider of last resort in all the key sectors or areas of activity.\(^7\)

The stakeholders of urban planning and land consist of all individuals, groups and institutions that can affect or be affected by urban planning, urban development and land management. The stakeholders include potential beneficiaries, as well as those who could be adversely affected. An example is shown in figure 3.2 and is based on Port au Prince, Haiti in 2009. It illustrates, on two axes, which groups were involved in urban planning prior to the 2010 earthquakes.

3.4 Connecting design and reality

The guidelines provided in the following chapters are highlighting the challenges of a specific architectural intervention in urban areas trying to copy with policy questions, which apply both in rural and urban settings. Many policy questions and challenges are to complicate, although obvious and visible within humanitarian response, to answer with one single intervention in an urban area. The given design solution could therefore not include all the issues within the urban assistance discussion but should be seen as an example to be used within this ongoing discussion. Besides the focus on urbanity within this research, the design should function as an inspiration and example for other flood and typhoon shelters to be built in the future. A definition of the proposed transitional community center and its benefits are given in the following concluding sections of this chapter.

3.5 Definition:
Transitional community centre

A transitional community shelter is an entirely separate structure that can function as an education and community centre, that is designed and constructed to protect its occupants and nearby residents from specific natural disasters, in this case those characterized as typhoons, floods and earthquakes. Transitional community centres are built in disaster prone areas, especially in slum areas, which are mainly underdeveloped and have poorly constructed houses and often lack proper sanitation. Those centres accommodate educational, community and sanitation facilities to upgrade standard living conditions and

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5 Urban shelter guidelines, Norwegian Refugee Counsil, p13
6 UN-HABITATs analysis of urban stakeholders in Haiti 2009
7 Urban shelter guidelines, Norwegian Refugee Counsil, p16
hygiene and offer new opportunities to boost new developments by means of a strong connection with a market place, modern communication networks and proper accessibility. When disaster strikes, those community shelters are intended to transit into a safe house to provide proper protection against high wind forces, the impact of windborne debris, monsoons and high water levels caused by typhoons and floods. In case of heavy earth shocks caused by earthquakes, the building should withstand these and immediately transform into the centre of emergency relief. Large stocks of tents, medicines and food in combination with proper access routes by land, water and air should provide a base for relief help and subsequent improved redevelopment of the community. A community shelter is intended to provide protection for a large number of people, up to several hundred. Transitional community shelters are usually built within or near large public or/and high-density areas and could be functioning as an institutional or commercial building such as schools, town halls or health care facility. A transitional community shelter is preferable built in a neighbourhood to provide protection for residents whose homes are not suitable to shelter. Although transitional community shelters are designed to accommodate large numbers of people, they are not recovery shelters. In other words, they are not intended to provide housing for people whose homes have been damaged or destroyed during disasters. Transitional community shelters intend to provide protection only during a short-term event that lasts no more than 36 hours. In the post-disaster phase the centre is intended to be the community base of emergency relief. It provides housing for humanitarian organization which are active in the community, offers proper WASH-facilities for a large number of people, up to several hundred and could be the base where information about casualties and lost/found (red cross office) could be posted. Especially this transitional community shelter should have an exit strategy and should transit into the pre-disaster phase of education (also about reconstruction of the community) and facilitation.

3.6 Benefits of a transitional community centre

During Disaster (1500 short term <24 hours / 750 long term <48 hours )
After Disaster (1000 short term <3 days (tents) / 100 long term <1 month (tents))

The results of a risk and site assessments may show that the best solution to provide education, facilitation and protection for large numbers of people in slum situations is to build a new, stand-alone building specifically designed and constructed to serve as community centre and shelter in different phases.
A new build shelter like this has lots of potential in accommodation of other facilities that can be supportive. The guidelines for designing a transitional community center/shelter are stated in the following two chapters. The potential advantages of a stand-alone transitional community shelter/centre include the following:

**Location:**
- Can be located in very central areas and therefore service many people
- Close to the neighbourhood of origin of Community Centre users
- The shelter may be sited away from potential debris hazards.

**Accessibility:**
- Strong connection between community residents and Community Centre Users
- Specially built to resist extreme winds, landslides, floods and earthquakes
- Good access, well known within community
- Perfect access for delivery of services and emergency goods
- Prepared for the influx of many people in terms of access.

**Construction:**
- Clearly designated building for every phase
- Specially built to resist extreme winds, landslides, floods and earthquakes and meets national and international construction standards
- The shelter will be structurally separate from any building and therefore not vulnerable to being weakened if part of an adjacent structure collapses.

**Coordination:**
- Pre-set up: easier set-up of internal coordination mechanisms
- Provides basic infrastructure
- Clear management structure in place
- Quick set-up solution of coordination centre in case of emergency
- State or Social organisations may be directly involved as principal duty bearer
- Prepared for the influx of many people in terms of overall management.

**Education:**
- Durable solution before and after disaster
- Combination of school and community centre will improve preparedness for disaster
- Community Centre can become a factor in rebuilding houses in the neighbourhood by education
- Clear building function offers exit strategy to restart education after emergencies

**Facilities:**
- Clearly designated buildings
- Has a clear public function (community centre and/or school)
- Facilitates delivery of humanitarian assistance to high numbers of residents; made easier to establish the internal coordination mechanisms because of pre-disaster situation.
- Facilities are prepared for a very large number of people (including sanitation)
- Community Centre can become a

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8 Collective Shelter Guidelines, Norwegian Refugee Council 58
the Transitional Community Centre....

....as a place to become **educated**
- ....as a place for **cleansing** the body
- ....as a place for social **gathering**
- ....as a place to **shelter** in emergency

....and as a place for **urban relief**!
factor in economic recovery of users and neighbourhood
- Storage of tents, food and other materials make it possible to immediate start of relief phase after disaster
- Larger spaces available (covered market square / sports field)
- Smaller safe places available (class rooms / offices)

**Health services:**
- Provides immediate solution for the injured and good services for the extremely vulnerable
- Good physical facilities with good infrastructure

**Shelter:**
- Provides high-quality emergency shelter to the neighbourhood during future disasters
- Prepared for the influx of many people in terms of access, shelter during disaster and overall management.
- Perfect shelter concerning water and sanitation facilities during disaster.
- Basic shelter support, mostly in tents
- May provide privacy for some vulnerable residents
- Improved shelter solution can be stimulated by hand-out of repair kits

**Relief Aid:**
- Provides immediate privacy for gathering and office space for NGO’s
- Does not block or diminishes the quantity and quality of high demand services for population in times of increased need cause it is especially build for these circumstances.
- Perfect drinking water and sanitation solutions
- Perfect first aid and health care solutions
- Proper stocks of general items, water, food etc. are immediately available

**Safety:**
- High social coherence and solidarity among community centre residents
- Less risk of causing discontent within host community since mainly service will be local community.
- Lower security risks in the areas of security within the community centre, gender based violence (GBV) and protection
- Lockers will reduce crime and provide users and residents with possibility to secure private possessions and will increase safety of all
- Central market place can stimulate economic recovery and stimulate re-development and construction of surroundings.
- Building is adaptable for each phase so damage and disruptive of routines are minimized.
- Reduces potential protection risks for children and youths in case of education within the Community Centre.
Figure 4.1: Disaster management is an end-to-end process for recognizing and effectively combating the risk associated with earthquakes, floods and typhoons through planned actions. The process involves a number of activities that occur throughout the cycle: Standards are given within chapter for to provide rules of thumb for building structure. Designing for pre-disaster period, guidelines for education and facilitation are required. During-disaster requires guidelines for alarming and sheltering the community properly. The concluding requirements focus on the relief aid and re-build phase that completes the cycle of activities.
Ready to start with the design of a transitional community center as an urban base for relief? Please read carefully and start your design process with this manual.

This document is a guidance manual for interested parties, aid agencies staff, engineers, architects, building officials, and prospective shelter owners. It presents important information about the design and construction of transitional community shelters. Following guidelines are applicable to the design and construction of transitional community centres located in high-density urban areas characterized by substandard housing, squalor, and lacking in tenure security. This manual does not recommend one type of transitional community centre, which can be copied and used as a model for a specific situation or region. Each place, valley or hill, grove or plain, has specific conditions. Differences are also found amongst the people within a community, since their cultural, educational and economic activities differ very greatly. The communities in the slums of Rio de Janeiro are unlike the ones in Metro Manila and the use of each community centre will differ.

**Standards**

The guidelines within the chapter ‘standards’ are applicable in the first design phases of the project to provide the rules of thumb within construction design to be able to withstand disasters (i.e. earthquakes, floods and typhoons) are in the end. Further and more detailed construction criteria for final designs are not included since they are regarded as very specific conditions that are different in every design. They are strongly related with the type of soil, quality of materials, local building codes and many other region specific conditions. For the final design, it is recommended to consult specialists in each field and to outsource calculations to professional parties.

**Phases**

The guidelines mainly focus on ideas and considerations during the planning and design of a transitional community centre in a disaster prone area. What is needed or possible and what specific design rules could be implied in this scenario of an adaptable building. The specific usage of the building is categorized per phase. These phases are divided into three groups known as the pre-disaster period, during-disaster period and the post-disaster period. These all consist out of two phases, which are stated in the diagram on the previous page. Each phase will be described in terms of usage and intervention, programmatic elements, guidelines for architectural design and wider oriented considerations. Together with the minimal requirements in the ‘standards’ chapter, these considerations per phase and some wider orientation should give the designer the opportunity and knowledge to choose the correct path for each specific project that is most appropriate for the location.

Before starting, study all the possibilities, guidelines and considerations in order to create a transitional community centre that combines and integrates the specific needs and techniques for each project.
The overall concept of a transitional community shelter is as any other shelter that has been build so far: the provision of a safe hiding place. Main aspect of any flood or typhoon shelter is to withstand storms and in this case even earthquakes to secure the perfect base for urban relief in both pre- and post-disaster situation as well as the provision of a safe hiding place during floods and typhoons. The base of proper community shelter is therefore mainly focused on the safety and strength of the building structure. Since a transitional community shelter is based on this principle - it should offer the perfect building in every phase before, during and after disaster - the most comprehensive and most important 'phase' is the one of developing and designing a suitable building structure. That structure has to meet the minimum building requirements in a specific region and on top of that the construction has to withstand earthquakes, floods and typhoons. Since building codes differ from place to place, every country or region develops their own minimum standard derived from the local circumstances, these place-dependent basic construction requirements are not included in this manual. Since this design manual focuses on giving rules of thumb that are needed in the development of a basic design that should be able to endure various natural disasters it is assumed that these requirements often correspond with existing minimum requirements or even exceed them. Note that this manual provides handles for during the design process, to further develop the design, knowledge of specialists like constructors always remain required.

4.1 General design requirements

Transitional community shelters, as well as regular community shelters, intend to provide protection for the residents of neighbourhoods and communities within the scale of the specific urban fabric and different cultural traditions. This requires designers to focus on a number of issues in addition to the structural design of a shelter including ownership, admission rules etc. The following considerations are part of the design requirements associated with this first process of making choices for the design that will be further explained in the first section of this chapter. In the following sections the seismic, flood and typhoon requirements will be further handled. This section about general design requirements will include the considerations that are only assumed or not dealt within this research and sometimes references are made to other sources. This is done because it could be of great influence in the design of a transitional building although it is not fully included in the research and design project. Other assessment and interventions factors are considerations about concept, location, accessibility, materialization and climate requirements for the design.
Figure 4.2: Research by design: developing design guidelines concerning disaster like earthquakes, floods and typhoons by exploring with sketches and desk research.
A. Assumed or not dealt with
Since the research cannot cover all the particular essentials in the design of a community building it should be stated which other options should be considerate within the design process. Some of these considerations are applied in community centres or emergency shelters worldwide and some in certain situations and regions. In this section the mentioned considerations are only assumed or not dealt with in this research. Pointing out these other essentials in the design process of a community building is done because it could be of great influence in the design.

A.1 User-participation design
Assumed to be very useful in a community related project such like a transitional community center but this is not further specified in the research. This is done because the research focuses on basic construction design principles in multiple phases. User-participation design could be implemented besides this design process to develop a community center that is embraced by the neighborhood. Sources that can help to include this process of user-participation design can be found in Appendix 6.

A.2 Ownership of the building
In the process of a community centre/shelter set-up it is complicated to apply specific ownership to a transitional building that is used intensive in all these very specific and different phases. Each phase has a primary building user working together with many other sub users. Assumed is that ownership by government and/or implementation into a slum-upgrading program is the most obvious solution. State or social ownership is very common and an appropriate solution although agreements with the state may take time.1 In this situation no specific organization can take the exclusive rights to make use of the building and its facilities, which makes ownership even more complicated.

A.3 Admission rules
Rules governing admission to the building vary by phase. Each phase has a different main user and admission rules should therefore be defined in consultation with the building manager. In case of an emergency, a community center/shelter operation plan should be put into operation.2 In the section regarding the alarming phase an operation plan is partly discussed, although only in relation to design of the program and the transition of the building.
A.4 Parking
Parking at community centers/shelters can be a problem although very dependent on the urban density as well. In sub-urban areas, where space for cars is mostly available, community residents who are expected to walk may instead drive to the shelter from their homes. Parking problems can adversely affect access to the center/shelter, again preventing occupants from getting to the shelter before a disaster strikes. Placed in a high dense urban slum situation it is assumed there is no need to include parking area in the design. It must be taken in account that the building is accessible by a road in the immediate vicinity. See also requirements for accessibility later in this chapter and also in other phases.

A.5 Pets
Many people do not want to leave their pets during a disaster but shelters are typically not prepared to accommodate pets it is it assumed to be part of the policy of the building owner. Placed in a poor urbanized area it is assumed there is no need to include pet facilities within the community center/shelter.

B. Conceptual considerations
Requirements for the design of a building that needs to withstand natural disasters and should service in multiple phases at the same time, have strong relations with conceptual ideas for a community building. They affect shape, structure and organization of the design. Some other concept related considerations that should be thought of during the design process include:

B.1 Strong contrast
Trigger new (better and saver) building initiatives by adding structure in strong contrast with the surroundings. Predecessors have explored possibilities to transform slums by adding a structure that is neglecting existing structures.

B.2 Appropriate in the surroundings
Some communities will require buildings that are reflections of the surroundings, other need more radical intervention. Respect for the community and the surroundings of the location is highly recommended. For example: user participation (requirement A.1 of this chapter). Respecting the existing could result in building on top of the existing. However, ground based buildings have a more permanent character.

3 Community Shelters for Neighborhoods, Abstract of Fema 361, chapter 7a
4 Toilet Tragedy-Toilet Treasury, Lanting, pg 97
B.3 Add spatial qualities
Integrate building design and spatial interventions so both will interact and strengthen each other. For example: increasing height will make the building more visible but/and will create shadows as well.

B.4 Appropriateness of spaces
Concept and design must allow proper separation/privacy of different private/communal functions and areas within the building, taking into consideration cultural, religious or traditional concerns regarding the appropriateness of spaces.

C. Spatial intervention and location
In addition to being located where they are readily accessible, shelters must be sited to minimize additional hazards—for example and if possible, outside the locally known (seasonal flooded) floodplains and away from large objects that could become windborne debris, such as light towers, antennas, and satellite dishes. Location and physical properties of the site are the primary influences the entire design process.

C.1 Properly sited
The community centre building should be properly sited within the community, but, if possible, outside existing floodplains, potential falling debris or potential landslides. A centrally located building within the intended community is preferable.

C.2 Along main routes
Plots around ‘main’ streets are interesting in the frame of visibility and accessibility. Constructing on edges and along main roads makes access easy and can create a buffer between communities.

C.3 Permanent intervention
Make sure the location is permanent since permanent interventions in the slum might become an example for construction in the direct surrounding of the building.

C.4 Create open spaces
By creating open spaces density will decrease. Within the context of slums, adding something is always problematic since density is one of the main issues of the areas. Creating open space is therefore highly desired as an additional quality for community centres.

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Figure 4.6: C.2 Along main routes

Figure 4.7: C.4 Create open spaces

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5 Toilet Tragedy-Toilet Treasury, Lanting, pg 77-81
6 Collective Shelter Guidelines, p 67
C.5 Build inside available open spaces
In slums where open spaces can be found, these places can be used for building in order to not have the problem of intervening in the existing houses and buildings. However, open spaces are rare and their presence is precious in the dense structure.8

C.6 Soils and unconsolidated fills
Conduct subsurface investigations to discover loose soils or uncontrolled fill that could increase ground motion. Hard dense soils remain more stable, while solid dense rock is the most predictable and seismically safe building base. Presence of unconsolidated natural or man-made fills should be investigated. Check location for potential landslides or liquefaction on or near the site.7

D. Accessibility
Community centers/shelters must be readily accessible to their users, especially those with disabilities that affect mobility. Accessibility will be further dealt with in each specific phase since they require different attentions and design elements in each situation. In this case focus is on the accessibility of the location itself.

D.1 Connect to main routes
Some slums have a more distinct subdivision by streets and alleys then others. In those provided with some sort of main streets, the plots around the main streets are interesting for community centres in the frame of visibility and accessibility.8

D.2 Construction on edges
Constructing on edges of slums or other residential areas makes access easier and will improve awareness of the building.8

D.3 Building in dense structure
Building within an existing slum structure requires a different approach since the physical approach to the building, depending on heights as well, happens in a narrow area. If something is built within the existing structure, it therefore seems logic to create something that do emphasizes the inner world more then facade.8

7 Community Shelters for Neighborhoods, Abstract of Fema 361, chapter 7a
8 Toilet Tragedy-Toilet Treasury, Lanting, pg 78-81
E. Climate
The main concern of climatically appropriate design of a transitional community center is to create the building in such a way that an optimal (comfortable) or at least tolerable climate is created for the users of the center, while employing as little energy and technical equipment as possible. At the same time, it should be ensured that the building structure itself suffers no damage from climate. The target function of the climatically appropriate building is therefore always in the indoor climate, whereby in this case, and in relation to public buildings, the following components are of primary importance: room air temperature, surface temperature, absolute humidity and relative air humidity and finally the air velocity in the immediate proximity of the users. All these factors are highly dependent on the specific climate zone the building is designed for.

E.1 Size & arrangement facade openings
Size and placement of facade opening can have immense impact on surface temperature. Large openings or arrangements on facades that orientate towards the sun have negative impact on indoor temperature. Arrangement of openings in the northern facade and closed walls towards the sun will prevent the building of heating up to much.9

E.2 Positioning & Orientation
The indoor climate can be relatively influenced and determined by means of the component positioning and orientation. An incorrect orientation towards the sun, with large translucent or open surfaces will unnessary heat up the building.9

E.3 Floorplan solutions
The design of floorplans, staircases and other design influences that can connect large parts of the building will be able to positively influence the air velocity and the related indoor temperature and humidity. Big air flows that can go through large parts of the building can cause proper natural ventilation.

E.4 Shading devices
Shading devices and other related overhangs, including porches, to protect from direct sunlight will improve the room air temperature as well as the facade surface temperature. Shading the facade will help to reduce the warming-up of facades en therefore thermal insulation will be more effective.

E.5 Shape of the roof
The roof and its height or overhang can be a good protector from sun and rainfall. Shaping the roof to take in airflow could be possible to ventilate but not advisable because it is very vulnerable to typhoons.

9 Tropical Architecture, Sustainable and human building in Africa, Latin America and South-East Asia by Wolfgang Lauber, p85
E.6 Choice of color
Especially the color of outdoor-walls and roofing can have immense influence to prevent the building from heating up its building mass. The heat storage capacity of walls and roof will be much higher if lighter colors are used on these surfaces.

E.7 Building mass
Using the resistance of the building mantle for transport of energy by thermal insulation can positively influence the heat storage capacity of the building as well. The flow of energy from the outside to the inside will be much less since much more solar radiation is needed to transport energy (heat) inside.

E.8 Thermal insulation
In colder areas arrangements for the proper winterization of transitional community centres are critical, while in warmer areas ventilation to drain the heat will be more essential. In both cases, there should be adequate insulation.

E.9 Periods of use
Ultimately, airflow and ventilation rates will be very depend on individual ventilation patterns of the users and periods during which the building is used. Especially the intense use during shelter phase will require extra attention according to ventilation, temperature and humidity rates.

Figure 4.12: Classification of the world’s climate zones according to Koppen
The means of transporting materials from a distant place of production must be taken into consideration.

F.4 Status and knowledge
For many people, above all in the tropical megacity regions, the acceptance of a material is related to its status. The hut made of clay, wood or bamboo is rejected by most of the new, poor, slum dwellers as they long to build with the materials of the rich: concrete, bricks, natural stone, steel, glass and shiny metal.

F.5 Craftsmenship
The extent to which they can be worked with by hand or by local craftsmen or unskilled workers is a further influential factor in the choice of building materials.

Design to withstand natural disasters
Of course there are more considerations than those that were mentioned but the most challenging aspect of the design of a transitional community shelter is actually the design of a proper construction and the transition within the different phases. Focussing on the constructive part of a transitional community shelter, many intervention levels have to be taken care of. Despite the varied and many possibilities concerning construction, the characteristics of the design of a suitable community building structure that can withstand particular natural disasters,

F.  Materialization
Building a transitional community center means in many cases, for both builder and designer a constructive confrontation with extreme climatic conditions requiring high demands on the materials used. In the following section about earthquake each material is further specified. More specified information about materials to be used in the design should be found in books about the climate of the specific zone where the transitional building should be placed.

F.1 Termite and pest resistance
Using termite-resistant woods or plywood, containing high amount of tannin, resins essential oils or chemical protection can protect and extend the lifespan of the building highly effective. Especially organic building materials as thermal insulation, textiles, leather, foam etc are susceptible to attacks of insects.

F.2 UV and solar radiation
Especially in hot and dry climate zones all coated surfaces, metal-sheeting, plastic panels and wood surfaces could be destroyed by intense solar radiation. Immense temperature differences impose considerable strain on construction and materials.

F.3 Availability and suitability
It is essential to determine materials by local availability, their economy, durability and suitability for the particular climate.
consist out of requirements and objectives concerning earthquakes, floods and typhoons. Design requirements to withstand or at least survive heavy earthquakes with minimal damage, strongly affect the design concept of a building. Requirements to build “earthquake proof” are therefore stated as most important in the start of the design process. These are supplemented by requirements that will improve the design to withstand floods and typhoons, since they are often related to each other. After this three-step assessment the requirements per transitional phase and the transition between them will be stated in the subsequent paragraphs.

4.2 Seismic design requirements
When strong earthquake shaking occurs, a building is thrown mostly from side to side, and also up and down. That is, while the ground is violently moving from side to side, taking the building foundation with it, the building structure tends to stay at rest, similar to a passenger standing on a bus that accelerates quickly. Once the building starts moving, it tends to continue in the same direction, but the ground moves back in the opposite direction (as if the bus driver first accelerated quickly, then suddenly braked). Thus the building gets thrown back and forth by the motion of the ground, with some parts of the building lagging behind the foundation movement, and then moving in the opposite direction. The force $F$ that an upper floor level or roof level of the building should successfully resist is related to its mass $m$ and its acceleration $a$, according to Newton’s law, $F = ma$. The heavier the building the more the force is exerted. Therefore, a tall, heavy, reinforced concrete building will be subject to more force than a lightweight, one-story, wood-frame house, given the same acceleration.

Seismic performance objectives
Seismic provisions of most modern building codes are based on the ‘life safety’ performance objective: extensive structural damage is acceptable in a severe earthquake, but collapse should be avoided so the occupants can safely stay in the building. The requirements and design considerations in this manual are based on this life safety performance objective although the ‘life safety’ performance objective is taken a little higher since the building should withstand earthquakes with little damage to be useful in later phases. Experience with earthquakes in the past show that the conceptual design of a building is critical for satisfactory performance. Building damage is related to the characteristics of the building, and the duration and severity of the ground shaking. Properly designed and constructed buildings are not expected to be damaged due to earthquakes with Richter magnitudes less than 5. These rarely cause significant damage to buildings, since acceleration levels are relatively small and the durations of shaking are

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12 FEMA Earthquake Mitigation Handbook
relatively short. Larger earthquakes tend to shake longer and harder and therefore cause more damage. To withstand a more vigorous earthquake it is necessary to implement requirements during the design. Architects play an important role in developing the conceptual design, which defines the overall shape, size and dimensions of a building. Structural engineers should be involved in the first design processes and should be responsible for analysing structural safety. To ensure that the design meets both structural and architectural requirements architects have to work closely with structural engineers. Therefore, it is critical for architects to follow simple rules for the design of constructions that have to be able to withstand local seismic activity. Damage caused by buildings pounding against one another, ground failure that causes the degradation of the building foundation, landslides, fires and tidal waves (tsunamis) are ‘indirect’. These indirect forms of possible destroying forces are not addressed in this manual but are sometimes mentioned since they have to be implemented to resist earthquakes, floods or typhoons.

Three basic seismic systems
Damage to buildings from earthquakes is caused by an overload of structure or differential movements between different parts of the structure. If the structure is sufficiently strong to resist these forces, little damage will result. If the structure cannot resist these forces, structural members will be damaged, and collapse may occur. To design a building for near optimum seismic performance that should withstand these forces there is a choice out of three basic vertical lateral force-resisting seismic systems, which must be selected at the outset of the architectural design process. These basic systems have a number of variations, mainly related to the structural materials used and the ways in which the members are connected.

Shear walls
Designed to receive lateral forces from diaphragms and transmit them to the ground. The forces in these walls are predominantly shear forces. Shear walls must run from top to the foundation of the building with no offsets and a minimum of openings.

Braced frames
Braced frames act in the same way as shear walls; however, they generally provide less resistance but better ductility depending on their detailed design. They provide more architectural design freedom than shear walls.

Moment resistant frame
A moment resistant frame is the engineering term for a frame structure with no diagonal bracing in which the lateral forces are resisted primarily by bending in the beams and columns mobilized by strong joints between columns and beams. Moment-resistant frames provide the most architectural design freedom.

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14 Designing for Earthquakes: A Manual for Architects, chapter 5, p2
Figure 4.14: The three basic vertical seismic system alternatives
The application of these three basic seismic systems into a model structural/architectural configuration results in basic models designed for near optimum seismic performance. The particular characteristics that are seismically desirable and used as 'basic ingredients' in these various models are mentioned on the following pages as the main building attributes (A1 t/m 11).

These attributes are the first main requirements that could be used as handles during the entire design process. Subsequent to these attributes four serious configuration conditions will be stated (two vertical and two in plan) that originate in the architectural design that have serious negative impact on the seismic performance (B1 t/m B4).

The subsequent requirements could be used in the next phase of the design process when the specific building type (and main construction material) is known. These measurements are organized under the specific building material to which they relate. Some measurements may relate to several types, so they may not be representative of the specific building type discussed. This list of measures is not comprehensive, and may be expanded in the future.

A. Seismic desirable conditions

The structural elements of a building that comprise the 'skeleton' supporting the rest of the building, includes the foundation, load-bearing walls, beams, columns, floor system and roof system, as well as the connections between these elements. To carry its own weight ("dead load"), live loads, and wind and earthquake forces the building elements and connections are subjected to tension, compression, shear, bending, and torsion. Buildings are primarily designed to resist vertical forces from gravity. The roof and floor systems carry these vertical forces to the supporting beams. The beams carry the forces to the columns and bearing walls, which then carry the forces down to the foundation and the supporting soil. This process of carrying forces from the roof down to the soil is known as a load path. The failure of any building element or connection along the load path can lead to building damage or collapse. To make a design that is perfectly suited to withstand extreme forces on the load path is it necessary to include the following measurements in the design.15

15 FEMA Hazard Mitigation Handbooks Series: Earthquakes: structural concepts
A.1 Continuous load path

Make sure structural elements are uniform loaded and prevent stress concentrations by creating a continuous load path. The structure must be transferred to the foundation of the building and, finally, the ground by connecting the structural frame. A continuous load path is like a chain that ties the building together from roof to foundation and is critical during earthquakes and hurricanes.

It is important to remember:
- Loads acting on a building follow many paths through the building and must eventually be resisted by the ground.
- Loads accumulate as they are routed through key connections in a building.
- Member connections are usually the weak links within a load path.
- Failed or missed connections cause loads to be rerouted through unintended load paths, often resulting in building damage or collapse.\(^\text{16}\)

A.2 Low height-to base ratio

The building should not be excessively high. Building mass should be situated as low as possible, this will minimize tendency to overturn. Ideally the transitional community centre should be one story: a rule of thumb is that the building period,

\(^{16}\) Coastal Construction and Continuous Load paths, Chapter 5, pg 2
\(^{17}\) FEMA 454: Earthquake effects on buildings, chapter 4, pg 8
the time in seconds to complete one cycle of a seismic wave, equals the number of stories divided by ten. Since flood requirements will enforce not to use the ground floor for building program, multiple stories will be necessary. No more than four stories should be implemented since higher building tends to resonate with the frequency content of earthquakes resulting in more damage.\textsuperscript{17}

A.3 Equal floor heights
Applying equal floor heights will equalize column or wall stiffness and prevent stress concentrations since one of the most prominent problems is severe stress concentration in a so-called ‘soft’ story (see measurement B.1). If one of the

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure4.16.png}
\caption{Comparative building periods in seconds determined by height. These values are approximations: the structure, materials and geometric proportions will also affect the period.}
\end{figure}
Stories is less high than others, this so-called ‘soft’ story will be more flexible than others resulting in different overstress causing serious problems. A soft or weak story creates a problem at any height, but since the cumulative loads are greatest towards the base of the building, a discontinuity between the first and second floor tends to result in the most serious condition.

A.4 Symmetrical plan shape
A square plan, as shown in figure 4.18, provides for a near perfectly balanced system. The walls should be built in a symmetrical manner to minimize torsional effects. Note that it is not always possible to have a perfectly symmetrical wall layout – the one shown right above is not ideal, but is much better than the layout shown down on the right.18

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Figure 4.17: Comparative building periods in seconds determined by height. These values are approximations; the structure, materials and geometric proportions will also affect the period.

Figure 4.18: A symmetrical plan shape will provide a nearly perfect balanced system. A regular plan layout will improve a nearly perfect balanced system as well.
A.5 Identical resistance on both axes

Eliminate eccentricity between the centres of mass and resistance and provides balanced resistance in all directions, thus minimizing torsion. Since ground motion is essentially random in direction, the resistance system must protect against shaking in all directions. In a rectilinear plan building such as in figure 4.19, the resistance elements are most effective when placed on the two major axes of the building in a symmetrical arrangement that provides balanced resistance. To avoid twisting (torsion) of the building in an earthquake, the walls should be placed as far apart as possible, preferably at the exterior of the building.19

A.6 Identical vertical resistance

This is to prevent concentrations of strength or weakness. The walls should always be placed continuously, directly over one another. On figure ?? (right page) the picture above shows walls that are offset between storeys, while in the section below it shows vertically continuous walls.19

Figure 4.19: Wall distribution in a plan: the plan above has not enough walls in the left-right direction; the plan below has a better distributed wall plan.
A.7 Uniform section / elevations ratio
This minimizes stress concentrations. The building should be compact and not be excessively long. Ideally, the length-to-width ratio in plan should not exceed 4 to get a uniform section and elevations ratio.19

A.6 Identical vertical resistance

Figure 4.20: Continuity of walls between storeys (vertical sections shown)

Figure 4.21: The building should not be excessively long with a length/width ratio of less than four.

19 Seismic Design Guide for Low-Rise Buildings, p31
A.8 Seismic resisting torsional forces
Torsional forces should be minimized as much as possible by using symmetric constructions in façade and inner walls. This is to balance the resistance of the centre of mass. Using symmetric shear walls will maximize torsional resistance.

A.9 Short spans & Columns
Low unit stress in members and multiple columns provide redundancy loads to be redistributed if some columns are lost. Adding columns or extra shear walls will provide redistribution of redundancy loads in spans.¹⁷

Figure 4.22: Redundancy loads should be redistributed if columns are lost.

Figure 4.23: Torsional forces: make sure there is a balanced resistance in centre of mass.
A. 10. Cantilevers and parapets
Vertical accelerations increases the vulnerability of the construction. Reduce vulnerability to vertical accelerations using no cantilevers of high parapets. If cantilevers are necessary, always use columns to support them when they are larger than 0.3 meter. Parapets should never exceed 0.5 m or they should be confined with tie-columns and tie beams and or braces. Parapets, braced or not, should never exceed the height limit of 1,2 m since they can damage the construction when falling down.20

A. 11. No openings in diaphragms
Ensures direct transfer of lateral forces to the resistant elements using as little as possible openings in diaphragms. Of course there should be openings in floors, walls and sometimes the roof. When placing openings like doors and windows, they should be in line and in the same position on each floor. Larger openings need special requirements regarding supporting construction within the walls. Smaller openings do not need special supporting as long as the opening is outside the diagonals and as long as the surface is smaller than 0.1 x length x height. Figure ?? shows how to handle openings in diaphragms if they are necessary.20

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20 Seismic Design Guide for Low-Rise Buildings, p 31-33
The example buildings are quite acceptable both in architecture and construction, and would be simple and economical to construct. Especially by its exterior treatment, material use and refinement it could range from functional to an architectural jewel. Of course it is not a complete building because stairs, elevators, etc., must be added. However, its interior could be configured with non-structural components to provide the desired qualities with the exception of unusual spatial volumes.

In seismic terms, engineers refer to this design as a regular building. As the building characteristics deviate from this model, the building becomes increasingly irregular. It is these irregularities, for the most part created by the architectural design, that affect the building's seismic performance. Therefore it is important to use these 'attributes' in every design. Many seismic engineers believe that it is precisely these architectural irregularities that contribute primarily to poor seismic performance and occasional failure.
B. Configuration conditions

During the design process, it is well known that some design interventions are definitely not helping the seismic conditions of buildings. These so-called ‘architectural irregularities’ contribute to poor seismic performance. These four main configuration conditions are designated in this paragraph by mentioning commonly used architectural interventions that seriously impact seismic performances. Two of them are vertical (B1 & B2) and two of them are horizontal (B3 & B4).

B.1 Soft and weak storeys

The term has commonly been applied to buildings whose ground-level story is less stiff than those above. Soft stories are less stiff, or more flexible, than the story above; weak stories have less strength. A soft or weak story at any height creates a problem, but since the cumulative loads are greatest towards the base of the building, a discontinuity between the first and second floor tends to result in the most serious condition. There are three typical conditions create a soft (first) storey. The first condition is where the vertical structure between the first and second floor is significantly more flexible than those above (figure ??). The second form of soft story is created by a common design concept in which some of the vertical framing elements do not continue to the foundation, but rather are terminated at the second floor to increase the openness at ground level (figure ??) (see also: A.1 Contentious load paths). Finally, the soft story could be created by an open first floor that supports heavy structural or non-structural walls above (figure ??). This situation is most serious when the walls above are shear walls acting as major lateral force-resisting elements. This condition is discussed in requirement B.2 since it represents an important special case of the weak-and
B.1 Soft and weak storeys

Figure 4.26: Above: three types of soft storeys. Below: three conceptual solutions to reduce the impact of the ‘soft’ first storeys.
The solution is very obvious: eliminate the conditions that cause discontinuity in shear walls. Be very precise in the chosen seismic system and bring it in strong relationship with the concept of the design to fully integrate them. Recognize the presence of shear walls from the beginning of the first schematic designs and make their size and location the subject of careful architectural and engineering coordination.\textsuperscript{22}

B.3 Variations in strength and stiffness

This problem may occur in buildings whose configuration is geometrically regular and symmetrical, but nonetheless irregular for seismic design purposes. Seismic behaviour of buildings is strongly influenced by the perimeter design. Wide variations in strength and stiffness around the centre of mass will coincide with the centre of resistance and torsional forces will rotate the building. Open-front designs such as in fire stations, garage and large stores are often designed with three solid sides and an open glazed front or large doors. The solution is to reduce the possibility of torsion by endeavouvring to balance the resistance around the perimeter. In case of the store front or fire station there are a number of design strategies that are useful as shown in figure ?? on the next page.
B.3 Variations in strength and stiffness

Figure 4.27: Four conceptual solutions to reduce the impact of the 'store-front type' and the unbalanced perimeter resistance conditions that affect strength and stiffness.
B.4 Re-entrant corners

The re-entrant corner is the common characteristic of building forms that, in plan, assume the shape of an \(L\), \(T\), \(H\), etc., or a combination of these shapes shown in figure ?? on the left.

First problem created by these shapes is that they tend to produce differential motions between different wings of the building that, because of stiff elements that tend to be located in this region, result in local stress concentrations at the re-entrant corner. Second problem of this form is torsion caused by the fact that center of mass and rigidity cannot geometrically coincide in every direction. The resulting forces are very difficult to analyze and predict. The figure ?? on the right shows the problems with the re-entrant-corner form. The stress concentration at the “notch” and the torsional effects are interrelated. The magnitude of the forces and the severity of the problems will depend on:

- The characteristics of the ground motion
- The mass of the building
- The type of structural systems
- The length of the wings (length to width proportion)
- The height of the wings and their height/depth ratios

Re-entrant corner plan forms are so common and familiar that the fact that they represent one of the most difficult problem areas in seismic design may seem surprising. The courtyard form has always been useful; in its most modern form, the courtyard sometimes becomes a glass-enclosed atrium, but the structural form is the same.

There are two basic alternative approaches to the problem of re-entrant corner forms: structurally to separate the building into simpler shapes, or to tie the building together more strongly with elements positioned to provide a more balanced resistance as shown in figure ???. The last shown solution applies only to smaller buildings.\(^{23}\)

\(^{23}\) Designing for Earthquakes: A Manual for Architects, chapter 5, p24-26
Figure 4.30: Three conceptual solutions to reduce the impact of the re-entrant corner conditions.
C. Material related conditions
Seismic design objectives can greatly influence the selection of the most appropriate structural system and related building systems for the project. The following mitigation measures are organized under the specific building type or material. Some may relate to several types, so they may not be representative of the specific building type discussed. A distinction has been made between masonry, concrete, steel and wooden structures. The list is completed with some non-structural requirements, mainly about interior elements. This list of measures is not comprehensive, and could be expanded in the future. Also, they are meant only to be representative of the kinds of measures that have been proven to be effective, rather than provide details on how the measure could be implemented.

C.1 Masonry Requirements
Reinforced masonry walls have good energy absorption on the condition that walls and floors are well integrated within the structure. Proportion of spandrels and piers are critical to avoid cracking and collapse.24

C.1.1 Gable walls
Gable walls should be confined in the top with tie-columns and tie beams from the lower floor to the top of the gable wall. In figure 4.31 on the next page, the extended tie-column to the top of the gable wall is red-colored. Alternatively a gable portion of the wall, the area above the roof tie-beam, can be made of timber or other lightweight material.25

C.1.2 Tothing in confined masonry walls
The connection between masonry walls and the columns to reinforce them should be tothing to get a proper connection between masonry and tie-columns. This could be done using machine-made hollow units, hand-made solid units with tothing edges or the provision of horizontal reinforcement (shear connectors) between the layers of bricks when tothing it not possible.25

24 www.wbdg.org/resources/seismic_design.php
C.1.3 Spacing of tie-columns
Spacing between tie-columns should not exceed 4.5 m for regions of high seismic activity as shown below in figure 4.31. For regions with moderate seismic activity a spacing of 6.0 m between the tie-columns would be sufficient enough.26

C.1.4 Brace or Support Chimneys
Brick chimneys are heavy, brittle, and can fail unless reinforced near the top and supported by the building roof and walls. Chimney extensions above the roofline can be secured with steel straps anchored to the roof framing with steel angle braces.

C.1.1 Gable walls
C.1.3 Spacing of tie-columns
C.1.4 Brace or support chimneys

Figure 4.31: Gable walls should be reinforced by extending tie-columns which should be spaced properly. Masonry chimneys should always be braced and supported.
C.2 Concrete Requirements
Reinforced concrete walls have very good energy absorption if walls and floors are well integrated and properly connected to the structure. Reinforcements with fiber materials are critical to avoid cracking.

C.2.1 ‘Tuning’ concrete structures
Tuning in concrete design should focus on the height-weight ratio. The lower a concrete structure is situated the heavier it can be. Upper floors need more attention to reach for a perfect strength-weight ratio.27

C.2.2 ‘Damping’ concrete structures
Damping the design with architectural features such as partitions and exterior façade construction contribute to the damping. Using a heavy reinforced concrete structure will provide more damping than a light steel frame.

C.2.3 Confine columns with Fiber Wraps
Earthquake forces can buckle reinforced steel within concrete columns. A fiberglass or carbon fiber wrap around columns will strengthen them and may prevent such failures. The high strength of the fiber wrap confines reinforcing steel in the column and significantly increases the ultimate strength of the column.27

C.2.4 Reinforce walls with fiber materials
Earthquake forces may cause extensive crack damage in bearing walls, which can weaken the building. Walls can be strengthened using fiberglass or carbon fiber sheets. The fiber sheeting is secured to the exterior walls using a chemical adhesive and protected with a weather-resistant barrier or other exterior finish.27

26 www.wbdg.org/resources/seismic_design.php

Figure 4.32: Confine columns with carbon fiber ‘wraps’ or carbon fiber strand. Wall should be reinforced with fiber sheeting.
C.3 Steel Requirements
Steel frames, moment-resisting or eccentrically braced, could be extensively strong and are excellent in energy absorption. Connections, detailing and proportions are very important.

C.3.1 ‘Ductility’
A steel frame is very ductile and can absorb powers. The main reason to use steel structure is the quality of deforming instead of breaking. Deformation of plastic and deformation of metal will result in different results as shown in figure ??.

C.3.2 Extra cross bracing
Full-height enforcement of steel structures by using cross bracing can increase a building’s capacity to withstand seismic forces. Cross bracing can be exterior or interior related but should be secured to the building structure at floor level.

C.4 Wood Requirements
Wood or timber frame are very useful in constructions to withstand seismic activities because of the good energy absorption. The lightweight structures are very flexible although framing connections are critical.

C.4.1 Anchor sill plate to foundation
During an earthquake, a wooden building can shift on the foundation if its sill plate is not anchored to the foundation. Sill plates should be bolted or otherwise anchored to the building foundation.

Figure 4.33: Ductility of steel components will increase deforming instead of collapse.
C.5 Non-structural Requirements
Prevent interior damage and other non-structural components and systems by anchoring interior objects and strengthening other non-structural components with extra bracings or by anchoring them.

C.5.1 Anchor Raised Floors
Raised floors that support computer equipment should be anchored since raised floors may collapse from earthquake forces. To reduce the risk for this type of damage, anchor the pedestals that support the raised flooring to the building’s floor and secure the pedestals to the wall.

C.5.2 Suspended Ceilings & Lightning
Suspended ceilings and overhead lighting fixtures typically are weak to withstand lateral earthquake forces. Secure ceilings and lightning fixtures by installing “four-way” diagonal wire bracing and compression struts between the ceiling grid and the supporting floor.25

C.5.3 Strengthen Window Glass
During an earthquake, window frames can experience extreme shaking or distortions that trigger glass breakage. Wire-reinforced glass, or adhesive film applied to windows, can hold the glass fragments together, reducing damage and falling hazard.

Figure 4.34: Structure (right), non-structural components and systems like aircondition, insulation, lightning, ceilings and furniture needs to be anchored to become seismic proof (left).28

28 www.wbdg.org/resources/seismic_design.php
29 Designing for Earthquakes: A Manual for Architects, chapter 4, p28
4.3 Flood design requirements

Besides earthquakes there are two other significant natural disasters to which buildings are vulnerable. These two, floods and high winds, are extreme variants of natural processes in an exaggerated form of pleasant breezes and rain showers that freshen our everyday existence. Devastating floods are the result of excessive localized rainfall and in many cases origin is found in tropical storms like typhoons. Since the effect of both, floods and typhoons, have different impact on the building, the measurements to prevent damage in architectural design are worth to mention apart from each other.

Flood performance objectives

Damage to buildings from flooding is caused by three factors: saturation, velocity, and hydrostatic forces. All retrofits of building structures must allow the accommodation of hydrostatic forces. Actions taken during the design process can help buildings to resist flotation, collapse, and lateral movement during a future flood event. The use of sealants to reduce seepage, installation of pumps and/or check valves to reduce interior water levels, and the elevation of building components can all protect buildings and their contents to varying degrees. The classification of the different types of damage that can be caused by a floods is:

Damage caused by water saturation:
- Inundation of buildings and their contents
- Slope failures and instability.

Damage caused by high velocity flows:
- Erosion/scouring of embankments, slopes, levees, and foundations;
- Destruction of buildings and other structures;
- Drainage facility damage (i.e., dislodged or moved culverts).

Damage due to hydrostatic forces:
- Destruction of buildings, foundations, and other structures, or
- Soil erosion and/or subsoil movement.

Damage to utilities and pipelines:
- Malfunctioning of electrical power, water, sewer, and gas distribution, collection and transmission systems (i.e., distribution lines), as well as housing for utility operations or components (electrical substations) caused by water saturation.
- Damaged pipelines by high velocity flows or hydrostatic forces.
In addition to direct damage, collateral damage might include:
- Contamination of wells and other facilities inundated by sewage, hazardous materials, and other contaminants in the floodwater;
- Debris from damaged homes, vegetation, orphaned drums, etc., causing debris dams or exacerbating velocity damage as projectiles impact structures;
- Siltation of ditches, roadways, drainage facilities, etc.

Following design requirements are derived from this enumerated potential damage that can be caused by floods. The requirements are divided into two groups: measures related to ‘Inundation’ (A1 t/m A10), ‘High Velocity Flows’ (B1 t/m B7) and measures for ‘Accessibility, Utilities and pipelines (C-1 t/m C9)

A. Inundation
Damage to buildings, equipment, and other components are most commonly caused by floodwater inundation. Floodwater inundates the building, saturating the building materials and its contents. The floodwater is usually contaminated by a number of substances, such as sewage and other hazardous materials.

Objective: The most effective mitigation is fully protecting the building facility from floodwaters, such as through relocating or elevating the building.
A.1 Locate outside floodplain
If possible, locate the building outside the specific area that is subject to flooding once in 100 years (US example: always check local building codes). Building could be placed inside the 500 year floodplain (US example: always check local building codes). Place outside floodplain when no other measurements are applied. Since the structure has to be able to withstand floods and should be a safe shelter for the neighbourhood it is recommended to locate the centre within location specific floodplains.

Limitations:
- Not always desired or possible in high-density urban areas.
- Appropriate receiving site must be obtained.  

A.2 Elevation of the building
Elevate the building on fill or a structure above the design flood elevation or above the 100-year flood (US example: always check local building codes). Buildings can be elevated on perimeter walls, piers, piles, or fill. If walls are used to elevate, they must be vented to accommodate hydrostatic forces. This will minimize damages to building elements above. If on piles, space may be used for storage, parking, access or other functionalities.

Limitations:
- Building access will be impeded.
- May require additional mitigation considerations for heavy debris loading.
- Generally limited to relatively light structure.

Figure 4.35: Locate outside floodplains if possible. Central location goes above floodplain requirements.

Figure 4.36: Elevate the building on fill or a structure above the design flood elevation. If on piles, space may be useful for storage, parking or access to the building.
A.3  Slope failures and instability
Locate the building outside of the areas subject to slope failures and instability. Make sure there is enough space between the foot of the building and the top of the slope. A safe ratio is four meters distance for every meter of height differences. Soil conditions should be checked and stabilized in case of bare slopes.

Limitations:
- Not always desired or possible in high-density urban areas.

A.4  Increase Footing Depth and Weight
The depth of foundation footings should be extended below the expected depth of streambed scour or to bedrock when placed in floodplain areas where water velocities may incur. The expected depth of scour depends on the flood flow velocities along the footing and the nature of the streambed materials that mostly consist out of soft soils.

Limitations:
- Not always possible if solid ground is too deep or not present.32

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30 Flood Hazard Mitigation Handbook, p72
31 Flood Hazard Mitigation Handbook, p73
32 Flood Hazard Mitigation Handbook, p61
A.5 Wet Flood-proof building
Allow floodwater to inundate selected portions of the facility in areas that are not vulnerable to damage from floodwater saturation by using water-resistant construction methods, designing openings for flood water passage, and elevating vulnerable systems. Design should include the construction of openings to equalize hydrostatic pressure, and construction of the walls to resist hydrostatic pressure.

Limitations:
- Portions of building vulnerable to floodwater will be inaccessible during flood event.
- Advance warning needed so that stored materials can be removed.

A.6 Dry Flood-proof building
Seal the building so that floodwater does not enter. Components of dry flood proofing may include constructing exterior floodwalls, an impermeable berm around the building or sealing the building with water-proof material. The buoyancy of the building must be considered. Berms and floodwalls can be integrated into landscaping.

Limitations:
- May not be practical in areas of high velocity flows or heavy debris loading.
- May require access gates that have to be maintained and closed.
- Slopes exposed to moderate or high velocity flows should be armoured.

Figure 4.39: Allow floodwater to inundate selected parts of the building. Use water resistant construction methods and design openings for water passage.

Figure 4.40: Seal the building so floodwater can not enter the building. Construct exterior floodwalls or integrated armoured berms and floodwalls into landscaping.
A.7 Install backflow devices

Install backflow devices, including one-way and ordinary valves, on sewer lines and floor drains. These devices prevent sewage and/or storm water from being forced back into the facility.

Limitations:
- One-way valves may become blocked by debris and fail to close.
- Gate valves require that the valve be manually closed prior to inundation.35

A.8 Install extended pipes

Flooding can seriously contaminate water supplies, leading to potentially fatal diseases. Water should be stored in raised tube-wells. The top of the pipe of these tube-wells should be equipped with extension pipes. In case of flooding the top of the pipe can be quickly extended, keeping it above the level of any floods permitting safe storage of drinking water during both shelter and relief aid phases.

Limitations:
- Loose pipes to extend could get lost.
- Pipes require to be manually extended prior to floods.36

Figure 4.41: Install backflow devices on sewer lines and drains to prevent contamination.

Figure 4.42: Install extended pipes on tube-wells and water supply tanks to prevent contamination.
A.9 Install Openings
The crawlspace and foundation walls of buildings should be equipped with wall openings. These measures will minimize the damages from hydrostatic and buoyancy forces on the building due to water inundation. Anchor foundation walls of buildings to the footing and reinforce with steel bars and grout. Install crawlspace wall openings known as hydrostatic vents to allow floodwaters to enter and exit underneath the structure.28

Figure 4.43: Install openings in crawlspace and foundation walls to minimize hydrostatic and buoyancy forces on the building.

A.10 Use Flood-Resistant Materials
Construct walls and floors below potential flood level using flood-resistant materials and techniques. This wet flood proofing measure reduces damages and clean-up time for walls and floors subject to flood events. Avoid use of tile with gypsum board substrate and wood-framed walls. Use tiles or other flood-resistant flooring materials.

Limitations:
- Not sufficient for long-duration flooding, wastewater flooding, high velocity floodwaters, breaking waves, or debris impact.29

Figure 4.44: Use water-resistant materials and techniques to reduce damages and clean-up time after flood events.
B. High velocity flows

High velocity flows can scour the soil from under and around footings, threaten the building’s structural integrity, and even knock buildings off of their foundations.

Objective: Protect building facilities from damage due to erosion caused by high velocity flood flows.

B.1 Construct Piling or Spread Footing

Building foundations in floodplains can be undermined due to high velocity flows that scour away the soils supporting the foundation. By constructing a piling or new spread footing, the foundation is supported, thereby preventing failure in subsequent flooding.

Limitations:
- Spread footings should not be used in a coastal environment.
- Area may be inaccessible to pile driving equipment.
- Pile driving may cause damage to adjacent facilities.  

![Figure 4.45: Construct piling that support the foundation to resist high velocity flows.](image-url)
B.2 Flexible floor & Breakaway walls
If in use, ground floor of the shelter must be designed for flexible use and prepared for evacuation. Breakaway walls may be installed to enclose the area underneath elevated (coastal) buildings. This will minimize the damaging effects of breaking wave forces, erosion, and scour on the rest of the building. Effective at minimizing the damaging effects of breaking wave forces due to storm surge inundation as well as erosion and scour on the elevated structure. Area under the building could be useful for parking, access, or storage.  

B.3 Install proper drainage
Buildings can be elevated on perimeter walls, piers, piles, or filling with soil. When elevated by soil make sure proper drainage is installed. Especially when located on hill sides or if a bowl shapes are created by elevations. These could cause large puddles where water can remain and thus complicate relief aid.

Limitations:
- Valves may become blocked by debris
- Locked valves require that the valve is manually opened prior to floods

Figure 4.46: If in use, design breakaway walls and flexible floor use for ground floor to minimize damaging effect of floods.

Figure 4.47: Buildings elevated on filling with soil should have proper drainage to minimize impact of floods and prevent puddles.
B.4 Flow Deflectors
Install “V” shaped flow deflectors on construction parts that could be exposed to water to reduce flow velocities and protect columns and footings from scouring. Deflectors are particularly effective for higher levelled flood flows with high velocities. Pier collars and wing walls may provide additional protection from impact of rocks and debris.

Limitations:
- Flow deflectors should be inspected periodically after floods for impact damage and for streambed erosion.\(^{33}\)

B.5 Install Debris Deflectors and Batters
Debris deflectors or debris fins with batters (steel plates) could be installed on the upstream ends of (concrete) columns and wing walls and angled so as to direct floating debris into areas of high flood flow velocities. This may be effective in high urban areas that have significant debris loading in the upstream drainage. Less effective when flood flow velocities are low.

Limitations:
- Building height on ground floors need to be high enough to pass floating debris.\(^{34}\)

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31 Design and Construction Guidance for Breakaway Walls below Elevated Coastal Buildings
32 Protecting Building Utilities From Flood Damage
33 Flood Hazard Mitigation Handbook, p62
34 Flood Hazard Mitigation Handbook, p65-66

Figure 4.48: If the structure is elevated, use flow deflectors on construction parts that could be exposed to high flow velocities.

Figure 4.49: If the structure is elevated, install deflectors and batters on upstream ends to be protect for debris loading.
C. Accessibility, Utilities and Pipes

High velocity flows can scour and erode soils, which can undermine utility support and accessibility. The consolidation and settlement of soils can also damage a utility facility or pipelines during a flood event.

Objective: Protect the utility facilities and pipelines from floods and make precautions to make sure the building is accessible before, during and after flooding. Protect the utility and pipelines from soil settlement and future damage.

C.1 Elevate Utilities

Elevate and/or seal vulnerable components of the utility system, including electrical components and access points, above the design flood elevation. This will prevent floodwaters from entering the systems, such as: electrical control panels, transformers and switches, and utility access points.

Limitations:
- May inhibit maintenance access.
- May not be feasible in areas of deep flooding or in urbanized areas.

Figure 4.50: Elevate vulnerable components of the utility system above flood elevation.
C.2 Encase the Utility

Encase utility lines, such as electrical, communication, gas and water transmission and distribution lines in concrete and/or conduit to protect them from the damaging effects of floodwaters, including scouring.

Limitations:
- May not be feasible in areas with fine soils subject to high velocity flows, or where extensive erosion is common.
- Utility lines could be vulnerable to earthquakes, slides, or other earth movement events.36

C.3 Lining / Double Pipes

Provide double lining or dual pipelines inside sanitary sewer lines to prevent infiltration and/or exfiltration and associated erosion and settlement when they are damaged by disaster. Dual (standby) pipelines provide possibilities for quick recovery of sewerage etc. after disaster events. Several lining techniques are available. The most common techniques are slip lining and inversion lining.

Limitations:
- May turn into expensive solution
- Second lines may be damaged as well.37

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35 Flood Hazard Mitigation Handbook, p83
36 Flood Hazard Mitigation Handbook, p84
37 Flood Hazard Mitigation Handbook, p76
C.4 Strengthen Fencing

Strengthen fences by using heavy gauge materials, adding back bracing to the line posts, installing intermediate line posts. Strengthening fences is generally effective in areas that are flooded by low velocity flows with minimal debris loading.

Limitations:
- Fence strengthening has limited effectiveness in areas of moderate to heavy velocity and debris loading.
- Fence strengthening could, in some extreme cases, cause a damming effect, raising upstream water levels.38

C.5 Anchor & Tie-Down Buoyant Facilities

Provide anchors and tie-downs for fuel tanks and other buoyant facilities, such as mobile offices, storage buildings, and playground equipment to keep them from being washed away during flood events and prevent them from becoming a debris projectile or source of contamination.

Limitations:
- May not be effective in areas of moderate to high velocity flows with moderate to heavy debris loading. In these instances, relocation, elevation, or other mitigation alternatives should be considered.39

Figure 4.53: Strengthen fencing and other separating methods installing back bracing, heavy gauge materials etc.

Figure 4.54: Anchor and Tie-down buoyant facilities and tanks to keep them from being washed away during flood events.
C.6 Ramping Materials and Elevations
When ramps are designed with gravel or other loose material, erosion will often damage them. Use concrete for both foundation and ramp, stairs or any other important elevation to higher grounds. Other measures, such as riprap or other slope protection techniques applied to the downstream side of the ramp, may increase the effectiveness.

Limitations:
- Relocation of the elevation, if possible, or other alternatives to protect the ramp should be considered in these instances.\(^\text{40}\)

C.7 Accessibility during floods
Access to shelters must be maintained during flooding conditions. If access is not possible by ground transportation, alternative access must be provided. Alternative access can be achieved by a helicopter pad above the flood level or facilities for boarding boats. This can guarantee evacuation or may help to distribute emergency goods at the location. The platform also prevents the shelter from becoming an inaccessible island in an emergency situations.

Limitations:
- May not be effective in urban areas or slum conditions because of loose materials that become debris projectiles.

\(^{38}\) Flood Hazard Mitigation Handbook, p94
\(^{39}\) Flood Hazard Mitigation Handbook, p95
\(^{40}\) Flood Hazard Mitigation Handbook, p98

Figure 4.55: Make sure ramping material and accessibility during floods both are taken care of.
C.8 Equipment and facilities

Shelters in flood prone areas must be properly equipped to meet medical, food and sanitation needs during the time of isolation of occupants. Enough storage should be implemented to help victims in case of emergency. Make sure sanitation is accessible during disaster events and prevent contamination and diseases.

Limitations:
- Facilitate the centre with adequate equipment to prevent chaos in the event of a distribution function.

4.4 Typhoon design requirements

Both the measurements on earthquake and flood design work together in the situation of a typhoon. Effects of hard winds and heavy rains strongly influence the building construction with both short and long-term peaks of power forces. Devastating typhoons are the result of excessive localized circulation of wind caused by warm ocean water causing a warm core, low pressure and wind speeds in excess of 120 km/h.

Typhoon performance objectives

Damage to buildings from typhoons is caused by three factors: extreme wind loads both positive (pressure) and negative (suction), impact of windborne debris, and heavy rains.

Flood measurements caused by these heavy rains are mentioned in the flood design requirements. Actions taken during the design process can help buildings to resist high wind pressures. With a focus on weak openings in the facades and preventing major damage caused by windborne debris by using impact resistant materials, the potential damage of a typhoon can be largely repelled and therefore avoided. 

The classification of the different types of damage that can be caused by a typhoon is:

Figure 4.56: Make sure the shelter is equipped with enough dry and floodproof storage space, accessible during floods.
4.4 STANDARDS | typhoons

Damage by extreme wind loads:
- Detachments of building parts and/or their contents, or
- Destruction of buildings exterior/interior cause by failure of single building parts

Damage by impact of windborne debris:
- Destruction of buildings façade or main structures;
- Impact of debris might cause internal wind suction and implode parts of the building structure;
- Obstruction of accessibility of the building and its surrounding.

Damage due to heavy rains include:
- Destruction of buildings, foundations, and other structures, by soil erosion by high velocity flows.
- Saturation of structure and interior because of failure of building parts or construction causing the overflow of elevated floors and its interior components.

The measurements in this section about typhoons design requirements mainly concentrated on preventing internal water damage caused by wind driven rain damage. Precautions about flood effects on building structures can be found in the section Flood design requirements.  

Following design requirements are derived from this enumerated potential damage that can be caused by typhoons. The requirements are divided into two groups: measures related to ‘Extreme wind loads’ (A1 t/m A11) and measures for ‘Wind borne debris impact’ (B-1 t/m B5)

A. Extreme wind loads
Extreme wind loads most commonly cause damage to buildings, equipment, and other components by affecting parts of the building structure. Wind loads can cause extreme inward and outward acting pressure on facades and other construction parts causing loosening or breaking of building envelopes.42

Objective: The most effective mitigation is fully protecting the building facility from extreme wind loads, such as through proper locating and minimizing the edges and size of building envelopes to prevent failure from wind loads.

41 http://www.wbdg.org/resources/env_wind.php
42 Design and Construction Guidance for Community Shelters, FEMA, p87
A.1 Improve Pile Foundations

Improve pile foundations by providing solid pile-to-beam connections and adequate lateral bracing for unsupported pile lengths. This will reduce the potential for foundation damages due to storm surge. Provide diagonal or knee bracing to increase lateral resistance and help prevent pile buckling.43

Limitations:
- May require additional considerations for areas of heavy flood borne debris or high winds.
- Minimal benefit if piles insufficient depth for erosion and scour.

A.2 Optimize Building Orientation

The building orientation can be optimized by the use of a simple geometric shape (see also earthquakes requirements: A.2 & A4), which is optimally placed to resist the prevailing wind direction. Do not design buildings over three levels and minimize the edges and forms in the design and this positive effect of orientation will be strengthened.44

Limitations:
- May require additional considerations for locations in urban areas with high-rise.
- Minimal benefit if building orientation and site qualities do not correspond.

43 Hurrican Mitigation: A handbook for public facilities, FEMA, 2005, p45
44 Community Wind Shelter, Background and Resources, FEMA 2012, p94
45 Wind Mitigation Booklet, Florida Division of Emergency Management, FEMA, p64
A.3 Use of Surrounding Elements
The surrounding element of the site could be used to enforce the building design. Through the use of (existing) trees, the wind gusts could be damped and the wind loads on the facades will be proportionally lower. Using surrounding landscapes could help to reduce the impact of typhoons as well. Use the lee of hills and mountains by placing it behind these natural protectors instead of placing it in front of them.44

Limitations:
- Proper site might not be available

A.4 Improve Wall-to-Foundation Connection
Install wall-to-foundation connections using brackets or straps between the wall framing and the foundation to strengthen connections and prevent wall failure from positive (blow in) and/or negative (suction) wind pressures. Connections must ensure a continuous load path to foundation to prevent building from uplifting or being blown away.45

Limitations:
- Connections and fasteners may require some level of maintenance to protect them against corrosion.

Figure 4.59: Use surrounding elements on site to protect the building and damp wind forces and reduce impact of typhoons.

Figure 4.60: Use proper wall-to-foundation connections (brackets or straps) to strengthen connection and prevent wall failure.
A.5 Use Hip Roofs
Using hip roofs will increase the strength of the roof framing and reduce high wind damages in hurricane events. Hip roof systems provide additional lateral support by eliminating the gable ends (most common failure point), thereby increasing resistance to wind pressures coming from multiple directions. Roof slopes that minimize wind pressures are approximately 5:12.46

Limitations:
- Will significantly impact the appearance of the design.

A.6 Install Hurricane Clips or Straps
Install hurricane clips or straps between the roof framing and the walls to strengthen connections and prevent roof failure due to negative wind (suction) pressures. Connections should be made between the roof and walls, between trusses, and between rafters and trusses. This will increase the strength of the building connections and reduce high wind damages in typhoon events.47

Limitations:
- Most connections and fasteners will require some level of maintenance.

Figure 4.61: Use hip roofs or round shapes to increase strength and reduce damage.

Figure 4.62: Install hurricane straps to connect (wooden) framing and walls.
A.7 Install Framing Connectors
Install required number and size of connectors or apply construction adhesives to achieve full structural capacity of connections, thus reducing wind damage by providing continuous load path from structural elements to foundations. Consider lateral and uplift loads present in typhoon environment when designing connections.47

Limitations:
- Requires inspection and maintenance.

A.8 Secure Roof Sheeting
Secure roof sheeting to roof framing to prevent roof failure due to negative wind (suction) pressures: increase the number of fasteners, especially at the corners (where negative wind pressures are highest). Use screws instead of nails to secure the roof sheeting and make sure that they penetrate underlying roof trusses.47

Limitations:
- May be more expensive

Figure 4.63: Install framing connectors to achieve full structural capacity in connections.

Figure 4.64: Secure roof sheeting to prevent roof failure due to negative wind suction.
A.9 Improve Roof Flashing and Gutters

Improve roof flashing, coping and gutters by using the correct fasteners and sealants, increasing lap lengths, and using proper spacing between fasteners. Design and secure gutters for uplift; this will reduce the likelihood of edge flashing, coping bending or blow-off and subsequent damage to the underlying roof structure by wind and water penetration.48

Limitations:
- May not prevent damage due to failure of roof membrane, roof decking or large roof overhangs.

A.10 Anchor or Reduce Roof Overhangs

Anchor overhanging roofs and porch roofs to the structure using mechanical fasteners to connect the roof truss to the columns and the columns to the floor deck or foundation. Better is to reduce or eliminate roof overhangs wherever possible to reduce the uplift forces on the roof system. Avoid unsupported roof overhangs greater than 60 cm wide, these are often starting point for total roof failure.49

Limitations:
- Will not prevent failure of roof overhangs from poor attachment of roof sheathing.
- May reduce energy efficiency.

Figure 4.65: Improve roof flashing and gutters by using correct fasteners and sealants.

Figure 4.66: Reduce or at least anchor roof overhangs and porch roofs to the structure.

48 Hurrican Mitigation: A handbook for public facilities, FEMA, 2005, p58
49 Community Wind Shelter, Background and Resources, FEMA 2012, p45
50 Wind Mitigation Booklet, FEMA, p87
A.11 Strengthen Siding

Strengthen vinyl and metal siding by using additional fasteners and proper spacing between system components. This will reduce likelihood of siding pull out or blow-off and subsequent damage to the underlying roof from high wind pressures. Use vinyl siding manufactured for high wind areas (i.e., double thickness at nailing edge), and air-barrier film underneath siding against wind-induced water infiltration.

Limitations:
- Siding panel thickness should be sufficient to resist pull out.
- May not prevent damage due to failure of wall sheathing.

B. Windborn debris impact

Windborne debris impact most commonly caused damage to parts of the building structure. Wind borne debris can cause extreme pressure on concentrated places of facades and other construction parts causing weaknesses or openings in the building envelope. They have impact on structural elements (i.e., roof and wall framing), non-structural elements (i.e., building envelope), ancillary structures, and building utility equipment.

Objective: The most effective mitigation is fully protecting the building facility from windborne debris impact by design improvements of the façade and its openings.

Figure 4.67: Strengthen siding (vinyl and metal) by using additional fasteners and proper spacing.
B.1 Eliminate small Structures
Eliminate light structures by integrating ancillary functions into the main building. Integrating ancillary functions into the main building will reduce damage to light structures and their contents and reduce potential windborne debris during typhoon winds.50

Limitations:
- Code restrictions may prevent elimination of all light ancillary structures.
- Verify restrictions concerning equipment/materials prohibited from being located in main building.
- Decrease in available floor space.

Figure 4.68: Eliminate small structures by integrating functions into the main building.

B.2 Improve Exterior Doors
Improve exterior doors by using proper fasteners and stronger materials for door construction and connections to the wall system. Use minimal three hinges screwed into framing as well as doorframe. Use solid wood or metal doors and add top and bottom throw bolts. Consider outswinging doors to reduce degradation of weather-stripping to minimise water intrusion from wind-driven rain. This will reduce damage or failure of entry doors from typhoon-force wind pressures, thus reducing interior damage.51

B.3 Install Window Shutters
Install accordion or roll-down shutters to protect windows/other openings from glass breakage from windborne debris impact forces and interior damage to buildings. Accordion shutters have a unique, interlocking folding blade system, designed to cover large spans and fold away for an unobstructed view. Accordion shutter systems provide high wind protection, and may include a key-lock feature for security. All shutter systems must be properly anchored to the structural framing.52

Limitations:
- Shutters will not prevent damage from building roof or structural failure.

50 Community Wind Shelter, Background and Resources, FEMA 2012, p47
51 Wind Mitigation Booklet, FEMA, p132-134
52 Hurricane Mitigation: A handbook for public facilities, FEMA, 2005, p58
**4.4 STANDARDS | typhoons**

**B.4 Strengthen Window Glass**
Strengthen window glass using window film or laminated glass. This can reduce window glass breakage or breaching of openings from windborne debris impact forces during typhoons, thereby reducing interior damage to buildings and contents. Additionally, they should be designed to stay in frames and protect against water infiltration.53

**B.5 Anchor Rooftop Equipment**
Anchor rooftop equipment (satellite dishes, solar collectors and lightning systems) using properly fasteners. These measures will reduce blow-off of rooftop equipment from high wind pressures and limit the potential for windborne debris.53

Limitations:
- May not prevent equipment damage from windborne debris.

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53 FEMA 454, Chapter 10, Design for Extreme Hazards

Figure 4.69: Install window shutters to protect windows from breakage caused by windborne debris impact forces. Immense interior damage and cost can be prevented.
By concluding the chapter ‘standards’ it is assumed that your first design sketches, following the ‘rules of thumb’ have been made. It is assumed that these first sketches are based on the ‘standards’ and therefore, at its core, able to withstand disasters (i.e. earthquakes, floods and typhoons) in the end. Further and more detailed sketches of the construction to conclude the design should be done after studying the guidelines concerning the different phases of the design. The guidelines mainly focus on ideas and considerations during the further development of the design of a transitional community centre. Where are specific interventions needed and what specific design rules could be implied in each scenario of this adaptable building. The specific usage of the building is categorized per phase. These phases are divided into three groups known as the pre-disaster period, during-disaster period and the post-disaster period. The three groups all consist out of two phases, which are stated, in the diagram on this page. Each phase will be described in terms of usage and intervention, programmatic elements and guidelines for architectural and wider oriented considerations.

Before continuing the design process, study all the possibilities, guidelines and considerations for each phase in order to create a transitional community centre that combines and integrates the specific needs and techniques for each project.
Education can be designed in a variety of sizes, configurations, and layouts depending on the program of the school. There are many ways of expressing and one of the main questions is: what scope should it have in the context of a transitional community centre in an urban slum area that is highly dense? What people have to be reached and what architectural resources are required? In the situation of this transitional community centre the scopes on education mainly focus on primary/secondary education, adult education and livelihood information programmes. This mixture of education for all ages ensures a building that is strongly community related. Like in this case, community related schools often intend to be joint-used for other facilities. Community events and livelihood support programs are often part of the community centre as well as crèches and maternity information that are part of a health care centre. All these other community related facilities are covered in the following chapter about facilitation within a transitional community centre. Since the education and facilitation program happen to be in the same pre-disaster phase there will be some overlapping between these two main requirements of a transitional community centre. The combination of educational and community programs (facilitation) forces to focus on accessibility, scale, flexibility and durability of the design.

On top of that the physical organization of the school needs to provide easy navigation that builds confidence, safety and security. Besides this school configuration, children and adult need a healthful and stimulating environment in which to learn. Schools within a transitional community centre should be comfortable acoustically, and thermally and visually recognizable. Working with different levels, materials, colours or any other tools available should ensure an own identity of the different programs of the community centre. Not only the school program itself but the whole community centre should also be turned in to a teaching tool it selves. All actors within the community will value a school that has a strong connection to the community itself as well.

Program of requirements

In this situation of a transitional community centre in a slum environment it is assumed that the instruction mainly occurs in one classroom with one teacher. Despite the many varied possibilities concerning the way of giving education there has been chosen for this situation because these are probably the two main essentials in every kind of education. The cross-disciplinary teaching of children during the day and adults in the evening typically requires spacious and flexible facilities that of course have strong similarities with

Education about technology and school construction go together. Modernization, updating education facilities, and making a capital investment in education are all included.

- Major Owens

5.1 EDUCATION | pre-disaster

Education, health, and environment programs that integrate family planning and natural disaster management are one way to help the majority of Filipinos that live in densely populated and resource-stressed coastal areas.

- Major Owens

the program of a community centre. The program of requirements of the educational part of the building exists out of:

- Lobby/entrance hall  (20 m²)
- Administrative Office (10 m²)
- 4 classrooms (4x) (50 m²)
- Common areas  (50 m²)
- Gym/sports  (outdoor)
- Multipurpose Rooms (1x) (50 m²)
- Restrooms (4x) (2 m²)

Assessment and intervention process

Educational solutions within the structure of a transitional community centre are, as mentioned before, mainly focused on accessibility, flexibility, safety and scale. The physical environment and cleanliness of a school facility can significantly affect the health and well-being of children.1 The combination of education with proper facilities therefore is an opportunity that should be implemented in the design very

Figure 5.2: Program activity within the building during the education phase.

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1 Water, sanitation and Hygiene (WASH) in Schools, Unicef, 2008, p67
Disease spreads quickly in cramped spaces with limited ventilation, where hand-washing facilities or soap are not available, and where toilets are in disrepair. Too often, schools are places where children become ill.

All these challenging aspects of an educational function within a transitional community building proclaim the necessity that educational program not only has to be able to transit into other functions, but also should have a strengthening effect in combination with the community centre and its facilities. In this case it means that safety and continuity of education are the main cause for concern.2

Despite the varied and many possibilities concerning the way of giving education, the characteristics of the design of the educational intervention generally follows a three-step assessment and intervention logic of external factors, internal factors and over-all factors. External factors concern the accessibility, scale and aesthetics. Internal factors concern flexibility: functionality and productivity and over-all factor consist out of safety, security and sustainability and educational integration with the program. Main priority in this part of the design: make sure children can learn in a safe and healthy environment.

Figure 5.3: Spot plan of the program in the educational phase
A. Accessibility, Aesthetics and Scale

The importance of accessibility to the educational system should not be underestimated. Both education and shelter function require highly accessible rooms without causing major damage or inhibition in one phase that highly effects the other phase. The importance of the physical appearance of a school should not be underestimated as well since this can build a sense of pride and ownership among the community. The exterior should complement the neighbourhood and reflect the it’s values. The scale of both the school itself and the school within the building should have attention as well.

A.1 Design stairs/ramps recognizable

Design stairs and ramps in recognizable way. This will improve accessibility of the school and supports clear differences in educational and community parts during day and night.³

A.2 Design entrances for specific needs

Design spaces and entrance to meet the specific needs of students, teachers, and administrative staff with disabilities. This will support accessibility in multiple phases.

A.4 Physical appearance in context

A.5 Balance educational scale

Figure 5.4: Research by design: design options that can possible influence both education and upgrade general knowledge about safety, construction and climate conditions of structures.
A.3 Design for flexibility in appearance
Design for future flexibility, which enables exterior to be easily modified to future requirements about materials, climate adaptation etc.

A.4 Physical appearance in context
A school building that is attractive, responds to and is consistent with the design and context of the neighbourhood, builds a sense of pride and ownership among the community. The exterior should complement the neighbourhood and reflect the community’s values.4

A.5 Balance educational scale
Provide an educational scale that is acceptable for both the community and the building. The school should be able to support the majority of the demands. Within the building there should be a balanced surface of educational spaces and community spaces without being inferior to another.5

B. Flexible, Functional and Productive
Every school system has its own special requirements concerning the type of education that is been given. Some kind of adaptation of the rooms should be applied to develop the perfect setting in each region or village. At the same time there is a need of adaptation in the educational function at two levels of transition: The shift from day to evening education requires small adaptations and multi-functionality on classroom level. The transition from education to sheltering requires multi-functionality on both school and community centre level without losing structural safety standards. The architectural elements of the school must be suitable for both activities during the whole day during education phase and for 24-hours activity pressure during shelter phase. On top of that the interior should enhance the learning process and productivity of both children and adults.

B.1 Operable walls in large spaces
Use operable walls to increase the efficiency of large, multi-purpose spaces, such as classrooms, gymnasium and courtyards. This optional variation in sizes will increase the functional use of the building.4
B.2 Allow classrooms to change
Make sure that classrooms are connected with other spaces like hallways or multifunctional spaces to allow classrooms to change with the required activity and group size. This is particularly important in primary schools, where students typically stay in one room with one teacher throughout much of the day.

B.3 Cluster and connect spaces
Design clusters of classrooms around common multifunctional areas to increase interaction between children. Connect spaces visually with colours and patterns, particularly for primary school children.

B.4 Provide space for gathering & reflection
Encourage interaction by providing platform spaces for gathering, sitting, and presenting and alcoves for quiet play, reflection, and reading.

B.5 Interchange spaces of programs
Decentralize administrative spaces, educational spaces and community spaces to encourage active leadership and maximize interaction with students and community. Make sure the building can still provide a “home base” for each student and teacher.

B.6 Visually comfortable environment
Provide an interior environment that is visually comfortable and stimulating by integrating natural and artificial lighting, eliminating glare, and incorporating colours that stimulate or soothe, depending on the space function.

B.7 Design for diffuse, uniform daylight
Make daylight a priority, especially in classrooms where users have to control admission of daylight. Make sure that there is a diffuse and uniform daylight throughout classrooms. Avoid direct-beam sunlight and integrate lighting systems, controls and materials that reflect or absorb light.

B.8 Integrate daylight and electric lighting
Integrate daylight with high-efficient electric lighting and controls to optimize visual comfort. Glare and hot spots can undermine the learning process.

B.9 Ensure indoor acoustic comfort
Ensure indoor air quality by use of natural ventilation when possible. (This and day lighting also provides a connection to the outdoors.) Ensure thermal and acoustical comfort; keep humidity in the comfort zone.

6 Water, sanitation and Hygiene (WASH) in Schools, Unicef, 2008, p35-37
B.10 Connection indoor and outdoor
Connect the indoor environment to the outdoors by providing operable view windows in classrooms and easy access from classrooms to gardens and other outdoor areas that can be utilized in the curriculum.

C. Safety and Sustainability
Teaching children should be done in a safe environment where they are protected from threats outside the educational environment. This means proper roofing and good windows with shutters are critical as they allow the users to withstand all climate conditions. The security and safety of the Transitional Community Centre users should be considered high priority, as this will put the lives of the inhabitants at risk. Integrating renewable energy strategies can increase the knowledge of the community centre user about environmental issues.

C.1 Clearly define access and boundaries
Maximize visual access to corridors and school grounds and increase occupants' sense of ownership and “territority” by providing comfortable, not institutional, rooms and by clearly defining the school boundaries. If possible, provide opportunities for safe walking and bicycling to school.

C.2 Control and management of access
Design clear structures so control on access to the building and grounds by individuals can be observed well. Using a single entrance can improve this but provide sufficient and safe emergency egress as well.

Figure 5.5: Research by design: design options that can possible influence both education system as well as make transition to other phases easier to achieve by adding flexible wall systems or flexible main structure.
C.3 Fire detection mechanisms and alarms
Improve building safety and include sufficient fire extinguishers, emergency exits and escape routes. Use fire doors between educational and community units.

C.4 Dual use of educational facilities
Dual use of educational facilities can cause serious protection risks for children and youths; these risks must be mitigated by design solutions that provide storage and defining special child-only spaces to provide a ‘safe base’. Disruption, reduction or cancellation of education should be avoided during pre- and after disaster periods.

C.5 Sustainable and renewable strategies
Design sustainable, high performance educational spaces by integrating renewable energy strategies, including passive solar design and, where appropriate, solar thermal and photovoltaic.

C.6 Water and energy efficiency
Sustainable educational building should use energy, water, and other resources efficiently. Integrate systems to store and re-use water, generate energy or make the use of it more efficient when feasible.

C.7 Durable, non-toxic materials
Using durable, non-toxic building materials will improve the durability of the building. Environmentally preferable materials have a reduced effect on human health and the environment and contribute to improved safety and health, reduced liabilities and reduced disposal costs. When new materials are used, maximize their recycled content and specify harvested materials harvested on a sustained yield basis.

B.4 Provide space for gathering and reflecting

C.4 Dual use of educational facilities
C.9 Educational program integration
Guarantee sustainable, safe water supply points and hand-washing stands and sanitation facilities within the vicinity of classrooms to be able to fully integrate life skills education, focusing on key hygiene behaviors for schoolchildren to fully take advantage of the combination of facilitation and education. This will lead to students that are healthier, perform better in school, positively influence hygiene practices in their homes, among family members and of course within the wider community and the center itself.

C.8 Building orientation
The orientation, and landscaping of a building affects local ecosystems, transportation methods, and energy use. Improve solar access and wind conditions using climate conditions to provide the best building orientation.

B.3 Cluster and connect spaces
C.9 Program integration

Figure 5.7: Research by design: design options that clusters and connect spaces as well as the interaction of different programs.
5.2 FACILITATION | pre-disaster

To prepare for it, we need to have folks who are trained, we need proper facilities, equipment and supplies, that are going to be built into society, and we are going to spend a lot of money on it.

- Major Owens

Public facilities within the program of a transitional community centre requires designers to focus on issues other than only structural design requirements. The building type of a community centre is distinguished. There is a wide range of different facility types that could be added. While all community services facilities share a common purpose in the service of public need, each facility is very specialized and the functional requirements are extremely varied. The open and welcoming character of accommodation which is designed for the public is in strong contrast with some of the building spaces that are partially open to the public like child care facilities or intended to be occupied by trained professionals only, in the case of health care and storage facilities. Therefore, the design and functional layout of these facilities will vary widely. If there is one unifying theme to this program type, it is that the exterior architectural message should respect the cultural tastes and history of the community served. As stated before, community centres should also be turned in to a tool it selves. All actors within the community will value a building that has a strong connection to the community itself as well. In the situation of a transitional community centre in a slum environment it is assumed that the facilities will be used by a varied number of people per facility. Wash facilities or health care will attract divers numbers of people within the population, something that can only be estimated to develop a facility program for the transitional community centre. For example, despite the potential high number of users during the relief-aid phase it is not realistic to build sanitation systems that can provide service for the specific need in these situations. Different sources have been consulted to modify and determine the applicable number of, for example: latrines and showers. Of course there are many other requirements and dimensions in which the program should be useful. Of course the educational program has strong connections with the program of the facilitation and together with the multifunctional spaces of the community centre, in this case seen as part of the facilitation for the community, they constitute the base of a transitional community centre during the pre-disaster period.

Program of requirements

The cross-disciplinary facilities of sanitation and health care require sufficient guidance and an awareness program that explains the usefulness of the community centre and its facilities. The program of requirements of the facilitation phase forms, in combination with the education phase, the community centre. It should be stated that a clear management structure should be in place in this pre-disaster phase, to

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8 yourlocaladda.com/forum/wallpapers-77/world-water-day-4681/
9 http://www.wbdg.org/design/communityservices.php
make sure this mix of program is able to fully function. General office space for management function is therefore added to the phase of facilitation and education. The program of requirements to form the facilities of the community centre exists out of:

- Lobby/entrance zone (25 m²)
- Offices (2x) (10 m²)
- Multifunctional spaces (4x) (40 m²)
- 20 latrines (500 – 2500 people)
- 10 showers (500 – 1000 people)
- 8 water taps, (2000 people)
- Water storage (25,000 litres / 25 m³)
- Sewer system (50,000 litres / 50 m³)
- Outdoors market (200 m²)
- Treatment rooms (2x) (10 m²)
- Storage (100 m²)
- Lockers + electricity, 500 pcs (25 m²)
- Wi-Fi networks / equipment (10 m²)
- Public Kitchen (50 m²)
- Laundry facilities (25 m²)

Figure 5.8: Program activity within the building during the facilitation phase.
Facilities within the structure of a transitional community centre are as mentioned extremely varied and specialized in their functional requirement and accommodation. The one thing they have in common is to serve the public in their needs. Facilities within the structure of a transitional community centre are mainly focused on intervening in accessibility, hygiene and services to the community. Intervening in a slum area is different from building in formal environments due to a lack of formal regulations and the typical density and morphology. See also general requirements chapter, section C: Spatial intervention and location. Challenging aspect of the facility function within the structure of a Transitional community centre is the fact that access and use should be guaranteed in every phase for every user. Transition of facilities mainly takes place in intensity of usage, from typical use in pre-disaster phase to extreme usage during, and particular, post-disaster phase. Some facilities will transform but none of them will be useless in all phases. Despite the varied and many options for facilitation, the characteristics of the design of the facilitation phase generally follow a multiple-step assessment and intervention logic of different facilities which all have some overlaps in usage of various spaces. In this case measurements for facilitation phase are classified as: community, WASH, healthcare and communication facilities.

Figure 5.9: Spot plan of the program in the facilitation phase
A. Community

Most of the community programs can be accommodated through three functional space types: facilities, multifunctional space and offices. Additional functional areas include administrative spaces, dedicated storage spaces, and building support spaces, which are not specifically included in the program of the community. The community facilities need clear and visible entrances and options to display information for community resources or other activities. The rooms should be configured like typical training facility rooms and should be designed for flexible use. A flexible design will provide more options for running multiple classes. Consider providing a kitchen as part of or in addition to the classrooms.

A.1 Signage

Signage is critical for users of community facilities to be able to readily find the community centre within the density of a slum as well as entering a ‘public’ building.

A.2 Clear entrances

Design of clear entrances is critical for users of community facilities to be able to readily find and enter the community centre.

A.3 Community participation

If possible, communities should be fully involved in projects held in the community facilities, especially if they relate to their health and well-being. Communities should be activated to participate in all events relating to community facilities as well as the school. Communities must participate in decision-making about what should be done and how, contribute to the implementation of the decisions, and share in the benefits of the project or program. In this way the building can really become part of the neighborhood and actually support it during all phases.

A.4 Design multifunction spaces

Design spaces to meet the specific needs of people from the community. Make sure spaces are easily closed, cleaned and emptied to guarantee multifunctioning of the spaces. This will support safe and quick access and transition of the spaces in all phases.

A.5 Design for flexibility in appearance

Design for future flexibility, which enables interior and exterior to be easily modified to future requirements about materials, climate adaptation etc.

A.6 Physical appearance in context

A community building that is attractive, responds to and is consistent with the design and context of the neighbourhood builds a sense of pride and ownership among the community. The exterior should complement the neighbourhood and reflect the community’s values.

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10 Water, sanitation and Hygiene (WASH) in Schools, Unicef, 2008, p68-72
A.7 Balance community scale
Provide a community scale that is acceptable for both the school and the building. The community should be able to support the majority of the demands of both community and education. Within the building there should be a balanced surface of educational spaces and community spaces without being inferior to another.

A.8 Additional requirements
Additional requirements with regard to community centre spaces could be found in the previous chapter educational requirements. Especially the sections B and C about flexibility, functionality, safety and sustainability are considered as important basic design interventions providing a proper community service building.

B. Wash - facilities
The WASH-facilities aim to promote good personal and environmental hygiene in order to protect health of the community. WASH facilities consist out of access to safe and clean water, proper sanitation to guarantee healthy and hygiene conditions within the proposed community. The combination of WASH-facilities and education creates many opportunities. It does not only promote hygiene and increases access to quality education about these subjects but also supports national and local interventions to establish equitable, sustainable access to safe water and basic sanitation services in schools. Poor sanitation, water scarcity, inferior water quality and inappropriate hygiene behavior are disastrous for infants and young children and are a major cause of mortality for children under five. The WASH-program can be accommodated through three functional space types: water supply, sanitation and sewer. The WASH-facilities need clear and visible entrances and options to display information about health and hygiene. If the activity is to complex, difficult and time-consuming, users will skip necessary actions, creating potential health risks. Sanitation should be configured in clusters and should be designed for easy daily cleaning. To encourage hygienic behavior such as using a toilet, washing

Figure 5.10: Take care of climate conditions within the separate rooms in facilities and education
hands and comprises several small steps and necessary preparations for different users (gender/age). Therefore, sanitation improvement and design is more than just the provision of toilets; it is a process of sustained environment and health improvement and always should be accompanied by environmental, health and hygiene promotional activities.

B.1 Signage
Signage is critical for users of WASH-facilities to be able to readily find the facilities within the density of a slum as well as entering a 'pubic' building.

B.2 Clear entrances and access
Design of clear entrances is critical for users of WASH-facilities to be able to easily find and enter the required facility and actually start to use them. Connections with public areas are necessary as long as it does not affect privacy or any cultural traditions. It must be possible to reach the facilities during all weather conditions, including after heavy rains or flooding.

B.3 Privacy and cultural identity
Toilet facilities and urinals should guarantee privacy, particularly for people over the age of eight. In some cultures, it is important not to be seen entering or leaving the toilet. Access routes may be better situated away from the busy part of the community, while at the same time open and clear for security reasons.

B.4 Gender/age segregation
Make sure the design includes separate toilet facilities by gender. Some toilets should be built for younger children and older children; for girls and boys, particularly adolescents; and for female and male teachers. In smaller WASH-facilities, where different age groups use the same facilities, special provisions can be made for smaller children, such as a step in front of a pump or toilet seat, or an additional seat cover with a smaller hole.

Figure 5.11: Research by design: make use of modern and new communication network to improve development in both facilities and economic development.
5.2 FACILITATION | pre-disaster

B.5 Security within WASH-facilities

Users, especially children, need to feel secure when visiting WASH facilities. They should not be at risk of harassment by people or attacks by animals such as snakes, scorpions or spiders. Access routes must be open and clear and the facilities in audible and visible proximity to the community, in the event that immediate assistance is needed. The location of the facilities should allow for security to reduce the risk of vandalism, particularly when communal WASH facilities are being installed. An individual or group of supervisors can be assigned this task.

B.6 Water taps

Sufficient water-collection points and water-use facilities are available community center, allowing convenient access to, and use of, water for drinking and personal hygiene, and for food preparation, cleaning and laundry. A reliable water point, with soap or a suitable alternative, is available at all the critical points within the school, particularly toilets and kitchens.

1. Quality

Water quality for drinking, cooking, personal hygiene, cleaning and laundry should be safe for the purpose intended. There are no tastes, odours or colors that would discourage consumption of the water.

2. Capacity

Water taps must provide sufficient capacity and minimal waiting time. The number of people per source depends on the yield and availability of water. The approximate guidelines are: 250 people per tap based on a flow of 7.5 liters/minute, 500 people per hand pump bases on a flow of 17 liters/minute and 400 people per single user open well based on a flow of 12.5 liters/minute.

For water use within schools, WHO and UNICEF apply a ratio of 5 liters per student per day for drinking and hand washing. A ratio of 15-20 liters per adult person per day is applied for drinking water (2 liters), personal hygiene (2-6 liters) as well as food preparation (3-6 liters), cleaning and laundry when applicable.

Figure 5.12: Research by design: provide enough gender segregated sanitation and provide for security.
B.7 Toilets

Sufficient, accessible, private, secure, clean and culturally-appropriate toilets are provided for both schoolchildren and staff within the education phase as well as toilets provided for community center users and public use within the public sanitation area. Toilets should be easily accessible, provide privacy and security and appropriate to local cultural, social and environmental conditions. Toilets have to be hygienic to use and easy to clean, convenient hand-washing facilities close by and a cleaning and maintenance routine in operation should ensure clean and functioning toilets.¹²

I. Capacity School

Ensuring the right capacity in facilities is usually not a matter of applying a simple ratio. Different literature and country standards use a ratio of 1 toilet per 30 girls and 1 toilet per 60 boys both in short and long term. Beyond the total number of schoolchildren, factors that determine required capacity may include the times when children are allowed to go to the toilet.¹²

II. Capacity Community

Different literature and country standards use a ratio of 1 toilet per 25 adults (woman) and 1 toilet + 1 urinal (or 50 cm of urinal wall) per 50 adults (man). Beyond the total number of daily users, factors that determine required capacity may include the times when adults usually go to the toilet and the density of the slum where the building is located.

III. Capacity Market area

Different literature and country standards use a ratio of 1 toilet per 50 stalls in short term and 1 toilet per 20 stalls on long term.

III. Capacity Health Care

Different literature and country standards use a ratio of 1 toilet per 50 patients in short term and 1 toilet per 20 patients on long term.¹²

B.7 Showers/bathing

Sufficient, accessible, private, secure, clean and culturally-appropriate showers/bathing facilities are provided for community center users and public use within the public sanitation area. Showers should be easily accessible, although covered by extra doorways or spaces to provide privacy and security. They should be appropriate to local cultural, social and environmental conditions and hygienic to use and easy to clean.¹²

I. Capacity

Different literature and country standards use a ratio of 1 washing basin per 100 people and private launder and bathing areas available for women. Beyond the total number of daily users, factors that determine required capacity may include the times when adults usually go bathing and the density of the slum where the building is located.¹³

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Figure 5.13: Research by design: the community center should have market and wash-facilities as well as opportunities to collect rainwater.
5.2 FACILITATION | pre-disaster

C. Health facilities

Health facilities should mainly consist out of storage and small treatment rooms strongly connected to the other facilities. During the pre-disaster phase the health facilities should have a small operational office and a treatment room with waiting area that could be operated by a medical team. During disaster phase the health facilities should be replaced into the safe house to be able to help a larger influx of people. The health facilities are mainly important in the post-disaster phase when many injured people need emergency assistance. Large storage compartments, connected to the health facility can be used immediately after disasters, to accelerate the setup of an emergency health facility. The combination health and WASH-facilities creates many opportunities. It does not only promote hygiene and increases access to quality health care in the first phase but also supports national and local interventions to establish emergency support after disaster. Offering a base of healthcare, WASH facilities, food storage and a clear building structure that provides space for NGO’s and other help organizations could strongly improve emergency help during and especially after disasters.15

C.2 Waiting Area

Waiting room is essential and could be situated as a buffer zone between public area and treatment rooms. Connections with public areas are possible as long as it does not affect privacy or any cultural traditions. Waiting facilities should guarantee some privacy; depending on culture it is more important to have a certain level of privacy.13

C.3 Storage

Especially health care and all what is needed to initiate it, is one of the greatest priorities of those affected during emergency phase. Therefore, safe storage of larger stocks of commonly used medicines, vaccines and equipment should be available within a short radius of treatment rooms or at least within the building.

C.4 Protecting health care areas

The health care facility and all additional areas within the facility may need to be protected. These include medical and pharmaceutical supply storage areas and emergency care areas with non-ambulatory patients.14

C.5 Transition of facilities

Especially during the alarm phase the health facilities will have to transit into a new place and function within the building program. The transition from some small treatment rooms into a larger
D. Communication facilities

The importance of communication in general, during the alarming phase and the possible disappearance of it especially in the post disaster phase could be essential in alarming and both informing community members and should not be underestimated. Solid networks and communication structures and management, both local and national, are essential to develop slums in the first place but have huge impact in especially alarm and emergency phase. The impact of the communication facilities will be discussed in the following section about the alarming phase. A clear communication plan within the community and the building program should lead to clear and simple messages that will be able to reach the entire community and, more important in this phase, gives opportunities for slum residents to get in contact with each other and the rest of the world. This creates changes and opportunities to develop knowledge and education level of the residents as well as access to news and other media that strongly influence the world of today.

D.1 Recognize Communication Networks

It is extremely important that community dwellers know the different communication networks that are being used. Show communication networks within the design by merging digital world into the community centre. Public information efforts (e.g., posters, signage, meetings, flyer distribution) in combination with educational facilities should be deployed to ensure that the

relief aid emergency post will take place partially short before, during and right after disaster has struck. The scale of this transition depends on the public health impact and the type of disaster.

C.6 Prepare for intense use

In the emergency phase the function of health care is on its peak. The intense use of this facility depends of course on the type of disaster. In the diagram you can find the impact of several selected disasters. Note that even for specific types of disaster, the patterns of morbidity and mortality vary significantly from context to context. Since the shelter will function as a safe-house during floods and typhoons (high winds) it is clear that the effect on injuries is moderate in those cases which makes it easier to transit because of less demand on health care capacities. In case of earthquakes it is shown that many deaths and injuries could be expected which makes the centre more important in the field of health care. In this case the influx of people in the shelter will be much smaller since it is not possible to predict these disaster and warn people, this makes it much easier to transit and upscale the health care facilities within the building and its surroundings. Make sure the design is able to handle the different impacts of different disasters that are possible and at least make sure handles to expand the design easily in worst case scenarios are available.
residents of the neighbourhood served by the community centre know the different communication networks that are available.

D.4  Communication (visual)
It is extremely important that shelter users know the visual warning signals both visual and lights. These visual and light signals are strongly related to alarming and emergency phase and will be further set out in the relevant sections.

D.5  Communication (digital)
Novel communication methods like access to Wi-Fi networks and other digital communication networks within the slums can be of great impact on the slum residents. Access to local, national and worldwide networks is extremely important to further develop residential areas in these days. Many slum residents have access to communication equipment but easy access to these networks will improve their use of it and offers new opportunities within the community. Besides the new opportunities it will be much easier to find out weather forecasts and start subsequent preparations for incoming disasters.

D.5  Supporting facilities
Make sure that supporting facilities are available to guarantee access to communication facilities. Electricity point for mobile cell-phones or tablets and safe storage (lockers) should be available separate and in combination with each other.

E. Other facilities
E.1  Waste collection
Make sure that supporting facilities are available to guarantee proper waste collection within the building program as well as in the surroundings of the building. Waste depots, dustbins and R.C. containers should be available and should be part of the program. Fixed location and proper waste management will increase the success of waste collection facilities.

E.2  Sewerage
Make sure sewerage can handle the water supplied p/day within the community center and is easily accessible for maintenance. Try to minimize length of sewery lines and number of sewer connections. Propose minimal number of community septic tanks and minimal connection to sewerage is preferred due to discharging during and after disasters.

E.3  Environmental integrity
The environment must be protected from the potentially negative impacts of sanitation systems included in the community center.
If you have a major disaster involving hundreds of thousands, or in this case millions of people, whether it be a natural disaster or an act of terrorism, the first 72 hours are going to be totally chaotic no matter what you plan to do.

- Warren Rudman

Alarming can be designed in a large variety of configurations and manners in the context of communication. There are many ways of expressing and one of the main questions for this phase should be: what are the intentions of alarming in an urban slum area? How is communication about disasters done on the specific location right now and how can these messages kept as simple as possible within the domain of architectural design? Building related elements alone cannot handle these issues; the combination with an effective public awareness programme, proper emergency preparedness and response activity can contribute a great deal in reducing disaster-related losses. The response to a natural disaster warning must be immediate, comprehensive, and demonstrate very clear lines of command. There must also be a mechanism in place to quickly transit multiple spaces and adapt building features into ‘disaster-mode’. The mixture of education in pre-disaster phase can really make the difference in this case since community awareness needs time to be developed which should be done in a pre-disaster phase.

Proper disaster risk communication is the primary issue in these circumstances and the building should be fully supportive in providing the correct and required architectural elements. Communication in the alarming phase should be viewed as a continuous process, where the contents of the message should be continuously reviewed and improved. This is the main reason why proper management should be available when the building starts to transit in this phase. This is only possible when all these different programs, active in different phases, are combined in one single community building. When developing the building, it is important that the seriousness of the risk can be perceived accurately and that information is clear and matching the appropriate level of urgency. Keeping the messages as simple as possible, both in design and communication in text or words are the basic principles for the design of a transitional community centre in the alarming phase.

Program of requirements

Since the alarming program is the harbinger of the sheltering phase they are proposed to be active in the same ‘during-disaster’ phase. The program of the alarming phase will be the start of re-forming the community-building program into functions that clearly supports sheltering people. In this situation of a transitional community centre in a slum environment it is assumed that communication mainly occurs using light and sound signals to alarm the population. Despite the many

Residents ride on a makeshift raft during a heavy downpour along a flooded street in Malabon, Metro Manila. Typhoon Saola (Genex) pounded the Philippine territory for days, followed by heavy monsoon rains. The lack of proper alarming within the slums of Manila cause many unnecessary casualties annually.16

16 blackhelios.wordpress.com/2012/08/06
17 Guidelines for Reducing Flood Losses - unisdr
other varied possibilities concerning the way of communication there has been chosen for this situation because these are probably the two main essentials in disaster communication in the world. Next to the cross-disciplinary way of communicating by sound and lights there is of course the changing appearance of the building that can be of great value in this phase. Clear management structures are therefore of great influence since closing facades and securing the building for disasters to come will be mainly done by human interference. Since this cannot be transformed into programmatic features the program of requirements of the alarming phase exists only out of:

- Emergency centre (20 m²)
- Administrative Office (10 m²)
- Technical space (20 m²)
- Multipurpose Rooms (10x) (40 m²)

Figure 5.14: Program activity within the building during the alarming (adaptable) phase.
Assessment and intervention process

The program of the alarming phase will be the start of transforming the program into other functionalities. This forces to focus on accessibility, flexibility and organisation; which have been partly treated in the context of education. The overlap of these architectural elements strengthens the idea of transition and will increase the adaptability of the design. As stated earlier, aesthetics and signage will be of great importance to inform the community as well. Using visual detailing and functional design will increase the simplicity of communication about future disasters and the changing function of a community centre. Mobile communications networks and security measurements need attention as well since these have to continue in every case. Despite the varied and many possibilities concerning the way of communicating, the characteristics of the design of the alarming intervention generally follow a three-step assessment and intervention logic of organisation, aesthetics and safety. Organisation of the building should focus on accessibility, adaptability and internal organisation. Aesthetics has everything to do with low-tech architectural ways of communication and signage and safety mainly focuses on networks and overcrowding.

Figure 5.15: Spot plan of the program in the alarming phase
A. Accessibility, Adaptability and Organization

The importance of accessibility to the changing program should not be underestimated since change will increase indistinctness and chaos. Clear access and flexible and adaptable spaces will increase the success of transition within a building program. Together with a clear community awareness program and internal organisation of the building program this should lead to clear and simple messages that will be able to reach the community.

A.1 Distance, Travel Time and access

The time required for all occupants of a building or facility to reach the shelter should be considered within the design. Predicting specific disasters in advance allow shelter users time to seek shelter. Community shelters should be designed and located in such a way that all potential users of the shelter are able to reach it within 5 minutes (250 meters), and the shelter should be able to be sealed of within 15 minutes. For each disaster the restrictions are different. Earthquakes are unpredictable so time is less important; the building has to resist the earthquake. In case of floods and typhoons the warning can be issued much earlier, allowing more time for preparation.\(^\text{18}\)

A.2 Off-hours Shelter Expectations

It is important to clearly indicate to the community centre/shelter users when the shelter will be open. For example, will the shelter be accessible after the regular school day? Is the shelter open for friends and family of the community residents? These types of questions should be anticipated in the design and operation of a community centre/shelter.

A.3 Design clear authority spaces

Emergency response must include input from the community but cannot become a collective responsibility. There must be clear lines of authority and special staff areas to be able to require clear and accessible coordination. Therefore emergency offices should be centralized in the program.

A.4 Setting Coordination office

Emergency planning and preparedness requires collaboration and coordination. Strong and reliable communication linkages to storm warning and forecast centres are essential. The network of linkages from the local level upward must be established in advance and key players must periodically meet to exchange information. This requires central (office) spaces were shelter occupants could be provided with information during a disaster event.

\(^\text{18}\) Risk management for Safe Rooms, FEMA 453, May 2006, p83  
\(^\text{19}\) Sphere Project Handbook, pg 67
A.5 Set-up Emergency Office (Relief-Aid)
At the same time that efforts to seal off the transitional community centre are undertaken, basic or more elaborate adaption of multiple functions like setting up emergency, registration and first-aid posts should also be started. As future residents are coming in, special attention should be paid to the safety within the transitional community centre. Clarify by design where registration could take place as well as how and where to start placing evacuees and where and how to expand to within the structure. In this way setting up the emergency information post, the first-aid post and the expansion of shelter places will not mix up.

A.6 Set-up Emergency Office (War-room)
Rooms for coordination must be included in the design, including the structure of response committees, where they will meet and information is available. Often this takes the form of something equivalent to a “war room” where maps, plans, other material are available immediately. Multifunctional storage solutions are essential.

A.7 Storage of emergency resources
Key component of any emergency prepared building is storage of resources that should be accessed in post-disaster phase. This could include items such as emergency tents, general items, reconstruction equipment, pumps, plastic sheets, plywood, emergency generators, sandbags, and mobile communications equipment. The storage could also include gear for experts in search & rescue, construction, forecasting, and community leaders. Storage should be dry, highly accessible and equipped by loading dock.

A.8 Disabilities and special needs
Travel time is especially important when shelter users have disabilities that impair their mobility. Those with special needs may require assistance to reach the shelter; appropriate access for persons with disabilities must be provided. Consider these factors in order to provide the shortest possible access time and most accessible route for all potential shelter occupants.

Figure 5.17: Research by design: develop warning signage within the facade that is well known by its community center users.
A.8 Storage of emergency goods
Emergency shelters should be designed for storing sufficient capacity and supplies of water, food, and medicines to keep the shelter habitable for several days for the intended number of people. Storage should be dry, highly accessible and equipped by loading dock.

A.10 Prepare sanitation facilities
There should be sufficient toilets, washbasins and bath or shower facilities for the number of affected persons in the centre. These facilities must be segregated, include at least one universally accessible toilet and shower, and be located an appropriate distance from food preparation, eating and sleeping areas.

A.10 Avoid obstructions in access route
Access is an important element of shelter design. If obstructions exist along the travel route, or if the shelter is cluttered with non-essential equipment and storage items, access to the shelter will be impeded. It is essential that the path remain unencumbered to allow orderly access to the shelter.

B. Aesthetics and Visual Signage
The importance of aesthetics and the possible changing of it within the different phases could be essential in alarming community members and should not be underestimated. Clear architectural design in each phase and flexible building parts, both external and internal, will increase the success of transition within a building program. Together with a clear signage within the community and the building program this should lead to clear and simple messages that will be able to reach the entire community.

B.1 Access and Entry
Instruct occupants to proceed to a shelter on foot if time permits. Main pathways should be determined and laid out. Pathways should be marked to direct users to the shelter. Finally, the exterior of the shelter should have a sign that clearly identifies the building as a shelter.

B.2 Warning Signage (Facade)
Signage is critical for users to be able to readily find and enter the shelter. In addition to directing users to the shelter, changing facades can also identify the different phases the shelter is intended to serve. Using different colours, (moveable) screens, changing facades or any other specific element in any phase will increase clarity although education is needed.

B.3 Warning Signage (Interior)
Signs must be displayed at the centre to indicate key services (such as registration) and locations (such as toilets). Directional arrows may also be used to direct centre users where appropriate. Clear signage that defines evacuation routes, registration area, sanitation, eating/sleeping areas, children areas and the specific shelter/emergency spaces is needed. Also specify actions to be taken before leaving or entering the room, such as closing education storage or storing personal goods and furniture, must be available in advance.

20 Internal and external measures of Philippine slum dwellers’ social capital and their relevance, Petr Matous, p2
21 FEMA 361, Design and Construction Guidance for Community Shelters
C. Communication Networks and Safety

The importance of communication networks and safety and security should not be underestimated since lack of communication channels will increase indistinctness and chaos. Special consideration should be given to language and cultural barriers to increase the effectiveness of the system. These predictions have to be applicable to people having varying economic status and reflect gender differences. Especially in high-density slum location it is important to reach groups both with and without ‘social capital’, so that all elements of society can understand what response actions should be taken.\(^2\)

C.1 Shelter safety and operations plan

It is extremely important that shelter users know the warning signal that means they should go to the community shelter. Public information efforts (e.g., mass mailings, meetings, flyer distribution) should be conducted to ensure that the residents of the neighbourhood served by the shelter know the meaning of any warning signals to be used.\(^2\) It is important to have personnel assigned to various tasks and responsibilities for emergency situations before they occur. Different coordinators should be in place to implement all the responsibilities. Before the alarming phase the coordinator’s responsibilities include the following:

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B.4 Warning Signage (Maps & Placards)

Determine what signage and maps are needed to help intended shelter occupants get to the shelter safest manner possible. Ensure that signage is obvious, illuminated and luminescent after dark and that all lighting will operate if a power outage occurs.

B.5 Warning Signage (restrictions)

Provide signage that clearly identifies all restrictions that apply to those seeking refuge in the shelter (e.g., no pets, limits on personal belongings). The policies in a community shelter should be clearly stated and posted to avoid misunderstandings and hostility.

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Figure 5.18: Research by design: introduce different opportunities to introduce warning signals: from maps & placards, to interior and facade and other visual and digital opportunities.
• Conducting training programs that include the following:
  – various warning signals used, what they mean, and what responses are required
  – what to do in an emergency (e.g., where to report)
  – identification, location, use of common emergency equipment (fire extinguishers)
  – shutdown and startup procedures
  – evacuation and sheltering procedures (e.g., routes, locations of safe areas)
• conducting drills and exercises (at a minimum, twice annually) to evaluate the Shelter Operations Plan and to test the capability of the emergency procedures
• ensuring that employees with special needs have been consulted about their specific limitations and then determining how best to provide them with assistance during an emergency
• conducting an evaluation after a drill, exercise, or actual occurrence of an emergency situation, in order to determine the adequacy and effectiveness of the Shelter Operations Plan and the appropriateness of the response by the site emergency personnel

During the alarming phase the coordinator’s responsibilities include the following:
• opening the shelter for occupancy
• controlling the movement of people and vehicles at the site and maintaining access for emergency vehicles and personnel
• “locking down” the shelter
• assisting with the care and handling of injured persons

• preventing unauthorized entry into hazardous or secured areas
• informing employees in their assigned areas when to shut down work or equipment and evacuate the area
• accounting for all employees in their assigned areas
• turning off all equipment

Figure 5.19: Make sure the shelter and operations plan will fully use the adaptability of the design.
C.2 Connection to Emergency systems
Many countries have systems in place where a provincial/state wide or national disaster can be declared to bring in the resources needed. The keys to effective emergency response are advance planning, ability to mobilize sufficient resources quickly, and periodic exercises to identify weaknesses and problems.

C.3 Warning Signals (sound)
It is extremely important that shelter users know the sound warning signal that means they should head to the shelter. The sound should be recognizable and sufficiently audible within the surroundings of the community centre. The sound signal should be tested periodically to ensure that all persons know when to seek refuge in the shelter.

C.4 Warning Signals (lights)
It is extremely important that shelter users know the light warning signal that means they should head to the shelter. The lights should be recognizable and sufficiently visible within the surroundings of the community centre. The light signals should be tested periodically to ensure that all persons know when to seek refuge in the shelter.

C.5 Warning Signals (radio)
Novel communication methods including wind-up radios and translation of forecast to the level to slum dwellers have helped informing residents of slums to reduce the impact of disasters.

C.6 Warning Signals (internet)
Using new communication technologies including Wireless, Internet, mobile networks and social media (data display and using the internet) and make them accessible to slum dwellers will help residents of slums to reduce the impact of disasters and increase their communication possibilities at the same time.

C.7 Operation and maintenance
Ensure there is enough room for operating and maintaining all shelter equipment (communications, lighting, Wi-Fi networks and safety equipment) during and after disaster strikes.

C.8 Shelter entrance and queuing
Ensure there is enough space for the entrance of larger groups and queue facilities to ensure orderly entering of shelter occupants. Entering the building should be safe to reduce the risk of panic and disturbances.
All architecture is shelter, all great architecture is the design of space that contains, cuddles, exalts, or stimulates the persons in that space.

- Philip Johnson

Sheltering can be designed in a large variety of configurations and manners in the context different disasters with different effects on the environment, people and duration in time. There are many different codes and guidelines, which have different interpretations and minimum requirements because of the variety of disasters in the first place as well as variety in duration of staying in an emergency shelter.

One of the main questions for this phase should be: what are the intentions of sheltering in the context of floods and typhoons that strike an urban slum area? How long is the shelter user intended to stay and is it safe to leave the shelter when the slum area is still plagued by floods? Of course all building related elements should be able to withstand the proposed disasters like floods, typhoons and earthquakes. Although sheltering people will only be applicable in case of floods and typhoons since earthquakes are unpredictable and therefore impossible to warn people to shelter. In case of earthquakes the building should be able to withstand and become the centre of emergency aid, health care. Storage of tents can help to set-up a camp near the centre to shelter homeless people or those who are afraid of aftershocks. More on these requirements can be found in the next section about phase 5: relief aid.

The transitional community shelter will be used for predictable disasters like typhoons and floods. Especially in the case of typhoons it is important for residents to leave the streets and poorly constructed houses to avoid casualties. Since the building will be transitioned during the alarming phase it is important to take measures in the design, which make it easy to transit into shelter mode and create comfortable communal shelter places to stay during typhoons and, in many cases, related floods. Depending on the disaster, duration of stay will be of great influence on the well being of shelter residents. Proper sanitation, seating and beds should be available and accessible during typhoons and floods in safe and dry storage facilities to accommodate the influx of people in a proper and safe way.

Program of requirements

The shelter phase is of course, in combination with the emergency phase, one of the core tasks of the building. In combination with the previous alarming phase they form the core functions that are active in the same ‘during-disaster’ phase. The program of the sheltering phase will be the start of uncertain times for both people who found refuge as well as for the management in charge. Therefore a strong and reliable building in the background is very desirable. Massive ‘strong’ walls and use of several
smaller spaces is preferred over large open spaces with light structures. Weather forecast is of course well known and interaction and communication with other transitional centres and national emergency centres should be updated in high frequency to predict near future circumstances, which gives the opportunity to respond in time. Storage of communication equipment and management offices should be easily accessible but proper locked and highly secured as well in order to avoid chaos by refugees entering these areas. Sheltering people in a transitional building will of course be of great influence on the existing interior and requires different and more intense use of the building than during normal conditions. The required features of shelter spaces are highly depending on duration and intensity of the disaster. Clear and defined spaces will strengthen the feeling of security and proper storage for education materials during emergency can store shelter equipment (like pillows and folding

Figure 5.20: Program activity within the building during the sheltering phase.
5.4 SHELTERING | during-disaster

**Entire Building!**
- **150 m²**
  - 20 public lavatories (10 male & 10 female)
  - Public laundry area (10 places)
  - Water taps (20 pcs)
  - 10 public showers

- **500 m²**
  - Clear marketplace
  - Make accessible

- **50 m²**
  - 2 treatment rooms (10 m²)
  - Office (15 m²)

- **50 m²**
  - Offices
  - Set-up relief aid
  - Contact NGO's
  - Update about situation

- **10 m²**
  - Technical space
  - Wifi/phone network

**Wash**
- Accessible
- Evenly use
- 150 m²
- 20 public lavatories (10 male & 10 female)
- Public laundry area (10 places)
- Water taps (20 pcs)
- 10 public showers

**Health**
- Intense use
- Peak
- 50 m²
- 2 treatment rooms (10 m²)
- Office (15 m²)

**Emergency Office**
- Intense use
- 50 m²
- Offices
- Set-up relief aid
- Contact NGO’s
- Update about situation

**Communication**
- Intense use
- Seasonal
- Entire Building!
- Viable for larger groups
- Set-up dispensary facilities
- Mapping attendees
- Open up storage

**Connection with the surroundings**
- Highly accessible

**Assessment and intervention process**

The program of the sheltering phase will be the start of both and more intense or at least different use of the educational and facilitation program. This forces to focus on the firmness and lustiness of the materialization and functionality of chairs during education phase. Make sure enough seating is available and take in account the required possibility of putting up extra emergency beds. Registration of residents within the shelter during disaster will be of great value afterwards when counting of the victims starts and people start looking for each other.

Next to the cross-disciplinary way of transition by replacing education and shelter equipment there is of course the changing appearance of the building itself, which can influence the appearance of the shelter. These transitional programmatic features are often particularly design interventions on interior level, which ensures a relatively short program of requirements for the sheltering phase:

- Emergency Aid Centre (20 m²)
- Reporting Centre (10 m²)
- Technical space (20 m²)
- Multipurpose Rooms (10x) (40 m²)
- Sanitation facilities (see section 5.3)

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**Figure 5.21:** Spot plan of the program in the sheltering phase
in routing, accessibility, flexibility and organisation. These factors have partly been treated in the context of education but some additional requirements will be stated. The overlap of these architectural elements strengthens the idea of transition and will increase the adaptability of the design. Creating adequate shelter solutions in the function of a so-called 'safehouse', within the structure of the existing transitional community structure is probably the most challenging aspect of achieving both minimum standards for shelter and staying within the concept of a transitional community centre. Especially the requirements concerning building and design codes to create a structure that will be able to withstand disasters is one of the main tasks that should be implemented in the building and will be intensely used during the shelter phase. Despite the varied and many possibilities concerning the characteristics of the design of the transitional community centres, the shelter intervention, in principle, follows a four-step assessment and intervention logic concerning structure, accessibility and internal routing, occupancy requirements within the safe-house and security and safety. Since design requirements for proper building structures are intensely treated in the first chapter the step concerning structure will be referring to this chapter.

A. Structure

Structure within the concept of the transitional community centre is, of course, of great importance. The changing program should not influence construction and structure in a negative way as well as the other way around. The balance of those could be found in the transition of the phases and final materialization and flexible interior and exterior objects. Clear access, routing and structure in combination with flexible and adaptable spaces will increase the success of transition within a building program.

A.1 Safety standards

Transitional Community Centres must meet structural safety standards. Transitional Community Centres must not only meet requirements for stability in ordinary situations, but also in emergencies such as earthquakes, typhoons, floods or other extreme situations. More on building requirements and structural design guidelines can be found in previous chapter.

A.2 Materialisation

Facade and roofs should be strong enough to resist the impact of heavy windborne debris and high winds as well as strong and heavy monsoons. Roofs and facades should be properly fastened and materials should be waterproof during heavy downpours. More on materialisation requirements can be found in the first section of this chapter.

24 Collective shelter guidelines, p 90
B. Accessibility and Internal Routing

Proper access to the shelter itself and especially to the different shelter rooms should be guaranteed during alarming and sheltering phase. The transition from one function to another could turn into obstructions and incomplete shelter interior and equipment. Clear access, routing and spaces will increase the success of access and routing within a building program.

B.1 Routing and accessibility

Travel time to the shelter must be minimized to and within the building. Shortcuts within the internal routing of the building are essential to navigate through larger groups of people and to make sure it is easy to reach everyone by short routes instead of having to go through larger spaces with large groups. This will increase the chance of refugees losing each other in the shelter. Widening and paving of community roads to the shelter will help to facilitate easier ways of entering the shelter with larger groups. Wider internal routing of the building will cause refugees to stay in hallways, which are being used for transportation within the building. A combination of small internal routes where standing is prohibited and larger hallways will prevent routing being used as whereabouts.

B.2 Clearly identify routes and spaces

Shelters and the routes to them must be clearly identified by signs, both extern as intern within the shelter. Clearly identify shelter residence where people can hang out and where it is prohibited to stop or congregate.

B.3 Free of obstructions

Walkways, hallways and other routes to the shelter must be free of obstructions so entering of larger groups is not being hindered.
C. Occupancy requirements

First priority of the transitional community centre after disaster has began, is completion of ‘sealing off’ the building, which includes protecting individuals from the natural elements as mentioned before. This means proper and working window shutters and other adaptable and flexible facades and shutters are critical as they allow the community centre user to withstand all climate conditions. While residents occupy the building to shelter for disasters it is essential to fulfill some essential occupancy requirements for shelter accommodations. In colder areas arrangements for the proper winterization of transitional community centres packed with refugees are critical, while in warmer areas natural ventilation in shelters with high influx of people will be more essential. In both cases, there should be adequate insulation with respect to available local materials and regional practice. Next to requirements according to climate, also discussed in the first section in this chapter, it is essential to design with a minimum square footage per refugee to safely shelter people without having security problems by the influx of too many people in the shelter. During and after the sheltering phase it is also important to have enough storage for all the required equipment and supplies that are needed within these phases.

C.1. Square footage requirements.

Occupancy recommendations for transitional flood and typhoon shelter design are hard to determine since they all differ by the sort of natural disaster and duration of stay of the refugees. The shelter designer should be aware of the occupancy requirements of the building code governing the construction of the shelter. Most building codes will require the maximum occupancy of the shelter area to be clearly posted. Multi-use occupancy classifications are sometimes provided in state and local building codes. Conflicts may arise between the code-specified occupancy classifications for normal use and the occupancy needed for sheltering. For example, if the occupancy classification for educational use is 20 ft² per person; and the recommendation for a shelter is 5 ft² per person. Without proper signage and posted occupancy requirements, using an area in a school as a shelter can create a potential conflict regarding the allowed numbers of persons in the shelter. In these guidelines for transitional centers we assume that the minimum recommendation is 0.5 m² per standing person for emergency shelter with a duration of less than 24-hours and 1 m² per standing person for events between 24-hours and 48-hours. However, other circumstances and human factors may require the shelter to

Figure 5.23: Research by design: integrate various design intervention with each other!
accommodate persons who require more space. Square meter recommendations for persons with special needs are presented different:

- 0.5 m² per person adults standing
- 0.6 m² per person adults seated
- 0.5 m² per person children (both seated/standing & under the age of 10)
- 1.0 m² per person wheelchair users
- 2.8 m² per person bedridden persons

An American Red Cross (no. 4496) publication recommends the following minimum floor areas based on long-term use of the community shelter, i.e., use of the shelter both as a refuge area during the event and as a recovery center after the event:

- 1.8 m² per person for a short-term stay (i.e., a few days)
- 3.6 m² per person for a long-term stay (i.e., days to weeks)

For the design of a transitional community shelter it is assumed to be able to offer a shelter where people can seat and stay for duration of 48-hours which means there should be 1.2 m² per adult. After those 48-hours it is assumed that typhoons passed by and only floods remain. Since the building is always connected to an elevated market square there should be enough dry places to offer short-term stay in tents that are stored within the center. If floods tend to increase then evacuation must be undertaken to save people. For both educational and shelter uses it is required to have 0.06 meter of egress per person for buildings not equipped with a sprinkler system. For normal [educational] use, this calculates to a minimum of two doors. For shelter use, the requirement is a minimum of three doors. Therefore, three doors of 0.9 meter should be provided.  

C.2 Occupancy duration

As stated before, the duration of occupancy of a shelter will vary depending on the intended event for which the shelter has been designed. Occupancy duration is an important factor that influences many aspects of the design process. Shelters designed to the criteria in this manual are designed to provide protection from high wind events, wind born debris impact, earthquakes and floods. The intent is to save lives during an actual typhoon or flood. In the interest of developing cost-effective designs able to be built in low-income areas as urban slums, some items that would have increased occupant comfort were not included in the recommended design criteria. However, examples of items that might help to make shelters more comfortable and functional during an event, and during post disaster recovery efforts, are discussed in guideline C4.

25 Construction guidance for Community Shelters, p117-119
26 Construction guidance for Community Shelters, p122
C.3 Ventilation and lighting

Ventilation should be provided to the shelter area through either the floor or the ceiling. Although horizontal ventilation openings may be easier to design and construct, vertical ventilation openings have a smaller probability of being penetrated by a missile. Nevertheless, a protective shroud or cowl that meets the missile impact requirements should be provided to protect any ventilation openings in the shelter that are exposed to possible missile impacts. The ventilation system for both single- and multi-use shelters must be capable of providing the minimum number of air changes required by the building code for the shelter's occupancy classification. For multi-use shelters, the design of mechanical ventilation systems is recommended to accommodate the air exchange requirements for the occupancy classification of the normal use of the shelter area. Although the ventilation system may be overwhelmed in a rare event when the area is used as a shelter, air exchange will still take place. Passive means of ventilation may be used as long as the building code requirements for normal use are met. Ventilation may be accomplished with passive air systems using ducts that open to an outside air supply. For example, the 1997 Uniform Building Code (UBC) provisions for natural ventilation require exterior openings with a minimum area of 1/20 of the total floor area. When complying with code requirements for openings, the designer needs to protect the openings to prevent windborne debris from entering the shelter. For the regular use of multi-use shelters, lighting, including emergency lighting for assembly occupancies, is required and especially emergency lighting is recommended for community shelters. A backup power source for lighting is essential during a disaster because the main power source is often disrupted. A battery-powered system is recommended as the backup source because it can be located and fully protected within the shelter. Flashlights stored in cabinets are useful as secondary lighting provisions but should not be used as the primary backup lighting system. A reliable lighting system will help calm shelter occupants during a disaster. Natural lighting provided by windows and doors is often a local design requirement but is not required since no glazing system proposed to provide natural lighting for shelters meets the missile impact requirements.

Figure 5.24: Roserarch by design; integrate shapes, sheltering opportunities and improvements concerning disaster prevention with eachother to fully integrated all the design principles.
C.4 Equipment & emergency supplies
Shelters designed and constructed to the criteria in this manual are intended to provide safe refuge from extreme wind events like typhoons and heavy monsoons resulting in floods as well as a safe refuge to stay after earthquakes. The design of such a transitional shelter serves a different function from shelters designed for use as specific long or short-term recovery shelters. However, shelter managers may elect to provide supplies that increase the comfort level within these transitional shelters. Shelter should be equipped with emergency supplies, including flashlights, fire extinguishers, first-aid kits, radios (including weather radios and extra batteries) and a signaling device (such as an air horn). Special equipment regarding the provision of uninterruptable power supplies could be restricted for healthcare facilities, emergency lighting and communication systems. Guideline B.4 of the next sections shows a more accurate list of suggested equipment and supplies for transitional community shelters to increase the comfort level during shelter phase and relief aid phase. It is assumed that food and water storage should be provided in all situations since, as noted before, the duration of occupancy in a transitional community shelter could be as long as 48 hours. Food and water will be required, and storage areas for them will need to be included in the design of the shelter.

D. Safety and Security
The security and safety of the transitional community centre users during the sheltering phase should be considered first priority.

D.1 Maximum Safe Occupancy
Indetermining themaximumrecommended number of people who will use the shelter, the design professional should assume that the shelter will be used at the time of day when the maximum number of residents are present. The maximum recommended occupancy should be posted within the shelter area.

D.2 Head count during shelter
It is advisable to re-count the refugees within the shelter during disaster to give feedback information for the relief aid phase and prepare opening of storage if required space is available. Safety is enforced since lost and found within the shelter could be prevented by posting this information within each part of the shelter.

D.3 Security during shelter
Make sure every shelter space is controlled by one of the staff members of the emergency team to respond directly in the event of chaos or panic within parts of the building. Spreading chaos through the building could be managed by closing of different spaces or routings.
“Any assistance provided in disasters can only be useful if it is based on correct views or assumptions of what actually occurs. If the assumption is wrong, the assistance may well be misdirected, unnecessary, inappropriate, or simply duplicate what is already available.”

- E.M. Quarantelli

Volunteers prepare bags with relief goods for flood victims in Bulacan, north of Manila.31

Relief aid centres tend to have very specified and clear configurations according to several sources and handbooks related to the subject of emergency relief and the related management models. There are many different codes and guidelines, which have different interpretations and minimum requirements because of the variety of disasters in the first place as well as variety in destruction and damage level and the amount of casualties that are within the direct (or wide) surrounding area of the emergency centre.

The reason to start up the relief aid phase of a transitional community centre is to provide essential needs to persons affected by natural disasters and other urban emergencies. The relief aid phase of the centres considers the specific needs of children, youth, seniors and people with additional needs and cultural and linguistic diversity community members in the layout, design and services provided. Since the relief aid centers and its facilities are pre-identified they must meet current universal accessibility policies, cultural and access needs of the local community. It is important to realize that relief centers are established on a temporary basis to cope with the immediate needs of those affected during the initial response to the emergency and do not imply any longer-term use of shelter facilities since they should act as an urban center for relief aid. Of course the sanitation and WASH-facilities should be fully functioning to be sure that the community center is fully used for recovery services.

The set-up of emergency facilities during the alarming phase will require management protocols to decide who is responsible for what but especially during the relief aid phase many different organizations can be active within the field of emergency relief. Co-ordination (regional or state) can be in hand of state departments and municipal councils and should be connected to (the network of) transitional community centres/shelters to function properly. Emergency relief planning and functional management within emergency relief centres could be the responsibility of many different organizations as long as main responsibility and leadership functions are clear. Besides governmental organizations many different actors like relief aid organizations (NGO’s like the Red Cross), the (salvation) army and other volunteers are part of the complicated provision of relief aid during emergencies.

Program of requirements

The relief aid phase of course, in combination with the sheltering phase, one of the core tasks of the building during emergencies. The transition from the sheltering phase into the relief aid phase is probably one of the most complicated in terms of management and related building transitions. The program of the relief aid phase will be the start of unpredictable times for both people.
who found shelter in the centre and are being ‘expelled’ since the shelter phase is ended, as well as for the management in charge. Therefore a strong and reliable building in the background is very desirable. Opportunities for easy transition and proper evacuation of the building should have attention during the design phase. Several areas with strong demarcation that can be accessed one by one are preferred over large open spaces where large group can gather and panic can spread rapidly. Storage of communication equipment and especially of food and general items should be easily accessible after shelter phase but also properly locked and highly secured in order to avoid chaos by refugees within and outside the building structure. Next to the cross-disciplinary way of transition by ending shelter and start-up relief aid spaces and equipment there is of course the changing appearance of the building itself, which can influence the appearance of the shelter. From being an enclosed cocoon during shelter times the building changed in to a more open structure and suddenly fierce communicates with its environment. These transitional programmatic features are often particularly design interventions on program and facades level and highly depend on location and design features. Main task of the building, during relief aid, is the provision of essential needs to persons affected by, or involved in the management of an emergency (with a focus on the impact of natural disasters i.e. earthquakes, floods and typhoons). The primary functions of a transitional community centre during the relief aid phase are: meeting food and water needs, immediate needs (general item distribution), provision of sanitation and hygiene (WASH-facilities), provision of first emergency shelter (by tents), provision of accommodation for emergency relief centres and related registration offices. Other functions of emergency relief typically include first aid, primary care,

Figure 5.25: Program activity within the building during the relief-aid phase.
personal support, financial assistance and information provision. These functions require the following program of requirements:

- Emergency Office (50 m²)
- WASH facilities
  - 25 latrines (2500 people)
  - 10 showers (1000 people)
  - 8 water taps, 10 shower (2000 people)
  - Water storage (25,000 litres/25 m³)
  - Sewer system (50,000 litres/50 m³)
- Supply Emergency Goods
  - Loading Dock (20 m²)
  - Dry Storage (100 m²)
  - Queue areas (50 m²)
- NGO’s meeting spots
  - Offices (4x) (20 m²)
  - Meeting rooms (2x) (50 m²)
- Shelter facilities
  - Storage (50 m²)
  - Tents set-up (200 m²)
- Healthcare facilities
  - Treatment rooms (4x) (20 m²)
  - Storage (25 m²)
  - Office (20 m²)
  - Lockers (250 pcs) (25 m²)
  - Wi-Fi networks (10 m²)
- Optional facilities
  - Public Kitchen (50 m²)

Figure 5.26: Spot plan of the program in the relief aid phase
Assessment and intervention process

The program of the relief aid phase will be the start of an even more intense phase for the building and its users. The large groups of refugees that found shelter in the building will be evacuated and other relief aid related organizations and provisions of stocks etc. will be brought in to start the emergency relief. This forces to focus on the firmness and lustiness of the materialization and functionality in routing, accessibility, flexibility and organisation. These factors have partly been treated in the consent of education and sheltering but some additional requirements will be stated. The overlap of these architectural elements strengthens the idea of transition and will increase the adaptability of the design. Creating adequate solutions for mainly office and facility related functions; within the structure of the existing transitional community structure is a challenging aspect. Achieving a proper transition from actual providing shelter into ‘just’ providing minimal living conditions should be taken serious. People in emergency situation should be handled with care since emotions can be varied and intense. The sudden realization of surviving a natural disaster can cause euphoria since people survived but the switch to disbelief can cause extreme emotions as damage and loss becomes apparent. Therefore management provisions are part of the intervention process to set-up a proper relief-aid centre. Despite the varied and many possibilities concerning the characteristics of the design of the transitional community centres, the relief intervention, in principle, further follows the three-step assessment and intervention logic concerning primary and secondary needs. Since design requirements for proper building structures that can facilitate sanitation and other facilities are intensely treated in the facilitation section of this chapter the guidelines in this section will mainly cover emergency provisions, the related storage and other related design criteria.

A. Management provisions

The management for setting up an emergency facility after the sheltering phase will require management protocols to decide who is responsible for every part of the operation. Especially during the relief aid phase many different organizations can be active within the field of emergency relief. There is a wide range of actors involved in carrying out these efforts. Each of them has varying responsibilities throughout the phases of relief aid. The actors usually include: military, disaster relief units or agencies like the Red Cross, government ministries, reconstruction commissions, local authorities, international agencies, media, volunteers, professional/commercial sector and last but not least, the affected communities themselves. As stated before, co-ordination and
management within the centre (regional or state) can be in hand of state departments and municipal councils and should be connected to the network of other transitional community centres/shelters to function properly. Emergency relief planning and functional management within emergency relief centres could be the responsibility of many different organizations as long as main responsibility and leadership functions are clear.

A.1 Starting up Relief Aid centre
When disaster has occurred, determining if conditions allow shelter occupants to leave and return to their homes safely is first priority. In case of an intense earthquake a proper and fast inspection of the entire structure must be done to see if the structure is able to withstand aftershocks. Provide opportunities to monitor the situation outside after a typhoon has struck. Other design requirements to design proper facilities for coordination and monitor weather information could be find in the previous chapter on sheltering.

A.2 Monitoring of logistics
In managing the logistics of the relief aid centre it should be considered to monitor inter alia the cleaning and waste disposal, stock of material supplies and arranging replenishments as required, restricting parking so as not to inhibit site or vehicle access and the public security for crowd control. This will only be the beginning of thing to arrange after disaster is over, people are getting out of the shelter and relief aid phase is started. The design should intervene and provide enough proper office and meeting spaces for management provision. Security, overview and flexibility are essential in providing proper spaces for monitoring and management of logistics.

A.3 Public information centre
Besides setting up and managing search & rescue teams and other relief aid teams it is essential to inform the community and other general public by offering information points or walls to provide in information about lost and found, planned food and water issuance and other information. Make sure there are possibilities for crowd control and proper access for both community and staff. Preparing and distributing newsletters to area residents could be operated from the community centre as well since it is close to the affected people and therefore the information more accurate.

A.4 Coordination of first-aid teams
When various organizations enter the community to provide help it is essential to provide in enough spaces to shelter the search and rescue teams and other related person. Make sure the sheltering
phase can be transited into relief aid phase quickly by providing spaces with inside facilities like sinks and privacy screens and nearby sanitation.

A.5 Data collection for re-building
While assessment of damage, needs and resources need to be specific and prioritized for the task at hand, i.e. relief, often rehabilitation and reconstruction decisions are based on these early data. This is partly due to the cost and time it takes to collect data and to meet the public demand to act rapidly. Ideally, it is necessary to monitor the changing needs as the situation develops. Therefore, the drawbacks of early disaster assessment for the forthcoming process of rehabilitation and reconstruction, the initial data collection should be maximized and taken into account when planning the program of a community relief aid center.52

A.6 Sanitation Management
Sanitation management and the proper functioning of the facilitation within the center is high priority. The toilets will need to function without power, water supply, and possibly waste disposal for several hours. Although some sanitation facilities may be damaged during a disaster, siting of a shelter above a pump station (if required at a shelter site) and required use access thus safe access to the sanitation facilities would allow the system to have a relative high capacity after the event.

Figure 5.28: Research by design: search for a self-sufficient building that is able to achieve fully functional spaces for relief aid by using low-tech, and thus energy efficient measurements.
A.6 Safety and security issues
Population density in urban areas heightens the need for security and crowd management at sites where water, food and other general items are distributed. Wet feeding programs may be justified where beneficiaries face the risk of attack while transporting a dry ration home from the distribution site. However, to avoid overcrowding and minimize risks to beneficiaries of having to walk far away from home, urban wet feeding programs usually require a large number of small feeding sites which makes them more vulnerable to crime and looting. The risk of harassment of beneficiaries may grow if the food distribution or food prices become highly politicized, such as where the low-income urban population is disproportionately represented both in the food assistance beneficiary population and in the political opposition. Social sanctions to control crime may be increased by ensuring community ownership and participation in the program. Finally, as in rural settings, urban food distribution programs pose the risk of sexual exploitation of beneficiaries by people with the ability to influence beneficiaries’ access to the ration.33

B. Primary provisions
Affected people attending an emergency relief center have often left their homes in haste with minimal possessions or without aids and medical equipment. They may be extremely emotionally distressed, hungry or thirsty and concerned for loved ones, pets and personal possessions. They are likely to expect a community center/shelter with a range of immediate emergency relief needs. Although emergency relief is a distinctive stage of post-disaster activities, many of the actions and decisions of this period can influence later stages. Extended external relief assistance can undermine local and national coping capacity and create dependency. For example, food aid following a typhoon in the Philippines might meet short-term food needs, but if the traditional coping mechanisms are underestimated and under used the communities’ ability to feed itself may be damaged. Any relief assistance, therefore, should balance relieving of immediate pressure on the communities with support for local coping for rapid recovery.34

B.1 Primary emergency needs
The primary emergency needs for residents of the community and the people who found shelter within the building are in need of some basic emergency needs like water, food, safety

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32 Rehabilitation and Reconstruction, Disaster Management training programme, Unicef, p32
34 fema.gov/disaster-process-disaster-aid-programs
(for both people and property), shelter (to rest/sleep), clothing and physical well-being. Applying earlier stated amenities like enough dry storage and accessibility of the community centre location during the design process could ensure this. Emergency needs concerning water points, shelter and safety are already established and treated within the facilitation section. Proper issuance will be achieved by applying the following guidelines within the design.

B.2 Serving area & issuing point
Proper issue of these emergency needs is necessary to avoid chaos. Design serving areas and issuing point within or nearby the community centre to accommodate large crowds and be able to queue the people in a safe and orderly way. The space available for queuing will strongly effect and impact the serving capacity and methodology; therefore the design must be provided with opportunities for proper coordination within the queue area. Make sure these areas are able to connect or are situated nearby secured and dry storage spaces.

B.3 Loading docks
Loading docks are the arrival and departure point for large shipments brought to or taken from the community building by trucks and vans. Loading docks are utilitarian spaces that should be designed for function and durability. However, it is also important that they are designed to ensure the safety and security of their users and the users of other nearby spaces. This space type must be able to accommodate large vehicles, forklifts, and pedestrian traffic. Also ensure that adequate space has been provided for all service providers to perform their function. The loading dock must be coordinated with storage requirements.34

B.4 Storage facilities
Continuity of the relief aid support of various relief aid and humanitarian organization can be obtained by enough and proper, dry, safe and accessible storage. Following items are suggested equipment to provide in the storage compartments of the community center (in pre-disaster phase, quantities to vary with site/anticipated capacity of emergency relief center and number of staff required to resource the relief center). Items may be added and deleted from the list as required to suit the needs of each emergency relief center, and the circumstances under which it has opened.35

Figure 5.29: Reserch by design: search for a safe relief aid building with accessible facilities, proper storage and spaces with lots of daylight.
Health and hygiene
- Disinfectant
- Disposable gloves
- First aid kits
- Fire blankets
- Hand wash
- Insect repellent
- Large black bin liners

General items
- Matches
- Paper towels
- Kerosene cookers
- Cooking utensils
- Plastic cups, plates and cutlery
- Rope
- Sunscreen
- Tea towels
- Tissues
- Toilet paper
- Water bottles
- Washing powder
- Wet wipes
- Boots
- Satellite telephones

Food Supplies
All basic staple food items with long expiry are applicable for storage in pre-disaster phase. These are for example tea bags, instant coffee, UHT milk, muesli bars and other high energy biscuits, milk powder, baby food, rice etc.\textsuperscript{34}

Shelter
- Generators and electrical equipment for energy supply
- Tents
- Flashlights (one per 10 shelter occupants)
- Fire extinguishers (number required based on occupancy type and surface mounted inside the shelter)
- Water filters
- Batteries
- Field hospitals beds
- Mattresses
- Sleeping bags
- Clothing
- Chairs
- Privacy screens
- Blankets
- Notice-boards
- Tables
- Whiteboards

Technology
- Computers (networked)
- Fax machines
- Megaphone
- Photocopier
- Printers (networked)
- Portable radio (with backup battery)
- Telephones (preferably landlines)
- Audible sounding device (e.g., canned air horn) to signal

\textsuperscript{34} http://www.wbdg.org/design/loading_dock.php
\textsuperscript{35} The Sphere Project, Chapter 4, Minimum standards in Shelter, Settlement and Non-Food items.
A difficulty in providing relief is the coordinating of activities. After a disaster has happened, many relief organizations are attracted within this area where they all have their own aid initiatives launched. Cooperation and coordination is often lacking, and there is lack of cooperation with the local population.

- J. Telford and R. Houghton (Tsunami Evaluation Coalition)

One of the main questions for this phase should be: what are the intentions of rebuilding within the specific community related to government regulations. Will a program for re-location be started up or is retrofitting and proper re-construction the main goal of governmental organizations. In general, starting up the re-construction phase basically should coincide with the exit-strategy for non-governmental humanitarian organizations that offer relief aid within the first weeks or months after disaster, of course, depending on the impact of each particular disaster. The initial first response by emergency agencies by setting up offices and stocks for the provision of food, water, tents and other basic human needs is not the main concern of the community any more. Local markets started up again and so is normal life. Especially the start-up of education is very important. Even in case of high-impact disasters it is important to restart education within several weeks after disaster. Since search and rescue teams and Red Cross information points mainly have completed their tasks and possible damage to electrical power and other utility lines has been restored, the education area, advised to be on the top floor of the centre, should be cleared and restored to start-up the education phase again. The entire building was used intensively for several weeks and probably has some damage and overdue maintenance that should be done. The long-term recovery phase has to start-up to restore damage houses within the community as well as other public facilities and infrastructure.

Depending on the impact of damage, often not insured, it can overwhelm communities and government. The management protocol for the emergency centre, from where coordination was given during shelter and relief aid phases, should be changed/replaced into management for opening up a recovery centre where disaster victims can meet with program representatives of government and NGO’s from the cluster that is specialized in long-term sheltering and re-construction and obtain information about the aid that is still available and the rest of the recovery process. The community centre could perfectly accommodate these functions since this will be a community driven phase as well. Other possible disaster aid programs include crisis counselling and other state or local help, although presence is highly dependent on the location and impact of disaster. Education about proper re-construction and mitigation of houses should be provided and re-construction kits should be handed out. Examples include the elevation or relocation of chronically flood-damaged homes away from flood hazard areas, retrofitting buildings to make them resistant to earthquakes or strong winds, and adoption and enforcement of adequate codes and standards by local, state and federal government. Education in the pre-disaster phase has hopefully already improved knowledge about local standards and enforcement techniques but especially in this phase of re-construction higher demand on re-construction education could be expected.
Program of requirements

The phase of reconstruction has actually the purpose of getting back into ‘general’ pre-disaster mode. It will complete the cycle of phases that the building should adapt to, which means that there are similarities with both the program of relief aid as well as with the education and facilitation pre-disaster phases. The transition from the relief aid into the reconstruction phase is probably one, in contradiction with the previous phases, of the most undefined in terms of actual start and the related building transitions that will take place. The program of the rebuilding phase will be the start of a more long-term assistance phase to support and educate people to get into regular mode and at the same time improve living standards compared to before the disaster and so, prepare for future disasters to come. Therefore actually, the building doesn’t need many more special design requirements since these

Figure 5.30: Program activity within the building during the re-building phase.
have been stated in all previous sections of this chapter. Mainly internal changes in the program and transition to regular program of education and community centre in the end. Besides that the facilities like sanitation and WASH are still up and running with only the intensity being variable. Main concern for the building itself will probably re-storing and maintenance of construction and building parts. Proper materialization, as stated in chapter 4, will have a major impact on the scale of this maintenance. In short, primary functions of a transitional community centre during the re-building phase are: meeting pre-disaster education needs plus required education about re-construction and retrofitting, provision of accommodation for disaster recovery centre to accommodate related organisations and hand-out of repair-kits. These functions (excluding WASH and health related facilities) require the following program of requirements:

- Education Rooms (4x) (50 m²)
- Recovery Centre (NGO's) (100 m²)
  - Meeting rooms (2x) (50 m²)
  - Offices (4x) (10 m²)
  - Storage (50 m²)
- Administrative Offices (2x) (10 m²)
- Supply Re-building Goods
  - Loading Dock
  - Dry Storage
- Lockers + electricity, 250 pcs (25 m²)
- Wi-Fi networks / equipment (10 m²)

Figure 5.31: Spot plan of the program in the re-building phase
Assessment and intervention process

As mentioned before, the emergency response does not end with tapering relief, but continues through clean-up and resettlement stages. Although the need for comprehensive medical care will be reduced and the need for education and opportunities for re-building and retrofitting houses and living conditions increase, people still want to know what assistance will be made available, who is responsible, and how to go about seeking that assistance. The recovery centre, under direction of NGO’s with specialties in sheltering en reconstruction, will take over responsibilities from the relief aid specialized organizations. Senior levels of government should develop clearly defined response policies and programmes in advance. Special attention should be given to starting up regular activities, like education, that where ended during the alarming and emergency shelter phase, to immediately improve the safety, health or quality of life of the former school children. Restoring and changing adaptable spaces into education and facilitation mode should be done under the supervision of the community centre manager. The restart of the internal communication of the transitional community centre from pre-disaster phase encourages both former schoolchildren and ‘new’ users to take better care of the building. Despite the little building related design characteristics it is still necessary to develop an intervention process to realize the different needs of the building are in this phase and thus ask for some proper design interventions. The design interventions that have been developed should focus on the following three-step assessment and intervention logic concerning: deactivation of shelter and relief aid processes, restarting education and community related programs and developing proper education about retrofitting and rebuilding programs and hand-out of financial, material or equipment support.37

A. Deactivation

The decision to deactivate a relief center and open up the recovery center should be taken collaboratively in consultation between the involved governmental, non-governmental humanitarian organizations and the community shelter management. Closing a relief center, particularly an emergency relief center within close connection with the community, may cause some negative feelings as it disrupts the routine and predictability the affected community may expect. It is therefore essential to manage the process carefully and communicate accurately and consistently about the closing of the relief aid relief center and

Figure 5.32: Reserach by design: Provide spaces to be able to clearly communicate with and activate the community center user by education.
opening up the recovery center. Both activation and deactivation requires highly accessible and flexible spaces although the shift from emergency to recovery requires small adaptations and especially multi-functionality on interior level. Therefore, for guidelines regarding functionality, flexibility, accessibility, etc., please refer to the first section of this chapter on education. Features for the design automatically show the significant overlap, which clearly indicate the completion of the cycle of different phases.

A.1 Clear communication
Use very simple and clear communication that indicates the shift between relief-aid and re-building phase. Massive signals to communicate this to the community are not necessary as long as management and communication about the withdrawal of relief aid and start-up of recovery services is timely and planned. In case of complete closing of the shelter function by ending recovery services, it is needed to clearly state closing time and date to the community.

A.2 Ensure accommodation
De-activation of the relief-aid center and start-up the re-building phase is only possible if temporary or permanent accommodation is ensured to all vulnerable and displaced people. Ensure that affected people are receiving guidance on recovery options like alternative housing plans and financial assistance if houses are completely destroyed.

A.3 Activation of other centres
In case of the existence of other nearby community centers it is possible to identify and activate different uses of those centers. In some cases the center location or building is not appropriate for future use or may not be available for the length of time needed. Identify and activate the required uses (more and extended use for sheltering, even long-term, in case of many displaced people by high impact disasters) and clearly communicate and confirm function, closing time and date to the affected people.

A.4 Flexibility for internal re-organisation
Development of a plan to close the relief aid phase includes the development of clear communication and logistical plans. Identification of internal replacement and related down or up scaling of several functions require design interventions that could support this process of coordination. Clear and lockable spaces with small differences in scale and facilities increase flexibility without having the need for large undefined spaces.

\[37\] Rehabilitation and Reconstruction, Disaster Management training programme, Unicef, p33-34
A.5 Removal of signage
When closing the recovery center remove all signage, forward and archive documentation to municipal or NGO’s.

A.6 Cleaning and storage
When closing the relief aid center arrange for cleaning of the relief aid or recovery center and return the building to preoccupancy. Proper materialization with materials that are easy to clean and replace will improve the process of cleaning.

B. Restarting
Starting up education and facilitation phase and try to stimulate trade and thus economics are essential during the rebuilding phase. Education is essential and should be started within several weeks after the disaster. This could already happen before the transition between relief aid and re-construction phase depending on the impact of the disaster. Independence could be created by economic activities at the nearby market square. Economic activities will generate income and this will contribute to the transformation of the damaged neighbourhood. Activation of education requires safe and secure spaces within the building. Especially when starting up during relief aid phase entrance of the education part of the school should be guarded to secure safety for school children. Economic activities require highly accessible and flexible open door areas. Since the market square is used as a tent camp the quick start of economic activities will highly depend on the degree of damage caused to housing. Although the shift from tents to market requires small adaptations it is recommended to separate both shelter and market areas. For other guidelines regarding the specific functions education and market, please refer to the first two sections of this chapter on education and facilitation.

Figure 5.33: Rosorach by design: integrate shapes, sheltering opportunities and improvements concerning disaster prevention with eachother to fully integrated all the design principles.
B.1 Adjacent outdoor area
Safety within a school in relief aid or re-construction phase can be endorsed by connections with adjacent outdoor areas without the necessity for children having to leave the school spaces inside the busy community center. As peace has returned within the community center and education and facility phase are back in general mode these precautions for safety could be less strict. School and community center should be able to blend to enforce accessibility of education.

B.2 Clear separation of functions
Since ending and starting up different functions within a building could cause unknown and especially vague borders between different uses it is recommended to design possibilities that can intervene in between. Using different levels of height could divide the surrounding market area, which is connected to the community center, into multiple clearly defined spaces. The shift from tents to market could be done in multiple shifts which will make it more adaptable and both safer in use. Other guidelines within the sheltering phase (section 5.4) already refer to a clear separation of functions within the building.

Figure 5.34: Roserach by design: Integrate shade, sheltering opportunities and improvements concerning disaster prevention with each other to fully integrated all the design principles.
C. Developing

Although rehabilitation and reconstruction are distinctive activities, they should not be seen in isolation from other pre- and post-disaster phases but should be part of them. Reconstruction after a disaster provides many mitigation and development opportunities that may not be possible in ‘normal’ conditions. It is a unique opportunity to carry out other mitigation programs such as implementation of construction codes, land-use changes and zoning, decentralization of critical facilities and a diversification of the local economy. If properly utilized, these opportunities can, in return, improve the effectiveness of recovery from possible future disasters. Similarly, integration of rehabilitation planning into local and national preparedness plans contributes to better recovery. Reconstruction also has a direct link to development. Post-disaster planning must be carefully executed to avoid damaging development potential.38

C.1 Out-door education

Provide outdoor possibilities for educational use to improve accessibility for larger groups and reach larger parts of the community with proper knowledge about retrofitting, improving and restoration of houses. Design multiple options with height differences and elevations to create multi-use gathering places. Also see guidelines in section 5.1 about Education where guidelines on functionality, flexibility and productivity for education are given.

C.2 Signage and visibility

Provide outdoor possibilities for signage and educational materials to be shown. If possibilities for education on retrofitting and re-construction classes if widely spread by signage and poster, more people will attend classes to improve their houses for future storms.

C.3 Design point of issue

By providing a point of issue, with proper indoor connection with large storage spaces, it is possible to provide outdoor possibilities for educational use to improve accessibility for larger groups and reach larger parts of the community with proper knowledge about retrofitting, improving and restoration of houses. Providing in proper possibilities for handout makes it possible to provide large groups in an orderly way with re-building tools like reparation packages, tools and teaching materials that can be studied individually. If enough space is available, even a renting office can be stationed where people can rent tools or a shop to buy building materials.

Residents wait for their family members being rescued at the end of a flooded street in the village of Tunana, Markina town, in suburban Manilla, on August 7, 2012, after torrential rains inundated most of the capital. Will the transitional community shelter be able to change this situation?39

38 Rehabilitation and Reconstruction, Disaster Management training programme, Unicef, p33-34
To develop a permanent building in a high-dense urban area in the Philippines, it is important to respond to the geographical conditions. In the situation of Manila, the capital of the archipelago, it is therefore important to do some further research on various aspects like the local geographical context, climate type and related weather conditions to be able to adapt the building in the context. Together with the guidelines of the previous chapters, which stated the minimal building standards and the guidelines for each proposed phase, this chapter will give the final input for the design of the transitional community center.

5.1 History

The Philippine Islands became a Spanish colony during the 16th century; they were ceded to the US in 1898 following the Spanish-American War. In 1935 the Philippines became a self-governing commonwealth. Manuel Quezon was elected President and was tasked with preparing the country for independence after a 10-year transition. In 1942 the islands fell under Japanese occupation during WWII, and US forces and Filipinos fought together during 1944-45 to regain control. On 4 July 1946 the Philippines attained their independence. The 21-year rule of Ferdinand Marcos ended in 1986, when a widespread popular rebellion forced him into exile and installed Corazon Aquino as president. Several coups were hampered, which prevented a return to full political stability and economic development. Several new presidents followed and reformed economics, which marked greater stability and progress. The Philippine government still faces threats from arm communist insurgencies and Muslim separatist in the south. Also stormy impeachments on corruption and increasing differences of high and low incomes are high priority for the government nowadays.

5.2 Geographic context

The Philippines occupies an area that stretches for 1,850 kilometers from about the fifth to the twentieth parallels north latitude. The total land area is slightly more than 300,000 square kilometers. Only approximately 1,000 of its islands are populated, and fewer than one-half of these are larger than 2.5 square kilometers. The 11 largest islands contain 94% of the total land area. The capital Manila is located on the largest of these islands, which is Luzon (105,000 km2). The next largest island is Mindanao at about 95,000 km2. The archipelago is around 800 km from the Asian mainland and is located between Taiwan and Borneo. The islands are divided into three groups: Luzon, Visayas, and Mindanao. The Luzon islands include

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6.0 THE PHILIPPINES

This chapter will shortly introduce the geographic and climate conditions of the archipelago of the Philippines, the location where the design of the transitional community is located.

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\(^1\) geography.about.com/library/blcphilippines.htm

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Luzon Island itself, Palawan, Mindoro, Marinduque, Masbate and Batanes Islands. The Visayas is the group of islands in the central Philippines, the largest of which are: Panay, Negros, Cebu, Bohol, Leyte and Samar. The Mindanao islands include Mindanao itself, plus the Sulu Archipelago, composed primarily of Basilan, Sulu Island, and Tawi-Tawi. The three stars on the national flag identify these three principal groups of islands. Topographically, the Philippines are broken up by the sea, which gives it one of the longest coastlines of any nation in the world.

The Philippine archipelago is positioned in Southeast Asia, which made it becoming a crossroads of several different cultures - a place where Malays, Hindus, Arabs, Chinese, Spaniards, Americans, and others had interacted into a unique cultural and racial blend. Off the coast of eastern Mindanao is the Philippine Trench, which descends to a depth of 10,430 meters. The Philippines is part of a western Pacific arc system characterized by active volcanoes. Among the most notable peaks are Mount Mayon near Legazpi City, Taal Volcano south of Manila, and Mount Apo in Mindanao. All of the Philippine islands are prone to earthquakes since the country is located on the so-called ‘Ring of Fire. The Philippine Archipelago is geologically part of the Philippine
Mobile Belt which is a complex portion of the tectonic boundary between the Eurasian Plate and the Philippine Sea Plate, located between the Philippine Sea Plate, the South China Sea Basin of the Eurasian Plate, and the Sunda Plate. The Philippine Trench (also called the Mindanao Trench) is a 1,320-kilometer-long submarine trench found directly east of the Philippine Mobile Belt and is the result of a collision of tectonic plates causing earthquakes now and than. The Philippine Sea Plate is subducting under the Philippine Mobile Belt at the rate of about 16 cm per year. Its deepest point, the Galathea Depth, has a depth of 10,540 meters (5,763 fathoms or 34,580 feet). The Philippine Fault System consists of a series of seismic faults that produce several earthquakes per year.

**Manila**

Manila is located about 1120 kilometers southeast of Hong Kong and about 2390 kilometers northeast of Singapore on the west side of the northern island of Luzon. The city lies at the Manila Bay at the mouth of the Pasig River and is divided by this river. Almost the entire city is built on the alluvial soil deposited by the Pasig for centuries. A part of the territory of the city is impoldered land that originally belonged to the Manila Bay. Several cities and towns that are all part of Metro Manila border the city of Manila. Administrative Manila is classified in the region, National Capital Region, which is usually referred to as Metro Manila. The city itself is divided into 897 barangays. This is the smallest administrative unit in the Philippines. A chairman and councilors govern each barangay and for administrative reasons the barangays in Manila are grouped into 100 zones, which are grouped into 16 districts.

**5.3 Climate**

The Philippines has a tropical wet climate characterized by relatively high temperature, oppressive humidity and plenty of rainfall and is dominated by a rainy season and a dry season. The summer monsoon brings heavy rains to most of the archipelago from May to October, whereas the winter monsoon brings cooler and drier air from December to February. Manila and most of the lowland areas are hot and dusty from March to May. Even at this time, however, temperatures rarely rise above 37 °C (98.6 °F). Mean annual sea-level temperatures rarely fall below 27 °C (80.6 °F). Annual rainfall measures as much as 5,000 millimeters (196.9 in) in the mountainous east coast section of the country, but less than 1,000 millimeters (39.4 in) in some of the sheltered valleys. Monsoon rains, hard and drenching, are not normally associated with high winds but the Philippines is in the middle

3 wikipedia.org/wiki/Geography_of_the_Philippines
of a typhoon belt, and therefore suffers an annual onslaught of dangerous storms from July through October. These are especially hazardous for northern and eastern Luzon and the Bicol and Eastern Visayas regions, but Manila gets devastated periodically as well.4

Temperatures
The average year-round temperature measured from all the weather stations in the Philippines is 26.6 °C (79.9 °F). Cooler days are usually felt in the month of January with temperature averaging at 25.5 °C (77.9 °F) and the warmest days, in the month of May are not much higher with an average of 28.3 °C (82.9 °F). Elevation factors can significantly influence the variation of temperatures in the Philippines. Since Manila is very close to the equator it means that the temperature range is very small, rarely going lower than 20 °C (68 °F) and going higher than 38 °C (100 °F). However, humidity levels are usually very high which makes it feel much warmer.5

Rainfall
The summer monsoon brings heavy rains to most of the archipelago from May to October. Annual average rainfall ranges from as much as 5,000 millimeters (196.9 in) in the mountainous east coast section of the country, to less than 1,000 millimeters (39.4 in) in some of the sheltered valleys.

Figure 5.2: Manila in numbers: acreage, number of inhabitants and climate related numbers about rainfall, humidity, hours of sun and temperature.
Monsoon rains, although hard and drenching, are not normally associated with high winds and waves. At least 30 percent of the annual rainfall in the northern Philippines can be traced to tropical cyclones, while the southern islands receiving less than 10 percent of their annual rainfall from tropical cyclones. The wettest known tropical cyclone to impact the archipelago was the July 1911 cyclone, which dropped over 1,168 millimeters (46.0 in) of rainfall within a 24-hour period.

Humidity
Relative humidity is high in the Philippines. A high amount of moisture or vapor in the air makes hot temperatures feel hotter. This quantity of moisture is due to different factors - the extraordinary evaporation from the seas that surrounds the country on all sides, to the different prevailing winds in the different seasons of the year, and finally, to the abundant rains so common in this tropical country. The first may be considered as general causes of the great humidity, which is generally observed in all the islands throughout the year. The last two may influence the different degree of humidity for the different months of the year and for the different regions of the Archipelago.4 In the cooler months, even though the rains are more abundant in the eastern part of the Philippines, owing to the prevailing northeasterly winds, the humidity is less than in the western part where a dry season prevails. From June to October, although the rains are quite general throughout the Archipelago, the rains are more abundant in the western part of the Philippines, which is more exposed to the prevailing westerly and southwesterly winds; hence the humidity of the air is greater there than in the eastern part of the Archipelago.

5.4 Natural disasters
In the last decade, the Philippines have been hit severely by natural disasters. In 2005 alone, Central Luzon was hit by both a drought, which sharply curtailed hydroelectric power, and by a typhoon that flooded practically all of low-lying Manila’s streets. Still more damaging was the 1990 earthquake that devastated a wide area in Luzon, including Baguio and other northern areas. The city of Cebu and nearby areas were struck by a typhoon that killed more than a hundred people, sank vessels, destroyed part of the sugar crop, and cut off water and electricity for several days. The Philippines is prone to about 18-21 typhoons per year. Of course the 1991 Mount Pinatubo eruption also damaged much of Central Luzon, the lahar burying towns and farmland, and the ashes affecting global temperatures.

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5 Philippine Atmospheric, Geophysical and Astronomical Services Administration
6 The Climate and Weather of the Philippines, 1903 to 1918”, p.125.
Earthquakes
The Philippines lies within the Pacific Ring of Fire, a series of interconnected seismic plates that cause the country to have frequent seismic and volcanic activity. Several major earthquakes, with magnitudes above 5 in the Richter scale, have hit the Philippines. Much larger numbers of earthquakes of smaller magnitude occur very regularly due to the meeting of the Philippine Plate, which is sandwiched by two other major tectonic plates called the Pacific Plate and the Indian Plate.

Typhoons
The Philippines sit astride the typhoon belt, and the country suffers an annual onslaught of dangerous storms from July through October. These are especially hazardous for northern and eastern Luzon and therefore Manila gets devastated periodically as well. Bagyó is the local term to any tropical cyclone in the Philippine Islands. From the statistics gathered by PAGASA from 1948 to 2004, around an average of 20 storms and/or typhoons per year enter the PAR (Philippine Area of Responsibility) - the designated area assigned to Pagasa to monitor during weather disturbances. In 1993, a record of 19 typhoons made landfall in the country and the least amount per year were 4 during the years 1955, 1958, 1992 and 1997.7

Figure 5.4: The variation in the urban fabric of Manila. All pictures are on the same scale and within a radius of several kilometers. Imagine the need for a transitional community center in some parts of the city.8
PAGASA categorizes typhoons into four types according to wind speed. Once a tropical cyclone enters the Philippine Area of Responsibility, regardless of strength, PAGASA gives it a local name for identification purposes by the media, government, and the general public.

- Tropical Depressions have maximum sustained winds of between 55 kilometres per hour (30 kn) and 64 kilometres per hour (35 kn) near its center.

- Tropical Storms have maximum sustained winds of 65 kilometres per hour (35 kn) and 119 kilometres per hour (64 kn).

- Typhoons achieve maximum sustained winds of 120 kilometres per hour (65 kn) to 185 kilometres per hour (100 kn).

- Super typhoons having maximum winds exceeding 185 kilometres per hour (100 kn).

5.5 Impact on built environment

Building construction is already undertaken with natural disasters in mind. Most rural housing has consisted of nipa huts that are easily damaged but inexpensive and easy to replace. Most urban buildings are steel and concrete structures designed (not always successfully) to resist both typhoons and earthquakes. Damage is still significant, however, and many people are displaced each year by typhoons, earthquakes, and other natural disasters. In 1987 alone the Department of Social Welfare and Development helped 2.4 million victims of natural disasters.

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9 worldpopulationreview.com
Besides literature and general practical references, information obtained from interviews helped me to verify literature and other sources to be able to make a better link to practice.

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8.2 Interviews

Roel Gijsbers  
Sheltergroup, TU/e  
-17th of January

Jim Kennedy  
Project Manager Care, Haiti  
- Skype meetings

Alexander Vollebregt  
Urban Emergencies, TU Delft  
- Multiple

Robert Nottrot  
Explore Lab, TU Delft  
- Multiple

Elise van Dooren  
Building Construction, TU Delft  
- Multiple