Regional Policy on Integrating E-sustainability and Resilience into School Buildings Development

September, 2014
Overview
Disaster = Hazard · Exposure · Vulnerability

Increased Consequences
Lack of post-event management and recovery, and re-bound capacity
Hazards

Environmental Sustainability → Climate Change → Increased Hazards

Other factors

Disaster = Hazard . Exposure . Vulnerability
Exposure

Urbanization and un-planed Development

Population Growth → Greater Exposure

Disaster = Hazard × Exposure × Vulnerability
Vulnerability

Higher Environmental Impact

Un-planed Development

Poor Quality of Built Environment

Disaster = Hazard . Exposure . Vulnerability
Some Observations

- Built environment is the common factor between ES, DR and CC
- Policies and actions that effect the planning and quality of built-environment will have direct impact on ES and DR
- Policies and actions need to be implemented at global, regional, national and local level and context
- Integrated building codes can provide one vehicle to define and implement the policies and actions
Climate Change

• Dual relationship between sustainable development and climate change
• Cities both contribute to climate change and affected by it
• Urbanization put strain on natural resources and significantly contribute to greenhouse gas emission
• Climate related natural disaster that impact immediately:
  • Intense rain
  • Extreme temperature Highs- Heat waves
  • Storms, including windstorms, hurricanes
  • High levels of precipitation, and associated flooding
  • Lack of Precipitation, and associated droughts

World’s Population Growth

5 billion in 1987
6 billion in 1999
7 billion in 2011

World’s Urbanization Prospects

• In 1950, from 746 million to **3.9 billion** in 2014 and expected to reach **6.3 billion** in 2050

• Africa and Asia are urbanizing faster than the other regions

• Asia, is home to **53** percent of the world’s urban population followed by Europe (**14 per cent**)

• Projected to add **2.5 billion** people to world’s urban population by **2050**, with nearly **90 per cent** increase concentrated in Asia and Africa

Source: UN World Urbanization Prospects, The 2014 Revision
Effects of Unplanned Urbanization

- Urban Poverty
- Over Crowding
- Inadequate Housing
- Environmental Unsustainability
- More Vulnerable to Natural Disasters
Proposed Policy Pillars to Tackle this Issue

- Hierarchical context
- Integrated approach
- Building Codes as a vehicle
- Low-cost buildings as a special case
- Schools as primary focus

- Make it relevant to the Philippines (and other countries)
Hierarchal Context

Global – Regional – National – Local
## Context

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<th>Action and Impacts</th>
<th>Individual</th>
<th>Local</th>
<th>National</th>
<th>Regional</th>
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- **Actions and Impacts**
  - Individual
  - Local
  - National
  - Regional
  - Global

- **Awareness**
  - Individual
  - Local
  - National
  - Regional
  - Global

- **Policies**
  - Individual
  - Local
  - National
  - Regional
  - Global

- **Regulations**
  - Individual
  - Local
  - National
  - Regional
  - Global

- **Enforcement**
  - Individual
  - Local
  - National
  - Regional
  - Global
Policy Initiated by UN

• By World’s Urbanization Prospects, UN, The 2014 Revisions
  • Government must implement policies to ensure that the benefits of urban growth are shared equitably and sustainability
  • Diversified policies to plan for and manage the spatial distribution of the population and internal migration are needed
  • Policies aimed at a more balanced distribution of urban growth
  • Accurate, consistent, timely data on global trends in urbanization and city growth
  • Successful sustainable urbanization
HFA – Priority for Action

**PFA 1**
- Ensure DRR is a national and local priority with a strong institutional basis for implementation

**PFA 2**
- Identify, assess and monitor disaster risks and enhance early warning

**PFA 3**
- Use knowledge, innovation and education to build a culture of safety and resilience at all levels

**PFA 4**
- Reduce the underlying risk factors

**PFA 5**
- Strengthen disaster preparedness for effective response at all levels
Regional Policies and Action Recommendations

• Slow down Population Growth
• Reduce Urban Migration
• Improved planning and infrastructure for urbanization
• Policies recommendation by **UNESCAP** (November, 2013)
  • Improved urban planning in cities and improved urban governance
  • Enhance urban infrastructure and services
  • Establish economic policies that focus on the reduction of inequalities at the city level
  • Promote more environmental-friendly practices to ensure sustainable growth of Asian-Pacific cities

Source: urbanization trends in Asia and the Pacific by UN ESCAP November 2013 issue
World Population Growth


Less Developed Countries may need more Low Cost Housing and infrastructure
Asia and the Pacific Urbanization Prospects

- More than half of the world’s mega-cities, **(13 out of 22)** are now in Asia
- Southeast Asia has some very large cities Jakarta, Manila and Bangkok
- Projected Urbanization **46.7 per cent in 2020**

Source: ARI Working Paper No. 196, Singapore from UN Population Division 2009

Source: urbanization trends in Asia and the Pacific by UN ESCAP November 2013 issue
Regional Context – Needs High Attention

Disaster Aspects

- High Hazards
- High Exposure
- High Vulnerability
- Potential for large disasters

Environmental Aspects

- High population growth
- High urbanization
- Extensive development
- Potential for large environmental impact
Integrated Approach

Multi-Aspect Integration
Integration

• Structural and Non-structural aspects

• Integrate ES and DR

• Consider Multi-hazard approach
Structural and Non-structural

Non Structural

- Awareness
- Preparedness
- Management
- Lifestyle
- Regulations, Incentives

Structural

- Planning
- Design
- Construction
- Maintenance
- Rehab, Retrofit, Rebuild
ES and DR

Environmental Sustainability
- Water Conservation
- Energy Conservation
- Soil Conservation
- Resources Conservation
- Pollution
- ----
- (Reduce, Recycle, Reuse, Renew, ...)

Disaster Resilience
- Wind, Storms, Hurricanes
- Earthquakes
- Landslides
- Floods
- Volcanos
- Snow, Fire, Wild Fire
- ----
## Indicative interdependence of DR measures and ES requirements

<table>
<thead>
<tr>
<th>Disaster Resilience</th>
<th>Site</th>
<th>Soil Conv.</th>
<th>Water Conv.</th>
<th>Energy Conv.</th>
<th>Material Conv.</th>
<th>CO2/GHG</th>
<th>Air Pollution</th>
<th>Indoor Env.</th>
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<tr>
<td>Earthquakes</td>
<td>M</td>
<td>M</td>
<td>N</td>
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<td>Volcano</td>
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<td>Flooding</td>
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</table>

H=High, M=Medium, L=Low, N=None
Conflicting areas for ES and DR

• Vulnerability reduction of buildings
  • Need for larger sizes of structural members and stronger materials
  • Contradicts/conflicts with resource conservation

• Some other obvious conflicts
  • Roof overhangs and window sun shades for better energy conservation and Improved indoor environment
  • Increase vulnerability to hurricanes and strong winds
“Durability and longer building life span can benefit both ES and DR”
## Environmental Sustainability

### Design Process

<table>
<thead>
<tr>
<th>Design Process Step</th>
<th>Design Considerations</th>
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<tbody>
<tr>
<td></td>
<td>Soil &amp; Environment</td>
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<td>Site Selection</td>
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<td>Construction Practices</td>
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<td>Material Selection</td>
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Multi hazard DR Requirements may Conflict

• Provisions for high resistance to strong earthquakes and strong winds
  • Design for wind – large stiffness, large mass, and greater strength
  • Design for earthquake – low mass, high ductility, lower strength interaction between ductile and brittle failures

• Gable roofs and walls
  • More suitable for rainstorms and energy efficient
  • Seismic resistance less than flat roofs

• Window Openings
## DRR Strategies for Multiple Hazards

<table>
<thead>
<tr>
<th>Basic DRR Strategies</th>
<th>Earthquakes</th>
<th>Landslide</th>
<th>Floods</th>
<th>Fire</th>
<th>Avalanche</th>
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<tbody>
<tr>
<td>a) Hazard reduction/mitigation</td>
<td>None</td>
<td>Medium</td>
<td>High</td>
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<td>b) Vulnerability reduction</td>
<td>High</td>
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<td>c) Increasing Resilience</td>
<td>High</td>
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<td>d) Reducing and managing consequences</td>
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<td>f) Avoidance and relocation</td>
<td>Low</td>
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# Disaster Resilience

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<tr>
<th>Design Process Step</th>
<th>Location</th>
<th>Plan &amp; Layout</th>
<th>Appropriate Material</th>
<th>Strength &amp; Integrity</th>
<th>Evacuation</th>
<th>Location</th>
<th>Design Elements</th>
<th>Material Selection</th>
<th>Strength &amp; Integrity</th>
<th>Debris</th>
<th>Location</th>
<th>Basic Design</th>
<th>Mitigation Plan</th>
<th>Material Usage</th>
<th>Location</th>
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- **Earthquakes**
- **Cyclones, Typhoons**
- **Floods**
- **Landslide**
Schools as the Focus

Why schools need special attention
Why Start with Schools?

• The probability of hazard event occurring at any given time of the day on any day of the year is the similar.
• Probability of student to be exposed to earthquake hazard in the school is about 25% (Low risk)
• One room has 30 to 40 children > Very high Exposure (8 to 10 times more than house room)
• Consequence of failure of one room >> Disaster
Why Start with Schools?

• Increased emphasis on education/literacy rate need more schools for same population
• Increased population means two-fold need for more schools
• Increased urbanization means higher densities of students per class-room, per building

• Higher densities of students leads to higher exposure
Schools need special attention

- High consequences in case of disaster
- Schools can be used as community shelters
- Disaster Resilience (DR) and Environmental Sustainability (ES) of schools can have long-term and far-reaching effect
  - Education and awareness in students >> of families and communities
Current Public School Buildings

• Many are relatively small, low-rise

• Inappropriately designed

• Construction quality Low

• Posses high risk due to high exposure and high vulnerability
Low Cost Building

- Using relatively lower space requirements
- Using minimalistic approach in terms of non-essential building components
- Using material of "just sufficient" specifications and relatively lower cost
- Using low cost construction techniques and technologies
- Economy of scale by using mass production, standardization, modularization of components and systems
- Mechanized construction techniques, use of pre-cast, pre-fabricated components, improved logistics
- Improved and optimized designs, specially developed low cost materials, use of re-cycled materials, or use of waste
Low Cost Building

• Low-rise, with simple configurations, with smaller spans and heights, using typical and standardized layout plans and also have simpler plumbing systems

• No Heating Ventilation and Air-Conditioning (HVAC), elaborate firefighting, complex electrical or mechanical systems, and do not have elevators

• It may not be necessary to carry out a separate or explicit structural and building services design, and may be integrated into the basic architectural layout and design of the enclosure
Application of Low Cost Buildings

**Public Housing**
- For Low income groups
- For public employees

**Social Housing projects**
- By development agencies, NGOs, and corporate entities as part of CSR initiatives

**Public Buildings in Rural and Suburban Areas**
- Schools
- Hospitals/health units

**Private Housing by Low Income Group**
Issues with Low Cost Buildings

Do not get sufficient attention and commercial interest from highly qualified and competent architects and engineers.

Lower quality of basic design for ES and DR compared to highly funded projects.

Construction by the less qualified contractors and local laborers, leading to a lower quality of construction thereby reducing resilience to disasters.

Lack of required attention from the building officials and not enough officials available to visit/inspect.
Special Challenges for Schools

• Challenges identified in Hyogo Framework:
  • Increased vulnerability due to urbanization, increased enrollments, establishment of private schools with less controls
  • Schools have received less attention from hydro-meteorological and other natural disasters
  • Need to integrate school safety in mainstream and governance: specific to schools
  • Limited early warning systems and inadequate access to proper hazard maps
  • Limited emphasis on reducing underlying risk, through vulnerability reduction, and lack of substantive studies on vulnerability
• Three global targets for the first ten years
  • Reduce disaster mortality by half by 2025 (or by a given percentage in a
given period of time)
  • Reduce disaster economic loss by a given percentage by 2025
  • Reduce disaster damage to housing, educational and health facilities by
a given percentage by 2025

Consideration on the post-2015 framework for disaster risk reduction, Third UN world conference
on Disaster Risk Reduction – 16 June 2014
Key Policy Suggestions

• Integration of ES and DR in various initiatives
• Develop policy and frameworks for Low Cost Buildings
• Assign schools highest priority for DR and ES
• Use school DR and ES as means of awareness, education of these aspects
• Use schools as “safe” and “sustainable” models for the community
• Prepare schools for a temporary “safe houses” for communities during disasters
Building Codes

As main vehicle for Policy Implementation
Importance of Building Codes

**PFA 3**
- Use knowledge, innovation and education to build a culture of safety and resilience at all levels

**PFA 4**
- Reduce the underlying risk factors

- Improved Awareness
- Improved Built Environment
- Development and Enforcement of Proper Building Codes and Regulations
Key Policy Suggestions

• Develop local technologies and solutions for low-cost, sustainable and resilient buildings that can be used for schools and residential buildings

• Develop specific and integrated, simple and enforceable “Building Codes” and guidelines for design, construction, up gradation, retrofitting and operations of schools
International Building Codes and Regulation

• Key characteristics
  • DR and ES often covered by separate and independent codes and guidelines
  • Sometimes enforced by different agencies
  • Cover many aspects and comprise of several documents
  • DR aspects covered in structural design codes
  • ES aspects distributed across many codes
  • Sometimes special (voluntary) codes ES aspects present for greater detail and higher standard
Sample Code: California, USA

California Building Standards Law
(within California Health and Safety Code)

California Code of Regulations, Title 24, 2010 edition
(named California Building Standards Code)

Building Code and Residential Code (including Structural Design)
- Electrical Code
- Mechanical Code
- Plumbing Code
- Energy Code
- Fire Code
- Green Building Standards Code
- Building Standards Administrative Code
- State Historical Building Code
- Existing Building Code
- Reference Standards Code

Snow, Wind, Rain, Flood, Wildfire, and Earthquake resistance
- Water conservation
- Energy Conservation and efficiency
- Environmental quality protection of the sites
- Energy efficiency
- Water efficiency and conservation
- Material conservation and resource efficiency, Waste reduction and recycling
- Reduction of air contaminants, ozone depleting substances and greenhouse gases

Energy efficiency
Water efficiency and conservation
Material conservation and resource efficiency, Waste reduction and recycling
Reduction of air contaminants, ozone depleting substances and greenhouse gases

Environmental quality protection of the sites
Energy efficiency
Energy efficiency
Water efficiency and conservation
Material conservation and resource efficiency, Waste reduction and recycling
Reduction of air contaminants, ozone depleting substances and greenhouse gases

Green Building Standards Code
Environmental quality protection of the sites
Energy efficiency
Water efficiency and conservation
Material conservation and resource efficiency, Waste reduction and recycling
Reduction of air contaminants, ozone depleting substances and greenhouse gases

Building Standards Administrative Code
State Historical Building Code
Existing Building Code
Reference Standards Code

California Code of Regulations, Title 24, 2010 edition
(named California Building Standards Code)
Development of Low Cost Building Code

- Integrate ES and DR
- Promote local technologies and materials
- Single Document
Overall Proposed Framework

• Project Oriented Approach rather than discipline or trade oriented approach
• Integrated, simple, specific, illustrative

• It is important that the code document be developed in such a way that it can be understood and applied by a single professional, such as the architect, associate architect, or a qualified technical and skilled technicians.
Nature of the Code

• Look into the limitations that may need to be addressed for the building code to be enforced

• Capability and capacity of available resources

• Stakeholder participation and coordination

• Addressing local needs rather than one policy for everyone
Conceptual Framework

Disaster Risk Considerations
- Hazard Characterization
- Risk Estimation
- Multi Hazards Risk Reduction

Code Development
- Simplistic
- Prescriptive/Illustrative
- Customizable

Environmental Considerations
- Water, Soil, & Material Conservation
- Energy Conservation
- Wastewater Treatment and Re-use
- Solid Waste Disposal

Acceptance & Enforcement
- Capability & Capacity Development
- Stakeholder Participation & Coordination
- Addressing Local Needs
Proposed Model

Integration Framework for Low Cost Buildings Code

- **Site Selection**
  - Soil Conservation
  - Flood Mitigation
  - Landslide Mitigation
  - Water Disposal and Recycling
  - Rainwater Harvesting

- **Architectural Planning**
  - Energy Conservation
  - Seismic Consideration
  - Cyclone Considerations
  - Flood Considerations
  - Rainwater Harvesting

- **Structural Design**
  - Cyclone and Wind Resistance
  - Seismic Resistance
  - Flood Resistance
  - Landslide Resistance
  - Fire Resistance

- **Material Selection**
  - Material Conservation
  - Material Reuse
  - Energy Conservation
  - Fire Resistance

- **Plumbing**
  - Water Conservation
  - Wastewater Disposal and Recycling
  - Solid Waste Disposal and Alternate Energy
  - Rainwater Harvesting

- **Electrical Design**
  - Electrical Efficiency
  - Energy Conservation
  - Solid Waste Disposal and Alternate Energy
  - Rainwater Harvesting

- **Constructional Practices**
  - Material Conservation
  - Energy Conservation
  - Water Conservation
  - Solid/Land Conservation
  - Water Reduction
  - Air Pollutant Controls
Customized Codes for Localization

ES and DR Considerations
- Environmental impact may differ from region to region
- Natural hazard risks may differ region to region

Stakeholders
- Capacity and capability of local bodies
- Incorporating innovative practices

Resource Optimization
- Available local resources
- Local techniques and skills
Enforcement Consideration

• Key aspects
  • Not all the building codes incorporate elements of environmental sustainability and disaster resiliency
  • Not all codes are enforced strongly in the region which also applies to the Philippines
  • Need to identify practices that increase the rate of implementation of the codes

• Key features for an effective enforcements
  • Simplicity of the codes
  • Awareness level among the community
  • Provision of certain incentives
Example of Simple Building Codes

• Case of Nepal
  • Category 1: Code for the state of the art buildings
  • Category 2: Code for professionally engineered structures
  • Category 3: Code for non-engineered buildings (mandatory rules of thumb)
  • Category 4: Guidelines for rural buildings

• However, does not include ES consideration
Relevance to Philippines
The Philippines

• High and multiple natural hazards
• High population growth and urbanization rate
• Low quality of built environment
• High student densities in public schools

• On positive side
  • High awareness
  • High intent, resolve and several initiatives to tackle the issues
The Philippines Population Growth

- High Population Density (328 per sq. km)
- population growth rate of 2.04%, one of the highest in Asia

Cities in East Asia and the Pacific vulnerability to Multiple Hazards

"Strong, Safe and Resilient", A strategy policy guide for Disaster Risk Management in East Asia and the Pacific by World Bank (75847)

Multi Hazard Aspects

- **Storms**: 71%
- **Earthquake**: 9%
- **Floods**: 10%
- **Landslides**: 10%

### Major Natural Disasters

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<th>Economic Damage (Million USD)</th>
<th>People Killed</th>
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<tbody>
<tr>
<td><strong>Storms</strong></td>
<td>12,780</td>
<td>17,300</td>
</tr>
<tr>
<td><strong>Earthquake</strong></td>
<td>62</td>
<td>345</td>
</tr>
<tr>
<td><strong>Floods</strong></td>
<td>10</td>
<td>222</td>
</tr>
<tr>
<td><strong>Landslides</strong></td>
<td>120</td>
<td>1,380</td>
</tr>
</tbody>
</table>

### Economic Damage and People Killed

- **Economic Damage**
  - Storms: 12,780 million USD
  - Earthquake: 62 million USD
  - Floods: 10 million USD
  - Landslides: 120 million USD

- **People Killed**
  - Storms: 17,300
  - Earthquake: 345
  - Floods: 222
  - Landslides: 1,380
Natural Disaster in Philippines

- Almost Every Year
  - Flood

- Approx. 20 Typhoons Per Year
  - Typhoons

- Approx. 5 Earthquakes Per Day
  - Earthquakes

- 20 Active Volcanoes, 6 are Monitored Regularly
  - Volcanoes

- Once in every 5 years
  - Droughts

Catastrophic Impacts on

- Development Process and Poverty Alleviation Initiatives
- Government Finances, Budgeting and Efforts of Sustainable Development
- Infrastructure Development and Transportation
- Other Social Requirements
Type of Material for Construction

No. of occupied housing units by type of construction materials of outer walls and roof

Philippines in Figures 2014 – National Statistic Office, Philippines
Elementary Schools

Fact Sheet (September 2013), Research and Statistics Division, Office of Planning Service, Department of Education, Philippines
Secondary Schools

Fact Sheet (September 2013), Research and Statistics Division, Office of Planning Service, Department of Education, Philippines
Environmental Sustainability

National Strategic Framework on Climate Change (2010-2020)

“Climate-risk resilient country with healthy, safe, prosperous, and self-reliant communities, and thriving and productive ecosystems”
Seven Strategic Priorities By Climate Control Commission (CCC)

- Sustainable Energy
- Water Sufficiency
- Knowledge & Capacity Development
- Human Security
- Ecosystem & Environmental Sustainability
- Climate smart Industries & Services
- Food Security
- Sustainable Energy
- Water Sufficiency
- Knowledge & Capacity Development
- Human Security
- Ecosystem & Environmental Sustainability
- Climate smart Industries & Services
- Food Security
National Building Code of the Philippines 1977
(Presidential Decree No. 1096)
And its revised Implementing Rules and Regulations 2004

- General Design and Construction Requirements (including Structural Design)
  - General Requirements of All Buildings by Use of Occupancy
  - Light and Ventilation
  - Fire-Resistive Requirements in Construction and Requirements for Fire Zones
  - Sanitation
  - Electrical Mechanical Regulations
  - Other Provisions (e.g., Pre-fabricated construction, Glass and Glazing, Signs, etc.)
- National Structural Code of Buildings
- One Specific Requirement for Wind Load Resistance
- Fire Resistance Construction Materials
- Codes on Sanitation
- Revised National Plumbing Code
- Philippines Electrical Code
- Philippines Mechanical Code
- National Plumbing Code
- Sanitation
- Other Provisions (e.g., Pre-fabricated construction, Glass and Glazing, Signs, etc.)
None of provisions specifically/explicitly address ES considerations.

Covers several general aspects of building design.
Customized Codes for Localization

ES and DR Considerations
- Environmental impact may differ from region to region
- Natural hazard risks may differ region to region

Stakeholders
- Capacity and capability of local bodies
- Incorporating innovative practices

Resource Optimization
- Available local resources
- Local techniques and skills
Proposed Integrated Code Hierarchy

- National Building Code
  - National Code for Low Cost Buildings
  - National Code for School Buildings
  - Regional Codes
    - Illustrative Guidelines
Conclusions and Summary

• Disaster Resilience and Environmental Sustainability need to be integrated for safe, sustainable development

• Need specific policies and buildings codes for low cost buildings, with emphasis on schools that are:
  • Integrated
  • Specific
  • Simple
  • Local
  • Enforceable
Thank You!