

## **Sustainable Architectural Design in Indonesia: Responding the Current Environmental Challenges**

**Gunawan Tanuwidjaja<sup>1</sup> and Lo Leonardo<sup>2</sup>**

<sup>1</sup> Lecturer of Department of Architecture, Petra Christian University, Indonesia

<sup>2</sup> Students of Department of Architecture, Petra Christian University, Indonesia

*Email address of corresponding author: gunteitb@yahoo.com, gunte@peter.petra.ac.id*

### **ABSTRACT**

The impacts of environmental destructions were felt in Indonesia. The irregular weather patterns, extreme temperatures, as well as floods affected many vulnerable areas in the Country oftentimes. Further, poverty and weak legal enforcement caused deforestation of 1,871,500 ha of forests annually and the extinctions of 147 species of mammals, 114 birds, 28 reptiles, 91 fishes and 28 invertebrates.

Indonesia also encountered great numbers of environmental as well as manmade disasters. It was recorded 12 earthquakes & tsunamis (in 2009), 8 volcanic eruptions (in 2008), 631 floods & landslides (in 2009), and 340 typhoons (in 2009). In total 416 lives were killed and 7,444 houses damaged.

Therefore, Indonesian Sustainable Architectural Design Framework should consider the requirements of these environmental challenges, not only prescribing "green rating". The framework should be built considering the social economic conditions of Indonesian as well as local wisdoms of local Architectures. And lastly, it should be sustained by the active participation of Architectural Education Institutions and other stakeholders in Indonesia

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Keywords: Indonesian Sustainable Architectural Design, Environmental Challenges in Indonesia]

### **1. Introduction**

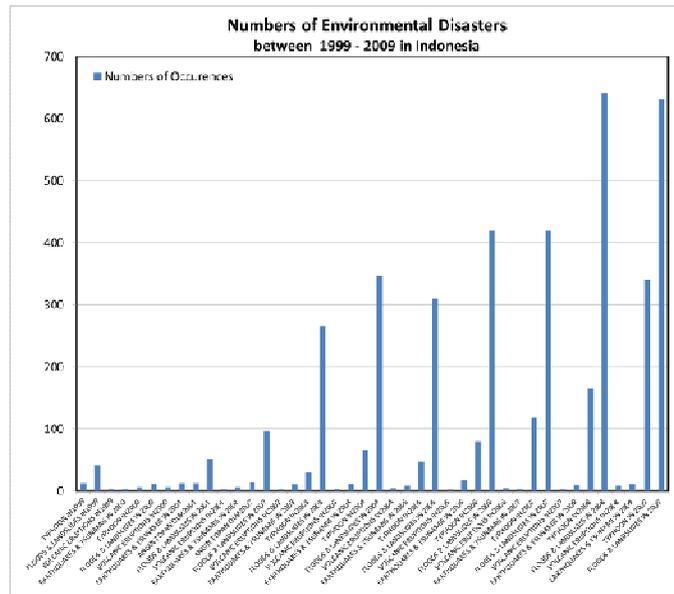
The impacts of environmental destructions were felt in Indonesia. The irregular weather patterns, extreme temperatures, as well as floods affected many vulnerable areas in the Country oftentimes. Further, Miller reminded that natural resource depletion, extinction of plants and animals, loss of wildlife habitats, increasing pollution, and poverty influenced Indonesia as much as the World (Miller, 2003). Covering of 1.9 million sq km of land and 3.3 sq km of ocean, Indonesia had abundance natural resource. However, the development of the Country was inhibited by the extreme poverty that constitute of the 49% of Indonesian population (World Bank Press Release, 2006 - Making the New Indonesia Work for the Poor). Because of weak legal enforcement and poverty, 64 million ha Indonesian tropical forests were destroyed since 1950. In addition, 1,871,500 ha of forests were slashed every year. This caused the extinctions of 147 species of mammals, 114 birds, 28 reptiles, 91 fishes and 28 invertebrates. (WRI et al., 2002 - State of the Forest Indonesia; WRI et al., 2000 - Trial by Fire; FAO Global Forest Resources Assessment, 2005).

### **2. Literature Review**

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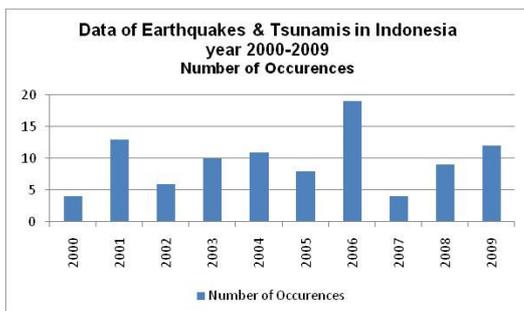
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Located in the Pacific Ring of Fires, Indonesia faced a very high frequency of earthquakes and volcanic eruptions. And many environmental challenges such as floods, landslides, and tidal waves occurred. It was recorded 12 earthquakes & tsunamis (2009), 8 volcanic eruptions (2008), 631 floods & landslides (2009), and 340 typhoons (2009). In total 416 lives were killed and 7,444 houses damaged ([http://www.bnpb.go.id/website/index.php?option=com\\_content&task=view&id=2101](http://www.bnpb.go.id/website/index.php?option=com_content&task=view&id=2101); <http://geospasial.bnpb.go.id/category/peta-tematik/statistik-bencana/>; <http://dibi.bnpb.go.id/DesInventar/statistics.jsp>).



Source: ([http://www.bnpb.go.id/website/index.php?option=com\\_content&task=view&id=2101](http://www.bnpb.go.id/website/index.php?option=com_content&task=view&id=2101)  
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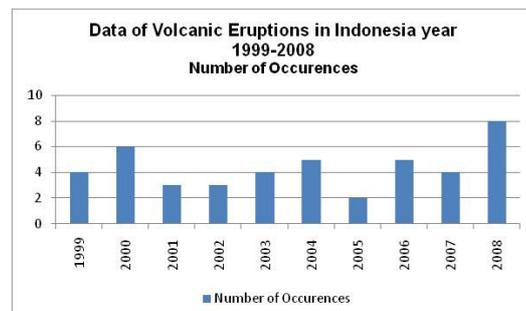
Figure 1. Increase of Environmental Disasters recorded 1999 – 2009



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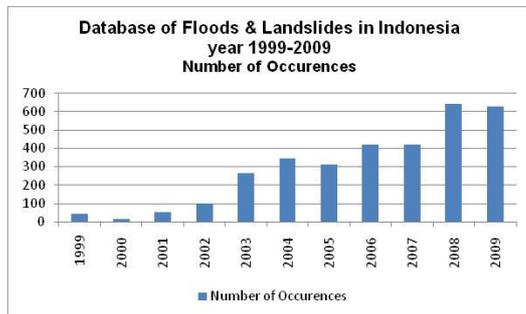
Figure 2. Increase of Earthquakes & Tsunamis recorded 2000 – 2009



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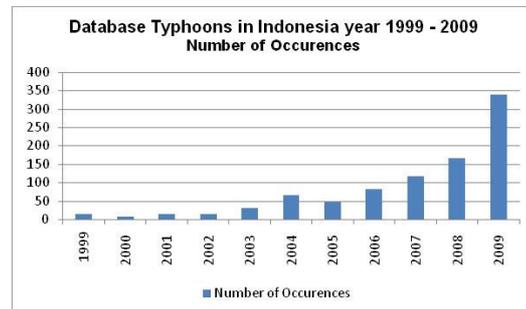
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Figure 3. Increase of Volcanic Eruptions recorded 1999 – 2008



Source:  
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<http://dibi.bnpb.go.id/DesInventar/statistics.jsp>)

Figure 4. Increase of Floods & Landslides recorded 1999 – 2009



Source:  
([http://www.bnpb.go.id/website/index.php?option=com\\_content&task=view&id=2101](http://www.bnpb.go.id/website/index.php?option=com_content&task=view&id=2101)  
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Figure 5. Increase of Typhoons recorded 1999 – 2009

Unfortunately, the increasing numbers of environmental challenges affected the human sustainability. The phenomenon seemed to be difficult for conventional solution therefore sustainable architectural design strategy was crucial.

Sustainable Architectural Design could be defined as “the architectural design that delivered with environmental-friendly approach in conscious framework of sustainability. Its design carried out with minimising the negative environmental impact of buildings by enhancing efficiency and moderation in the use of materials, energy, and development space.” ([http://en.wikipedia.org/wiki/Sustainable\\_architecture](http://en.wikipedia.org/wiki/Sustainable_architecture)). And it was related to the concept of “Sustainable Development” by World Commission on Environment and Development as “the development that fulfilled the current generation needs without compromising the future generation ability to fulfil their needs” (WCED Report of 1987).

International Union of Architect (UIA) presented an important concept of Sustainable Architectural Design on 7th December 2009 in Copenhagen. It stated its commitment for implementing “Sustainable by Design Strategy” such as:

- Sustainable by Design should begin with the earliest stages of a project and needed commitments between all the stakeholders: clients, designers, engineers, authorities, contractors, owners, users and the community.
- Sustainable by Design needed to incorporate all aspects of construction AND future use based on full Life Cycle Analysis and Management
- Sustainable by Design could optimise efficiency through design. Renewable energies, high performance and environmentally benign technologies could be integrated to the greatest practical extent in the project conception.
- Sustainable by Design recognised that all architecture and planning projects were part of a complex interactive system, linked to their wider natural surroundings, and reflect the heritage, culture, and social values of the daily life of the community.
- Sustainable by Design would seek healthy materials for healthy buildings, ecologically and socially respectful land-use, and an aesthetic sensitivity that inspires, affirms and ennobles.
- Sustainable by Design aimed to significantly reduce carbon imprints, hazardous materials and technologies and all other adverse human effects of the built environment on the natural environment.
- Sustainable by Design endeavoured improving the quality of life, promoting equity both locally and globally, advancing economic well-being and providing opportunities for community engagement and empowerment.
- Sustainable by Design recognised the local and planetary interdependence of all people. It acknowledged that urban populations depend on an integrated, interdependent, and sustainable

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rural-urban system for their life support systems (clean water and air, food, shelter, work, education, health, cultural opportunity, and the like).

- Sustainable by Design endorsed UNESCO's statement that cultural diversity, as a source of exchange, innovation and creativity, was very important for humankind.

All the strategies showed that the socio-economic context and environmental challenges would generate distinctive Country's Sustainable by Design Strategy. Understanding this, the Indonesian Sustainable by Design strategy was prescribed by our team.

Several Green Building Codes were evaluated to yield the more contextual Sustainable by Design strategy for Indonesia. These codes were: Leadership in Energy and Environmental Design (LEED) – US Green Building Council USA; Green Mark – Singapore; Green Neighbourhoods Planning and Design Guidelines - Center for Housing Innovation, University of Oregon, USA; High Performance Building Guidelines - City of New York, Department of Design & Construction, USA; and The Land Code, Guidelines for Environmentally Sustainable Land Development - Yale School of Forestry & Environmental Studies, Yale University, USA. And some of the parameters were adopted in our recommendations.

Further potential environmental challenges such as earthquakes, volcanic eruptions, floods, landslides, tidal waves, and typhoon needed to be incorporated. And some Indonesian National Standard (Standar Nasional Indonesia/ SNI) had prescribed several safety measures that aligned the Sustainable by Design Strategy such as:

- Structural Safety
  - SNI 03-1727-1989 - Procedure of Load Design for Houses and Buildings,
  - SNI 03-1729-2002 - Procedure of Steel Buildings Design,
  - SNI 03-1734-1989 - Procedure of Reinforced Concrete and Reinforced Retaining Wall for Houses' and Buildings' Design,
  - SNI 03-2847-1992 – Structural Calculation Procedure of Concrete Structures in Buildings,
- Earthquakes & Tsunamis Safety
  - SNI 03-1726-2002 Procedure of Earthquake Safety for Houses' and Buildings' Design,
- Floods and Landslides Safety
  - SNI 03-1962-1990 Procedures of Planning for Landslides Prevention,
- Extreme Weathers Safety
  - SNI 03-2397-1991 - Procedure of Wind-Resistant Houses Design,
  - SNI 03-6652-2002 – Procedure of Buildings' Lightning Protection Design,
  - SNI 03-7015-2004 – Lightning' Protection System for Buildings,
- Fires Safety
  - SNI 03-1735-2000 - Procedures of Buildings' and Neighbourhoods' Fire Safety Accesses Planning,
  - SNI 03-1736-2000 - Procedure of Houses' and Buildings' Fire Safety Design,
  - SNI 03-1745-2000 - Installation Procedures of Houses' and Buildings' Hydrant System,
  - SNI 03-1746-2000 - Procedure of Buildings' Fire Escape Routes Planning.

And these regulations could be developed further to become the integrated sustainable by design strategy in Indonesia.

### **3. Methodology**

The research was conducted with evaluating the Sustainable by Design recommendation by UIA and several Green Building Codes. Further existing Indonesian National Standard were also evaluated to incorporate a new Sustainable by Design strategy. Later on, discussions were made internally in Petra Christian University acknowledging this issue and prescribing more integrated framework. Last but not least, a study case was examined. The case study selected was a home designed by Dr. Heinz Frick. The case was hopefully able to show sustainable design.

### **4. Results and Discussions**

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### 2.1 Sustainable by Design Strategy for Indonesia

The Sustainable Architectural Designs Strategy in Indonesian context should encompass the following aspects:

Table 1: The Sustainable Architectural Design Strategies for Indonesia

General Aspects	Primary Aspects	Sub-Aspects	Strategies
The Economical Aspects	Improving Quality of Live (especially Local Poor)		Providing employment for local workmen and utilising local material/ recycled material
	Functionality		Provide optimal function of the building
	Cost Effectiveness & Efficiency		Utilise cost-effective structures and efficient building materials and finishing
	Integrated Design – Construction – Management Process		Provide integrated approach in design, construction and building management with optimum number of building experts
	Security		Provide optimum security measures
	Safety	<ul style="list-style-type: none"> <li>• Structural Safety</li> <li>• Earthquakes &amp; Tsunamis Safety</li> <li>• Floods and Landslides Safety</li> <li>• Extreme Weathers Safety</li> <li>• Fires Safety</li> </ul>	Provide cost effective measures to ensure the safety of the building users
	Future Adaptability		Provide possible adaptation for building uses
The Social Aspects	People Awareness for Sustainable Design		Provide campaign to increase the people awareness for sustainable building design and building uses
	Legal Protection		Provide strong legal status for building such as land certification and building construction permit
	Participatory Design Process involving all stakeholders		Facilitate possible optimum participation of numbers of stakeholders
	Aesthetics		Increase aesthetics for the design
	Cultural Diversity Preservation		Facilitate possible cultural diversity of the users in private buildings
	Social Inclusiveness	<ul style="list-style-type: none"> <li>• Facilitating Social Interaction</li> <li>• Universal Accessibility</li> </ul>	Facilitating social interaction and increase accessibility for all
The Environmental Aspects	Appreciation of Interrelationships with the Environment	<ul style="list-style-type: none"> <li>• Location Selection</li> <li>• Micro-climate</li> <li>• Site Planning and Design</li> <li>• Environmental Impact Assessment</li> </ul>	Appreciating the sites, climates and the local and global environment
	Full Life Cycle Analysis and Management	<ul style="list-style-type: none"> <li>• Thermal Comfort</li> <li>• Building Materials</li> <li>• Water Efficiency</li> <li>• Energy Efficiency</li> <li>• Waste Management</li> </ul>	Utilising the low cost and low technology with low negative impact in building technology measures

From the framework above, some aspects were important to be highlighted for Indonesian context. Improving Quality of Live (especially Local Poor) was the main issue for Indonesia context. One example of improving quality of life strategy was done by Mangunwijaya (1998). He created his

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building designs with the local builders with local unique design utilizing recycled materials. Therefore, he supported the local economy with sustainable construction methods. This strategy was found very important to be implemented in Indonesia.

Cost Effectiveness & Efficiency was also the important aspect stated by Vitruvius ([www.scribd.com](http://www.scribd.com)). Vitruvius stated, "Economy denotes the proper management of materials and of site, as well as a thrifty balancing of cost and common sense in the construction of works." In Indonesian, cost efficiency became the main concern of the building developments. Consequently, the buildings were less safe from earthquakes, floods landslides, etc. Therefore, cost-effective measures were needed for ensuring the building safety; on the other hand the unnecessary building finishing could be eliminated as prescribed by Eko Prawoto and Adi Purnomo (Akmal, I., 2005).

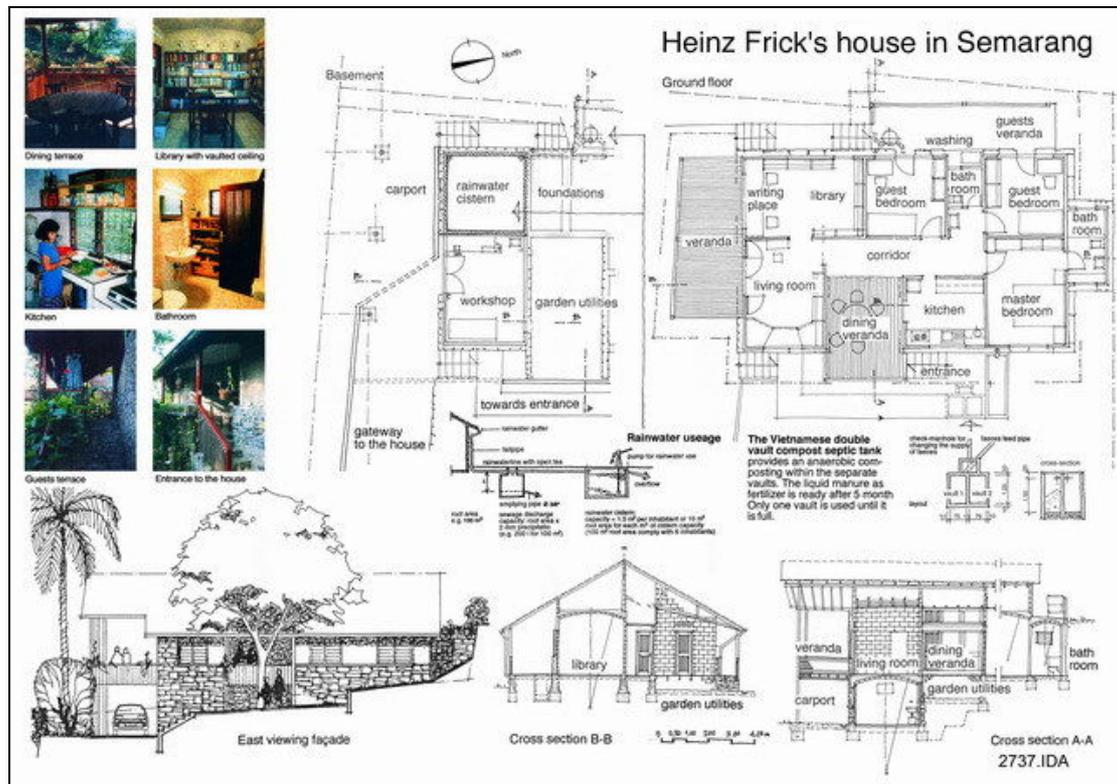
### *2.1 Sustainable by Design in Heinz Frick House Semarang*

Evaluating Heinz Frick's house in Semarang, Indonesia, several aspects were evaluated to measure and prove the importance of environmental challenges consideration in the sustainable by design in Indonesia. Three main aspects discussed in the paper were the Functionality, Cultural Diversity Preservation, Safety and Full Life Cycle Analysis and Management of Heinz Frick House. Other aspects were still analysed in the on-going research.

Firstly, The Heinz Frick House was found very functional as well as honouring the local cultural diversity as described in Figure 6. The building is located in the Semarang, Indonesia within the Javanese and Muslim community. Heinz Frick adopted the local Javanese house organisation. The house adopted the Javanese approach such as facilitating social interaction, living, eating, reading as well as cooking. On the other hand, the kitchen was located in the front part of the house, because increasing defensible space or safety.

Secondly, Heinz Frick home was located in the steep highland areas of Ngemplak of Central Java. And it was designed using cost-effective structure system and building material. And it was designed considering the earthquake and landslide threats. Therefore, concrete foundation with special tar asphalt mixture was used for extra mitigation. The house was built in the split-level avoiding major cut and fill.

Further, the Full Life Cycle Analysis and Management were also taken care. The high humidity (80-90%) of the site was responded with proper cross ventilation. This further caused lower energy consumption. Further, innovative rainwater collection (a 12,000-litre cistern) was utilised. It actually provided water for washing, cleaning and irrigation. Waste separation container and composter were also introduced for supporting the gardening activity. Sustainable paints and adhesives were used. Greeneries were also found in many building parts vertically and horizontally. All these shown that low cost, low technology, low negative impact solutions were possible for Indonesia condition.



Source: ([http://archnet.org/library/images/one-image-large.jsp?location\\_id=11714&image\\_id=99937](http://archnet.org/library/images/one-image-large.jsp?location_id=11714&image_id=99937))  
 Figure 6. Heinz Frick House Semarang



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 Figure 7. Heinz Frick House Semarang

## 5. Conclusion

Sustainable by Design Strategy needed to be implemented in Indonesia with consideration of Environmental Challenges as well as Economical and Social Local Context. The Low Cost, Low Technology and Low Negative Impact Development strategies could be adopted successfully as implemented in Heinz Frick House in Semarang.

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<http://www.fema.gov/hazard/types.shtm>  
<http://www.fsr.itb.ac.id/en/wp-content/uploads/2007/12/THE%20APPLIED%20STUDY%20OF%20ECO.pdf>  
<http://www.indonesiadesign.com/v2/top.php?resolve=4&edition=060035&main=6>  
<http://www.indonesianforest.com/>  
[http://www.nyc.gov/html/ddc/html/design/sustainable\\_home.shtml](http://www.nyc.gov/html/ddc/html/design/sustainable_home.shtml)  
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