Agustus 2013

# Jurnal Arsitektur

ISSN: 2338-7912

# scale

Sustainablity City Architecture Landscape Environment



FAKULTAS TEKNIK
UNIVERSITAS KRISTEN INDONESIA

Volume 1
Nomor 1
Halaman 1 - 70

*SCALE* ISSN: 2338 - 7912
Volume 1, No. 1, Agustus 2013

# SUSUNAN REDAKSI

*SCALE* ISSN: 2338 - 7912
Volume 1, No. 1, Agustus 2013

# DAFTAR ISI

*SCALE* ISSN: 2338 - 7912
Volume 1, No. 1, Agustus 2013

# BIOHAZARD AND THEIR IMPACT TO THE SETTLEMENT IN WETLAND AREAS

**James Rilatupa**
Architecture Department, Christian University of Indonesia
Kampus UKI, Mayjen Sutoyo, Cawang, Jakarta, Indonesia
(jrilatupa@gmail.com)

***Abstract***

*Indonesia as a tropical country consist of some island which separated by water/oceans. Meanwhile Indonesia also has some kinds of water like lakes, rivers, underground water and rain. Many of land in Indonesia are wetland area, especially in lowland plain and coastal. Wetlands area as a settlement is very important part in maintaining the balance of the cities weather as well as influence to global warming.*

*In settlement, people activities need some water and resulted wastewater. To reduce the negative effect of wastewater needed waste management treatment. Meanwhile, biological attack is biohazard can the disfiguring surface and contents of the building, caused their settlement has changed. Rodents, termite algae, fungi and other pests (mosquito, fly, cockroach, etc.) as attack biohazard are not limited to the settlement.*

***Keyword: settlement, water, biohazard.***

## I. INTRODUCTION

Allsop *et.al.* (2004) defined biohazard as '*any undesirable change in the properties of a material caused by the vital activities of organisms*'. Another term in common use is that of biodegradation. Although no formal definition has general acceptance, it may be useful to think of biodegradation as being '*the harnessing, by man, of the decay abilities of organisms to render a waste material more useful or acceptable*'. Both definitions involve humankind, in a negative or harmful way in the case of biodegradation as defined here. Both definitions also involve materials.

Meanwhile wetland, we define as a land has much water around it; like coastal, mangrove, swamps and peat lands. Indonesia has many wetlands, especially in lowland plain. Now, wetlands in Indonesia become settlement for residential and commercial. With the existence of new settlement in wetlands, interaction between biohazard and wetland has developed.

This paper seeks to introduce some of interaction between biohazard and humankind's materials through the disciplines of environmental biology and ecology.

## II. SCHEMATIC OF ANALYSIS

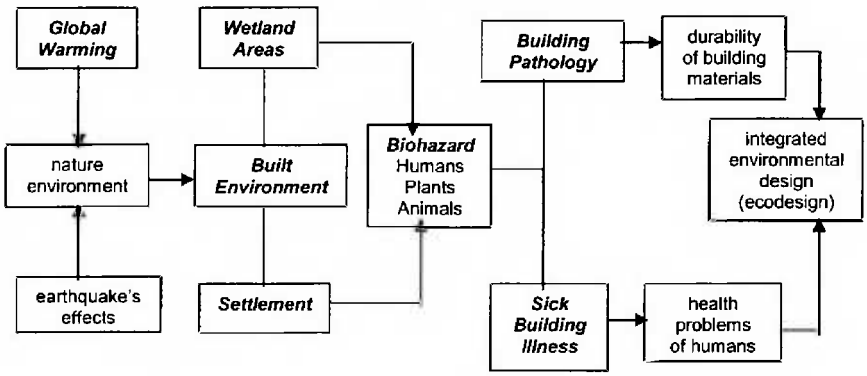


**Figure 1. Analysis schematic of Global Warming Effect**

The schematic of analysis the effect of global warming will discuss only for wetland areas (built environment and settlement) and biohazard. Furthermore, biohazard has impact to material building (building pathology) and human (sick building illness). To minimize the effect of biohazard, we must design building for settlement which suitable with environment (ecology and biology), or common use is integrated environmental design (ecodesign).

## III. ENVIRONMENTAL IN NORTH JAKARTA

The ice melted in Artic area (92 percents) in North Pole and forest area in Indonesia remain 25 percents to make impact for extend wetland areas in coastal Indonesia, especially in north coastal of Jakarta. Based on satellite photos explained that to occur change of Jakarta in 2010, which estimated seawater would entered in land. Meanwhile in 2020, a part of Soekarno-Hatta Airport has flooded by seawater; even in 2050, seawater has threatened National Monument in center of Jakarta.

Population of inhabitant Jakarta (density of population in 2003 is 13,012 inhabitants/km$^2$), and to patch this people the Government of North Jakarta, West Java. Province prepared the area of Pantai Indah Kapuk, Pluit, Ancol and Cilincing. The development of these areas and its vicinity to become coastal environmental (wetland areas) changed to new (manufacture) environmental for built residential and commercial. In developing of Jakarta and its vicinity, it often occurs the coastal open space is lack attended. This problem is dangerous because the lack of coastal open space can have influence environmental balance in Jakarta and its vicinity. The understanding of paradigm changes urban planning is very important, especially in developing better approach for built environmental qualities.

Moreover, the land area for most of physical development was originally wet land or floating area, where microbial world thrives and

pest building. Especially for building site ex coastal areas (Pantai Indah Kapuk, Pluit and Ancol) usually abundance with rodents, algae and fungi. Change of the ecosystem condition tend to increase the activity of microbial population and new environmental for built residential and commercial and fill in new soil on coastal areas. This impact from soil transferred as termite's contents to becoming building destroying pest, and their attack caused economic losses. Actually in Pantai Indah Kapuk, Pluit and Ancol, termites as recognized as a part of biotic component of the environment to decomposed dead wood into soil nutrient, but now several termite species has become building pest. In many modern structures, both residential and commercial, termite attack is not limited to the structural elements. The insects may feed on flooring, paneling, window and doorframes, even when structure is of a concrete or steel frame. In Indonesia, for the last fifteen years, termite has claimed as the most destructible for buildings. Not only because of the many cases happened, but the economic losses due to termite damage are unbearable.

## IV. BIOHAZARD: THEIR AFFECTING TO THE BUILDING AND HUMAN

Our concern is generally limited to the damage biohazard do to building materials and human health. To know their characteristics is important to discount their damage. Pest organism cannot be considered in isolation from their habitat. Often, the habitat and the food source are essentially the same; hence, wood boring insects are considered mainly under the sections on wood.

### Rodents in buildings

Our interest in rodents, however, owing to their effects on humans and to their omnivorous eating habits. The activities of rodents are not confined to dwelling houses; the significance of rodents as deteriogens is in their activities as commensal organisms. The rodents are a large group of mammals with some 2000 representative species worldwide. The word "rat" may properly apply to any of about 500 species of animal and the word "mouse" to at least 130 species.

Rodents are most easily distinguished from other mammals by the characteristic arrangement and form of their teeth. Rodent incisors have three basic characteristic that together distinguish them from the teeth of most other animals. They are strongly curved, they grow continuously throughout the animals life, and the carry a layer of enamel on the outside surface only. The gnawing action results in the softer dentine being worn more rapidly than the hard enamel, giving a chisel-like outer edge to the teeth, which can penetrate soft metals such as lead and aluminium.

Rats as one of damaging rodents eat and contaminate foodstuffs and animal feed. They also damage containers and packaging materials in which foods and feed are stored. Both rat species cause problems by gnawing on electrical wires and wooden structures such as doors, ledges, corners, and wall material, and they tear up insulation in walls and ceilings for nesting. Rats can undermine building foundations and slabs with their burrowing activities and can gnaw on all types of materials, including soft metals such as copper and lead, as well as plastic and wood. If roof rats are living in the attic of a residence, they can cause considerable damage

with their gnawing and nest-building activities. They also damage garden crops and ornamental plantings.

Many diseases carried by rats and mice, plague at once comes to mind. This is spread from rats to humans by fleas. Plague is still endemic in many areas, and will be found in wetland areas, especially if flooded. For example leptospirosis disease, causal organism *Leptospira spp*, is excreted in rat's urine. Among the diseases rats also can transmit to humans or livestock are murine typhus, salmonellosis (food poisoning), and ratbite fever.

**Termites**

Termites are social insects, meaning that they reliant on one another for their individual as well as collective survival. Because of their body make-up, they must live in a closed environment, which is nest, with regulated temperature and humidity. This requirement limits their mobility. Likewise, their diet is restricted to cellulose obtained from wood, leaves, and humus. That said, termites have been able to radiate adaptively into various food niches, such as books and other paper sources (Watt, 1999).

The wood destroying termites consists of underground termites, subterranean termites and dry wood termites. Underground termites gain access to building through adjacent earth-filled steps, porches, terraces, patios, breezeways, and planters. The subterranean termites, typically eat softwood and hardwood. Their intricate galleries tend to form concentric circles around the annual rings in the cross section of the wood, working along the grain, leaving paperlike pieces of wood divisions. They builds their nest in the ground and tunnels connecting their forage and needs high humidity to live. In contrast, the dry wood termites live inside the wood and do not have direct contact with the ground. These types of termites are commonly found in attics of building, where they can survive without any soilconnections. Damaged wood infested by the drywood termite exhibits clean, smooth cavities, which look as though the surface had been gone over with sandpaper.

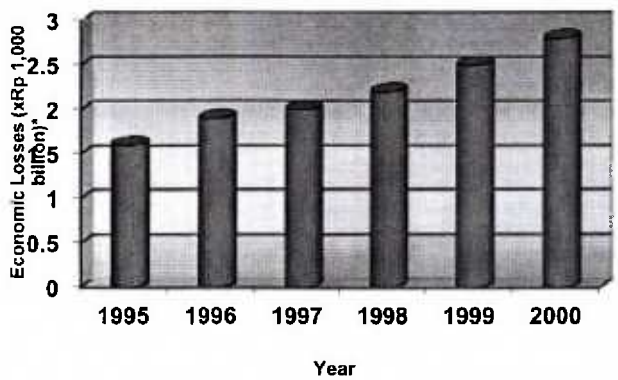


**Figure 2. Economic Losses Caused by Termites Attack In Indonesia (Nandika *et al*, 2003).**
*** 1 US$ = Rp 9,000.-**

About 2,000 species of termites exist in the world, which 200 species of them found in Indonesia. Most of them are subterranean termites and only several species are dry wood termites. The most damaging and devastating are *Coptotermes spp.* In Jakarta has been reported 15 (fifteen) species of subterranean and 2 (two) species of dry wood termites. Among the subterranean, 5 (five) *Coptotermes* species has been found : *C. curvignathus, C. havilandi, C. kalshoveni, C. heimii,* and *C. travians*. Nandika *et al.* (2003) clarified the economic losses due to termite damage in Indonesia can reach 2,800 billion rupiahs in 2000 (see Figure 2).

**Marine borer**

Shipworms is a spectacular damage in all coastal areas. Shipworms hava a worm-like appearance and are notorius for causing extensive damage to wooden ships and other wooden waterfront structure (include wooden settlement). Shipworms are really not worms at all, but marine mollusks similar to clams, with long, worm-like bodies with greatly reduced shells at the end. Floating larvae bore tiny holes on the surface of woody materials, and the adults use their shells to create larger tunnels inside the wood. Damage is often discovered too late to do anything except replace the infected structures. This insect are generally more destructive in tropical and subtropical waters. Their population depends on a number of factor such as salinity changes, water temperature and dissolved oxygen content.

**Alga**

Being autotrophs, alga grow where there is sun. They are thus fund outdoors, mainly on material surface of walls. A number of species thrive on external walls of buildings depending on the types of habitat available. The moisture from the occasional rain and nutrients from dust blows off the road are the two main necessities of habitat. The species of algae that would proliferate on a specific habitat would depend on its degree of tolerance to desiccation. Under drier conditions, where the occasional rain provides moisture for a limited period, the most xerophytic of the species can survive.

**Fungi**

On internal wall surfaces and external surfaces shaded from the direct rays of the sun and where the humidity is high, fungi rather than algae are the organisms that are likely to proliferate (Lim, 1988). The medium on which the fungi are growing must provide the organic nutrients necessary for their growth. This is one basic difference between algae and fungi. Not having chloroplast in their cells, fungi cannot synthesize their own organic food. This is one reason why fungi do not grow under bright sunlight, which will in fact retard growth, if not kill the organisms altogether.

Because of these characteristics, fungi are often found on walls of bathrooms and surfaces where the adjoining room is air-conditioned. Surfaces can be bare concrete, brick walls or even wood. Fungal attack results in change of color, structure, chemical composition and properties of wood. Whether the surface is painted or otherwise will not make any difference, as long as conditions for growth are favourable.

Ceiling boards are another area of attack as these materials can soak up large quantities of water, remaining damp for a long period. Where the medium can provide nutrients for the growth of the fungi, growth will be prolific.

There are two types of fungi: parasites and saprophytes. Parasites exist on living plants and animals, whereas saprophytes feed on dead matter, such as the cell walls of deceased trees. Potential and actual human health problem (other than food contamination) can occur because of microorganisms in buildings. Fungal spores, dead or alive, especially when present in large numbers, can trigger allergies, such as allergic rhinitis, or induce asthma.

**Other pests**

The two primary dangers from mosquitoes are dengue fever (day-biting mosquito) and malaria (night-biting mosquito). While malaria is not endemic in Jakarta, it is found in many areas of Indonesia. Dengue fever is a concern throughout the country, including Jakarta. The mosquitoes that carry dengue fever breed in clean stagnant water and are thus more of a threat in the rainy season. Some people have tried mosquito repelling plants with some success. The recommendation is always to do everything possible to prevent being bitten by mosquitoes.

Cockroaches live in unclean conditions, where garbage is open and there is access to food. Many new residents are startled by the scurrying of cockroaches into cracks and crevices whenever they enter a room and turn on the light. Controlling ants is a constant challenge in Indonesia. Their industrious efforts to sustain their nests mean that trails of ants into your home may be a fact of life during your stay. Spraying trails of ants in your home is totally ineffective. Ants make their nests in your yard, in the attic or in your neighbor's yard and attic (http://www.expat.or.id/info/pests.html).

The other pest such as fly, ant, flea and louse has found in settlement of North Jakarta. Many diseases carried by these pests; like fever, allergic, cholera, itch, dysentery and etcetera. Such biological factors are involved in sick building syndrome, a complex situation in which occupants experience a variety of symptoms and become generally unwell, recovering only when they cease to frequent the building.

## V. BUILDING PATHOLOGY

The principles upon which building pathology is based rely on a detailed knowledge of how a building is design, constructed, used and changed, and the various mechanisms by which its structural, material and environmental conditions can be affected. The term pathology is defined as the systematic study of diseases with the aim of understanding their causes, symptoms and treatment. Definition of building pathology (Watt, 1999) is the:

- Identification, investigation and diagnosis of defects in existing buildings;
- Prognosis of defects diagnosed, and recommendations for the most appropriate course of action having regard to the building, its future and resources available; and

- Design, specification, implementation and supervision of appropriate programmes of remedial works, and monitoring and evaluation of remedial works in terms of their functional, technical, and economical performance in use

Based on Harris (2001), the science of building pathology and diagnostics addresses the deterioration and the demise of buildings and their components systems. The combination of building material properties and environmental conditions create the requisite components that perpetuate materials deterioration, hence building failure. It is the job of the building pathologist to aptly access and diagnose these sources of the decay; ideally, this assessment will be comprehensive, thorough, and circumspect. The object is to ascertain the condition of the building and the source of the defects, and to prioritize them in orderly and intelligible form. As evaluators, experts in the field, it is our job to meet all the technical objectives of the assessment and to present the assessment in a manner that is understandable and acceptable to the client or layperson. The deterioration mechanism is to building pathology as disease is to human pathology (see Figure 3).

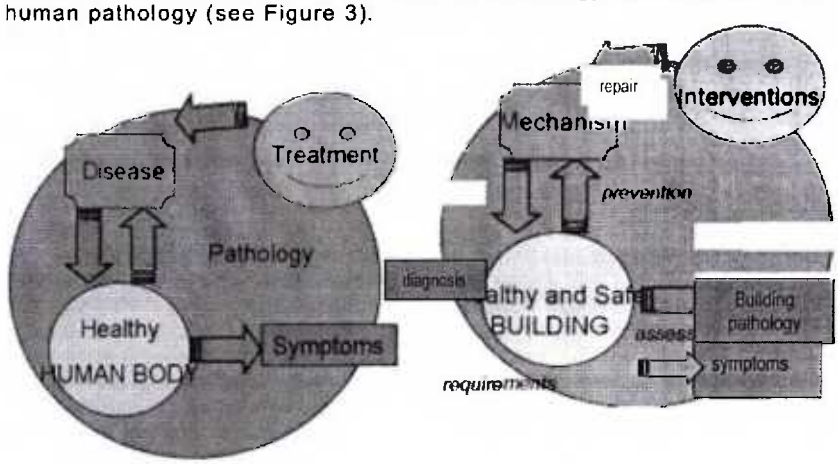


**Figure 3. Analogy of Human Pathology and Building Pathology (Harris, 2001)**

The problem of biohazard in buildings are many and various. Some relate to the materials used and some to the environment created by the building itself, its associated services, and the uses to which the building is put. We must acknowledge that many organism view the building and materials with which they are constructed as either food or shelter, and occasionally, as both. To do otherwise is naïve. To limited to the damage these organisms do to the building and materials is very important. Based on Rilatupa (2007), almost of biohazard's (especially termite) activities are depending on utilities, environmental and protection systems of buildings.

## VI. CONCLUSIONS

The population of inhabitant Jakarta and its vicinity has increased; therefore the necessity of residential and commercial also increase. It becomes nature environmental (land area) changed to new (manufacture) environmental for built residential and commercial. In developing of Jakarta, it often occurs the green open space is lack attended. This problem is dangerous because the lack of green open space can have influence environmental balance in Jakarta.

The green building in Jakarta provide some level of environmental comfort and amenities of light and air by virtue of the designed interactions between building and environment. The main biohazard problems can be listed and considered under a series

a. Rodents and other pest causing mechanical damage of fabric and presenting health risks general headings
b. Termites: affecting structural strength (wood structure), causing aesthetic problems, affecting components of construction and economic losses
c. Algae and fungal growth: affecting the structural strength; affecting decorations, paintwork, furniture; causing aesthetic problems and causing health problems
d. Other pests: many diseases carried by pests; like fever, allergic, cholera, itch, dysentery and etcetera.

Building Pathology is the systematic treatment of building defects, their causes, their consequence and their remedies. The principles of building pathology rely on a detailed knowledge of how building is designed, constructed, used and changed, and the various mechanisms by which its structure, materials and environmental conditions can be affected.

## REFERENCES

Alisopp, D., K.J. Seal and C.C. Gaylarde (2003), *Introduction to Biodeterioration*, Cambridge University Press, Cambridge.

Bachman, L.R. (200), *Integrated Buildings: The System Basis of Architecture*, John Wiley & Sons, Inc, New Jersey.

Eisele, J. and E. Kloft (2002), *High Rise Manual: Typology and Design, Construction and Technoloy*, Birkhauser– Publisher for Architecture, Basel-Boston-Berlin.

Harris, S.Y. (2001), Building *Patholog : Deterioration, Diagnostics, and Intervention*, John Wiley & Sons, Inc, New York.

Kompas (200), *Climate Justice Harus Disuarakan*, Kompas, 1 Oktober 2007:13. Kompas, Jakarta.

Kompas (2007), *Diandalkan, 88 Juta Hektar Hutan*, Kompas, 4 Oktober 2007:13. Kompas, Jakarta.

Lim, B.B.P. (198), *Control of The External Environment of Buildings*, Singapore University Press, Singapore.

McMullan, R. (2002), *Environmental Science in Building (Fifth Edition)*, Palgrave, New York.

Rilatupa, J. (2007), *Pendugaan Indeks Kondisi Kontruksi Akibat Serangan Rayap pada Komponen Bahan Berkayu Bangunan Tinggi*, Institut Pertanian Bogor, Bogor (*unpublished*).

Simonds, J.O. (1960), *Landscape Architecture: Ecological Approach to Environmental Panning*, McGraw-Hill Book Company, Inc., New York, Toronto, London.

Sigit, SH and UK. Hadi (ed.) (2006), *Hama Pemukiman Indonesia: Pengenalan, Biologi, dan Pengendalian*, Institut Pertanian Bogor, Bogor.

Watt, D. (1999), *Building Pathology: Principles and Practice*, Blackwell Sciences, Ltd., Oxford

Yeang, K. (2006), *Ecodesign: A Manual for Ecological Design*, Willey-Academy, London.

Anonymous (Copyright © 1997-2013), *The information on Living in Indonesia, A Site for Expatriates: Pest Control*, http://www.expat.or.id/info/pests.html.