

Proceeding 6th International Experts Meeting on Borobudur 2013



Direktorat
Kebudayaan

KEMENTERIAN PENDIDIKAN DAN KEBUDAYAAN
DIREKTORAT JENDERAL KEBUDAYAAN
BALAI KONSERVASI BOROBUDUR

**Proceeding 6th International
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2013**

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DIREKTORAT JENDERAL KEBUDAYAAN
BALAI KONSERVASI BOROBUDUR**

Proceeding 6th International Experts Meeting on Borobudur 2013

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Sambutan Kepala Balai Konservasi Borobudur

International Experts Meeting on Borobudur merupakan agenda lima tahunan yang mempertemukan berbagai pakar dari latar belakang yang berbeda untuk membahas perkembangan pelestarian Candi Borobudur. Agenda ini dilaksanakan terutama untuk membahas kondisi keterawatan (*state of conservation*) Candi Borobudur setelah dipugar oleh pemerintah Indonesia yang dengan dibantu oleh UNESCO, pada tahun 1973-1983. Dari pertemuan ini, berbagai rekomendasi telah dihasilkan untuk mempertahankan tingkat keterawatan Candi Borobudur. Hasilnya adalah Candi Borobudur masih terjaga keterawatannya sampai dengan saat ini.

6th *International Experts Meeting on Borobudur* telah dilaksanakan pada tahun 2013 di Magelang yang bertujuan untuk membahas berbagai aspek pelestarian di Candi Borobudur, seperti keterawatan batu, kestabilan candi dan bukit, ancaman bencana alam, serta konservasi kawasan Borobudur. Dari berbagai topik tersebut, rekomendasi telah disampaikan di akhir pertemuan. Rekomendasi yang dihasilkan kemudian akan diikuti dengan penyusunan rencana aksi tahunan yang semuanya bermuara bagi terjaganya kelestarian Candi Borobudur.

Akhir kata, semoga berbagai makalah di buku ini dapat meningkatkan kesadaran akan pentingnya pelestarian Candi Borobudur. Rekomendasi yang telah dihasilkan pun harus menjadi masukan bagi para *stakeholders* terkait, terutama Balai Konservasi Borobudur, dalam merumuskan program jangka panjangnya. Keluaran dari rekomendasi tersebut kemudian harus dilaporkan dalam pertemuan selanjutnya yang akan dilaksanakan pada tahun 2018.

Magelang, Desember 2014
Kepala Balai Konservasi Borobudur
Drs. Marsis Sutopo, M.Si.

Kata Pengantar

International Experts Meeting merupakan agenda lima tahunan yang dilaksanakan untuk mengevaluasi dan memantau kondisi keterawatan Candi Borobudur pascapemugaran kedua Candi Borobudur pada tahun 1973 – 1983. Candi Borobudur telah mengalami dua kali pemugaran. Pemugaran yang pertama dilaksanakan oleh Pemerintah Kolonial Belanda pada tahun 1907-1911, dipimpin oleh seorang insinyur bernama Theodore van Erp. Pemugaran ini berhasil dalam mengembalikan bentuk arsitektur asli Candi Borobudur dengan melakukan pencocokan dan pemasangan kembali batu-batu yang jatuh dan berserakan dengan metode anastilosis. Bentuk arsitektur Candi Borobudur yang sekarang kita lihat merupakan hasil dari pemugaran pertama.

Candi Borobudur kembali dipugar untuk kedua kalinya pada tahun 1973 -1983 dikarenakan kondisi candi yang sudah memprihatinkan. Candi Borobudur pada saat itu terancam akan runtuh dikarenakan kemelesakan struktur dinding yang cukup parah. Untuk mengatasi hal tersebut, Pemerintah Indonesia, dengan dibantu oleh UNESCO, memugar kembali Candi Borobudur. Bagian yang dibongkar adalah lantai 3, 4, 5, 6, dan 7. Lantai 1, 2, 8, 9, dan 10 tidak dibongkar karena dari penelitian disimpulkan bahwa lantai-lantai tersebut masih kokoh sebagai hasil dari rekonstruksi pada pemugaran yang pertama.

Pemugaran kedua dilaksanakan dengan membongkar batu-batu lantai yang berbentuk persegi, untuk kemudian dibersihkan. Selama pembersihan, pada struktur fondasi tanah candi dipasang perkuatan berupa beton bertulang yang didukung oleh sistem drainase air. Sistem pendukung ini diharapkan dapat membantu kestabilan struktur candi sekaligus bukit penyokongnya. Pemugaran ini berlangsung selama 10 tahun dengan melibatkan ahli dari berbagai bidang, seperti arkeologi, teknik sipil, kimia, dan biologi, baik yang berasal dari dalam negeri maupun dari luar negeri.

Setelah pemugaran selesai, para ahli tersebut, dengan difasilitasi oleh UNESCO, sepakat untuk mengadakan pertemuan setiap lima tahun sekali dalam mengevaluasi hasil pemugaran tersebut. Pertemuan tersebut disebut dengan *International Experts Meeting on Borobudur*. Pertemuan pertama dilaksanakan pada tahun 1988, yang kemudian berturut-turut dilaksanakan pada 1993, 1998, 2003, dan 2008. Pada pertemuan tahun 2003, disepakati bahwa pembiayaan pertemuan-pertemuan selanjutnya, pelaksanaannya diserahkan sepenuhnya oleh UNESCO kepada Pemerintah Indonesia. Pada tahun 2013 ini, dengan difasilitasi oleh Pemerintah Indonesia, dilaksanakan 6th *International Experts Meeting on Borobudur* pada 10-14 November 2013 di Atria Hotel and Conference, Magelang.

Dalam setiap pertemuan, permasalahan terkini yang dihadapi oleh Candi Borobudur dibahas dan didiskusikan untuk kemudian menghasilkan rekomendasi bagi pelestarian Candi Borobudur ke depan. Pada 5th *International Experts Meeting on Borobudur 2008*, telah didapatkan berbagai rekomendasi. Perkembangan dari rekomendasi ini yang kemudian akan dibahas dalam 6th *International Experts Meeting on Borobudur* tahun 2013 ini. Dari pembahasan ini, kembali diharapkan adanya rekomendasi yang dapat membantu pengelolaan dan pemeliharaan Candi Borobudur yang lebih baik.

6th *International Experts Meeting on Borobudur 2013* menghadirkan 16 pembicara yang terdiri dari 4 pembicara luar negeri dan 12 pembicara dalam negeri, yang dibagi kedalam 6 sesi panel yaitu:

1. Konservasi Candi Borobudur
2. Tekno Arkeologi Candi Borobudur
3. Candi Borobudur dan Ancamannya
4. Candi Borobudur dan Kebudayaan Indonesia
5. Candi Borobudur dan Pendidikan
6. Candi Borobudur dan Pelestarian Kawasan

Dengan tersusunnya buku ini, semoga menambah khazanah pengetahuan mengenai Candi Borobudur, serta menjadi pijakan bagi *stakeholders* terkait mengenai pelestarian dan pengelolaan Candi Borobudur selama lima tahun kedepan.

Magelang, November 2014

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**Penataan Ruang Cagar Budaya dalam
Pengelolaan KSN Candi Borobudur**

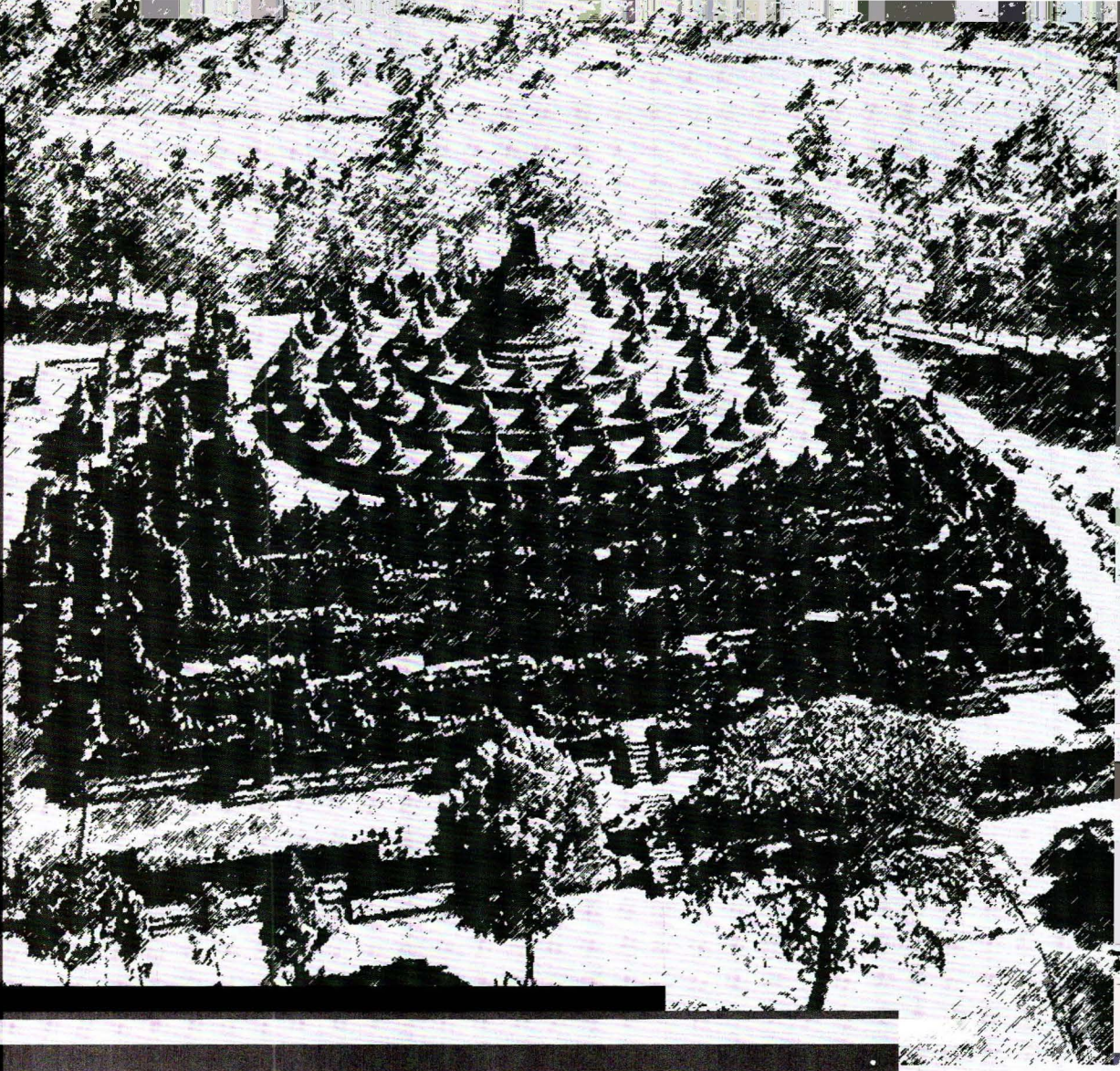
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**Conservation Problems
and Stone Deterioration Measures
for Stones of Borobudur**

New Challenge to Conservation of Stones on Borobudur Temple

Prof. Toshiya Matsui

Introduction

- The threats that endanger the heritage site becoming more and more diverse. Before the site was put into use, the materials of heritage had already suffered deterioration under various natural laws.
- When the people started to take advantage of this heritage as a resource and utilities, the deterioration rate is accelerated, and unknown threats arise.
- And, there is presenting a great problematic in front of our eyes.
- Unrelated to the diversification of the dangers revolving around sites, the techniques of conservation sciences that had been developed until today could respond accordingly to a historically known salt weathering and so on.
- Large-dimensioned monuments experience supreme visitors (tourist) before experienced since their construction, and events (concert) to promote the apprehension of this monument are commonly held.
- It may be assumed that these monuments were not designed for such amounts of visits and for events of such extent.
- When performing a diagnosis on a damaged site, it is necessary to handle correctly its damage. In the case of the Borobudur Temple, it is assumed that it was used at first for religious and ritualistic purposes, but as time passed by this spiritual meaning faded.
- The deterioration can be divided into the five categories described below. These phenomena include damage factors from the past, the present, and the mixed factors :
 1. Damage that may be ascribed to the first uses of the monument
 2. New forms of damage that arose when the utilization forms were transformed
 3. Degradation that has progressed further by changes in usage patterns
 4. Damage that was stopped when the utilization from changed (the original damage results remain)
 5. Mixed damage from the above-mentioned damage types

Change the utilization form = Change Environment = Generate Deterioration

New Approaches

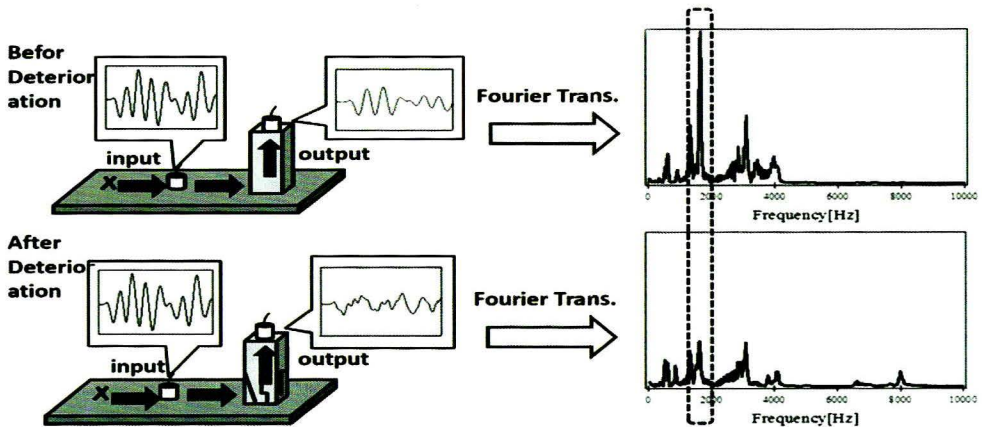
- Conservators have to look for the causes of damage.
- But the place already evolved with the surrounding environment and has reached a state of equilibrium would only be in second priority in treatment.
- Two goals of conservation sciences is to prevent the current progressing damage and the new damage that will be generated.



- We challenge the new conservation scientific studies.
 1. Deterioration Prevision of Heritage Site and Materials using Acoustic Sensing
 2. New Cleaning for stone
- Two ways for the role of practical conservation science on sites.
 1. The first one is to establish a conservation method that concerned with dispositions like sorting out materials for conservation and restoration methods.
 2. The second one is to carry out a preventative conservation as a precaution technique.
- We should know about this preventative diagnosis
 1. Catch deterioration potential
 2. Deterioration process
 - ➔ Detect the threshold of deterioration
- Our challenges;
 1. Deterioration Diagnosis with Vibration
 2. Deterioration Prediction By AE

Deterioration Potential

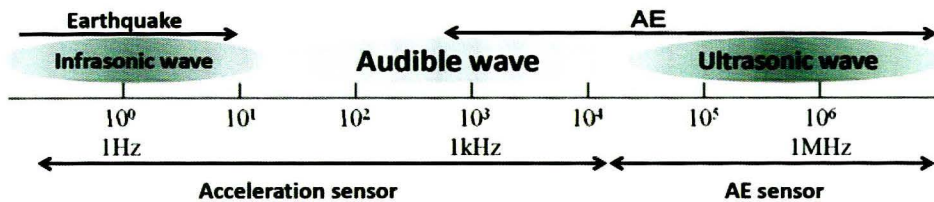
A material has its own eigen frequency. This frequency changes in accordance with its deterioration. So we will know a deterioration potential inside the material by analyzing the vibrations with this property.



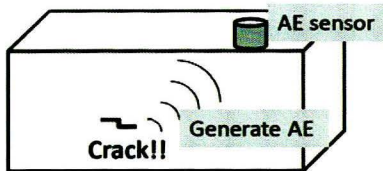
Deterioration Prediction by Acoustic Emission

The definition of AE is a phenomenon that emits strain energy stored in materials as elastic wave, at the time they are deformed or cracked. This method is used in many fields.

The deterioration prediction and its speed with the breaking out frequencies of AE which comes from micro-demolitions inside materials.



【Deterioration Prediction by AE】



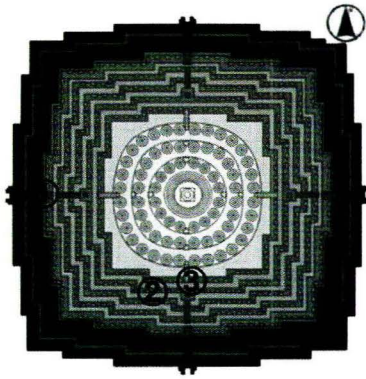
AE signals example

- Friction sound in landslide
- Absorbed water sound of plant root
- Termites having lumber

Objectives

- Microtremor measurements at Borobudur Temple was conducted in order to investigate physical impact caused by human activities (*c.f.* tourist) and natural vibration.
- This investigation aimed to evaluate condition of the stones and the restoration materials detecting the spread of vibration.

Measurement Points



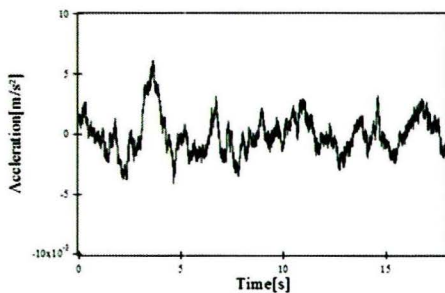
Point: west side-stairs (2-3F)

Point: south side (6F)

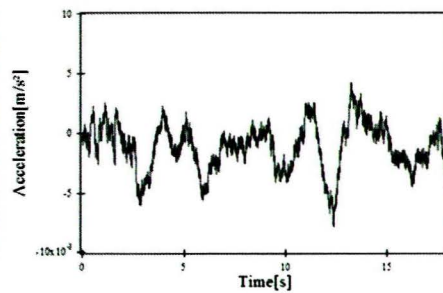
Point: south side-stairs(6-7F)

Investigation dates: 2010/7/30(Fri), 7/31(Sat)

Result : Microtremor



Point①(lower level)

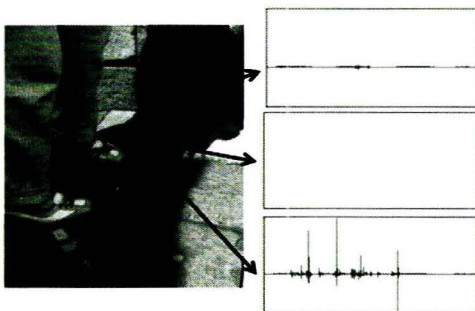


Point②(upper level)

The microtremor is a micro vibration induced by various vibrations among artificially or naturally propagating tremors in the foundation. No substantial differences were recognized in the upper and lower areas of the temple.

Walking Tremor

Point 2



Four people passed by the sensor.

Measured vibrations when people walk on gallery. A red sensor was set on the stone where people walk.

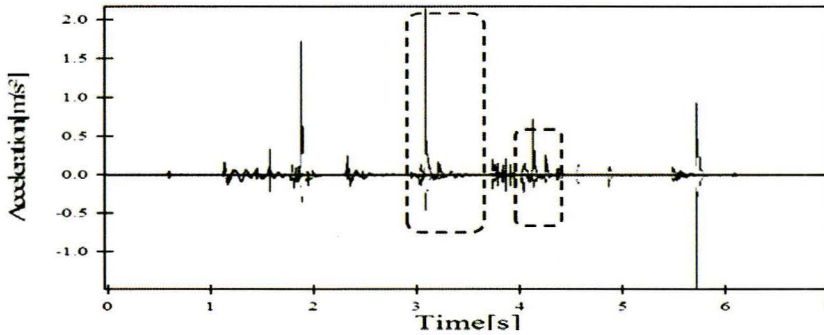
We chose some unstable areas on it and then researched the effects of surrounding stone materials when they walk in the rickety areas on that stone material.

Yellow stands for a sensor set on the adjacent stone material and Blue mark shows a sensor installed on the stone wall.

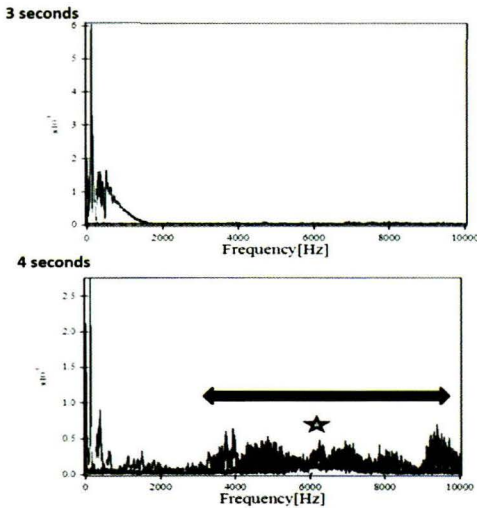
Result of Measured Data

Performed Fourier-transformation for the data nearby both at 3 and 4 seconds.

Fourier-transformation : an analytical method to convert acquired vibration data to frequencies .



Fast Fourier Transform (FFT); 0- 6000Hz

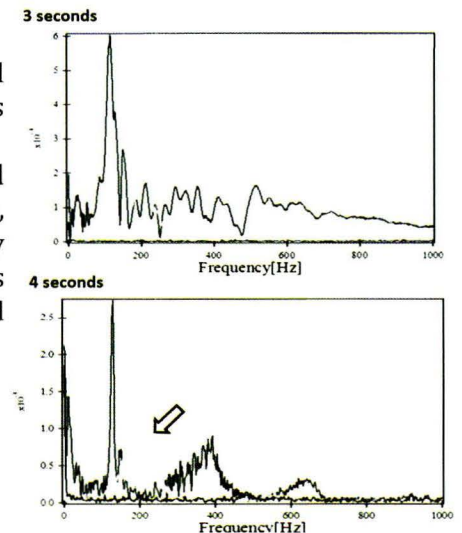


By comparing figure of 3 seconds with that of 4 seconds, while the former one detected only frequencies by 2000Hz, the latter one picked up a much wider range of frequencies and further more it showed a vibration on the wall at 6000Hz (★).

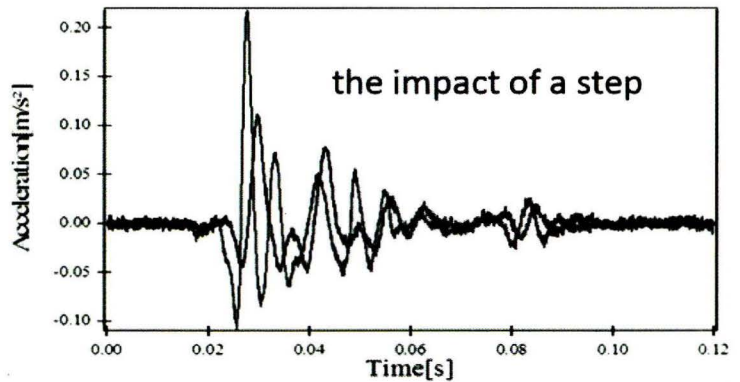
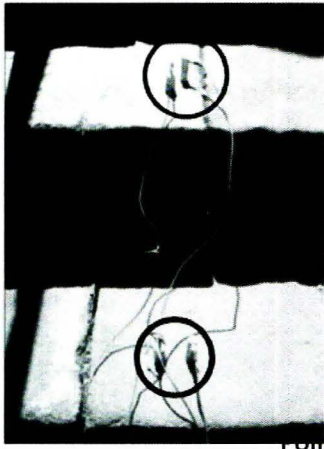
0-1000Hz. Here both 3 and 4 seconds show a shared property that the yellow line indicates bigger values than the red one at around 200Hz.

This is because a resonance occurred at 200Hz (↙) and the vibration from the red line shows amplifications, which, it can be said, belongs to the vibration property of andesite forming Borobudur Temple and indicates that the ruin resonates with the vibration at 200Hz and could be shaken substantially.

Fast Fourier Transform (FFT); 0- 1000Hz

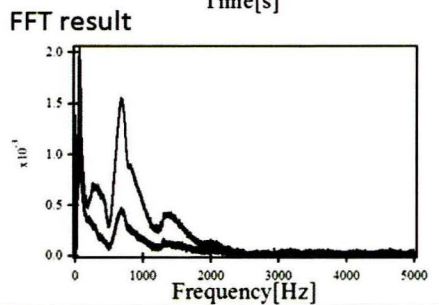
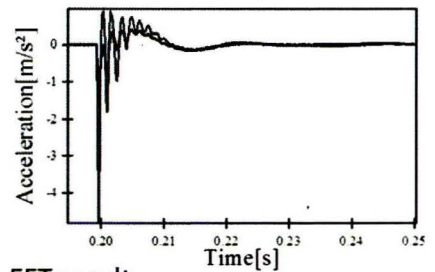
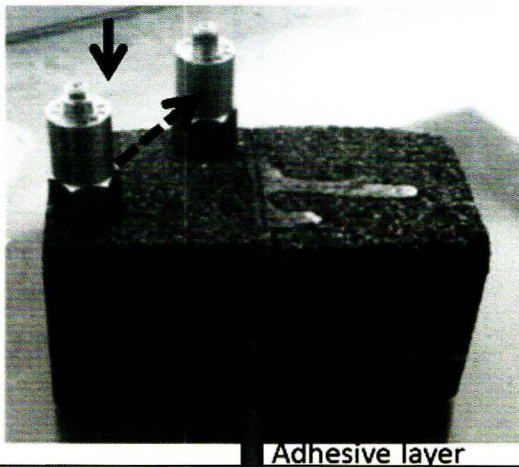


Tremor Caused by Climbing Stairs



- Measurement of vibration using an acceleration sensor when people climb the stairs.
- Walk on the stone material with a red sensor and paid much attention to the vibration of a stone located on the upper step indicated in blue.
- The right figure shows that moving on the stairs makes vibrations propagated to the upper stone, which tells us that the vibrations propagate absorbingly between the stones by amplifications or eliminations of a particular vibration.

Restoration Material Evaluation Test (Epoxy Resin)

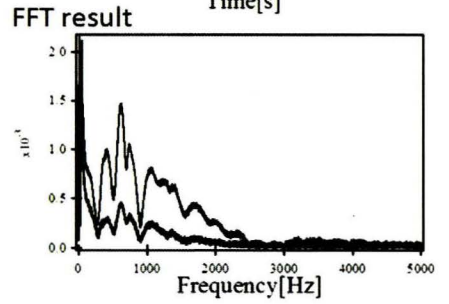
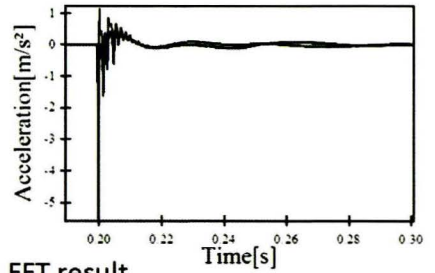
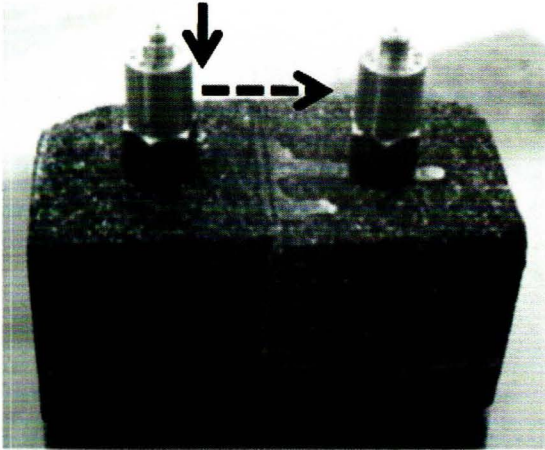


Results of the propagation for a vibration of restorative material that works as adhesive agent for rocks.

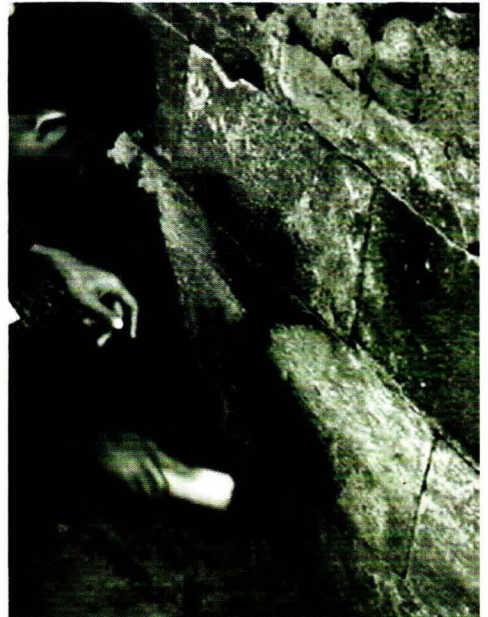
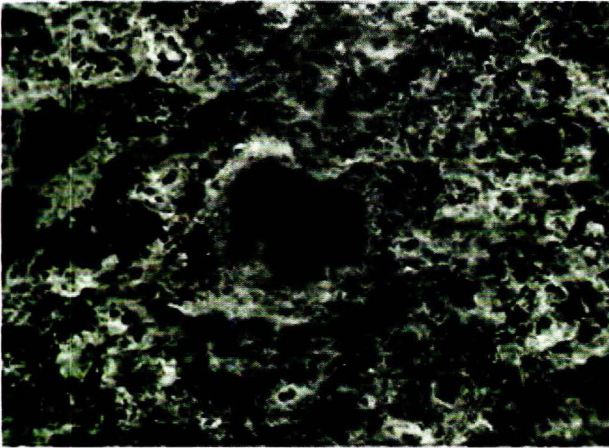
Tremor did not pass through bonding interface.

Restoration Material Evaluation Test (Epoxy Resin)

Measured a vibration that passes through the adhesive surface
Tremor passed through bonding interface.



Removal of Epiphytes on Stone

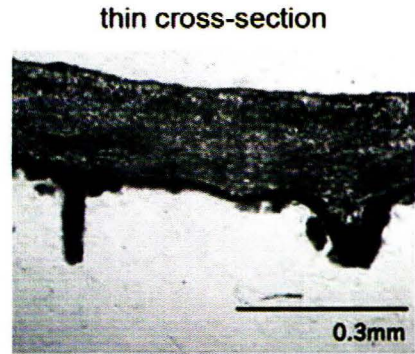
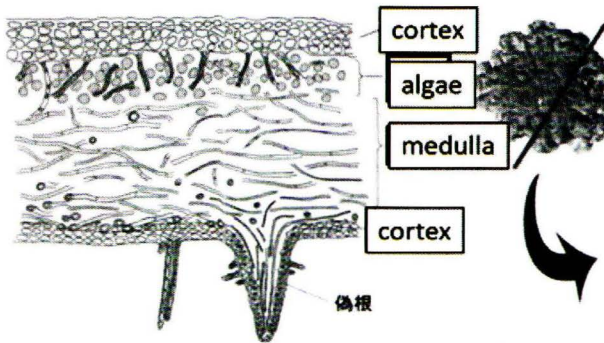


Lichen thallus structure 地衣体の構造

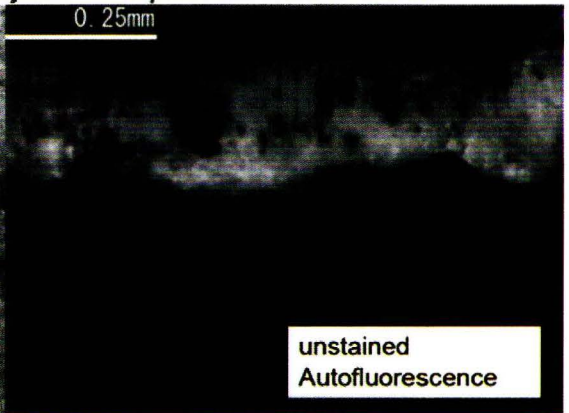
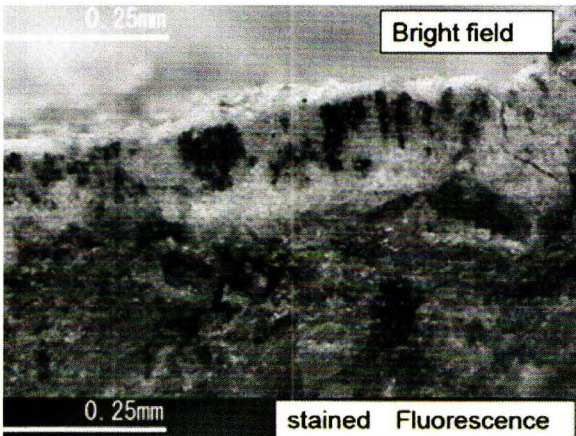
cortex : protect the entire body with tight uniting hyphae.

algae : parts located directly below the upper layers are algae and merged into the organization of hyphae

medulla : is an area where hyphae are united loosely.



Rhyolite - *Porpidia albocaerulescens*



Stain reagent : D A P I

The grain-refined stones progressing on rock surfaces showed a body of hypha penetration in them.

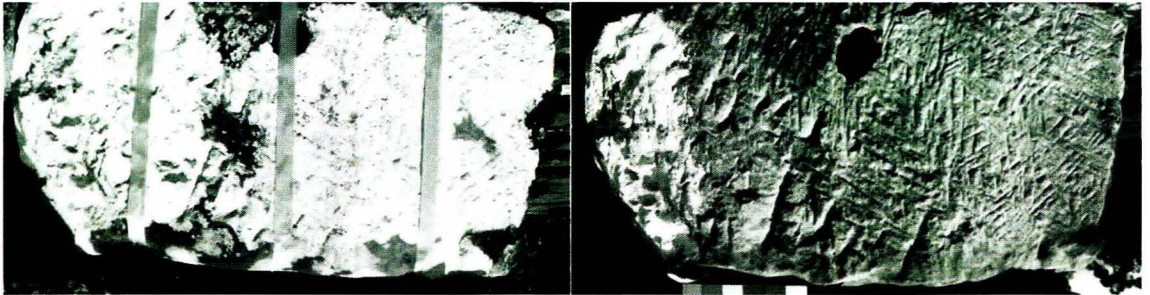
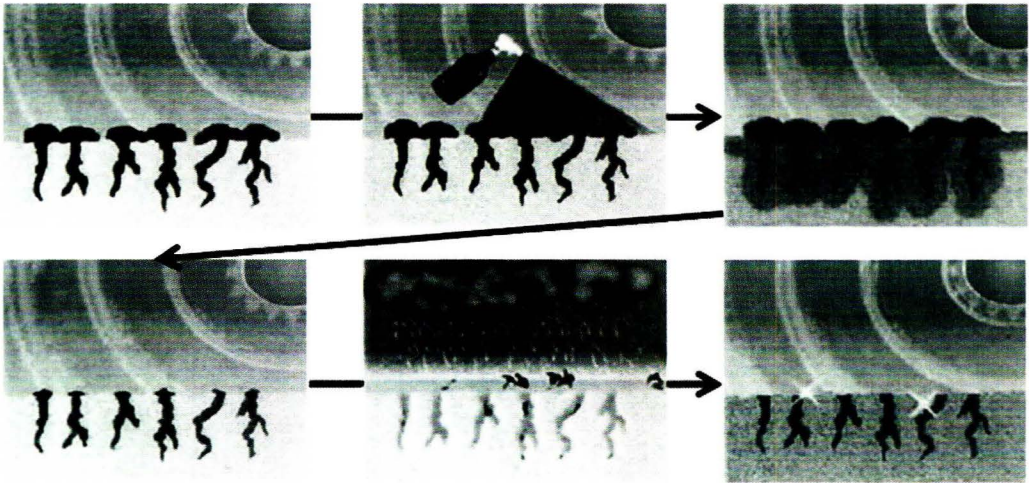
A (excitation:340nm-380nm、absorbance:425nm以上)

Photosynthesis Inhibitor

The hyphae of lichen metabolize matters that control the ability of photosynthesis to keep algae from thick growing.

This inhibitor is proved to stay away from damaging stones.

The initial sprinkling of the inhibitor takes time but other than this, there will be no need to work with the objects and you can leave them intact. That is a reason why the inhibitor is used for bio-counter measures to cultural assets.



Finally

- Some portion of these has gradually been implemented in the Borobudur Temple.
- The preservation of stones should be taken care of not only by uniting stones firmly with glues but also with methods that are accordance to the needs of the coming years of the research of the Borobudur temple.
- The effectiveness of those restorative technologies depends on the use and activities of the sites.
- The sites are to be positioned in the areas, the natural features in the regions and we have to make good enough efforts to follow the way the areas require us together with the needs of the people of the modern society.
- And doing so will help preserve the ruins and contribute to passing it down to the posterity.
- But for fundamental policies with explicit and clear goals for taking good care of the ruins, no one could get ready for the menace surrounding them and decide

restorative measures to cope with deteriorations.

- Bringing cultural heritage into the regions and offering places to work actively are greatly in need.
- Every one of people engaging the ruins should have a philosophy concerning its usage.

For example, as for me, I have something like the follows.

- We should pay some kind of respect to the culture with understanding that the locals are outstanding in establishing its history.
- And we should incorporate the cultural assets and ruins into the present living with attitudes good enough to pay respects and tributes for it and furthermore create a sound and heartfelt unification of mind through the conduct,

This might be yet matured for taking on the preservations but what is your opinion and consideration about this?

Conservation Problems and Stone Deterioration Measures for Stones of Borobudur Temple

Hans Leisen, Esther von Plehwe-Leisen, Eberhard Wendler & Thomas Warscheid



Investigation concerning ash eruptions of 2010

Soluble Ions of ash samples of two Merapi ash eruptions in 2010 (µg/g]														
	F	Cl	NO3	SO4	Na	K	Mg	Ca	Balance	(mS)	pH			
Oct.26th	26	429	56	2015	64	17	56	1133	1.133	0,049	5,45			
	22	423	51	1916	76	16	57	1095	1.161	0,049	5,47			
Nov 4th	24	279	34	8386	286	36	69	3732	1.116	0,133	5,29			
	23	277	33	8354	294	34	67	3813	1.139	0,135	5,35			
Analysis: Deutsches Bergbau-Museum Bochum 2012														
Soluble Ions of rain water collected at Borobudur on Jan. 10 th 2012 [mg/l]														
F	Cl	NO2	Br	NO3	PO4	SO4	Na	NH4	K	Mg	Ca	Balance	(mS)	pH
<0.2	0.36	<0.02	0.06	0.19	0.03	0.45	0.09	0.02	0.05	0.34	0.36	3.064	0.004	5.7
<0.2	0.34	<0.02	0.05	0.16	0.03	0.45	0.08	0.01	0.05	0.34	0.34	3.31	0.004	5.7
Analysis: Deutsches Bergbau-Museum Bochum 2012														

Investigation of Nahar Cahyandaru (BCO) showed that unwanted reaction of stone material only starts at pH of 3 and lower

Identification of Conservation Problems

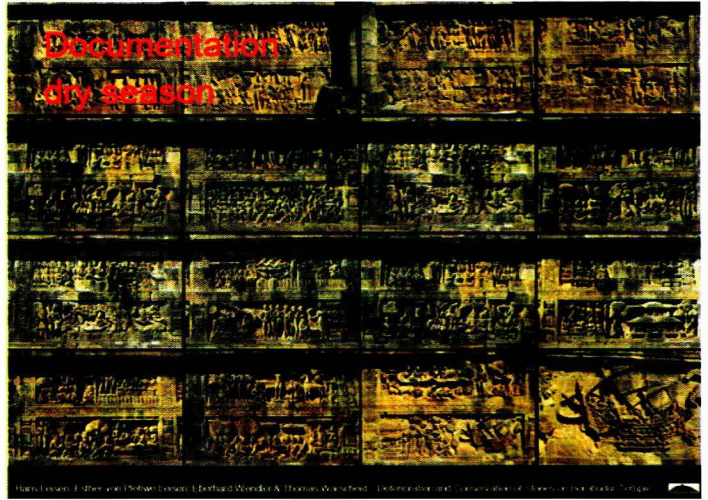
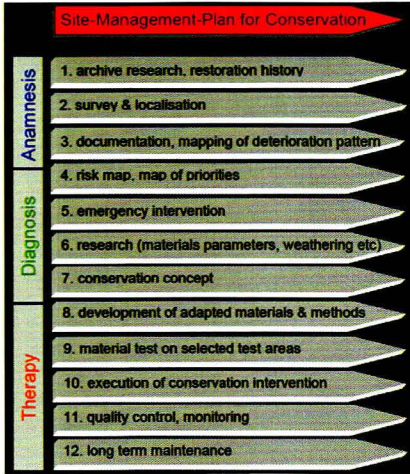
- Water seepage
- Superficial layers: pustules, crusts & paint
- Microbiological contamination and influence

A scientific approach has always to follow a clear structure; the different steps of the investigations are defined by the site-management-plan.

BCO is doing research on relevant problems since years; in cooperation with BCO complementary research is carried out.

The investigations at Site Focus Primarily on the

- full photographic documentation of the panels in the different seasons
- Recording and mapping of the state of preservation and deterioration patterns
- investigation the material parameters
- evaluation of the weathering influences and processes on the reliefs and the weathering dynamics.

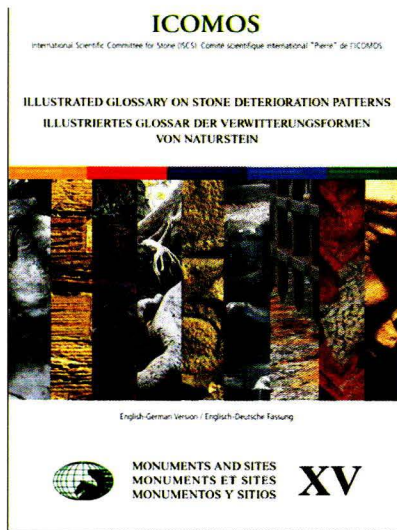


Deterioration pattern
Deposits

Legend

- Run off white crust
- Crusts general
- Biology moss
- Animal general

Date 14.06.2012
BOR 01 S wall A4



Identify Main Problems

loss of precious surface
different stone varieties show different state of preservation

Varieties of Stones at Candi Borobudur

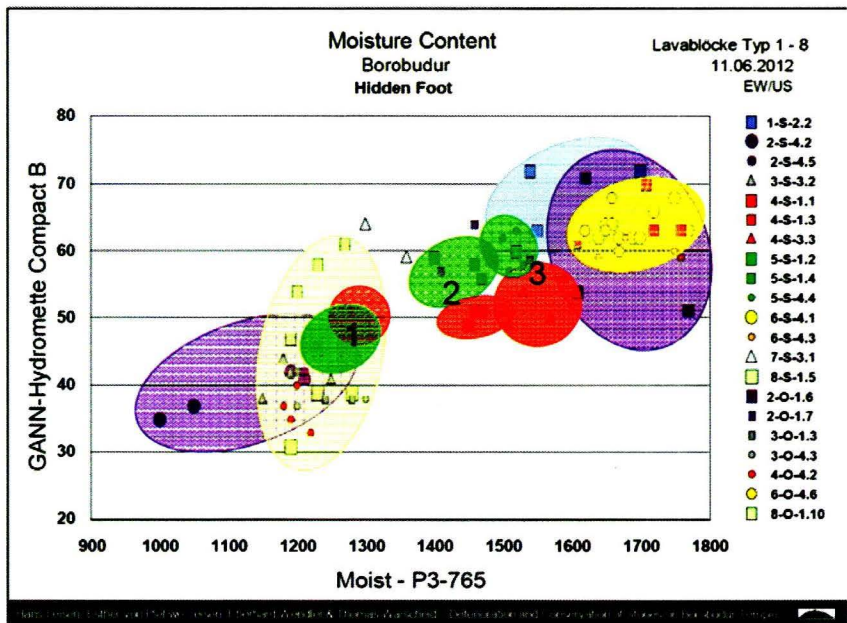
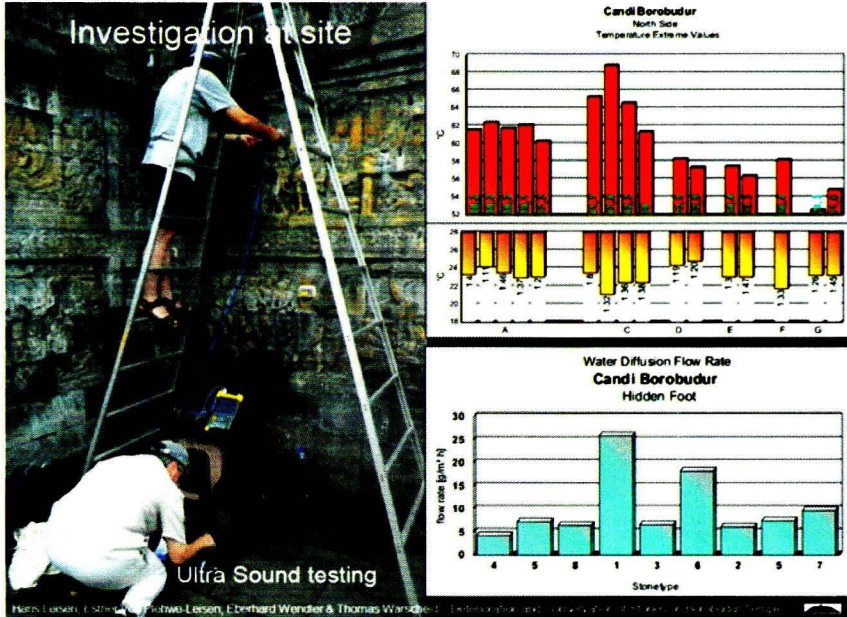
The different stone varieties show different weathering behaviour and resistance against deterioration processes

Investigation at Site

Identification of stone varieties

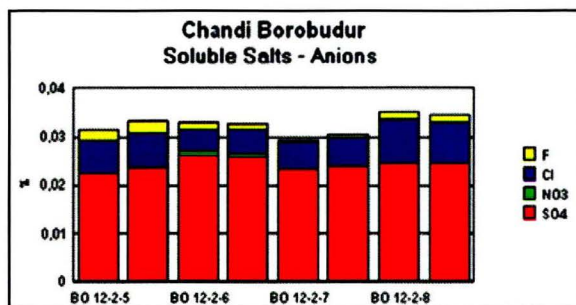
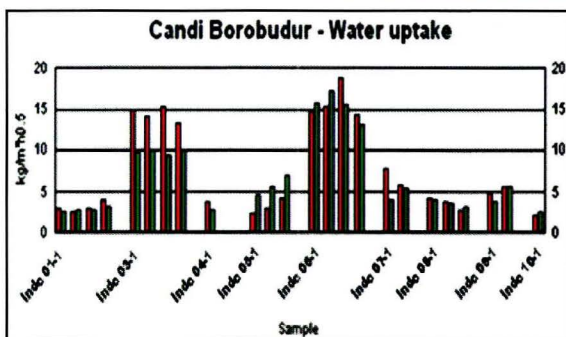
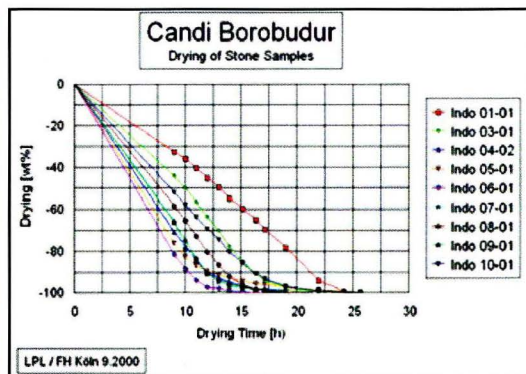


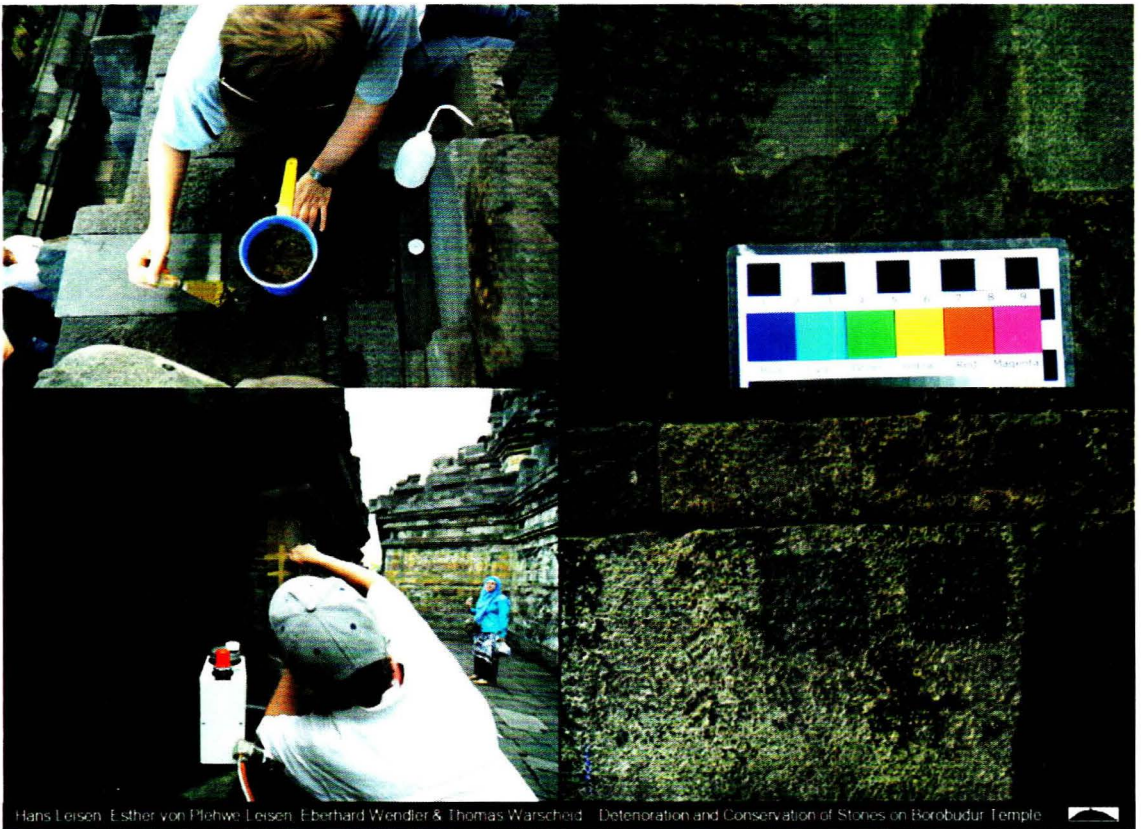
- Mapping of deterioration patterns
- Water absorption and water transport mechanisms
- Drying behaviour
- Mechanical condition and resistance
- Microbiological contamination and influence of biology



Scientific Investigations in the Lab

- Petrographic analysis
- Stone material properties
- Chemical analysis of crusts, alteration products and damaging salts
- Biological analysis
- Development of conservation materials





Practical Conservation Tests

Mortar testing for closing of joints cleaning tests

Additional Activities

Inspection of drainage system

Investigations on Buddha headsarscheid

Future Work Programme

- Compilation and evaluation of all data
- Continuation of the studies on weathering processes and micro-biological processes
- Modelling of the different deterioration mechanisms
- Formulation of requirements for the conservation steps
- Removal of crusts - larger cleaning test areas & monitoring
- Prevention of biological growth - new strategy, test areas
- Joint mortars – test areas with modified mortars
- Continuation of inspection of drainage system, improvement and control
- Investigations on Buddha heads and corpuses

Conservation and Weathering Problems Of Borobudur

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Fr Dian Ekarini, S.Si ⁽²⁾, dan Sri Wahyuni, A.Md ⁽²⁾

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2) Borobudur Heritage Conservation Office

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Abstract

Borobudur temple, a very old heritage, has been partially covered by crust of salt deposition together with moss, fungi and lichen, that can potentially promote the relief scaling and stone weathering. The salt deposition is promoted by rain water, acid rains, and also may be by leachate from garbage, while the growth of moss, fungi and lichen is facilitated by high humidity climate. To prevent the salt deposition, the acid rain water falling on the temple should be rinsed with neutral water. The scaling and weathering can be minimized by removing the moss, salt, hard crust effectively. The removal of the hard crust has been examined by using (ethilen diamine tetra acetic acid) EDTA solution, but the results seems less effective. The effectiveness of the crust removal is proposed to be improved by applying sequential cleaning by H_2O_2 followed by EDTA solution.

Key words : salt deposition, crust, aviole, EDTA, and H_2O_2

I. Weathering Problems of Borobudur

Borobudur temple is one of the old world heritages that gets large degradation in the forms of weathering and damaged. Damaged is the change process of the stone based materials without any physically and chemically properties changes, that may be caused by earthquake, float, and volcanic eruption. Weathering is disintegration and decomposition processes accompanied with physical and chemical properties changes that are usually induced by climates and environment.

The damages of the temple caused by disasters (earthquake, float, and volcanic eruption) in Indonesia are difficult to be avoided since Indonesia is located in a ring fire. Actions that can be prepared and performed are mitigation and minimization of the effects of disasters.t

The factors causing weathering include physics, biology, and chemicals. The main physical factor is temperature, the biological one is the growth of moss and lichen, and the chemical factor is environment.

a. Temperature

In Indonesia the temperature difference (dramatic change) between daylight and night is relatively large, as seen in Table 1. It is seen in table 1, that the difference of the

temperature between day and night around Borobudur temple is relatively large, and is getting increased from time to time.

Table 1. Temperature difference between day and night

Average T at daylight (°C)	Average T at night (°C)	T difference (°C)
24.2	31.7	7.5
23.3	31.0	7.7
23.4	30.8	7.4
23.6	31.1	7.5
23.4	31.7	8.3
23.2	31.4	8.2

This temperature fluctuation makes the stones frequently expansion and shrinkage, leading to the stones and temples cracked, as seen in figure 1, which is also supported by TEM image.

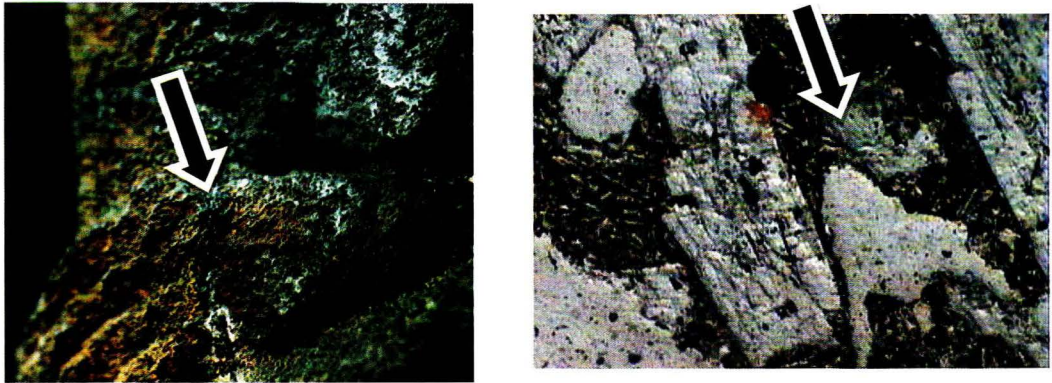


Figure 1. The stone cracking (left), and TEM image of the cracking under microscope (right)

The number of cracking of the stone composing Borobudur Temple has been also observed from 1991 to 2012, and the data is illustrated by figure 2.

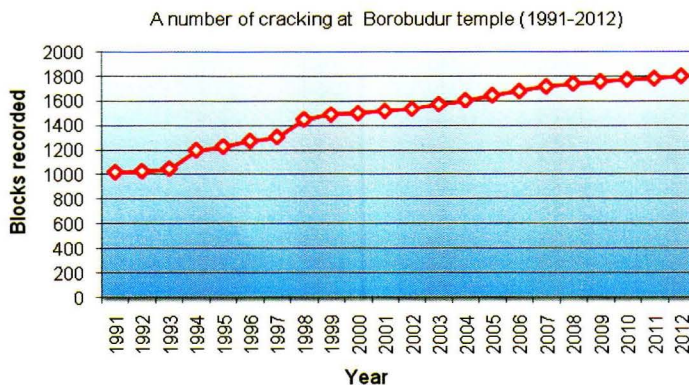


Figure 2. Data of the number of cracking in Borobudur Temple from 1991 to 2012

The figure shows that number of cracking has increased during 11 years. In more detail, it is seen that the cracking formation slightly increased from 1991-1993, but the rate of cracking formation seems faster from 1993 to 1998, and same increasing rate is observed from 1998 to 2012. This data indicates that cracking formation can not be prevented due to natural process.

b. Biological Factors

The biological factor causing weathering is the growth of moss, algae, and lichen. The growths of moss, algae, and lichen on the Borobudur temple are found widely, because the climate in Indonesia is very humid facilitating the growth.

The mechanism and process of weathering due to the growth of moss, algae, and lichen are explained as follows. The temple is composed by porous stone providing a kind of cavity. The cavities are easily filled up with dust, and in humid condition this can induce the growth of protonema of moss and algae to form Postule, or the stone become swollen. When the postule is pressured from inside, the postule may be broken to form alveole. The alveole formation would stimulate the occurrence of stone scaling, and the scaling leads to the relief removed and weathered. The postules and avioles on Borobudur temple are illustrated by figure 3.

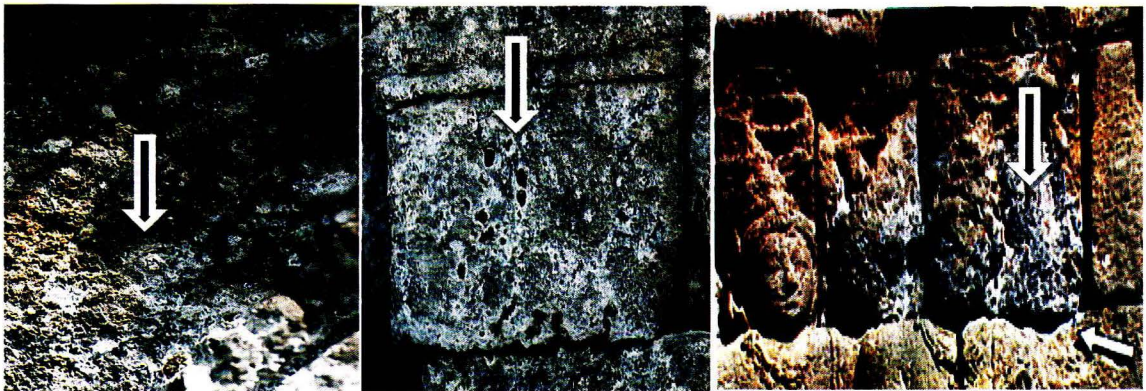


Figure 3. Postules, avioles, and the scaling at the Borobudur temple stones

The number of postules was also observed and the observation data is shown in figure 4. From the figure it can be seen that the number of postules increased from 1991 to 2012. Furthermore, the higher rate of the postule formation was happened from 1991 to 2010, while from 2010-2012 the number of the postules only slightly increased. The slight increase

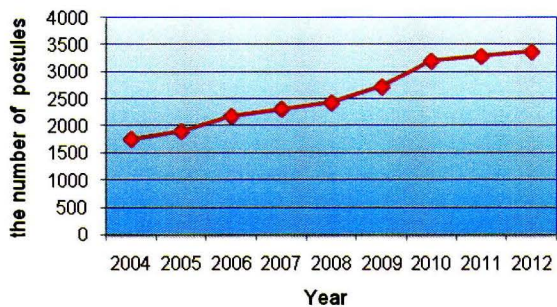
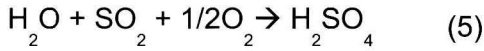


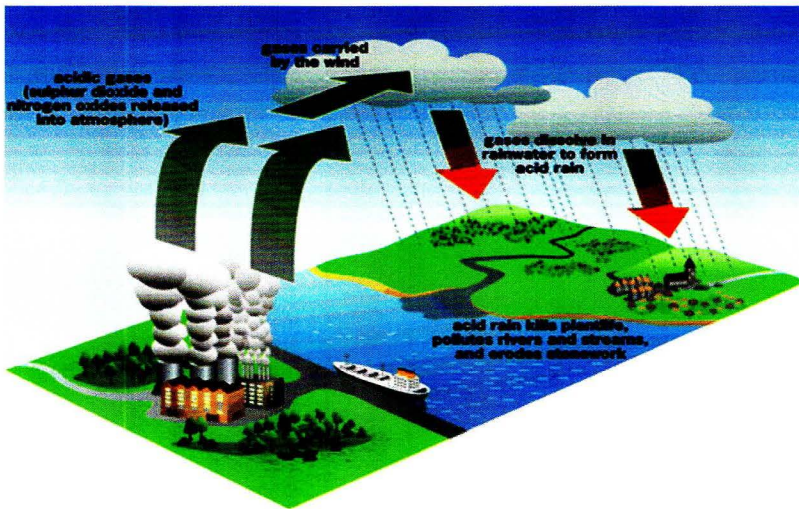
Figure 4. The postule formation in Borobudur Temple since 2004 up to 2012.

as well as more population. These CO₂, SO₂, and NO₂ gasses can dissolve in the water vapor or cloud to form carbonate, sulphate, and nitric acids respectively. The acids then acidify the rain water giving low pH. The acid rain water accelerates the disintegration and salt deposition. The reactions of acid rain are seen in equation (4), (5), and (6).



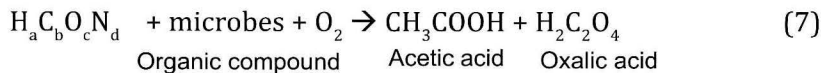
The process of acid rain formation is illustrated by figure 5.

Figure 5. The formation of acid rain



iv. Garbage biodegradation forming organic acid

The garbage of organic materials can face biodegradation in the presence of water and suitable microbes to form organic acids such as oxalic and acetic acids. The solution of the organic acid is also known as a leachate. The process of leachate formation through biodegradation process is known as leaching, and the reaction is presented as equation (7).



When the leachate wets the stone, there will be reaction between organic acid in the leachate and the mineral in the temple stone. Chemical reactions due to the acids is said as acidolysis, that is hydrolysis by water promoted by acids. General reaction of the stone acidolysis (acid rain, leachate) promoting disintegration or scaling or weathering is written as equation (8). The scaling makes relief degraded, as seen in figure 6.

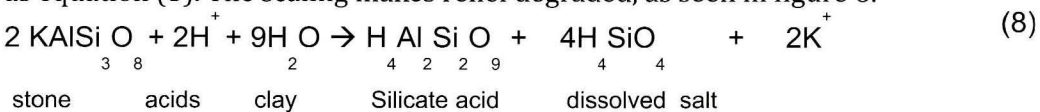
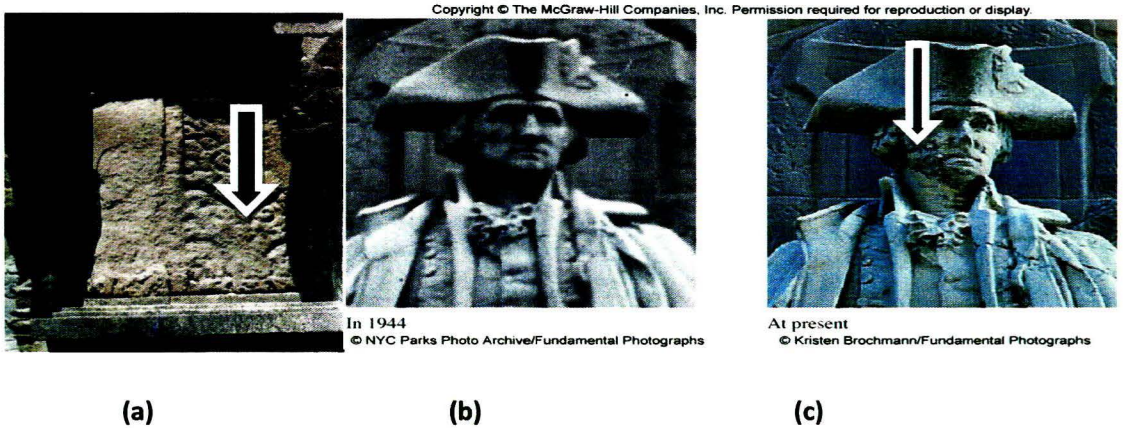


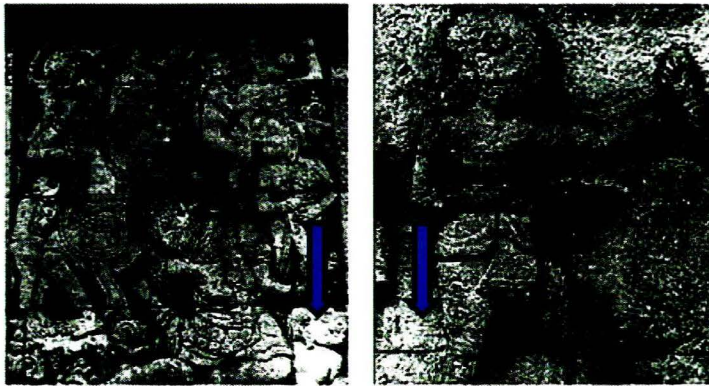
Figure 6. Scaling of the relief (a), a statue got less acid rain (b), and a statue got deterioration by acid rain (c)



II. The Crust at the Temple Stone Surface

Hard crusts are widely found on the surface of Borobudur temple stones, as seen in figure 7.

Figure 7. Hard crust on the surface of the stone



The composition of the crust has been determined by using EDX instrument, and the data obtained is presented in Table 2. It is seen in the table that fresh stone mainly contains SiO_2 , Al_2O_3 , CaO , Na_2O , and K_2O that are constituents of the minerals (plagioclase) in the stone temple. Meanwhile, in the crust in addition to the main oxides, Fe_2O_3 , MgO , P_2O_5 and S are also found. The content of CaO in the crust is also larger than in the fresh stone. The extra CaO , along with Fe_2O_3 and MgO attribute the existence of salt deposition at the stone surface.

Table 2. The chemical composition of the crust at stone temple surface

Sample	Chemical composition (%w)									
	SiO ₂	Al ₂ O ₃	CaO	Na ₂ O	Fe ₂ O ₃	MgO	K ₂ O	C	P ₂ O ₅	S
Fresh stone	65.45	21.05	4.71	5.52	0	0	3.27	0	0	0
Kalasan green crust	13.38	4.83	29.02	0.43	0.33	0.28	0	8.72	1.27	41.74
Borobudur crust	71.8	9.15	20.59	0	0.25	0.38	0	15.63	0	0
Mendut crust	66.91	3.45	9.02	0.97	0.77	0.28	0	6.18	0	12.42

Moreover, the crust also contains carbon, phosphor, and sulphur elements, but such chemicals are not found in the fresh stones. Carbon, phosphor, and sulphur elements are the components of organic materials from biota including moss, fungi, and lichen. This data clearly infers that the crust is also composed by moss, fungi, and lichen, which is consistence with the fact that no such materials are observed in the fresh stone. From the chemical composition of the crust, and fresh stone as a reference, it is obvious that the crust is compose by salt of Ca, Fe and Mg and moss, fungi and lichen, strongly promoting the scaling and weathering.

III. Conservation Problems

Conservation is a set of activities to prevent the temple from weathering, to restore the damaged temple, and to maintain the temple not to get further disintegration. The methods of conservation applied depend on the causes of disintegration. Some of them are simple methods and some others are more complicated. The conservation methods and the use of method are given below :

- a. The temple damaged by earthquake can be over come by some suitable structural treatments
- b. Prevention of the disintegration caused by acid rain can be carried out by rinsing the temple with fresh water just after being fallen by first rain fall in the beginning of rainy season, because such rain water usually has low pH (4-4.5) ^(BMKG, 2010) or contains high acid concentration. The rinse should be priority applied for part of the temple that more adsorbs the rain water
- c. The effect of leachate from garbage on the temple stone can be avoided by removing garbage from the temple before the garbage being biodegraded by microbes. If the leachate of garbage has already formed and contacted with, as well as acidified the temple, the acidified stones should be rinsed with fresh water
- d. Salt deposit and moss or algae growth are usually found at the same spots of the temple stones and form hard crusts. So far, such crust in Borobudur has been removed

by using ethylene diamine tetra acetic acids (EDTA) solution (Swastikawati, et al, 2013). Data of the crust removal by EDTA is displayed in table 3.

Table 3. The influence of ETDA concentration on the crust removal

EDTA concentration	Area before treatment	The clean area after treatment	Degree of clean up
3 %	590,7219	117,3110	20 %
5 %	567,0306	330,3068	58 %
15 %	569,1990	286,1230	50 %

In general, data in the table shows that EDTA solution can be used for cleaning the crust, although the effectiveness of the crust cleaning has not satisfied yet because the cleaning is less effective. EDTA is a compound in which the structure can react with Ca, Fe, and Mg solids to form dissolved complex compound as seen in figure 8.

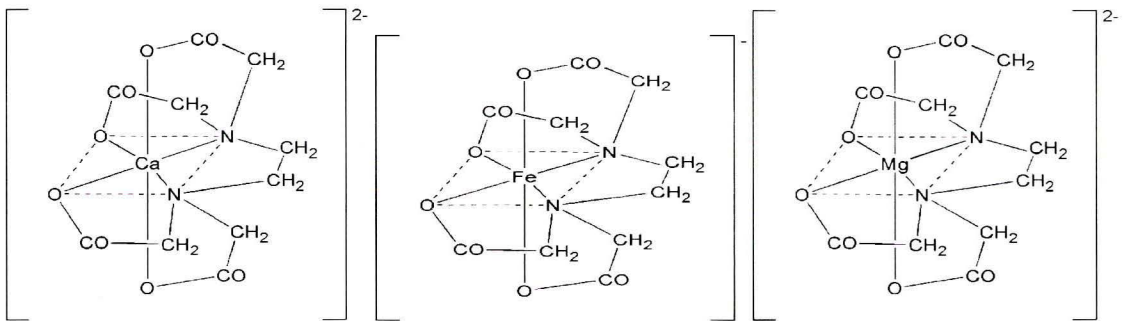


Figure 8. The structure of EDTA-M (M : Ca, Fe, Mg) compounds that are dissolved in water

By the formation of dissolved complex compound of EDTA-Ca, EDTA-Fe, and EDTA-Mg, the salts can be easily removed from stone surface. Based on this fact, the crust cleaning is supposed to be effective. The remaining crust must be dominated by organic compounds of moss, which are not dissolved in EDTA. Accordingly, an alternative chemical needs to be examined to remove the organic compound in the crust.

The alternative chemical proposed is hydrogen peroxide (H_2O_2), which has been studied to release the hard crust on the surface of underwater bowl (Yunita, 2013). The crust of underwater material is composed by salts of Ca, Fe, and Mg, together with organic compounds (Yunita, 2013). The underwater bowl that was cleaned with EDTA solution is illustrated by figure 9 and that of with H_2O_2 is seen in figure 10.

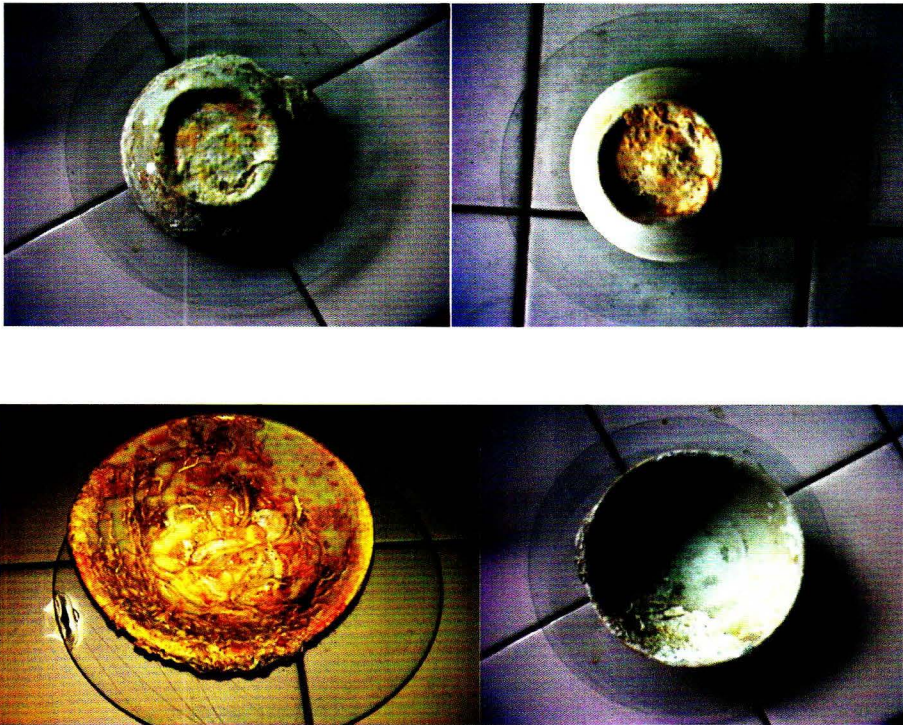


Figure 9. Underwater bowl (a) before, and (b) after treatment with EDTA 0.5M 3 hours.

Figure 10. Underwater bowl (a) before, and (b) after treatment 10% H₂O₂

The figures indicate that the crust can be cleaned by using EDTA and H₂O₂ alone, but crust is still remained. By using EDTA, the materials removed from the crust are only Ca, Fe, and Mg salts, meanwhile that of by H₂O₂ solution is only organic compound (Yunita, 2013). Based on that fact, removing the crust was also carried out sequentially by EDTA then by H₂O₂. The result of sequential cleaning is seen in figure 11. It is seen that the crust can be removed completely.

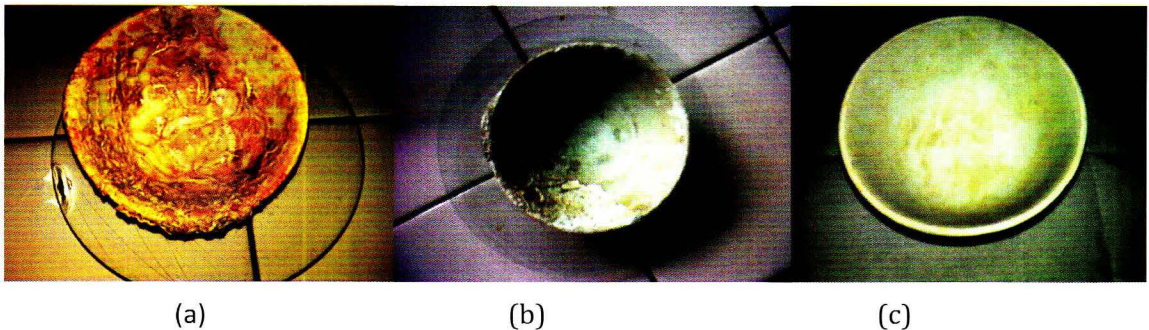


Figure 11. Underwater bowl a) untreated, b) after H₂O₂ treatment, and c) after H₂O₂ then EDTA treatments

Based on the results of sequential cleaning by H_2O_2 then EDTA solutions, it is likely to remove the hard crust on the surface of Borobudur Temple by using similar procedure.

III. Conclusions

1. Weathering can be caused by moss and fungi that lead to postule and aviole formation, as well as by rain water, acid rain, and acidified water that can stimulate disintegration and salt deposition
2. Postules and avioles, along with salt deposition lead to the scaling of the stone, that can cover and remove the temple reliefs
3. Removal of the crusts or salt deposit has been carried out by using EDTA solution, but the removal was less effective

IV. Recommendation

1. Monitoring should be carried out for :
 - CO_2 measurements periodically
 - Measurement of temperatures at day and night routinely
 - Measurement of the pH of the rain water regularly
2. Conservations :
 - Salt removal by using EDTA should be carried out at lower pH (4) and in several steps
 - Removal the crust by using H_2O_2 by several steps
 - The treatment should be carried out intensively, continuously and patiently

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Diskusi:

Pertanyaan 1. Masanori Nagaoka (UNESCO Office, Jakarta)

Bertanya tentang rekomendasi penggunaan steam cleaner, yang berdasarkan permintaan oleh pemerintah Indonesia, menurut para ahli apakah disarankan untuk dilanjutkan?



Jawaban: Hans Leisen

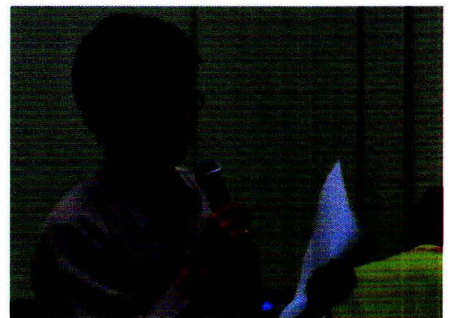
Disarankan untuk menghentikan penggunaan steam cleaner. Lingkungan di Borobudur mempunyai pengaruh yang berbeda, dengan reaksi yang hanya terjadi pada batu adesit. Batu andesit sangat spesifik dipengaruhi oleh matahari, sehingga kita mencoba mengetahui lebih banyak dari perilaku monumen, faktor dan parameter yang berpengaruh, kemudian mengumpulkan data untuk menemukan intervensi paling spesifik yang mungkin diterapkan.

Jawaban: Endang Tri Wahyuni

Klarifikasi tentang penggunaan steam cleaner dalam pembersihan, saya tidak merekomendasikan. Untuk membersihkan kerak, direkomendasikan dengan EDTA. Akan tetapi, bagaimana penggunaannya masih perlu dipikirkan. Percobaan aplikasi yang pernah dilakukan adalah menggunakan bubur kertas. Dan saya setuju dengan Prof. Hans Leisen. Saya bukan konservator tapi saya seorang ahli kimia. Saya mencoba untuk mengenal konservasi, dengan menerapkan ilmu kimia untuk konservasi dalam mendampingi staf di Borobudur. Ini merupakan tantangan yang besar, walaupun tidak bisa mengatasi semua masalah, paling tidak yang bisa dilakukan adalah dengan melakukan analisis mulai dari skala laboratorium.

Pertanyaan 2. Nuryono (Universitas Gadjah Mada)

Saya setuju dengan semua opini yang disampaikan karena dari situasi di tiap negara pasti berbeda. Masalah kita muncul karena kita mempunyai hujan dan sinar matahari yang berbeda dari Jerman dan Jepang. Prof. Endang menjelaskan tentang ada saran yang bagus. Apakah dari Jerman dan Jepang, ada teknik atau metode yang bisa diaplikasikan di Borobudur?



Jawaban: Hans Leisen

Masalah di Jerman sangat kompleks, dan sampai saat ini dipengaruhi oleh musim dingin, sehingga tentu berbeda dengan di Indonesia. Tapi ini merupakan pertanyaan umum tentang bagaimana mengembangkan sebuah proyek penelitian. Kita harus melakukan investigasi dengan belajar tentang monumen, lingkungan dan material. Di Angkor, saya telah melakukan penelitian selama 20 tahun, akan tetapi dampak karena lingkungan pasti berbeda, karena jenis batu di Angkor adalah batu sandstone, sehingga pola kerusakannya juga berbeda. Poin lain yang harus diperhatikan dalam melakukan intervensi konservasi adalah kita harus mempelajari apa yang dibutuhkan oleh monumen dan mengadaptasinya,

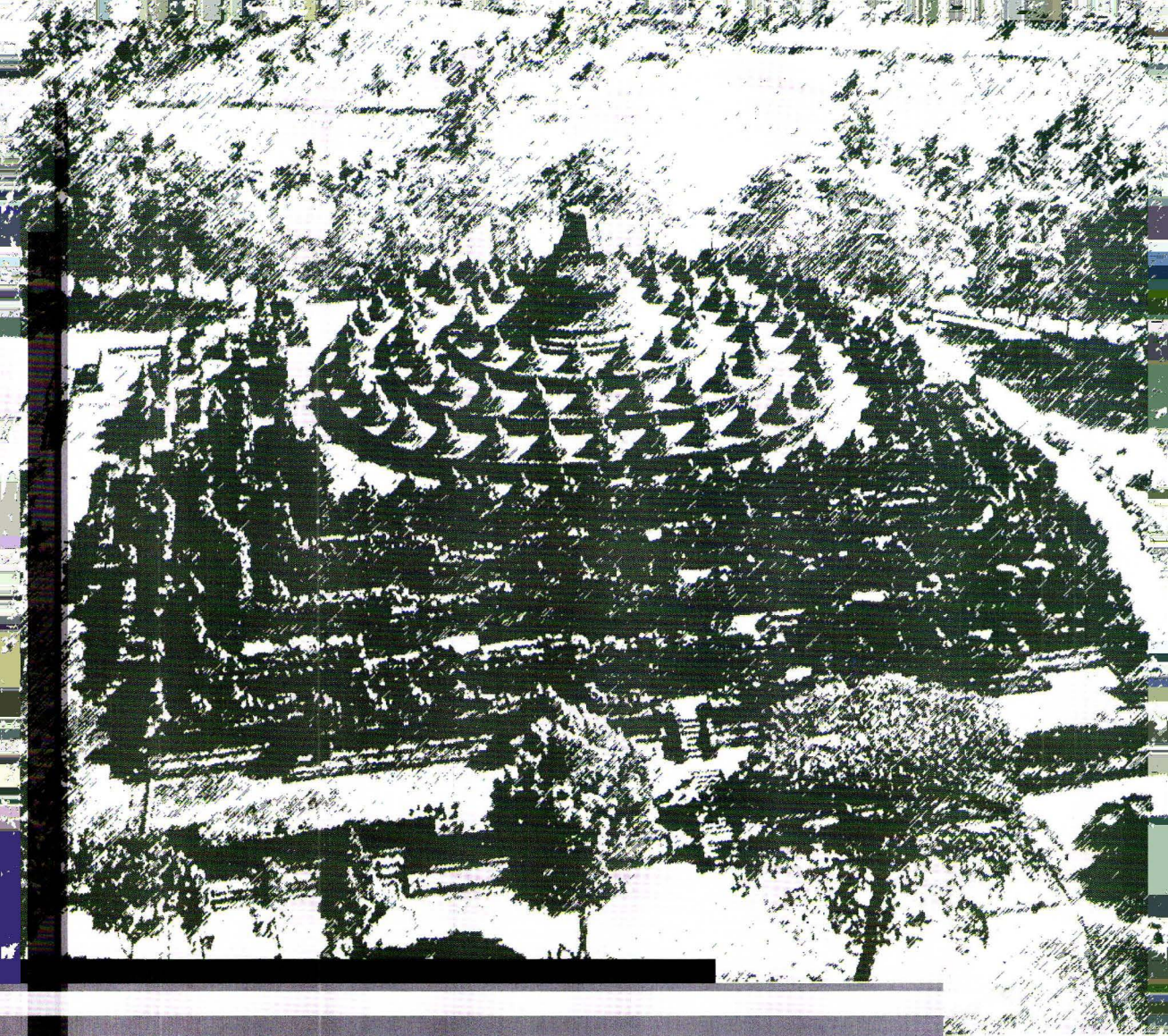
mengetahui segala sesuatu terkait monument, sehingga kita harus bekerja sama dengan berbagai multidisiplin ilmu.

Jawaban : Toshiya Matsui

Kita memiliki banyak masalah dan kita dapat mengembangkan metode dengan menjalin berbagai kerjasama.

Jawaban : Endang Tri Wahyuni

Borobudur adalah laboratorium yang bagus untuk penelitian sehingga banyak orang yang datang ke Borobudur, khususnya ahli kimia. Mereka mencoba menyelesaikan masalah berdasarkan sudut pandang ilmu kimia.

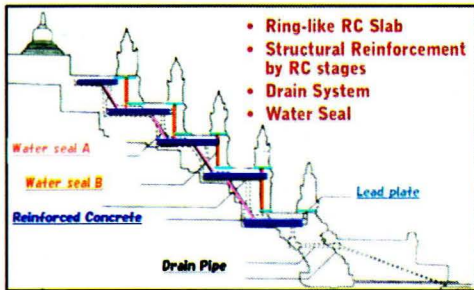


Technical Archaeology of Borobudur Temple Structural Stability of Borobudur Temple and Hill

Monitoring Evaluation on the structural stability of Borobudur

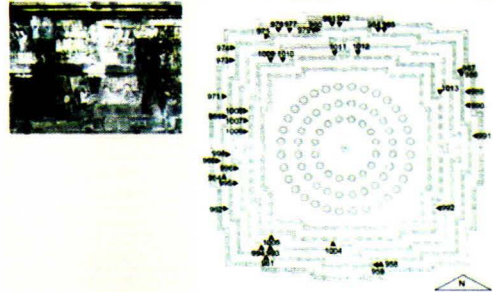
Dr. Ichita Shimoda

Restored Section of Borobudur, 1970s-80s

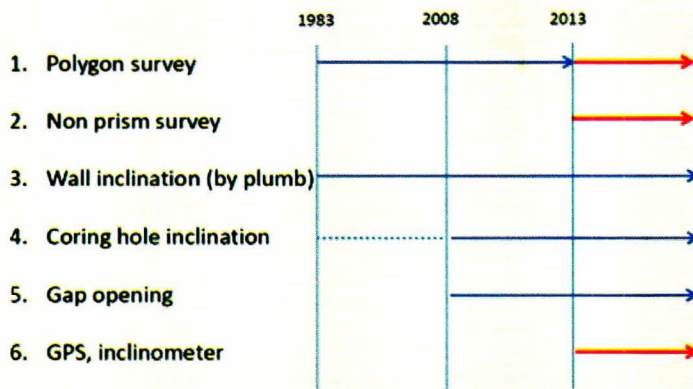


By the result of the comprehensive survey, UNESCO team designed the reinforcement structure.

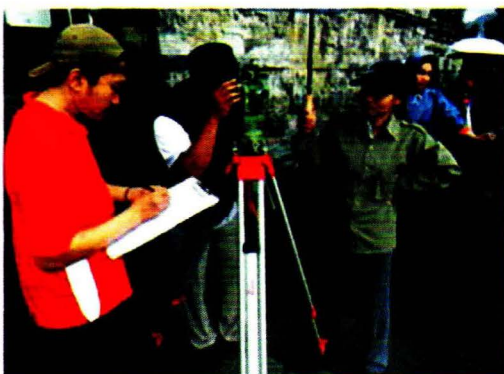
Water leakage spots on the relief panel, rainy season, 2012



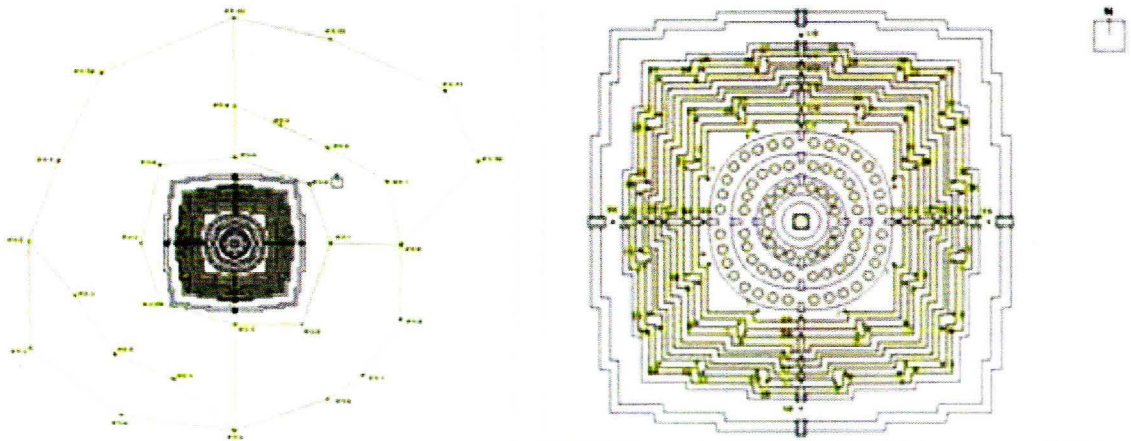
Monitoring of Structural behavior by the BCO



1. Polygon Survey

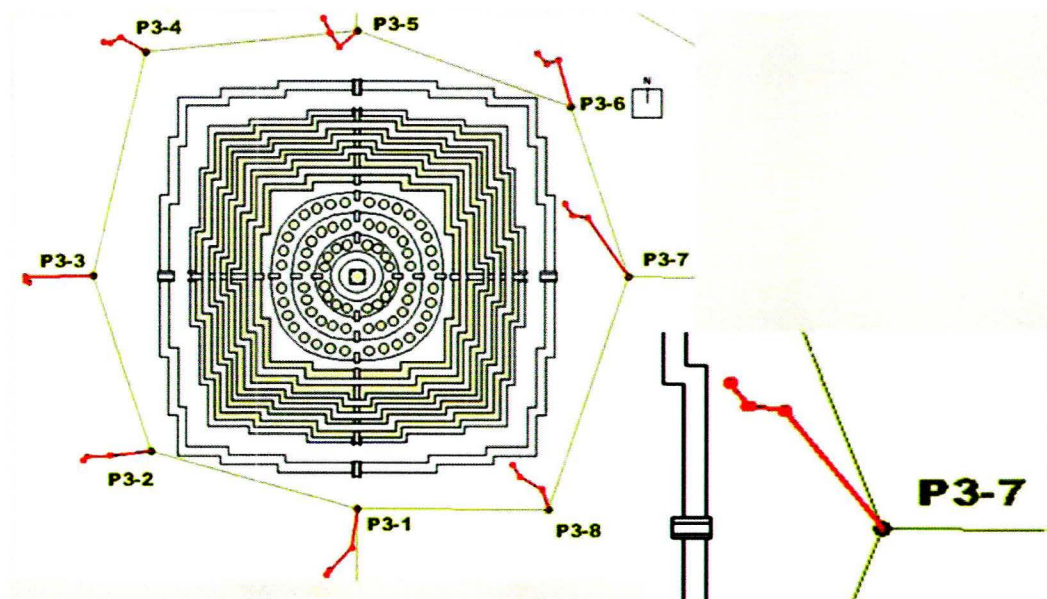


Wild T2(Theodolite)TCR805(Total Station)

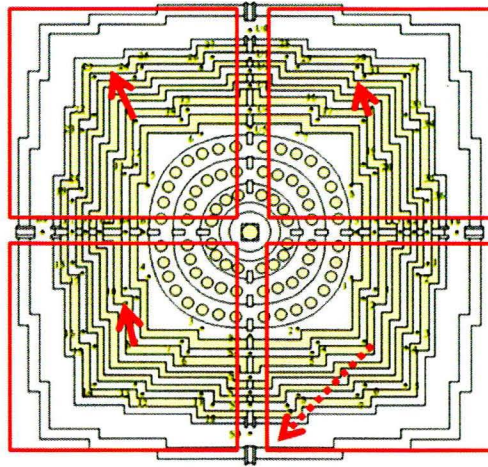


Present monitoring method

1. Leica WILD T2 is used for the angle survey. Every point is measured four times and strikes the average to guarantee the accuracy. Record is memorized on the paper.
2. Measurement for the short range distance is done by steel measuring tape. They measures three times and strike the average.
3. Measurement for long distance is done by Leica TCR 805. Record is memorized on the paper.
4. Corner of wall are measured by several reference points, and calculate horizontal distance from slope distance.
5. Measurement of level is done by Leica Sprinter (BFFB mode). Record is directly converted to PC.



Displacement of the reference points of Polygon III (1983>2008>2009>2010)



Problem points of the present survey

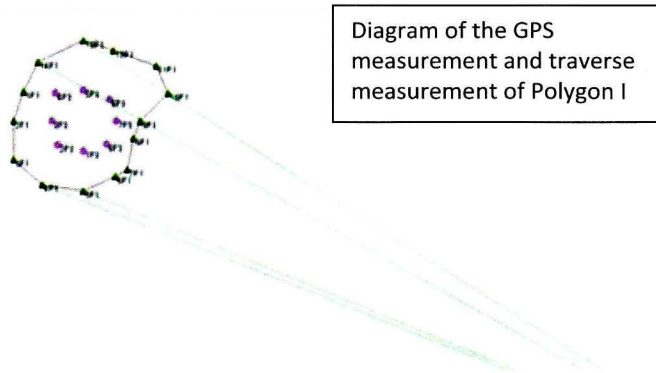
- Too many points in small area and connecting short distance
- Pavement small stone blocks is shaky and reference points are not stable
- Too many tourists disturb the long work and make unstable the pavement block
- Too long work term makes human error



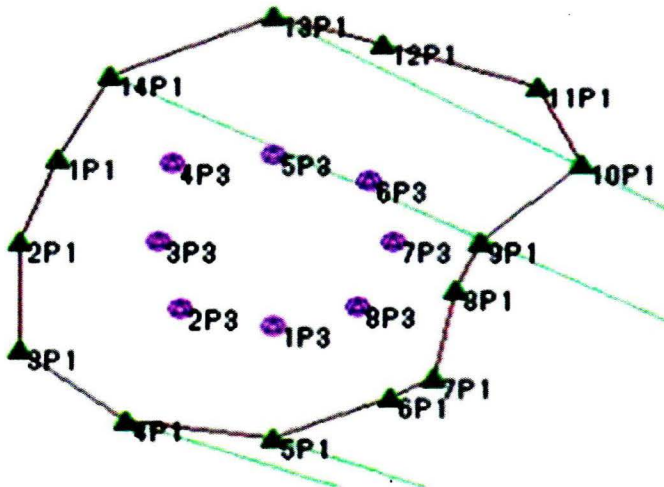
Improvement of the Polygon Survey (Traverse Survey)

We propose to survey the following four steps to monitor the structural behavior.

1. Static GPS measurement between newly installed point in the courtyard of BCO and some points of Polygon I (>>>need to introduce the GPS set into BCO.)

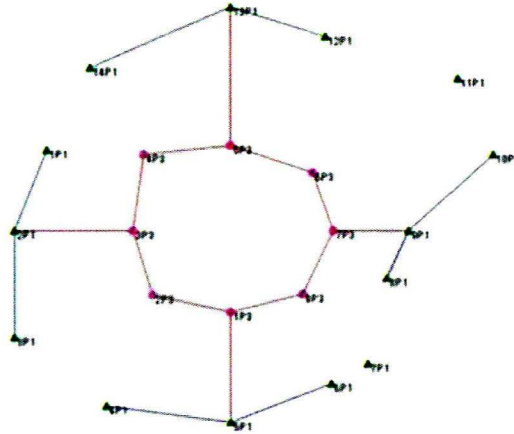


2. Traverse measurement of Polygon I by Total Station

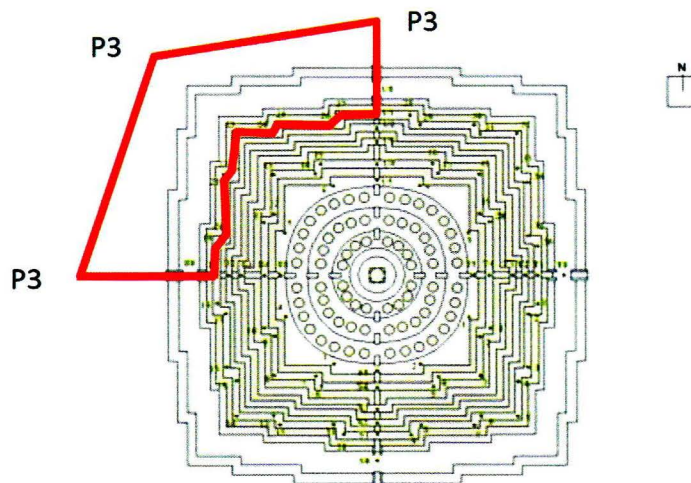


- Using **Total Station (TCR805)** for angle and distance measure
- Using three **large prisms (CIRC prism)** with tripod
- Two sets of measuring
- Using **Auto-Level (Leica Sprinter)** for level measure (and compare to the data by TCR 805)
- Data is transfer to PC and calculate by LGO (quarter traverse network should be confirmed)

3. Traverse measurement of Polygon III with related points of Polygon I by Total Station



- Using **Total Station (TCR805)** for angle and distance measure
- Using three **large prisms (CIRC prism)** with tripod
- Two sets of measuring
- Using **Auto Level (Leica Sprinter)** for level measure (and compare to the data by TCR 805)
- Data is transfer to PC and calculate by LGO (quarter traverse network should be confirmed)



4. Traverse measurement of each Polygon Lorongs with related points of outer polygon loop

- Using **Total Station (TCR805)** for angle and distance measure
- Using **mini-prism** with 10 cm pole
- Using Total Station (TCR805) and **non-prism measure for wall corners** (measure from several points)

- Two sets of measuring
- Data is transfer to PC and calculate by LGO

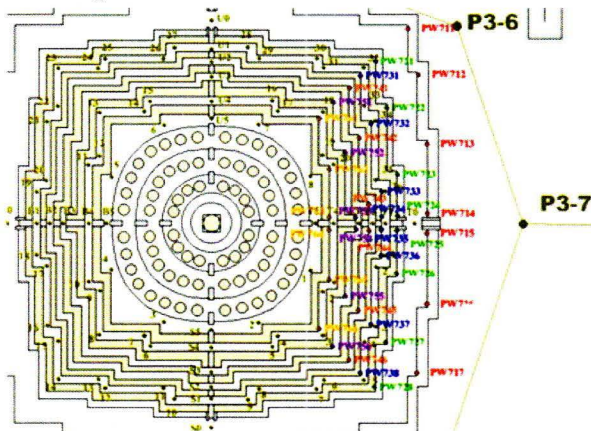
Maintenance

- Maintenance of round bubble level of mini-prism and large prism
- Store the large prism in the dedicated protection case

Necessary equipment

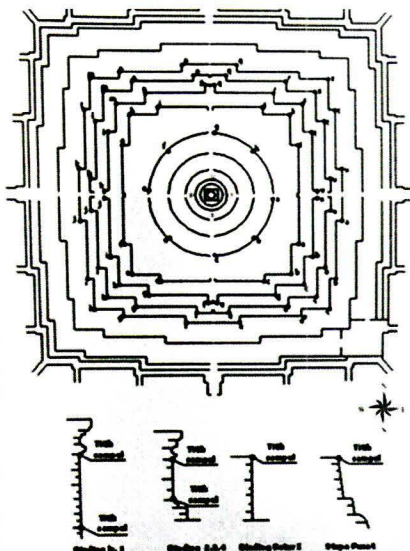
- LGO and option software (GNSS analysis, network averaging, Datum/Map, Rinex Import, Level analysis)
- GPS
- Adjusting jig for the round bubble level

2. Non prism direct measure



- * Only 2 hours for one side
- * High accuracy

3. Wall inclination (by plumb)



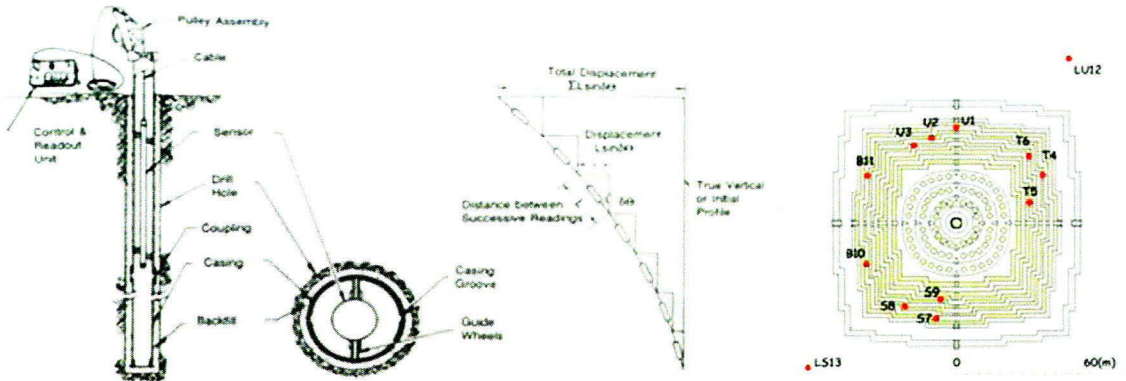
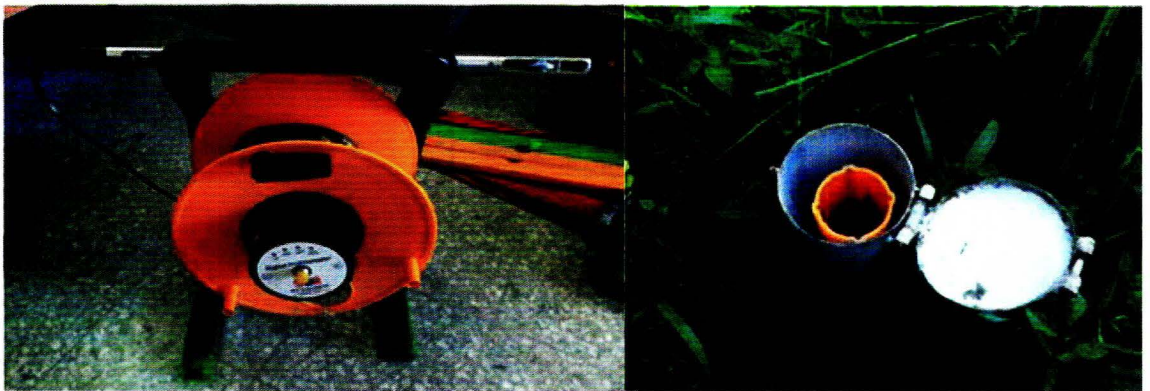
Wall Inclination

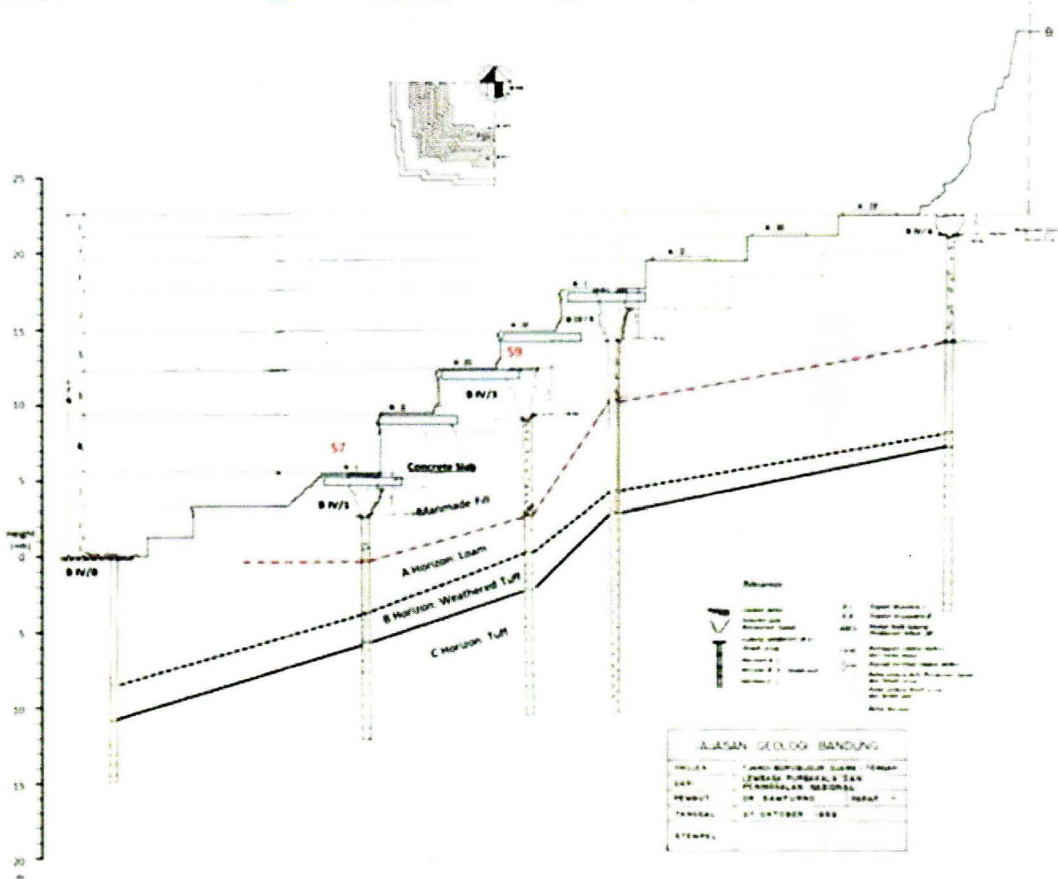
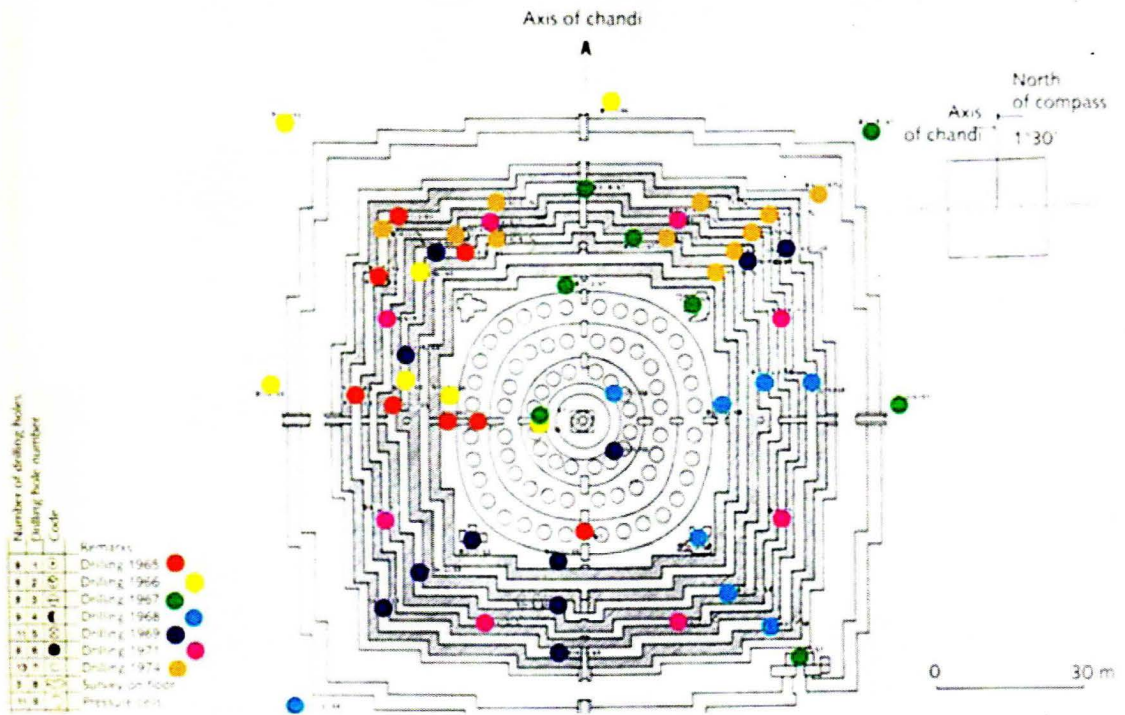
VARIABEL PENGUKURAN PERBEDAAN KEMIRINGAN DINDING
DIBANDING DENGAN KEDUDUKAN PEDOMAN
(SATUAN DALAM mm)

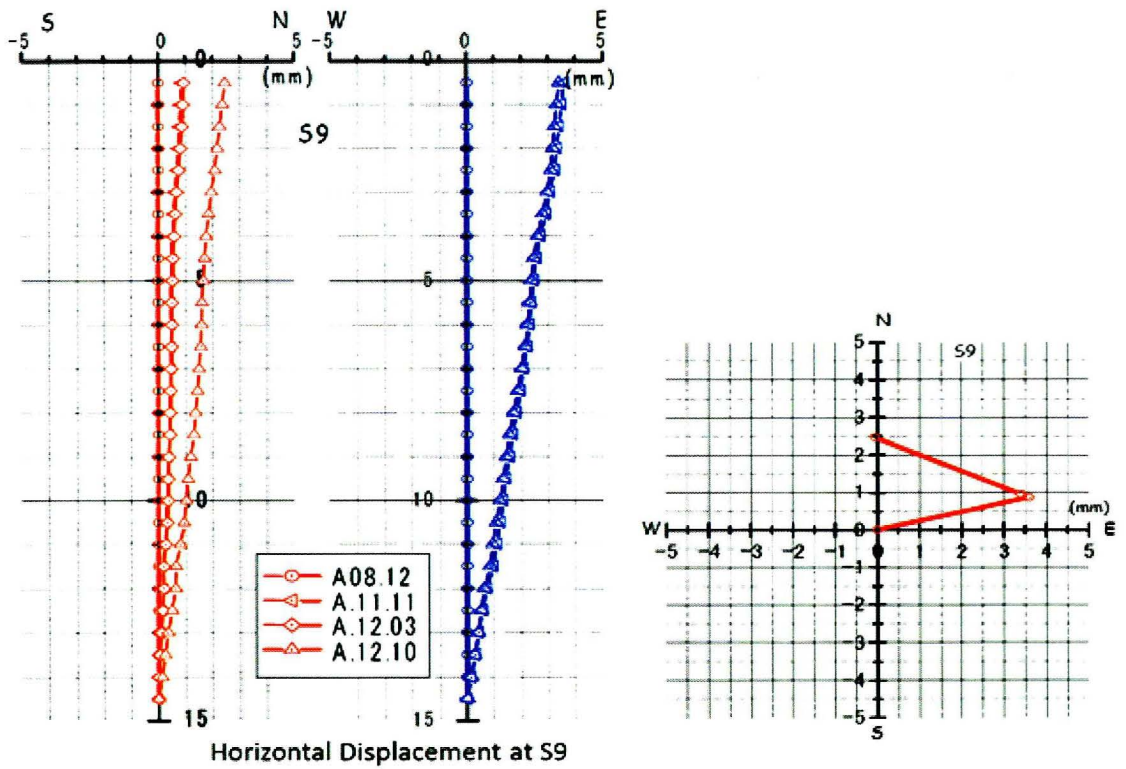
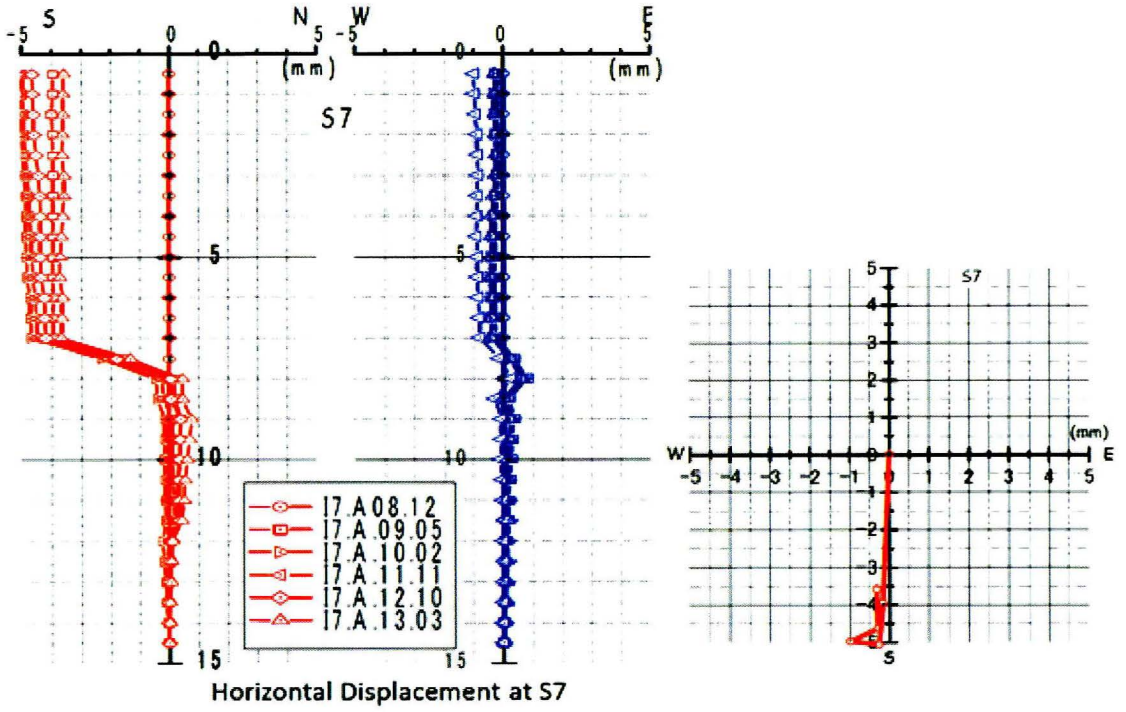
DI DINDING LORONG : 1.

TKX.SAMPUL	PERIODE : FEB. 1990 : AGST.1990 : FEB. 1991 : AGST.1991 : FEB. 1992 : AGST.1992 : FEB. 1993 : AGST.1993 : FEB. 1994 :																	
	1X	1Y	1X	1Y	1X	1Y	1X	1Y	1X	1Y	1X	1Y	1X	1Y	1X	1Y	1X	1Y
a	-3	0	+1	-3	+1	0	0	0	0	0	0	0	0	0	0	0	+2	0
b	-2	-2	+3	-1	+2	-2	+1	0	+2	-1	+2	-1	+2	-2	+3	0	+2	+1
c	0	+3	+2	0	+1	+2	+2	+1	+1	+2	+1	+2	+1	+3	+1	+2	+1	+2
d	-1	+1	-1	0	-1	-4	-1	0	-1	0	-1	0	-2	-2	0	-3	-1	+1
e	+1	+1	0	+4	+1	+4	+1	+3	0	+3	0	+3	0	+3	+1	+3	0	+2
f	-1	-3	-1	-3	-1	-4	0	-4	-3	-3	-1	0	-2	-1	-3	-3	-3	-4
g	0	+3	+1	+3	+1	+1	0	+2	0	+2	-1	+2	+2	0	0	+3	+1	+3
h	-1	-1	-1	-1	-2	-1	0	-2	-1	-1	-1	-1	-1	-2	-1	-2	-3	0
i	-1	-1	+1	-1	-2	+2	+1	0	0	+1	-2	+1	-1	-1	+1	+2	-2	-1
j	+1	0	+3	0	-3	-1	+2	0	0	0	+3	0	+1	0	+1	-2	-3	-2
k	+1	0	+1	+2	+1	0	+1	+2	0	+1	+1	+2	0	+1	+1	0	+1	0
l	+2	+2	+1	+3	+2	+3	+1	+1	0	0	+3	+4	+2	+2	-1	+3	+2	0
m	+1	-1	0	+1	+1	+1	0	+1	0	+1	0	+1	+1	+2	0	0	0	0
n	-1	+1	-2	+2	0	+1	-1	+1	-1	+1	+3	+1	-1	+1	0	+1	0	0
o	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	+2	-1	+1	-1	0	-1	+2	-1
p	0	+3	0	+2	0	+3	+1	+2	0	+2	0	+2	+1	+3	+1	+3	0	+2
q	-1	-2	+1	0	+1	+1	0	-2	0	-1	+1	0	+1	-2	+1	0	+1	-2
r	0	-2	+1	-2	0	-2	+1	-2	0	-2	0	-3	0	-2	+4	-4	-1	-2
s	-3	0	-2	+1	-4	0	-3	+2	-2	+1	-4	0	-3	0	+3	0	-2	+1
t	+3	0	+1	+1	-1	+1	+2	0	-1	+2	+1	+2	+1	+1	+1	+3	0	+1

4. Boring Hole Inclination

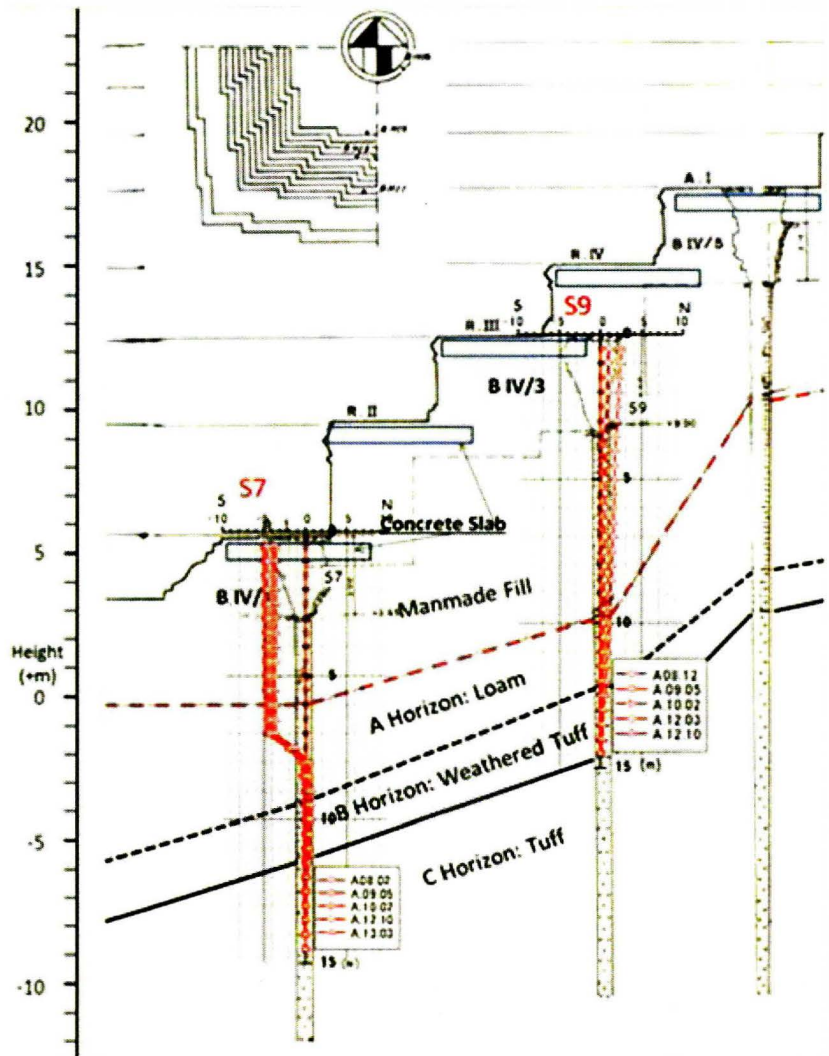






Manmade Fill

- A. Loam with Andesite Chips
- B. Weathered Tuff
- C. Tuff Rock



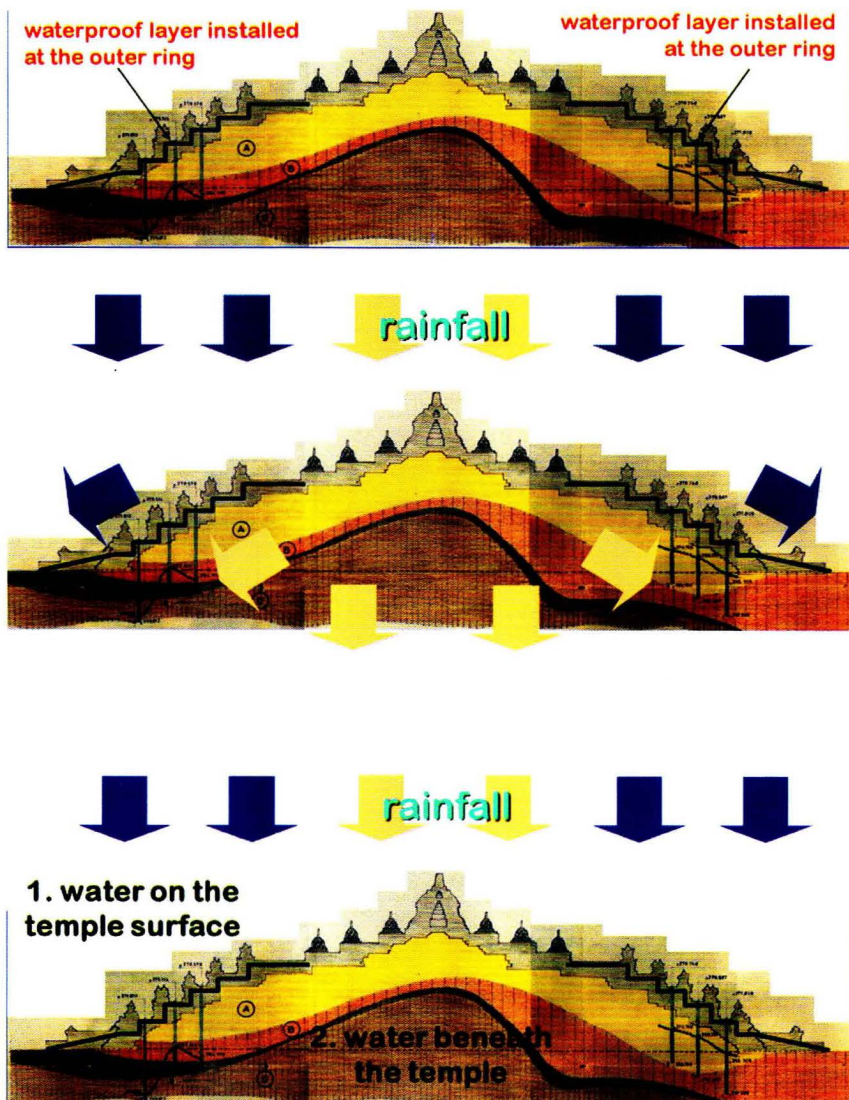
The Waterworld Inside the Hill Beneath Borobudur Temple

Ir. Djoko Luknanto, M.Si, Ph.D

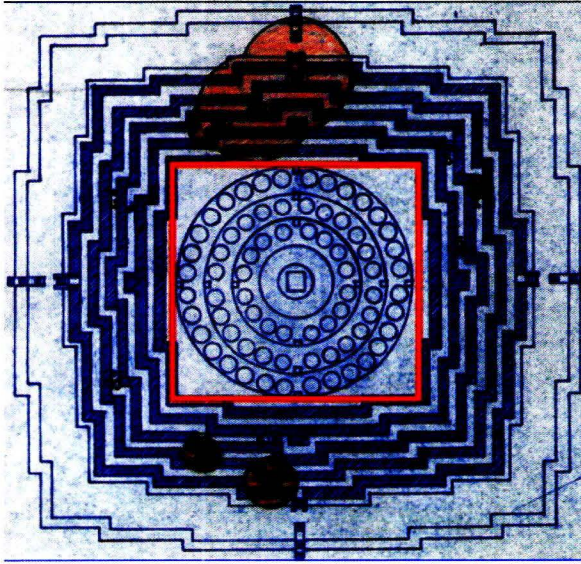
Objective of the study

- To monitor surface-water and groundwater at Borobudur Temple to avoid the detrimental effect to the temple.
- To recommend necessary action in the future to monitor water more accurately to sustain the well preserved Borobudur Temple at its surrounding area.

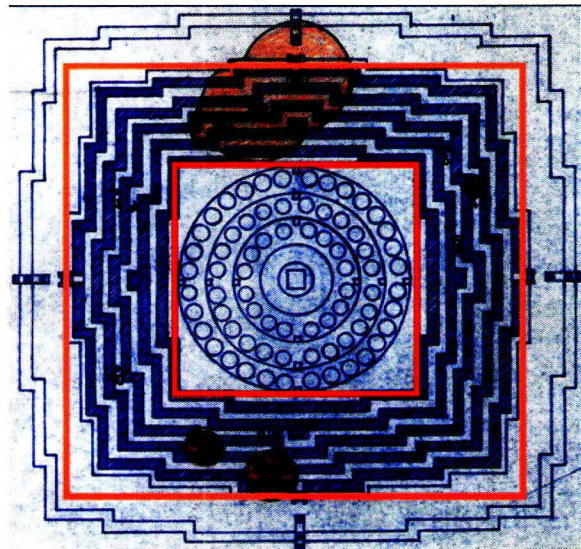
Water at Borobudur Temple



2 Types of Water



- at inner ring (terrace)
 - ◆ rainfall goes directly to the soil below the temple



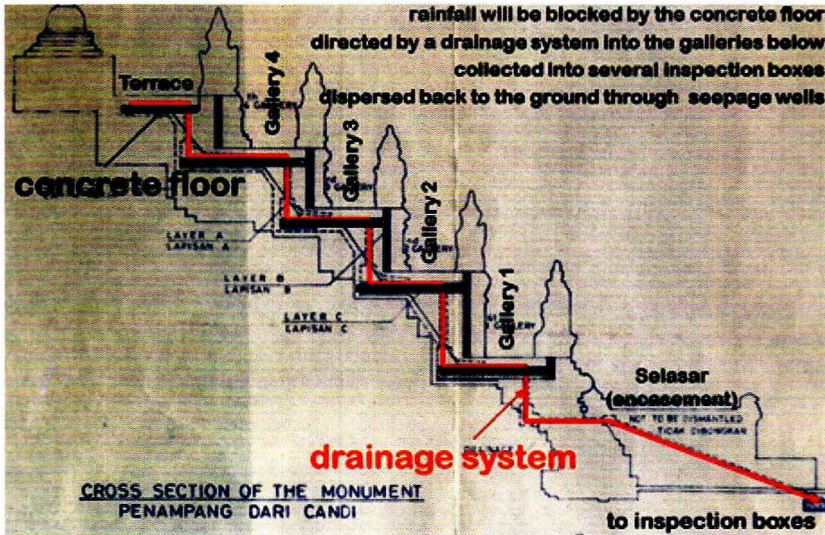
- at outer ring (galleries)
 - ◆ rainfall block by waterproof layer.

Plan View of the Temple

There are 2 types of water

1. Groundwater beneath the temple
 - small amount of it will eventually flows back through water filters to the surface of the temple
 - Most of it will stay as part of the greater groundwater system for a period of time
2. Surface run-off on the temple surface
 - block by waterproof layer and directed to the drainage system
 - eventually surface water will go to the seepage wells at the temple yard

Surface Water



Surface Water Observation

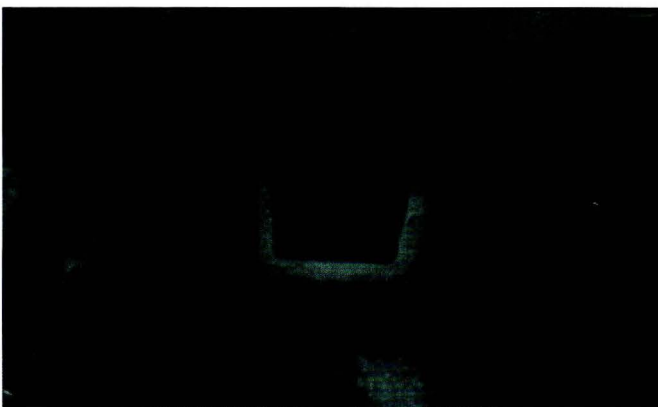
Field data observation by Borobudur Conservation Office (BCO):

- climatological data (rainfall and evaporation)
- drainage system
- inspection boxes and seepage wells
- waterproof layers
- water meters

Groundwater Observation

Indirect field observation of groundwater has also been done by BCO:

- water filters
- surface run-off volume
- water in the inclinometers

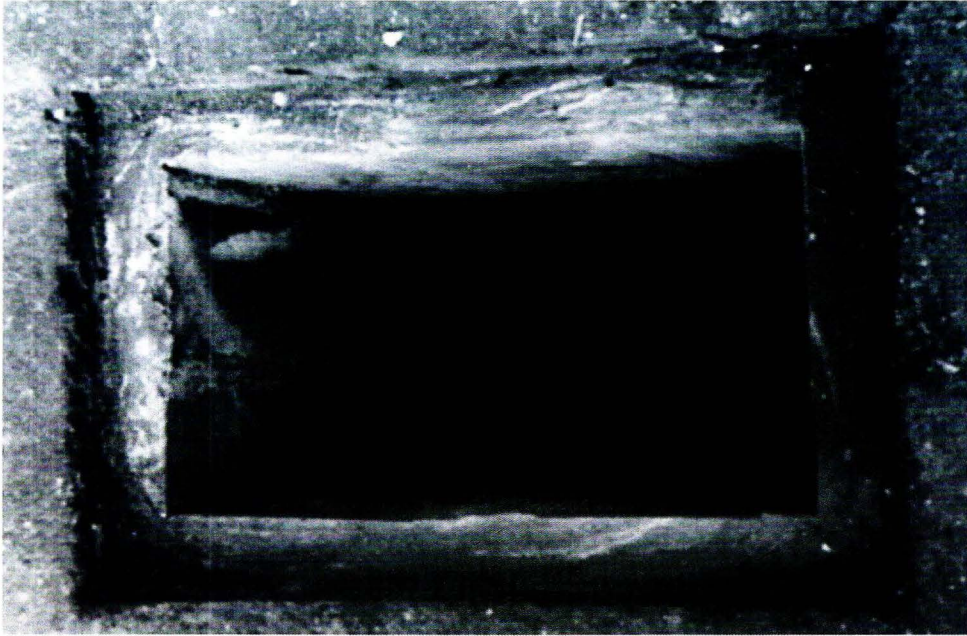


Water Filters

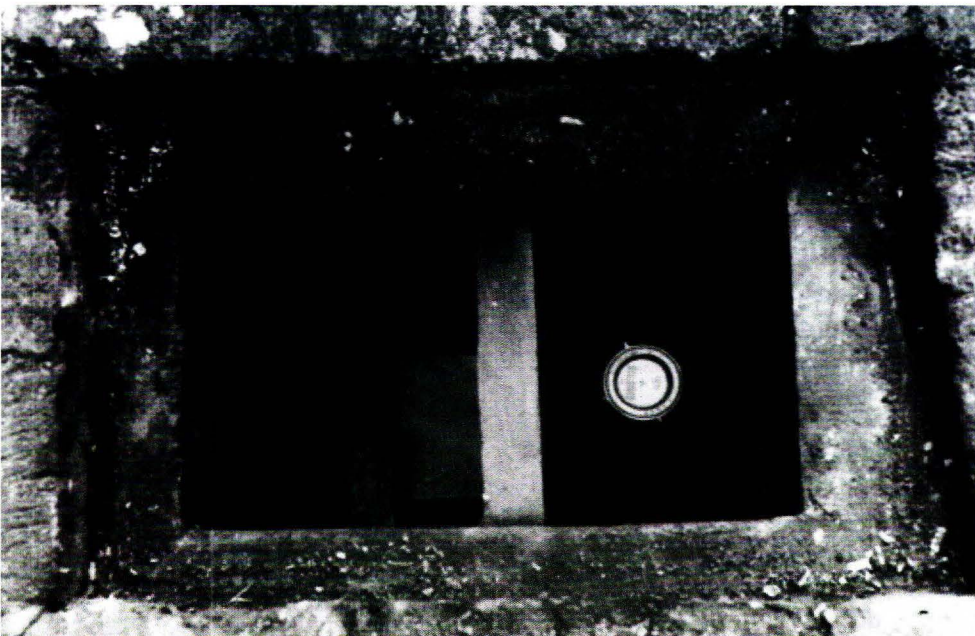
- Water filters are used to protect the groundwater below the temple from coming out directly to the temple floor, picking up soil particle beneath the temple along the way.
- Up to present the water filters performs well to avoid the piping at the soil.

Water Meters

- to measure the volume of surface run-off on the temple floors (BCO installed 8 water meters in the inspection boxes surrounding the temple)

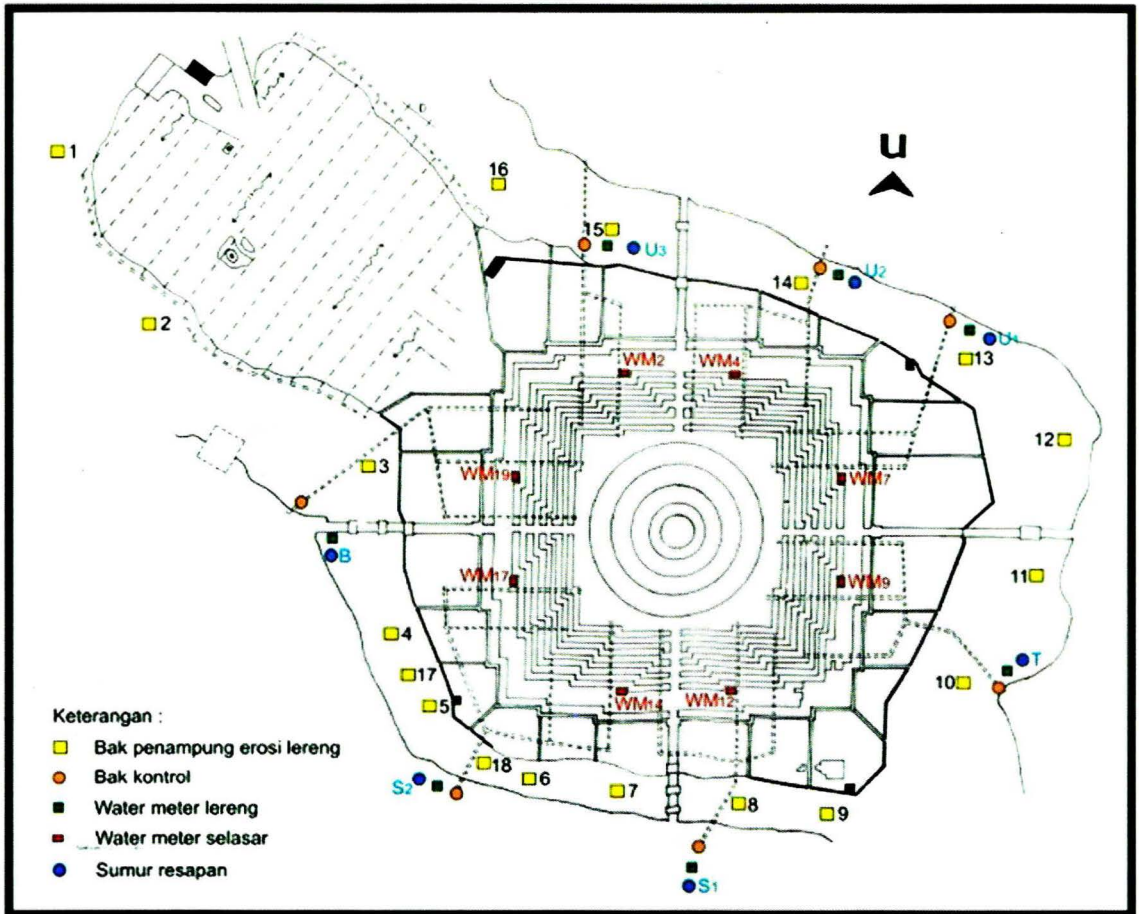


■ before installation



■ after installation

Map of all water related measurements



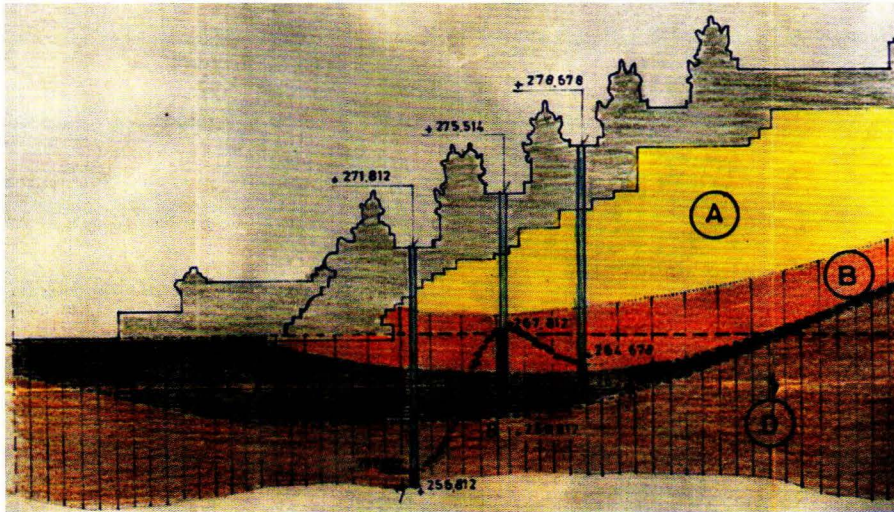
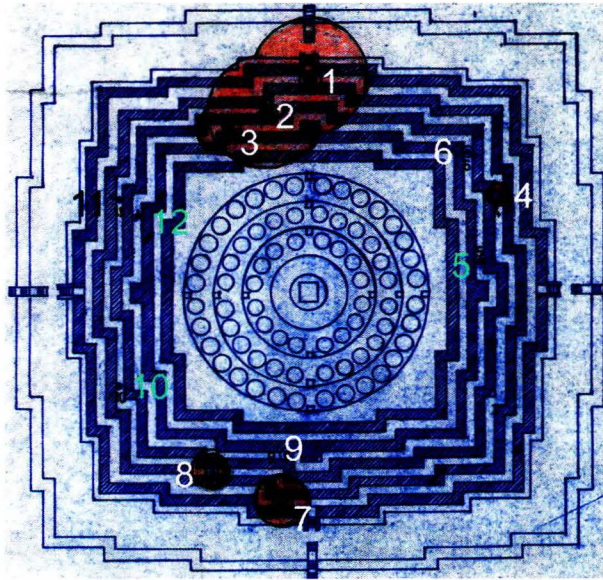
From Nahar Cahyandaru 2013

Inclinometers

- inclinometer is not appropriate for groundwater monitoring
- inclinometer is a device to measure horizontal movement of a structure
- at Borobudur temple the inclinometers were used to measure the horizontal movement of the temple and to monitor the groundwater table.
- there is no device to monitor directly the groundwater table.

Location of inclinometers

- inclinometers are available at 12 location:
 - ◆ there is water inside: 8 locations (w/ circle)
 - ◆ there is no water inside: 3 locations (w/o red)
 - ◆ multifunction 1 location (no 12)
- From the inclinometer data, it is very difficult to estimate the groundwater table



Waterlevel at inclinometer 7-8-9

- there are no specific pattern on inclinometer 7-8-9
- the groundwater table could not be predicted

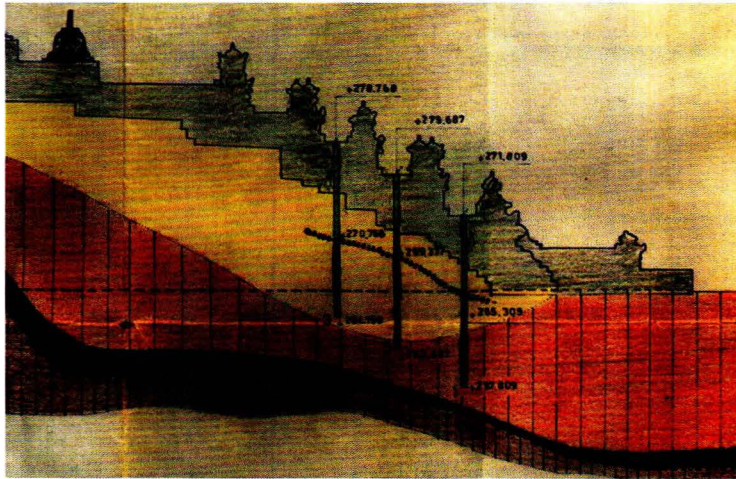
Waterlevel at inclinometer 1-2-3

- more regular pattern on inclinometer 1-2-3
- this might be the correct groundwater table for Horizon A

Groundwater tables

There are two groundwater tables at Borobudur Temples:

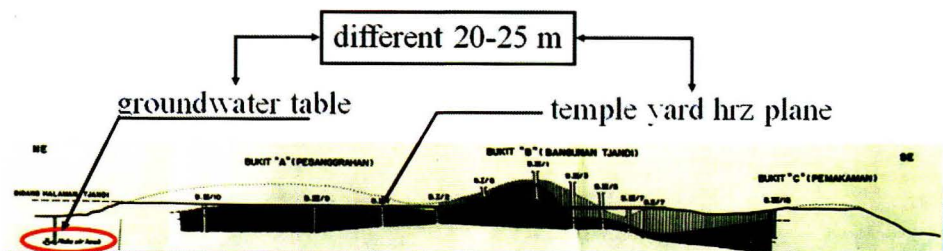
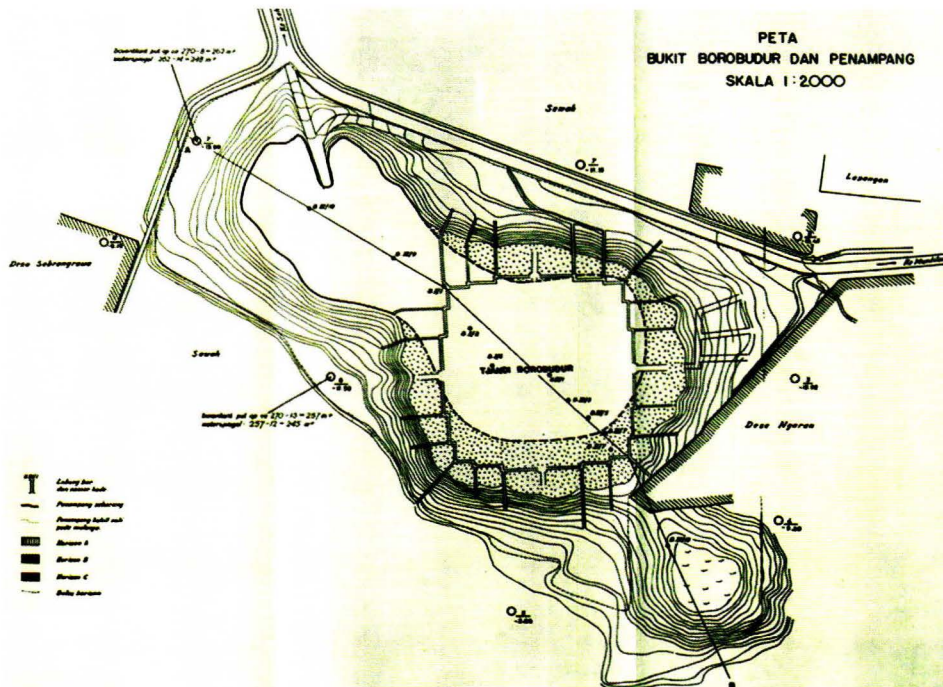
1. Groundwater table at the hill beneath the temple, and



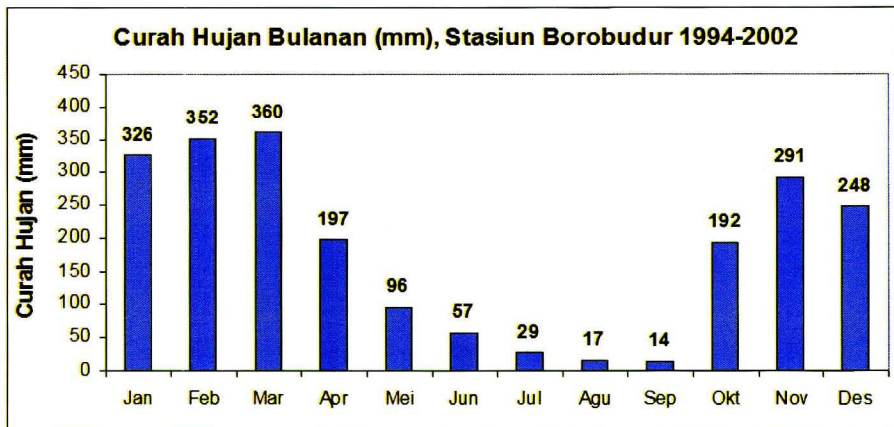
2. Groundwater table at the villages surrounding the temples

The water level different between these two tables is more than 20-25 m.

The Map of Borobudur Hill



Monthly Rainfall (mm), at Borobudur 1994-2002



Groundwater Flows

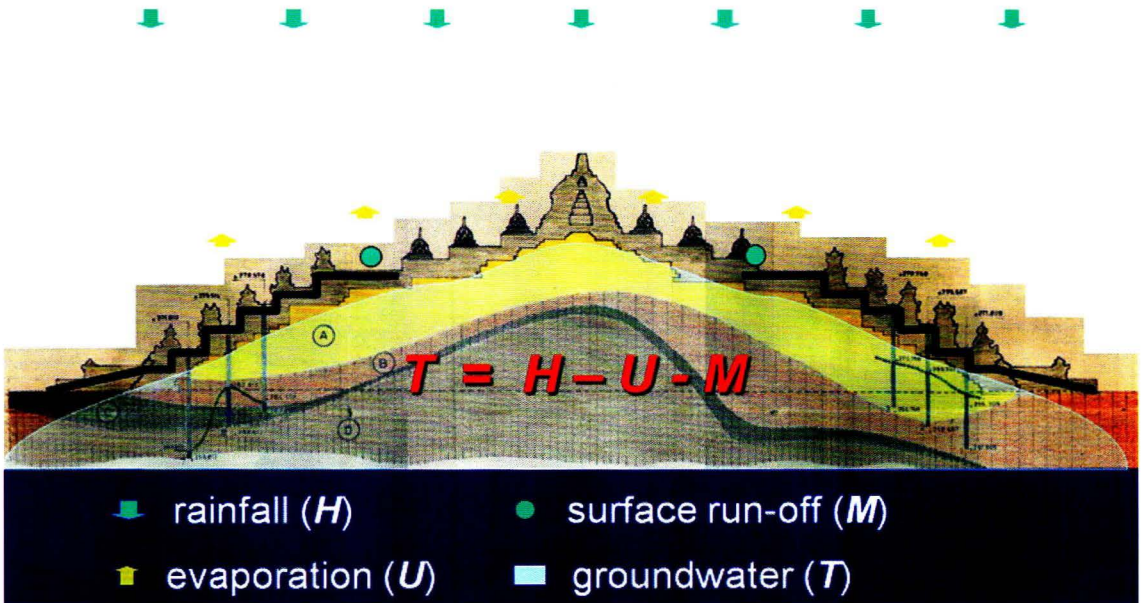
- according to groundwater hydraulics, water flows from locations with higher energy to a lower one
- at rainy season, there might be groundwater pressure to the temple wall
- groundwater flow pattern are quite complicated, since there are 4 layer of soils with different characteristic



Consideration

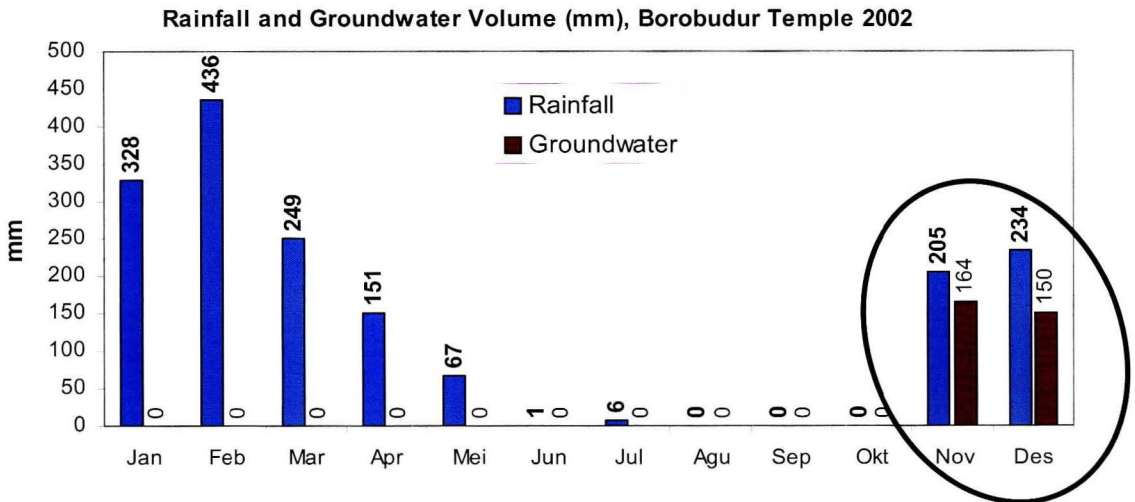
- It is very difficult to monitor the groundwater table without the appropriate devices
- Indirect measurement of the groundwater volume cannot exactly predict the groundwater table
- Observation of the groundwater table using inclinometers are not appropriate

Water Balance at Borobudur Temple

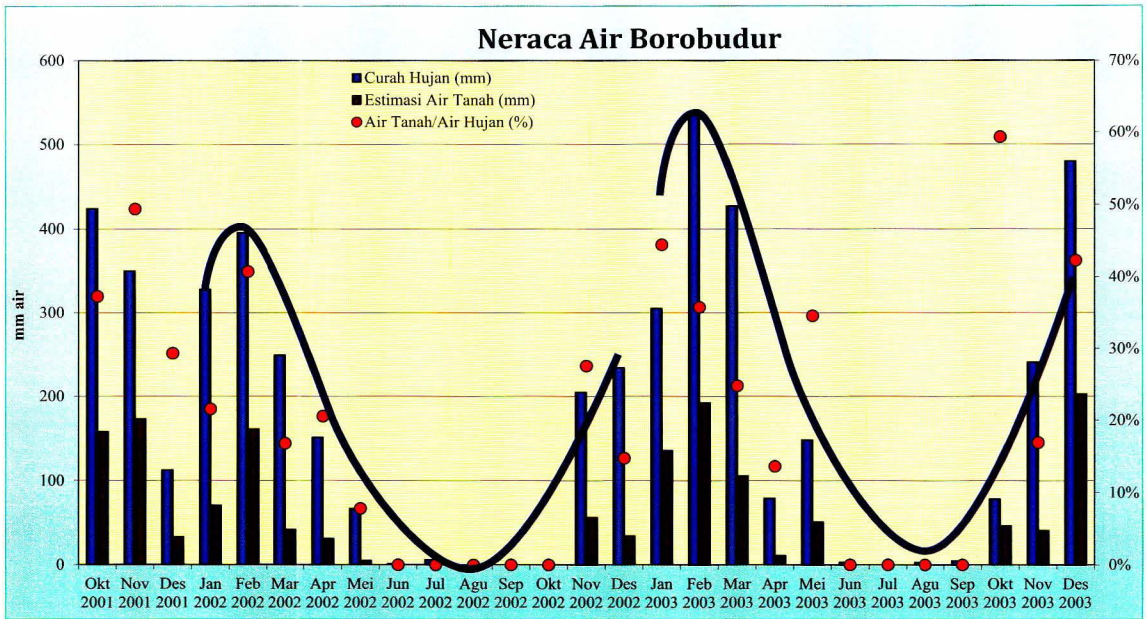


Groundwater Volume

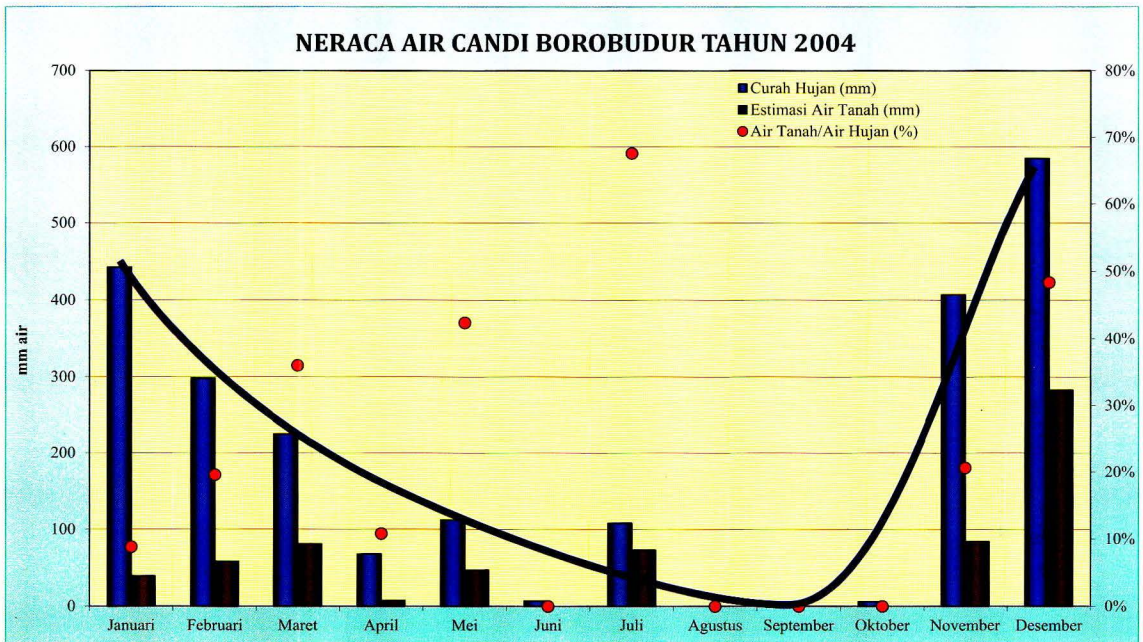
- With the use of simplified water balance, monthly volume of groundwater (mm) can be calculated



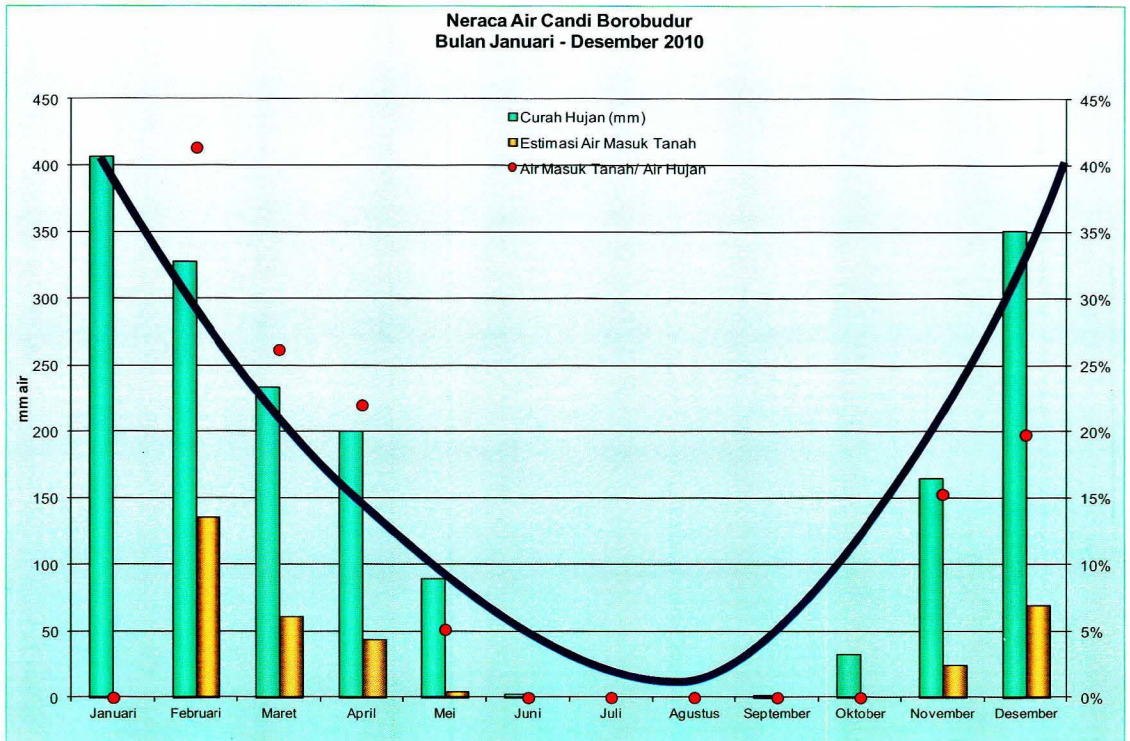
Estimation of groundwater, at Borobudur Oct 2001 - Des 2003



Estimation of groundwater, at Borobudur 2004



Estimation of groundwater, at Borobudur 2010

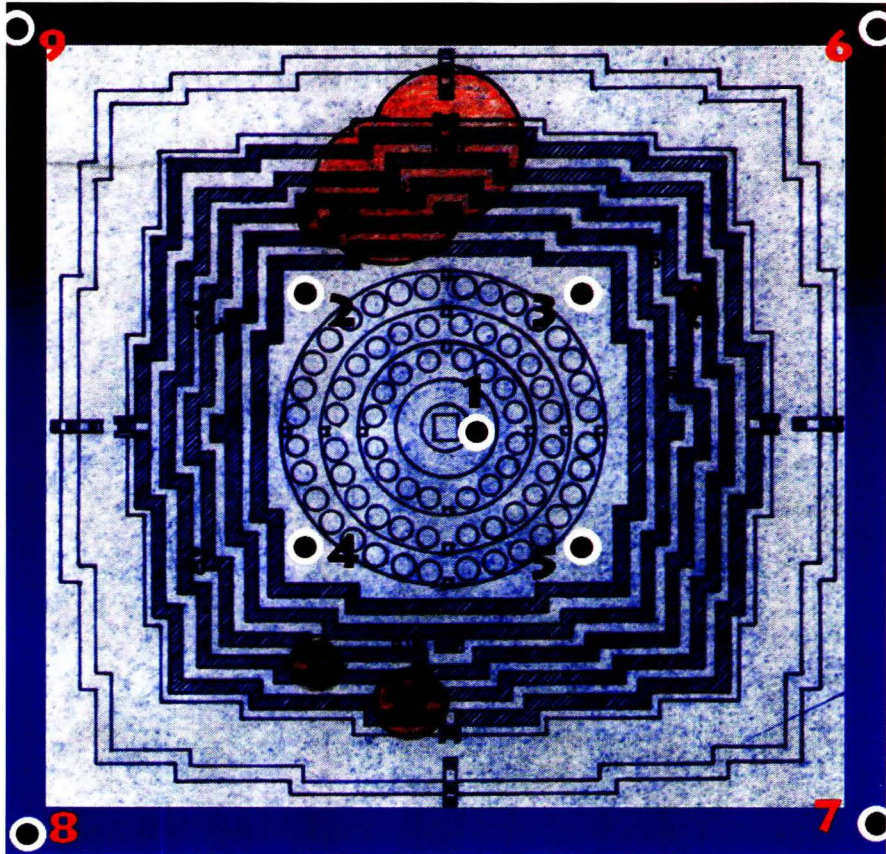
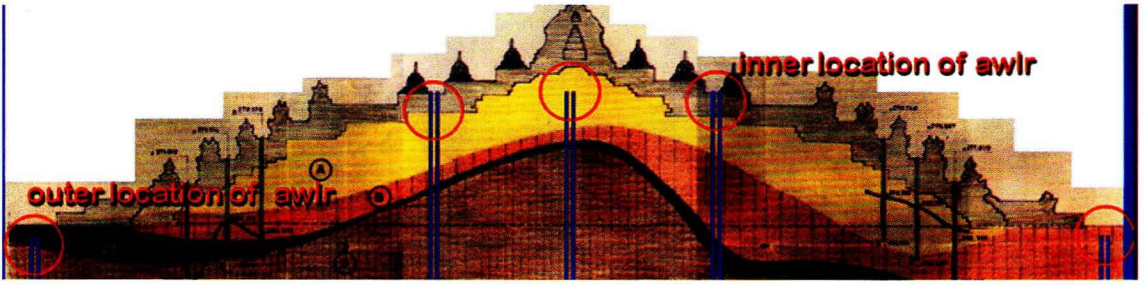


Recommendation

1. The surface water monitoring at Borobudur may still be carried with the improvement of water discharge measurement devices.
2. Direct measurement of groundwater table at the hill beneath Borobudur Temple must be carried out using appropriate devices.
 - a. For the time being, the study can only suggest the preliminary layout of the monitoring groundwater table, as describe in next slides.
 - b. The depth of the monitoring devices can not be decided at present, since more study from Item a has to be done first.
 - c. More geological investigation shall be done in the future, especially on the hill below the temple in the North-South direction. This geological data is very important when the study of the groundwater hydrodynamic is carried out in that direction.

Location of AWLR

- at the inner and outer rings of the temple
- simple to install
- never destroy any single feature of Borobudur Temple
- the depth of the AWLR will be decided after the more rigorous studies has been done



Diskusi

Pertanyaan 1. Yoshinori Iwasaki (Geo-Research Institute, Osaka, Jepang)

Saya setuju dengan konsep yang disampaikan Ir. Djoko Luknanto, tetapi mohon penjelasan data yang disampaikan. Bagaimana pendapat dari anda mengenai elevasi muka air tanah yang ditunjukkan dalam tabel walaupun diambil dari lubang inclinometer?

Mengenai lapisan tanah yang ada di bukit bawah candi, menurut anda mempunyai karakteristik yang berbeda sehingga akan menimbulkan dampak yang berbeda pula. Begitu pula dengan elevasi muka air tanahnya.



Jawaban : Djoko Luknanto

Apa yang dilakukan oleh Balai Konservasi Borobudur adalah menggabungkan data curah hujan dengan air melimpas yang diukur dari bak pengukur, kemudian dikurangi lagi dengan air yang menguap sehingga sisa dari itu dianggap air yang masuk ke bukit bawah candi.

Untuk melakukan pengukuran elevasi muka air tanah di bukit bawah candi perlu dibuat lubang pengeboran yang berbeda-beda sesuai kedalaman horizon tanah sehingga bisa diukur elevasi muka air tanahnya.

Pertanyaan 2. Hr. Sadirin (Konservator Balai Konservasi DKI Jakarta)

Pada saat pemugaran ke-2, disampaikan bahwa permasalahan utama adalah elevasi muka air tanah bukit bawah candi, oleh karena itu dilakukan pembongkaran dan membuat suatu sistem drainase untuk air hujan sehingga mencegah air tanah ini mempengaruhi stabilitas candi.

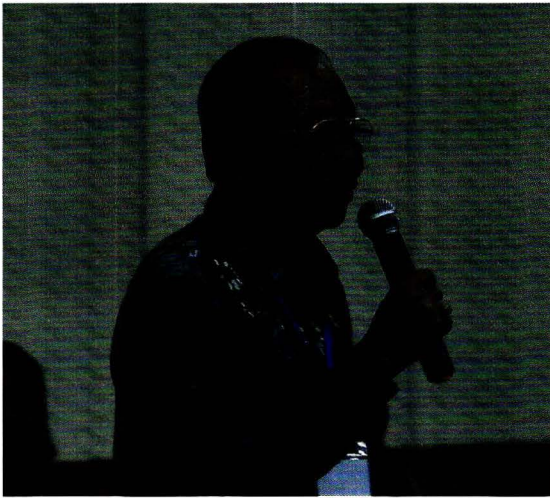
Masukan terutama bagi UNESCO untuk membantu Balai Konservasi Borobudur dengan mengirim tim ahli dalam bidang terkait sehingga dapat membantu dalam hal pelatihan tenaga untuk mengatasi permasalahan ini secara jangka panjang.

Jawaban : Djoko Luknanto

Bisa memahami sepenuhnya permasalahan ini, tetapi selain tenaga ahli juga membutuhkan peralatan yang sesuai dan ini perlu biaya yang tidak murah. Dan menurut saya, masalah air bawah tanah ini sangat penting.

Jawaban : Ichita Shimoda

Saya menggarisbawahi pentingnya data elevasi muka air tanah yang benar sehingga bisa menafsirkan apa yang terjadi dengan benar. Dari data yang sudah ada, terlihat adanya perbedaan antara musim hujan dan musim kemarau, sehingga pergerakan stabilitas lereng juga mengikuti tren musim hujan dan musim kemarau.

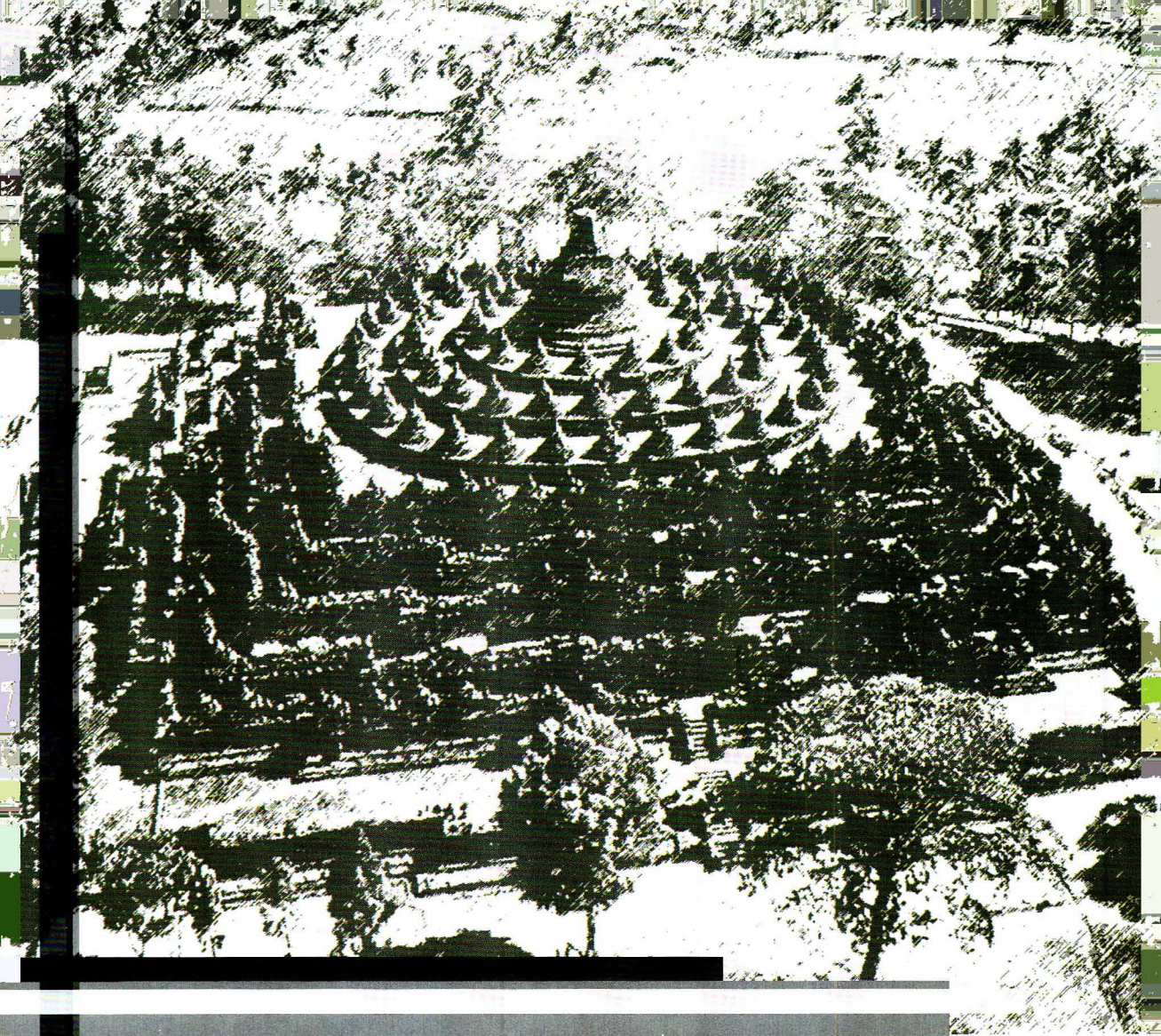


Pertanyaan 3. Dukut Santoso (Kepala Balai Konservasi Borobudur 1998 - 2006)

Pada waktu pemugaran, elevasi muka air tanah ini sudah diteliti begitu juga dengan klasifikasi tanah. Penelitian Ir. Djoko Luknanto sudah lengkap tetapi bila dikorelasikan dengan faktor lingkungan di bawah candi ada beberapa jenis tanah, yaitu tanah urug, tanah asli permeabel dan tanah asli impermeabel. Pertanyaannya adalah apakah jenis tanah ini mampu mengatur neraca air. Karena air mengalir kearah utara dan selatan, terlihat dengan suburnya tanah di sisi utara dan selatan candi.

Jawaban : Djoko Luknanto

Banyak hal yang ingin dicapai, termasuk penelitian yang sampai saat ini belum lengkap. Dengan kondisi yang ada, maka hanya hal seperti yang sudah dilakukan yang bisa dikerjakan. Kalau mengenai lapisan tanah, elevasi tanah yang berbeda-beda membuat penelitian ini menjadi rumit. Arah aliran sebenarnya sudah diketahui tetapi seperti yang sudah disampaikan, perlu alat yang mendukung untuk mendukung teori tersebut.



Borobudur Temple and Its Threats

Natural Hazards And Its Mitigation Of Borobudur Temple Site

Prof. Dr. Sutikno

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Faculty of Geography, Gadjah Mada University Yogyakarta
Research Center of Disaster (PSBA) Gadjah Mada University, Yogyakarta

Abstract

Borobudur Temple site is located on alluvial plain and surrounded by various sources of natural environmental hazards, such as volcanic, earthquake and landslides hazards. Historically Borobudur Temple and surrounding was several times struck by earthquakes and also covered by volcanic materials. Objective of this paper: to identify the natural hazards and their characteristics that possibly occurred and to propose alternative mitigation of natural hazards in the study area. Historical and secondary data, map and remote sensing imagery interpretation are used in this study; data analysis using spatial and descriptive method. The most probable natural environmental hazards supposed to be occurred are: earthquake, volcanic, landslide and flash flood with low-medium susceptibility classes. Alternative mitigation of each type of hazards should be based on their characteristics and the direction of current agent, through structural and non structural measures. Even though surrounded by various sources of hazards the Borobudur Temple still exist and gallant, it means that the site selection is perfect with genius consideration.

Introduction

Borobudur Temple is a famous Buddhist Temple in Indonesia and in the world, was decided as world heritage by UNESCO. Administratively it is located on Magelang Regency, Central Java Province, Indonesia. Naturally the temple is located on alluvial plain, a part of Kedu depression. The Kedu depression as whole belong to Progo River Basin/Progo River Watershed (Sutikno, 2012). The Progo River is a big river, and the water divide of the watershed is surrounded by various types of natural landscapes. The surrounded natural landscape compose of four active volcanoes, in eastern side by Merapi, and Merbabu volcano, in western side by Sumbing and Sundoro volcano, in northern side occupied by Ungaran volcano, while in southern side by structurally mountainous areas, namely Menoreh Mountain (Fig. 1). Physiographically the Progo River Basin is located on southern and central zone of Java Island (Pannekoek, 1949, Bemmelen, 1949; Verstappen, 2000). The Java Island it self is located on southern margin collision of the Eurasian and Hindia plate tectonic (subduction zone). All of them are sources of high potential of natural hazards.

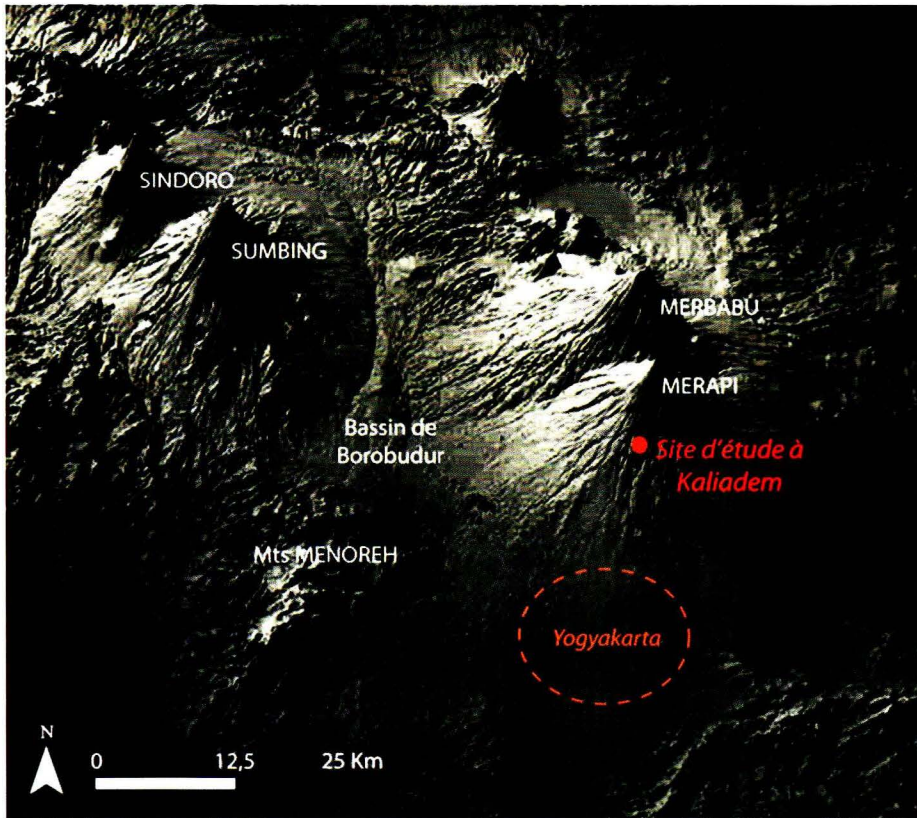


Fig.1 Location of Borobudur Temple and its surrounding (Gomes et al., 2012?)

Based on the natural landscape of the Progo River Basin several natural hazards can be identified, such as : i). volcanic hazards and their variations in relation to five volcanoes, particularly from Merapi volcano where the most active volcano, ii) mass movement related to the structural mountain of Menoreh, iii). earthquake hazard related to the location on the margin plate tectonic collision, and iv). flood hazard related to the Progo River watershed which has high amplitude and high rainfall. Based on the historical data Borobudur Temple and its surrounding has several times affected by disaster such as: i) earthquake, during 1006-2007 years period at least there were 20 times strong earthquake occurred in the Borobudur Temple site and the surrounding (Subagyo et al., 2012), ii). pyroclastic falls, especially from Merapi eruption, that usually occurred at 4-8 years return periods, and the last strong eruption occurred in 2010, iii). landslide from Menoreh Mountain area.

Natural hazards from geological and geomorphological point of view actually are geological and geomorphological processes that have potential for causing injuries to life, properties losses and environmental damages. If the magnitude of natural hazards become higher or stronger than normal processes, natural disaster will occurred, and a serious disruption of the functioning of a community causing widespread human, material or

environmental losses which exceed the ability of affected community to cope using its own resources caused by natural processes.

Since the natural hazards and natural disasters are related to geological and geomorphological processes, geology and geomorphology science has an importance contribution to disaster management, especially on mitigation phase. There is a fundamental concept in geology and geomorphology, in relation to the occurrence of natural hazards and natural disasters that mentioned “the present is the key to the past, and the past and the present is the key to the future” (Sutikno, 2012). It meant that natural processes at present also already occurred in the past and will also happened in future, even though the intensity is not always same.

Objective of this paper is to identify the natural hazard types in the Borobudur Temple site and its surrounding, and to mitigate the hazards in order to minimize their impacts. There are two reasons to formulate the objective, first is related to the situation of the watershed where the temple site is located has high potential of natural hazards, and secondly is related to the principle concept on geology and geomorphology that the past and the present natural hazard will occurred in the future. It means that Borobudur Temple site and it surrounding will not free from natural hazards. The types of natural hazards in the study area and their characteristics can be used to formulate mitigation measures. Mitigation is important step in disaster management.

Data and Method

Natural hazards study need data on physical condition of the study area, in this case the physical condition of the watershed. Climate, topography, geology, geomorphology, hydrology and land use conditions are important data for natural hazard study. Secondary data, manual remote sensing interpretation and field observation were used in this study, and geological and geomorphological approaches were used to identify the natural hazards types and their characteristics. Descriptive analyses were used to decide the mitigation measures.

Natural Physical Condition of Borobudur Temple Site and Its Surrounding

Natural hazard study ideally is carried out on river basin or watershed, because a river basin is a landscape ecological unit; each component of landscape ecological unit has closed interrelationship. Occurrence of natural hazards at any location of landscape ecological unit within the river basin are strongly influenced by the natural physical conditions, such as climate, topography, geology, geomorfophology, hydrology and land cover. The natural physical condition of the Progo River Basin where the Borobudur Temple is located are briefly described as follow.

1) Climate

Rainfall is the main climatic element that relevant to natural hazards in the study area,

especially in relation to lahar hazards and mass-movement. Annual rain fall in the study area varies from 875 mm-2373 mm/year, the number of driest months are 3-6 months and the rain fall in driest range from 162-489 mm/month (Sutikno, et al., 2007). Beside the rain fall, wind element is also important in relation to distribution of ash or pyroclastic fall when eruption of volcanoes occurred. In general, the study area is affected by southern and northeast monsoon wind system. Local wind some times occurred when the volcano in the study area in active condition.

2) Topography

Topography is important factor for analysis of natural hazards, especially on the susceptibility of an area to certain physical processes that may promote disaster, and distribution of the disaster prone area. Three aspects of topography will be described here, namely altitude, relief and slope. Altitude of the study area has high range from 380 m up to 337 m asl. The lower part mostly on the low land, medium altitude occupied on Menoreh Mountain and lower-middle volcanic slope, volcanic upper slope and volcanic cone has highest altitude, as example altitude of Merbabu volcano is 3141m asl, Sumbing is 3371 m asl, and Merapi is 2911 m asl. Relief of the study area roughly can be distinguished into three parts, namely: flat to undulating, undulating to hilly, and hilly to mountainous. The flat to undulating area is located in lower part, the slope is less than 13 % and the amplitude of relief 5- 50 m; the undulating-hilly area is located on lower slope of the volcano and lower slope of Menoreh Mountain, the slope range 14-55% and the amplitude of relief 50-500 m. The upper slope and cone of the volcano, and also the upper slope of Menoreh Mountain can

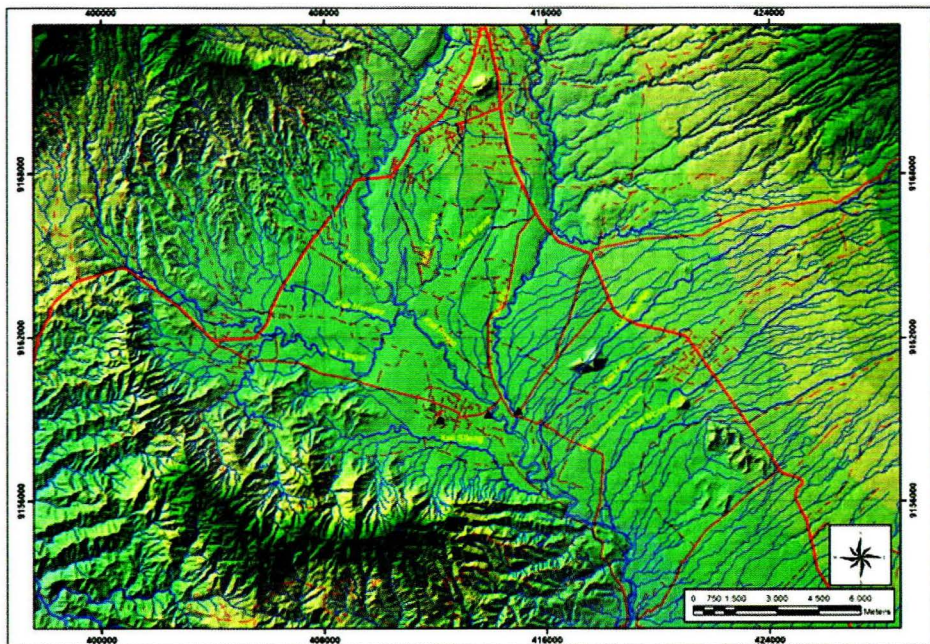


Fig. 2. Relief condition of the Borobudur site and its surrounding (Murwanto, 2011).

be classified as hilly to mountainous area which characterized by amplitude of relief 200 until more than 1000 m, and the slope more than 55%. Area distribution of the relief can be identified from Fig. 1 and Fig. 2.

3) Geology

Lithology, structural geology and stratigraphy has important role to the occurrence of natural hazards. In the study area there are 7 lithological units, e.g. black clay of ancient Borobudur lake, micro diorite (igneous rocks), limestone of Jonggrangan formation, volcanic breccia of Tidar, volcanic breccia of Old Andesite formation, volcanic rocks of Merapi Volcano, and volcanic rock of Sumbing Volcano. The spatial distribution of lithological units is presented on Fig. 3.

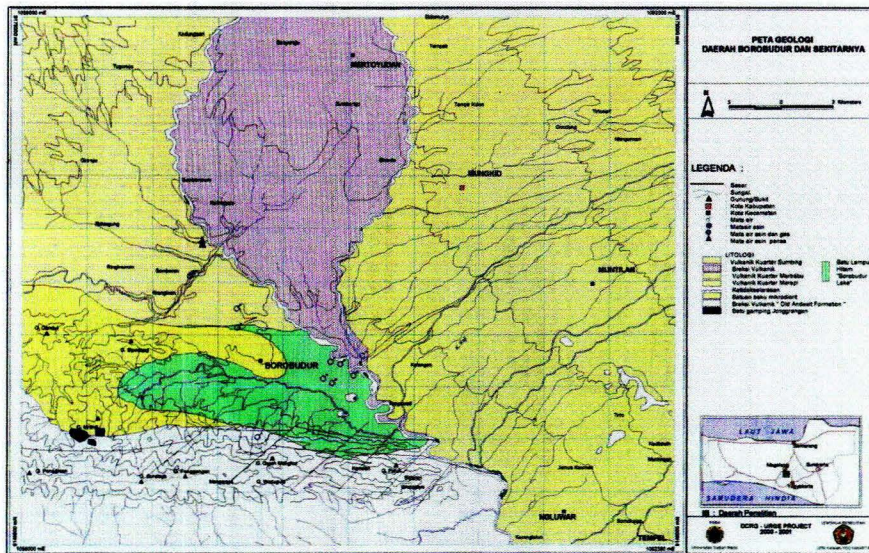


Fig. 3 Geological map of the Borobudur Tempel and its surrounding (Murwanto, H., 1996)

Based on the lithological units the area is dominated by volcanic products, mainly come from Merapi, Merbabu, and Sumbing volcano. These conditions have reflected that in early formation of the area was accompanied by huge volcanic activities. Due to the ancient volcanic activities there were some ancient archaeological remains covered by the volcanic materials (lahar deposit). Existing of black clay was also related to the ancient volcanic activities, the huge lahar deposits on volcanic slope of Merapi volcano collapsed then covered the Progo River course and ancient lake of Borobudur occurred. Due to headward erosion on former downstream of the Progo River and deposition of new volcanic material, then the lake became dry and black clay as deposit on bottom of the lake.

There are two main geological structures in the study area, e.g. volcanic and fault structure. The volcanic structure, of course, belongs to the volcanic landforms, and all volcanoes in the study area are strato volcano type. Fault structure mostly occurred in

the Menoreh Mountain, especially step fault, with two direction, east-west and northeast-southwest direction. The existing of step fault was caused by tectonic activities that is triggered by earthquakes.

4) Geomorphology

There are six major landform units in the study area, e.g. i). volcanic foot and volcanic lower slope of Merapi and Merbabu volcano, ii). volcanic lower slope of Sumbing volcano, iii). volcanic foot plain and volcanic hill of Tidar volcano, iv). denudational hills composed of igneous rocks, v). structural mountainous vi). alluvial fans, and vii). alluvial (lacustrine) plain. Spatial distribution of the main landform units more or less are similar to the distribution of lithological units. The landform unit is characterized by relief, lithology and the structure, and geomorphic processes, all of the landform unit characteristics directly or indirectly have relation to the occurrence of natural hazard. Integration between landform unit characteristics, lithological and structural geology and hidrology can be used to identify natural hazard types. What kinds of the natural hazard in the study area according to the landform unit will be described latter.

5) Hydrology

Surface hydrology as well as groundwater hydrology influence natural hazard susceptibility of an area within a river basin. Flood and mass-movement natural hazards mostly are related to hydrological condition. The hydrological condition depends on the climatic, geological and geomorphological condition. Due to the climatic, geological, and geomorphological condition, the study area has a good hydrological condition that support the occurrence of flood and mass movement hazards, and lahar hazard particularly on the active volcano.

The surface hydrology condition can be reflected by the river system of the Progo River basin. There are five river systems can be identified, e.g. the first four river system come from Merapi, Merbabu, Sumbing, and Sundoro volcano, and another one is a river system come from Menoreh Mountain. The river system come from volcanic area mostly are perennial rivers, while river system from Menoreh Mountain are intermitten rivers. The drainage pattern of the river system as whole is dendritic, and locally radial patterns are found (Fig.4). Discharge of Progo River in average for about 150,000 l/second

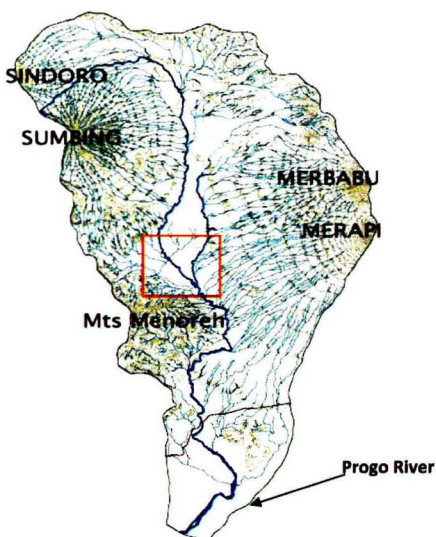


Fig. 4. Drainage pattern of the Progo River Basin, where Borobudur Temple is located (Gomes, 2008)

Natural Hazard of Borobudur Temple and Its Surrounding

Based on the physical condition as mentioned the natural hazard that is possibly occurred and become a problem in Borobudur Temple and surrounding limited to four types, e.g earthquakes, volcanic, landslide, flood and flash flood natural hazard. Below is briefly description of the natural hazards in the study area.

1) Earthquake Hazard

Existing data on natural disasters of the study area are earthquake and volcanic disaster. Earthquake several times occurred, at least there were 18 earthquakes with magnitude more than 6 (MM) in duration from year 1006 until 2006. (Pramuwijoyo, S and Pyi Soe Thein, 2012). The occurrence of the earthquake can be traced by distinctive imprint upon landform (Thornbury, 1969) or land surface, such on artificial features, fault structure, change of river course, escarpment and springs. Fig. 5A shows undulating of temple stones and Fig. 5B shows collapsing of the temple stones of Borobudur Temple may caused by earthquake. Fig. 6 show four fault structures on Menoreh Mountain with different direction and valley that develop along the fault scarp.



Fig. 5A shows undulating temple stone; 5B. collapsing of temple stone that indicate impact of earthquakes (Pramuwijoyo S. and Pyi Soe Thein, 2012; Sutikno, 2012).



A

B

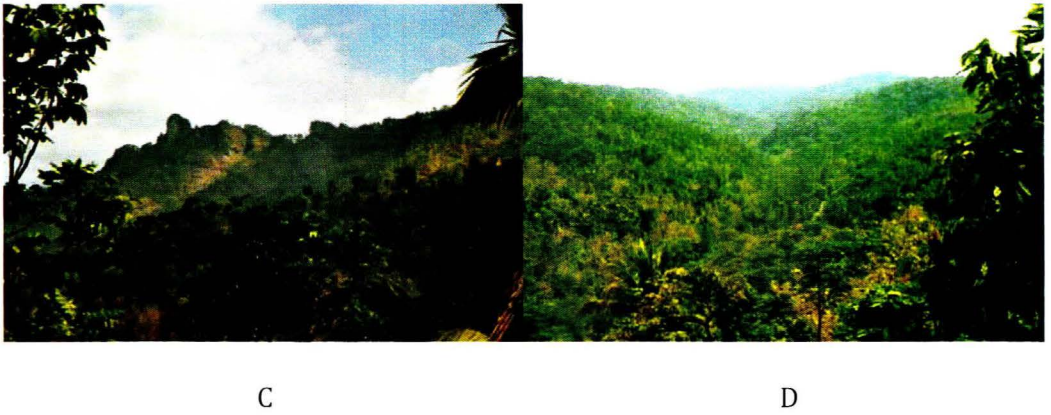


Fig 6. Fault structure on Menoreh Mountain: A Southwest-North-East fault; B. East-West fault; C. North-South fault; D. River valley on fault structure (Murwanto, H, 2013, personal communication).

Change of river course, strait river course and springs can also be used to indicate fault structure, such as on Fig 7 that show fault on strait river course and springs.

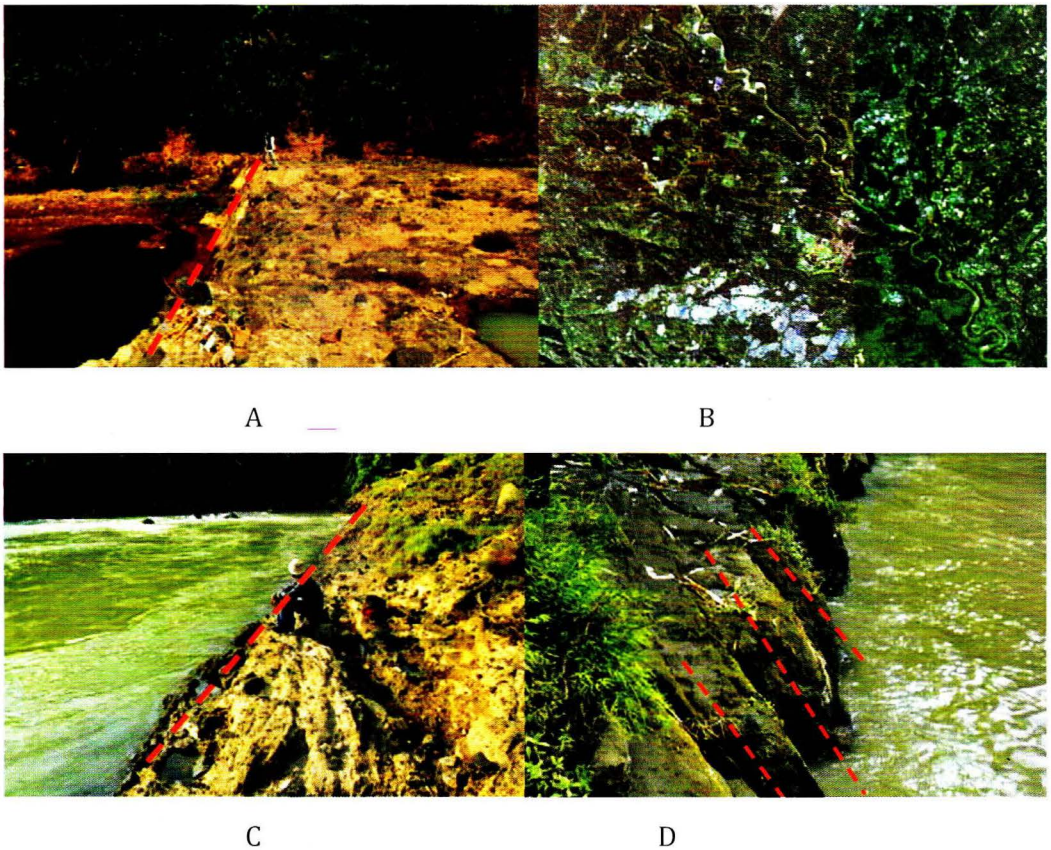


Fig. 7 A. Progo fault, northern of Sigug Bridge, B. Aerial photograph of study area; C. Progo fault northern of Sigug Bridge; D. Fault in eastern of Pawon Temple (Murwanto, 2011).

Some evidences of fault structures in the field, historical and secondary data prove that the study area has high susceptibility of tectonic that can be accompanied by earthquake. The location is near by to the collision zone between Eurasia and Hindia plate tectonic.

2) Volcanic Hazards

There are some volcanic activities that causing natural hazards, such as: volcanic earthquake, collapsing lava dome, lava flow, nue ardente or glowing cloud, pyroclastic fall, hot lahar flow, rain lahar flow, subsidence and toxic gas. Not all of the volcanic hazard types occurred in the study. The main sources of volcanic hazards in the study area are Merapi Volcano, but it does not mean that the other volcanoes do not hazardous. Although during centuries they do not show their activities; most of the other volcanoes are dormant. Historically Merapi Volcano has long records of eruption, such as:

- (1) in period of 3000- 250, 80 times eruption, and 7 of them were strong eruption;
- (2) new Merapi era, there were at six eruptions, in 1978, 1822, 1849, 1872, 1930-1931;
- (3) after 1931, eruption occurred again in 1961, 1996, 2004, 2010, 2014; and the largest eruption occurred in 2010.

The danger of Merapi Volcano eruption in this paper only limited on collapsing lava dome, glowing cloud (wedus gembel), pyroclastic fall and rain lahar flow. The collapsing lava dome usually occurred at limited distance from the crater, the distant depends on the size of the material. It does not danger to Borobudur Temple, but the accumulated material can support lahar flow hazard.

Glowing cloud, in local terminology known as “wedus gembel” is the most danger of the Merapi eruption, eruption in 1996, 2004, and 2010 accompanied by glowing cloud that causing so many victims, properties losses and environmental damages. Fig. 8 illustrates the glowing cloud and their impact. The glowing cloud can reach 10 km from the volcano peak, the temperature of the cloud for about $>700^{\circ}$ C. The possibility of glowing cloud could reach Borobudur Temple is rather small, depends on distant the opening of the crater rim, and magnitude of explosion.



Fig. 8. Glowing cloud (left) and the impact of the glowing cloud (right).

Pyroclastic fall occurred when the type of eruption is explosive. The ejected volcanic materials to the air can reach at several km high, it composes of various size particles: gravel, sand and ash. Due to decreasing energy upward, the material start going down with the larger first and follow by the finer, while causing fall or rain of volcanic material. The pyroclastic fall not only occurred surrounding volcano, but can be transported far away from the peak of volcano. The eruption of Merapi in 2010 caused air born volcanic materials were transported hundreds km, large area were affected. The spatial distribution of the pyroclastic fall following the wind direction. The impacts were many, including Borobudur Temple covered by 2 cm thick of pyroclastic materials. Another good example of large area affected by pyroclastic fall was eruption Kelud Volcano in East Java, that the volcanic materials (mainly ash) were transported through Central Java, Yogyakarta and West Java, including Borobudur Temple.

Rain lahar or cold lahar flow usually occurred after explosion eruption and followed by heavy rainfall. Unconsolidated of volcanic material product by new eruption become saturated by rain water, then flowing down the slope and accumulated on the river valley and flowing down stream with high content of sediment loads and very high velocity. Due to the high energy of lahar flow can damage river banks, structure facilities (bridges, dam, etc.) and covered human settlement and their facilities. The more dangerous site to lahar flow along the river channel are on the banding or sudden change direction of river chanel. Fig. 9 shows lahar flow on Kali Putih, Muntilan, Magelang that cross the main road Yogyakarta-Magelang and covered human settlement by thick volcanic materials. Some local people mentioned the rain lahar flow as cold lahar (lahar dingin), actually it is not cold, but still hot or warm as illustrated by Fig. 9B. Fig. 9B shows water vapor from lahar, the temperature at that time was around 50^o C.



Fig.9A. Rain lahar flow on Kali Putih crossing main road Yogyakarta –Magelang; 9B. rain lahar flow is still hot (warm) at Kali Gendol, Sleman, Yogyakarta.

Possibility of lahar flow reach the site of Borobudur is very low, because the distant factor, and separate the site location of Borobudur Temple to the valley of Progo River who has deep river bank.

3) Mass-Movement Hazard

Most of the physical condition of the study area can support the occurrence of landslide hazard, such as rain fall, relief, lithology, geological structure, landform unit and hydrological condition. The most susceptible area to landslide hazard is Menoreh Mountain, the slope of the volcanic area. The possible landslide hazards that is supposed to affect the study area coming from southern part, particularly from Menoreh Mountain. It is caused by the lithology that composed of weathered volcanic breccia, some step fault structure with different direction, and mostly steep slope. Fig. 10 illustrated the landslide on northern slope of the Menoreh Mountain. The product of landslide material in the past were deposited on alluvial plain far away (for about 1.5 km) from the mountain.

Steep slopes on Fig. 10 B and 10C actually are fault planes of step fault, on that position the condition unstable and have high susceptibility for occurrence of landslides. Hypothetically if the area is triggered by medium to strong earthquake it is possible that very large landslides occurred, because of the huge amount of materials that consist of

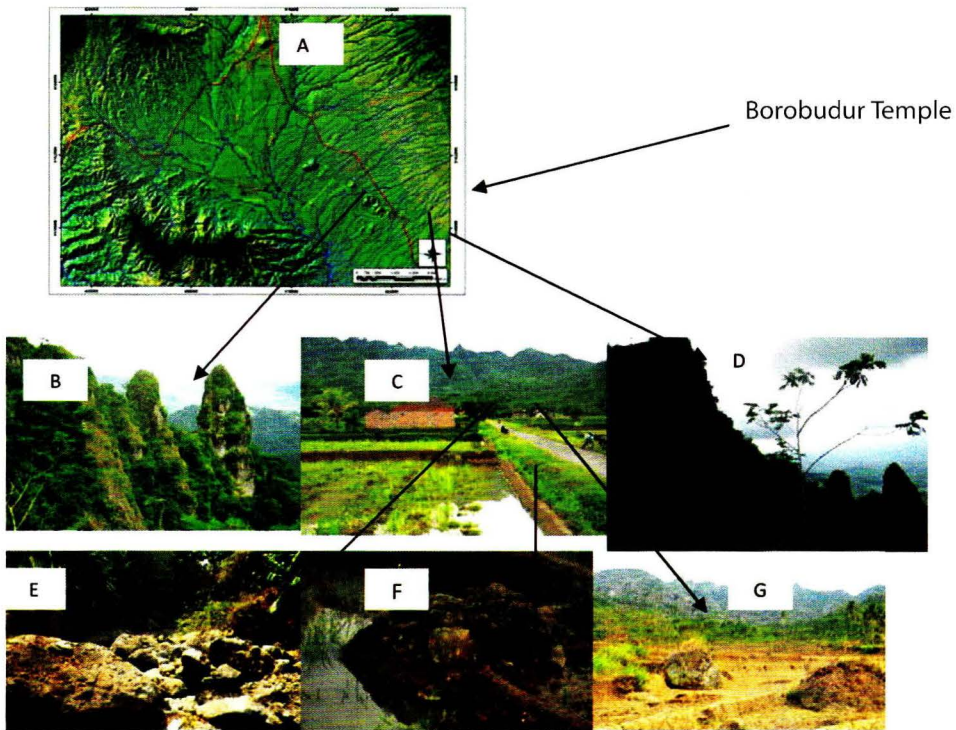


Fig.10 Illustrated landslide from Menoreh mountain: top is situation map of Menoreh Mt ; middle is landform features of northern slope of Menoreh Mtn, and bottom is deposits product by landslide from Menoreh Mtn.

block resulting from step fault. There is a chance that large landslides can reach at closed distance to the Borobudur Temple. The existing landslide materials on Fig. 10E, 10F and 10G in the form of compact block occurred after the ancient lake at dry condition. Based on the principle concept in geology and geomorphology previously it is possible that the such landslide may occurred in future.

4) Flood and Flash Flood Hazard

Flood occurs if the river discharge is higher than the channel capacity. There are two main factors influencing the flood. Firstly is stable river basin characteristics, that consist of: area of river basin, shape of river basin, slope, drainage density, lithology and soil properties; secondly is un-stable river basin characteristics, that consist of climate, especially rain fall, and land use or land cover of the river basin. Geomorphologically flood prone areas are located on fluvial landform, marine landform (Verstappen, 1983). The fluvial landform in the study area based on interpretation of remote sensing imagery and aerial photograph consists of alluvial plain, lacustrine plain, flood plain and river terraces. Meandering river channel can also be used as indicator for flood prone area.

Flash flood is characterized by very vast flood water flow (more than 20 m/second), short period and fast occurred. There are two main factors influencing the flash flood, e.g:

- 1) natural factor that consist of extreme rainfall (50-100 mm/day, duration 3-5 hours and the river basin characteristics (size, shape, slope, drainage density, drainage pattern);
- 2) anthropogenic factor that consist of artificial structures and land use changes (Purwadi Suhandini, 2011).

Based on the requirement of flash flood occurrence and related to the condition of the natural and anthropogenic factor can be estimate that study area has medium flash flood hazard susceptibility. The supporting condition for occurrence of flash flood hazard in the study area are:

- 1) annual rainfall is high (2252-3627 mm/year), rainfall intensity high will contribute high surface water;
- 2) the size of the Progo River basin is large and the form is rather circular, larger river basin can input water from rainfall, rather circular basin has medium in flash, and low of the infiltration rate;
- 3) the drainage density relatively high; high drainage density relates to high surface water availability;
- 4) most of the area have medium steep slope; more steep slope, more vast the surface run off;
- 5) most of the area are used for agricultural and settlement, the percentage of the forest covered relatively very low, a large part of the rain water become surface water flow.

All of the supporting condition above have contribution to higher surface water flow, high velocity and have potency to cause flood or flash flood.

Mitigation of Natural Hazards of Borobudur Temple and Surrounding

Four natural hazard types have been identified, namely earthquake, volcanic (consist of glowing cloud, pyroclastic fall, and lahar flow), landslide, flood and flash flood. Mitigation measures should be based on the hazard types and their characteristics, and element or object should be mitigate. In the study area, there are so many elements or objects that should be mitigated. In this paper, the mitigation will be based on type of the hazards, and the element or object is limited on the temple site. Mitigation measures here is not in detail, but just give an idea how to minimize impact if the potency of natural hazard rising become natural disaster. Basically there are two types of hazards mitigation: structural and non-structural mitigation. Mitigation measures idea of temple site and surrounding according to each type of the natural hazards as below.

Earthquake Mitigation

The study area several time have struck by earthquake; based on physical characteristics and position to the subduction zone, earthquake will occurred in future. If comparing with case of earthquake in Bantul and Yogyakarta, part of the physical condition is rather similar on their landform unit, unconsolidated alluvial deposit and the ground water. May be if the study area are struck by earthquake with similar magnitude (6.5 RS), the impact may be rather similar. According to Daryono (2011) the damaging area due to Bantul earthquake is located on alluvial plain, and along structural unit the damage is medium, while in hilly-mountainous area the damage is lower. Based on the case of Bantul earthquake, earthquake hazard mitigation in the study area is strengthening the structure of temple and other building, and spatial planning to not build any structure near by the fault zones. Preparing safe zones such as open area is necessary too.

Volcanic Hazard Mitigation

It is low possibility for glowing cloud hazard to reach the study area. Pyroclastic fall hazard has covered several time in Borobudur Temple. The pyroclastic fall can not manipulated by man and has to mitigate them using non structural effort by preparing tools and equipment for cleaning the ash or sand from the temple or another building. Lahar flow hazard usually flow through a certain river valley and surrounding river valley. Actually the spatial hazard zone of lahar flow can be determined and hazard zone map can be made. The hazard zone map must be used as input for land use planning. The land use planning must be carried out consequently. Artificial levee and check dam or sabo dam can be used to minimize the lahar flow. The size and the shape of the structure to minimize the impact of lahar flow should be based on the characteristic of lahar flow. If the structure does not based of the hazard characteristic, the structure will fail and even be damaged. Artificial

structural levee of Gendol River in Sleman, even the size of the structure is big enough but it is not well function to anticipate lahar flow in 2010-2011. Some of sabo dam are damaged during lahar flow in 2010-2011, after Merapi eruption in 2010. Lesson learned from lahar hazard from several sites on the volcanic slope, it is recommended to mitigate lahar flow hazard using structural efforts, land use planning and education in the study area.

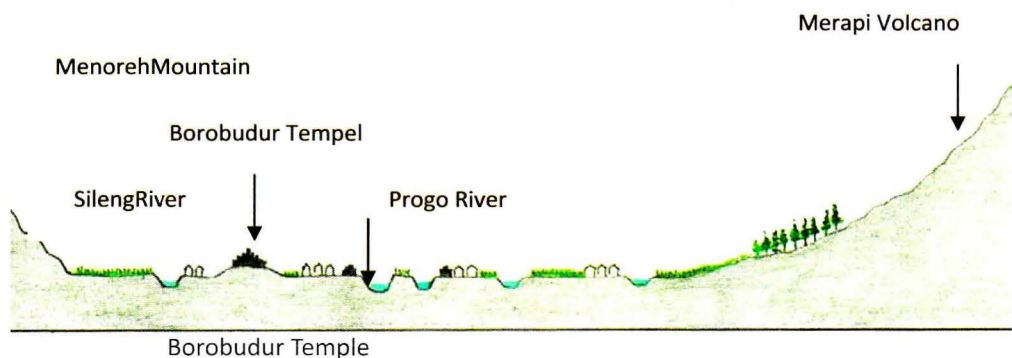
Landslide Hazard Mitigation

Landslide hazards coming from Menoreh Mountain are supposed to affect the Borobudur Temple. The physical condition of the Menoreh Mountain support the occurrence of the landslides. There are some features that landslide have occurred in the past, as mentioned in Fig. 10. Materials of past landslides are composed of volcanic breccia block, big size, distributed in large area and at distance from the sources. It means the landslides are caused by strong energy, may be triggered by earthquake. The landslide hazard susceptibility of the Menoreh Mountain is high. It is similar with other study done by Kuswaji (2012) at the same mountain but at different location. Mitigation effort to prevent Borobudur Temple from landslide hazard from Menoreh Mountain. Non structural measures are recommended, such as land use planning and education for local people on land utilization and natural resources management.

Flood and Flash Flood Mitigation

Supporting factors for flood and flash flood occurrence in the study area are quite feasible. The stricken area to flood and flash are low land, especially on alluvial plain near by the river channel. Fig. 10 shows the transect of the study area in east-west, and north-south direction, which can be used to give an idea to mitigate flood and flash flood hazard, as well as landslide.

The source of water for flood hazard are coming from rainfall and over bank flow of the river. Mitigation of flood hazard is recommended using structural effort strengthening the levee of the river, check dam at upstream, and non structural by land use planning or spatial and education. The source of water for flash flood hazard are coming from heavy rain, high rain fall intensity on upland at the same time on the whole river basin. Mitigation action for flash hazard mainly by non-structural efforts such as land use planning or spatial planning, soil and water conservation and education.



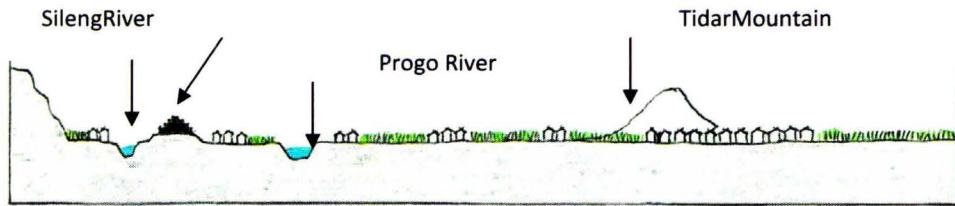


Fig. 10. Transect of the Borobudur Temple and its surrounding to give an idea for mitigation measures of natural hazard (Dwita Rahmi, 2012, modified)

Closing Remarks

- 1) Naturally the Borobudur Temple and its surrounding area are sources of various natural hazards.
- 2) Most natural hazards have occurred and assumed to be occurred in future, such as earthquake, volcanic, landslide, flood and flash flood with low-medium susceptibility classes. Landform unit can be used to identify the natural hazard types.
- 3) Mitigation measures should be based on the type and characteristic of the hazards, structural and non structural mitigation can be applied in the study area, but still need sufficiently supporting data.
- 4) The site selection of the Borobudur Temple was perfect and with genius consideration even though the surrounding is a hazardous area.

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Pengelolaan Candi Borobudur sebagai Warisan Dunia

Dr. Harry Widiyanto

Berdasarkan Konvensi UNESCO tahun 1972 Warisan Dunia terdiri dari Warisan Alam Dunia dan Warisan Budaya Dunia. Indonesia telah memiliki 8 Warisan Dunia yang terdiri 4 Warisan Alam Dunia dan 4 Warisan Budaya Dunia.

4 Warisan Budaya Dunia :

1. Borobudur Temple Compound, yang ditetapkan pada tahun 1991, dengan nomor Ref. C 592;
2. Prambanan Temple Compound, yang ditetapkan pada tahun 1991, dengan nomor Ref C 642;
3. Sangiran Early Man Site, yang ditetapkan pada tahun 1996, dengan nomor Ref. C 593;
4. Cultural Landscape of Bali Province, yang ditetapkan pada tahun 2012, dengan nomor Ref. C 1194.

4 Warisan Alam Dunia :

1. Ujung Kulon National Park, yang ditetapkan pada tahun 1991, dengan nomor Ref. N 608;
2. Komodo National Park, yang ditetapkan pada tahun 1991, dengan nomor Ref. N 609;
3. Lorentz National Park, yang ditetapkan pada tahun 1999, dengan nomor Ref. N 955;
4. Tropical Rainforest Heritage of Sumatera (TRHS), yang ditetapkan pada tahun 2004, dengan nomor Ref. N 1167

Selain itu ada 6 warisan budaya yang telah menjadi warisan budaya tak benda :

1. Wayang Indonesia,
2. Keris Indonesia,
3. Batik Indonesia,
4. Angklung Indonesia,
5. Tari Saman,
6. Noken Tas Rajut Multifungsi

Kekayaan Warisan dunia yang dimiliki oleh bangsa Indonesia harus dikelola secara profesional sesuai prinsip pengelolaan warisan dunia, yaitu:

1. Pengelolaan warisan dunia merupakan tanggung jawab bersama antara Pemerintah, Pemerintah Daerah, dan seluruh elemen Masyarakat. Pengelolaannya di bawah kewenangan Kementerian yang bertanggung jawab di bidang Kebudayaan. Pengelolaan dimaksud dilakukan dalam hal Pelindungan, Pengembangan, Pemanfaatan.
2. Kawasan Warisan Budaya Dunia selayaknya memberikan manfaat bagi peningkatan taraf kehidupan masyarakat di sekitar kawasan warisan dunia sehingga perlu dilindungi, dikembangkan, dan dimanfaatkan untuk sebesar-besarnya kesejahteraan

rakyat. Oleh karena itu Kawasan Warisan Dunia harus dapat dikelola secara terintegrasi atau terpadu

Upaya yang dikembangkan dalam Pengelolaan Warisan Budaya Dunia

1. Pelestarian: perlindungan, pemanfaatan, dan pengembangan
2. Pemberdayaan masyarakat
3. Public awareness
4. Capacity building
5. Pengelolaanterpadu
6. Coordinating Board

Pengelolaan Warisan Budaya Dunia tidak lepas dari berbagai permasalahan yang seringkali muncul, Beberapa masalah yang masih muncul dalam pengelolaan warisan budaya dunia di Indonesia adalah:

1. Kewenangan : Pusat-Daerah; Kementerian yang seringkali masih tumpangtindih
2. Kesadaran masyarakat yang masih rendah
3. Kelembagaan yang masih carutmarut
4. Tekanan pembangunan yang setiap tahun selalu bertambah
5. Manajemen yang belum profesional

Kewajiban Pemerintah terhadap pengelolaan warisan dunia adalah

1. Pelestarian (State of Conservation)
2. Mempertahankan nilai-nilai universal
 - a. Brief Synthesis
 - b. Criteria
 - c. Integrity
 - d. Authenticity
 - e. Management and Protection Requirement

Outstanding Universal Value Borobudur Temple Compounds sebagai World Heritage :

1. Mewakili sebuah mahakarya kejeniusan kreatif manusia
2. Memperlihatkan pentingnya pertukaran nilai-nilai kemanusiaan, dalam suatu rentang waktu atau dalam suatu kawasan budaya di dunia, terhadap pengembangan arsitektur atau teknologi, karya monumental, tata kota, atau rancangan lansekap
3. Secara langsung atau nyata terkait dengan peristiwa-peristiwa atau tradisi yang masih hidup, dengan gagasan atau dengan keyakinan, dengan karya seni dan sastra yang memiliki nilai-nilai universal yang signifikan

Rencana Awal Pemanfaatan
(Studi JICA 1997 - Tapurnas)



Studi (Penelitian)



Ziarah (Agama)



Wisata – Pendidikan - Apresiasi

Pengelolaan warisan dunia Borobudur

1. Balai Konservasi Borobudur : Mengelola Candi Borobudur, Candi Mendut, Candi Pawon (Zona 1)
2. PT TWCBP: Mengelola Zona 2 Candi Borobudur sebagai Taman Wisata
3. Pemkab Magelang: Mengelola Zona 3-4-5

Kajian Pengelolaan Terpadu, 2010

Mengacu pada:

1. Pelestarian meliputi perlindungan, pengembangan, dan pemanfaatan
2. Pelestarian Candi Borobudur bersatu dan terikat dengan lingkungan budayanya (cultural landscape)
3. Pelestarian untuk dan oleh semua
4. Pelestarian budaya tangible dan intangible
5. Pelestarian berwawasan kemanfaatan yang terintegrasi.

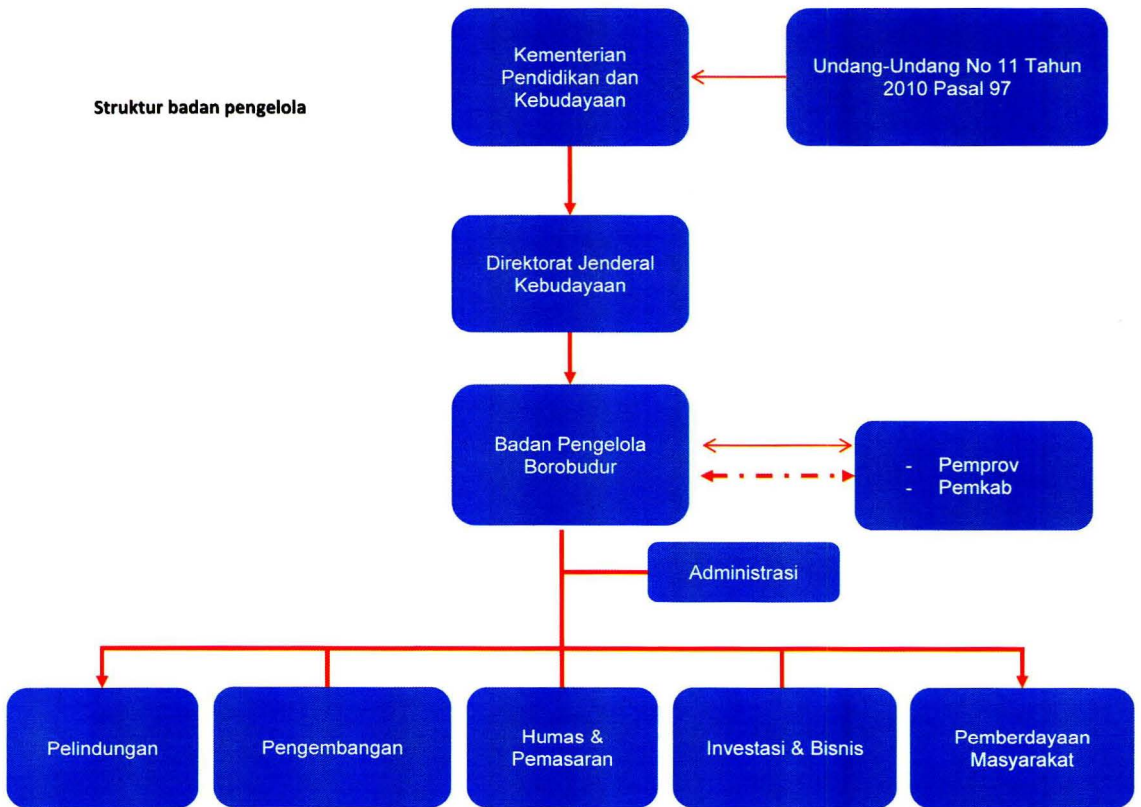
Lembaga Pengelola

Visi: *Lestari, mendidik, dan menyejahterakan.*

Bentuk lembaga:

1. Lembaga pemerintah atau semi-pemerintah yang bersifat not for profit.
2. Satuan kerja biasa / UPT
3. Satuan kerja berbentuk BLU
4. Perusahaan Negara atau Perusda

Struktur badan pengelola



Potensi Bencana Vulkanik dan Tektonik Di Kawasan Sekitar Candi Borobudur Provinsi Jawa Tengah

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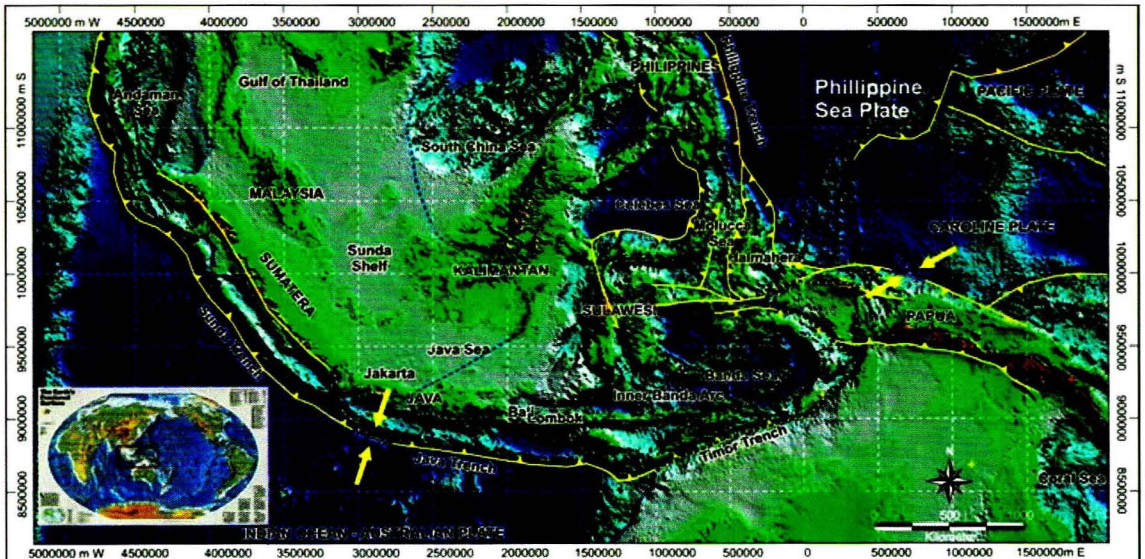
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PENDAHULUAN

Penemuan Candi Borobudur pada saat pemerintahan Gubernur Jenderal Raffles pada tahun 1814 (Soekmono, 1976) mengakibatkan Candi Borobudur menjadi terkenal di dunia. Bangunan Candi ditemukan dalam kondisi porak-poranda dan untuk memperbaiki diperlukan beberapa kali pemugaran. Penemuan candi ini menarik para ilmuwan untuk melakukan penelitian baik dari segi arkeologi, teknik, sejarah maupun lingkungannya. Hasil dari berbagai penelitian tersebut, menarik perhatian masyarakat baik nasional maupun internasional. Hasil penelitian yang masih menjadi banyak perdebatan hingga saat ini adalah tentang letak dan kondisi lingkungan bangunan candi. Beberapa peneliti meyakini bahwa bangunan candi dibangun di atas bukit Borobudur dan dikelilingi oleh danau yang berkembang menjadi rawa dan selanjutnya berubah menjadi dataran. Namun kondisi lingkungan tersebut tidak disebutkan dalam berbagai prasasti yang ditemukan di Candi Borobudur.

Pengamatan lapangan menunjukkan bahwa bangunan candi terletak di sebuah perbukitan yang dikelilingi oleh dataran. Dataran tersebut pada sisi selatan dibatasi oleh pegunungan yang memanjang arah timur-barat, dengan deretan puncak-puncaknya menyerupai menara, dikenal dengan Pegunungan Menoreh. Deretan gunungapi yang terdapat di sekitarkawasan Borobudur menjadikan bangunan candi dan alam sekitarnya mempunyai nilai seni arsitektur yang sangat tinggi. Hal ini dikarenakan Candi Borobudur dibangun pada daerah yang mempunyai panorama alam yang sangat indah. Kondisi ini menunjukkan bahwa dalam pembangunan candi sangat memperhatikan kondisi lingkungan alam sekitarnya. Dibalik keindahan panorama alam di sekitar candi, dari sudut pandang ilmu geologi, juga mempunyai potensi bencana geologi yang besar. Erupsi gunungapi (vulkanik) dan gempa bumi (tektonik) merupakan ancaman yang serius terhadap keberadaan bangunan candi. Apabila bangunan candi mengalami kerusakan akibat bencana, maka kerugian yang diderita tidak ternilai harganya (*intangibile*). Berdasarkan kondisi tersebut, makalah ini mencoba untuk mengidentifikasi secara awal, tentang potensi bencana vulkanik dan tektonik yang berpotensi mengancam bangunan Candi Borobudur dan sekitarnya. Langkah awal dalam proses identifikasi terhadap potensi bencana vulkanik dan tektonik dengan mengamati kondisi fisik lingkungan candi. Pengamatan tersebut akan menghasilkan jejak dan rekaman data terkait adanya aktivitas vulkanik dan tektonik.

Dataran Borobudur merupakan bagian dari Pulau Jawa yang dalam proses pembentukannya tidak terlepas oleh aktivitas tektonik. Indonesia merupakan negara kepulauan yang terletak di antara lempeng Eurasia, Indo-Australia dan Pasifik. Lempeng Indo-Australia terletak pada sisi selatan dan bergerak ke utara. Lempeng Pasifik terletak di timur yang bergerak ke barat. Kecepatan pergerakan lempeng tektonik ini sebesar + 6 cm/tahun dan di dekat ujung Pulau Sumatera mempunyai kecepatan +7,8 cm/tahun (Minster dan Jordan, 1978 dalam Ghose and Oike 1988 dalam Prasetyadi, 2007) lihat Gambar 1.

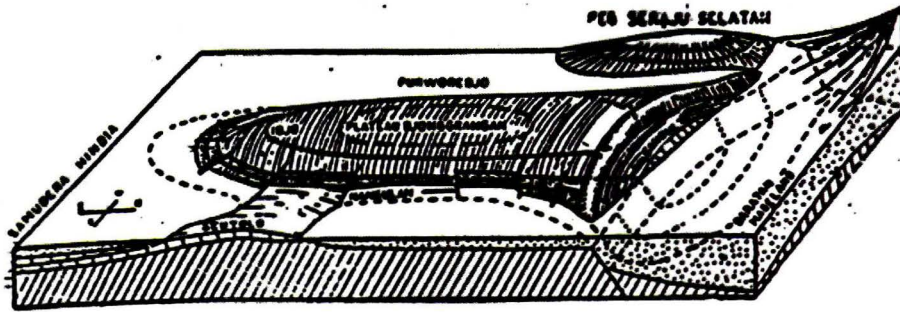


Gambar 1. Pergerakan Tektonik di Indonesia (Hamilton, 1979 dalam Satyana, 2012)

Lempeng Indo-Australia bergerak ke utara dan menunjам di bawah dataran Sunda menghasilkan sistem palung-busur yang disebut dengan Busur Sunda (Hamilton, 1979 dalam Prasetyadi, 2007). Proses tektonik ini akan mengakibatkan terbentuknya busur gunungapi, busur palung sebagai tempat menyusupnya lempeng samudra, busur cekungan sedimentasi terbentuk baik di busur muka maupun belakang dari busur gunungapi. Produk awal tumbukan lempeng di Pulau Jawa, menghasilkan busur gunungapi tua berumur Tersier atau kala Oligo-Miosen (18-27 juta tahun) dikenal dengan nama Formasi Andesit Tua (*Old Andesit Formation*) (Bemmelen, 1949).

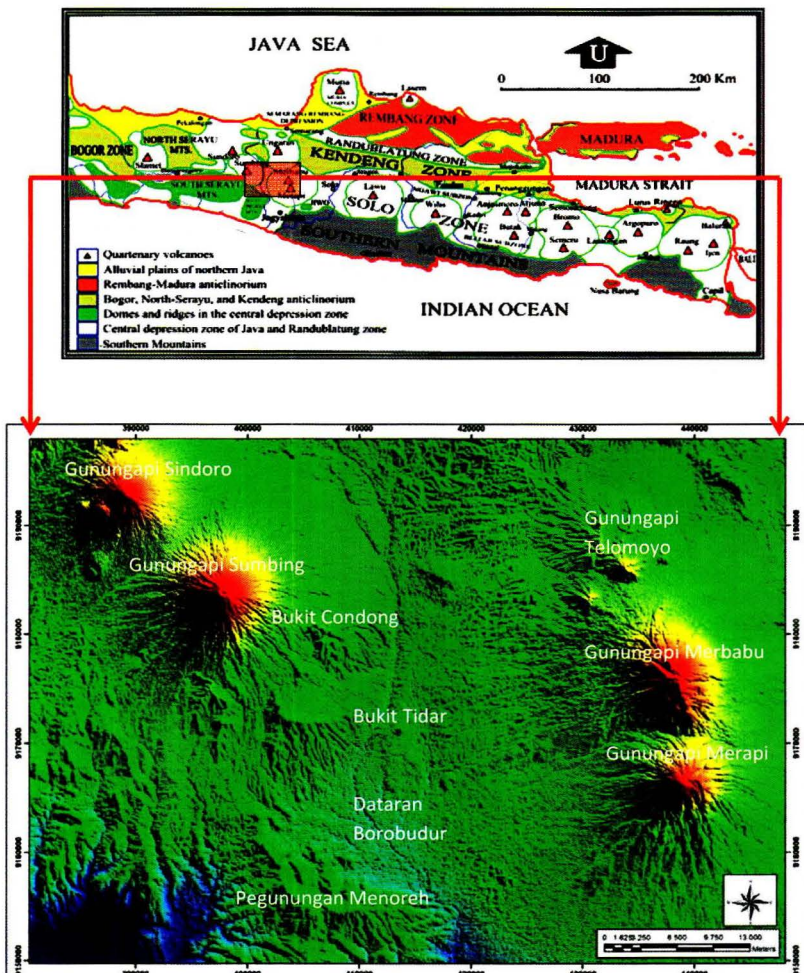
Aktivitas tektonik ini secara jelas berakibat pada terbentuknya gunungapi-gunungapi di Indonesia. Selain itu dengan adanya tumbukan lempeng tektonik, getaran yang disalurkan akan dirasakan oleh manusia yang dikenal dengan istilah gempa tektonik. Peristiwa-peristiwa tersebut akan berpengaruh terhadap kondisi morfologi dari permukaan bumi. Pergerakan tektonik ini juga berdampak pada wilayah Dataran Borobudur. Kondisi pegunungan, perbukitan dan dataran terbentuk tidak terlepas oleh adanya aktivitas tumbukan tektonik tersebut. Bemmelen, 1949, menyebutkan bahwa Bukit Borobudur yang

dikelilingi dataran merupakan bagian dari Kubah Kulonprogo “Menoreh” yang terpatahkan, kemudian mengalami proses penenggelaman pada akhir zaman Tersier, lihat Gambar 2.



Gambar 2. Diagram blok dari Kubah Kulonprogo (Bemmelen, 1949)

Pada zaman Kuartar di sekitar bagian yang terpatahkan, tumbuh beberapa gunungapi muda, di antaranya Gunungapi Sumbing, Gunungapi Sindoro di sisi barat laut, Gunungapi Tidar di sisi utara, Gunungapi Andong, Gunungapi Telomoyo, Gunungapi

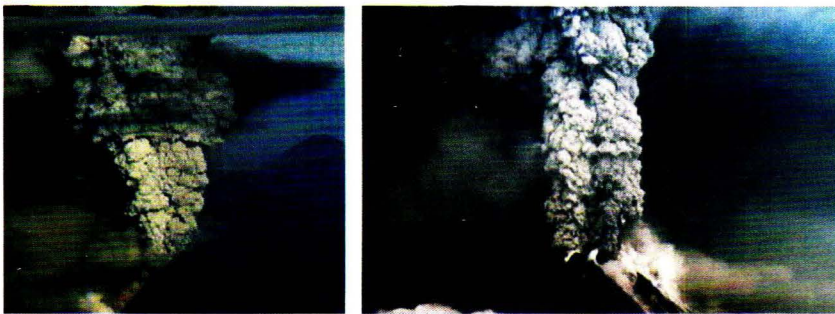


Gambar 3. Fisiografi Jawa Tengah-Timur dan lokasi Dataran Borobudur yang dikelilingi oleh Gunungapi

Merbabu dan Gunungapi Merapi di sisi timur-timur laut. Bagian yang terpatahkan, kemudian dikelilingi bentuk lahan Pegunungan Menoreh dan bentuk lahan gunungapi, membentuk sebuah cekungan antargunung "*intermountainous basin*" berumur Kuarter yang berkembang menjadi lingkungan Danau Borobudur (Murwanto, 1996) lihat Gambar 3. Candi Borobudur dibangun di atas Perbukitan Gunung Gandul-Sipodang, merupakan bagian puncak dari batuan vulkanik Tersier Kubah Kulonprogo yang terpatahkan (Nossin dan Voute, 1986).

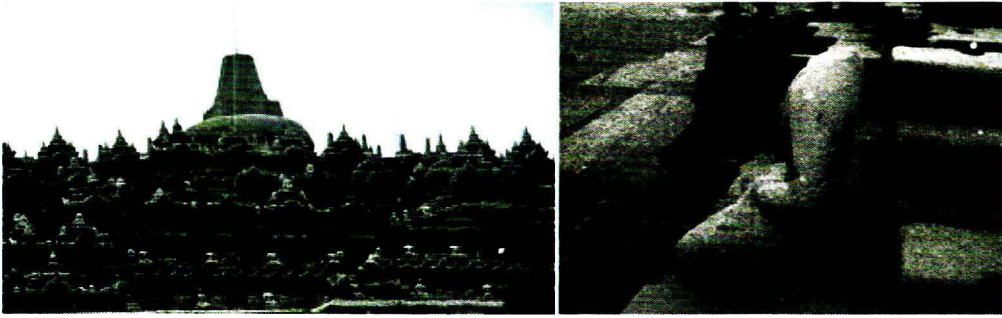
POTENSI BENCANA VULKANIK

Bencana vulkanik adalah fenomena alam erupsi gunungapi yang mengakibatkan kerugian bagian wilayah yang terkena material hasil erupsi. Material yang dihasilkan oleh erupsi gunungapi dapat berupa lava, material piroklastik, lahar, dan abu vulkanik. Material hasil erupsi tersebut mampu merusak apapun yang ditimpanya. Candi Borobudur terletak berdekatan dengan beberapa gunungapi aktif mengakibatkan wilayah tersebut mempunyai potensi terlanda bencana vulkanik. Gunung Merapi, Merbabu dan Sumbing merupakan gunungapi yang letaknya relatif dekat dengan Candi Borobudur (Gambar 4). Ketiga gunungapi tersebut merupakan gunungapi aktif yang setiap saat berpotensi mengalami erupsi, dan yang paling sering erupsi adalah Gunung Merapi. Erupsi besar Gunung Merapi terakhir terjadi pada tahun 2010 dengan tingkat kerusakan dan kerugian yang sangat besar bagi masyarakat begitu juga dengan Candi Borobudur.



Gambar 4. Erupsi Gunungapi Merapi Tahun 2010
(Sumber: Museum Gunung Merapi)

Erupsi Gunung Merapi tahun 2010, menghembuskan material vulkanik yang sangat tinggi dengan arah angin ke barat daya. Akibatnya Candi Borobudur tertutup oleh abu vulkanik yang sangat berbahaya bagi bangunan candi. Abu ini dapat mengakibatkan bangunan candi mengalami kerusakan. Selain karena adanya kandungan kimia dari abu, kerusakan juga dapat disebabkan oleh adanya beban oleh abu vulkanik dan kerusakan drainase akibat adanya abu vulkanik. Gambar 5. merupakan kondisi Candi Borobudur yang terkena abu vulkanik akibat adanya erupsi Gunung Merapi.



Gambar 5. Bangunan Candi Borobudur yang tertimbun oleh abu vulkanik Gunungapi Merapi
(Sumber : Balai Koservasi Borobudur)

Erupsi Gunung Merapi yang terjadi dari tahun-tahun sebelumnya hingga sekarang selalu memicu terjadinya aliran lahar hujan. Aliran lahar hujan terjadi karena adanya material lepas di sekitar puncak gunungapi, kemudian longsor terkena hujan dalam jumlah yang besar dan dipengaruhi oleh gravitasi, sehingga mengakibatkan material tersebut mengalir pada alur-alur sungai yang berhulu pada puncak gunungapi. Aliran lahar dingin ini berpotensi menimbulkan kerusakan bangunan yang ada di sungai dan sekitarnya, serta akan menumpuk material vulkanik pada alur-alur sungai. Penumpukan material vulkanik tersebut dapat berakibat terjadinya perubahan aliran sungai maupun pendangkalan sungai mulai dari hulu hingga hilir.

Beberapa sungai yang berhulu di Gunung Merapi bermuara di Danau Purba Dataran Borobudur. Sungai-sungai tersebut meliputi Sungai Mangu, Pabelan, Kunjang, Keji, Putih, Lamat, dan Gung. Sungai-sungai tersebut berfungsi sebagai tempat mengalirkan material hasil erupsi Gunung Merapi. Data material vulkanik di Dataran Borobudur ditemukan pada lembah-lembah sungai yang menimbun endapan lempung hitam. Endapan lempung hitam tersebut merupakan material endapan rawa berwarna hitam kecoklatan karena banyak mengandung karbon organik dari tanaman komunitas rawa. Pada lembah-lembah sungai ditemukan material berupa endapan rawa baik yang tertimbun maupun terkonsolidasi dengan material vulkanik Gunung Merapi (Gambar 6). Alur-alur sungai seperti Sungai Mangu, Sungai Gung, dan Sungai Kunjang merupakan alur sungai yang berhulu di Gunung Merapi dan saat ini bermuara di Sungai Elo.

Berdasarkan data endapan lahar tersebut, maka potensi bencana banjir lahar yang mampu merusak bangunan candi sangat kecil. Namun aliran lahar tersebut berpotensi merusak wilayah-wilayah di kawasan sekitar Candi Borobudur, terutama pada lembah-lembah sungai yang berhulu di Gunung Merapi yaitu Sungai Pabelan, Kunjang, Putih dan Blongkeng yang jaraknya cukup jauh dari bangunan candi. Apabila terjadi bencana pada wilayah-wilayah tersebut, maka juga dapat berpengaruh terhadap kondisi pariwisata di kawasan Borobudur.



Gambar 6. Endapan lempung hitam yang tertutup oleh material lahar Gunung Merapi dialirkan melalui Sungai Pabelan lama dan bermuara di Danau Borobudur Lokasi Lembah Sungai Progo sekarang (Foto : Murwanto, 2012)

POTENSI BENCANA TEKTONIK

Bencana tektonik adalah bencana yang diakibatkan oleh aktivitas tumbukan lempeng tektonik, dikenal masyarakat dengan istilah gempa tektonik. Bencana ini terjadi pada wilayah-wilayah yang terletak pada zona pertemuan lempeng tektonik. Aktivitas tektonik pada suatu wilayah terekam dalam bentuk busur gunungapi, busur cekungan sedimentasi, struktur sesar pada batuan. Jejak struktur sesar merupakan salah satu indikasi adanya aktivitas tektonik pada suatu wilayah. Pengamatan dan pengukuran struktur sesar perlu dilakukan untuk menentukan jenis dan karakter sesar serta arah gerakannya. Aktivitas tektonik pada suatu wilayah dapat diketahui melalui citra satelit sebagai dasar analisis kondisi topografi, pola aliran sungai, dan struktur geologinya.

Identifikasi struktur geologi merupakan langkah awal dalam menentukan potensi bencana tektonik. Sebelum melakukan pengamatan lapangan, terlebih dahulu dilakukan interpretasi struktur geologi dengan menggunakan data topografi dan citra satelit. Hasil interpretasi tersebut, selanjutnya digunakan sebagai acuan dalam melakukan pengamatan dan pengukuran sesar di lapangan. Gambar 7. merupakan data struktur geologi hasil interpretasi dari data topografi dan citra satelit daerah Borobudur dan sekitarnya. Dengan citra satelit struktur-struktur tersebut dapat terdeteksi, berupa kelurusan gawir sesar dengan deretan "*triangular facets*", pergeseran "*offset*" blok sesar, kelurusan dan pembelokan pola aliran sungai yang berkembang pada zona struktur. Kenampakan-kenampakan sesar tersebut terlihat jelas pada Pegunungan Menoreh yang terletak di bagian selatan dari Candi Borobudur. Keberadaan struktur sesar tersebut yang perlu diamati lebih lanjut di lapangan. Pengamatan keberadaan sesar di lapangan akan lebih mudah ditemukan pada lembah-lembah sungai pada dataran Borobudur, hal ini dikarenakan pada lembah sungai tersebut akan tampak kondisi batuan dasarnya.



Gambar 7. Hasil interpretasi struktur sesar di wilayah Dataran Kedu Selatan



Gambar 8. Sesar tebing Menoreh sebelah selatan Candi Borobudur yang memperlihatkan pergeseran dinding menoreh

Sesar Sungai Progo

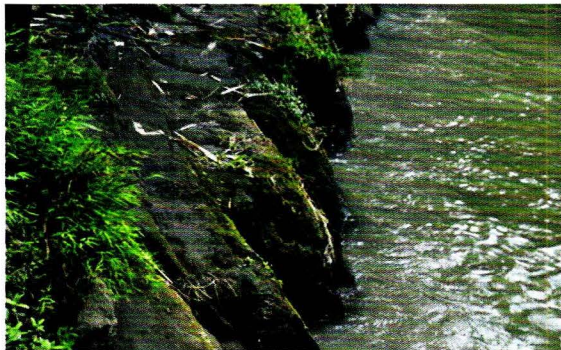
Sungai Progo merupakan sungai besar yang letaknya sekitar 3 km sebelah timur-timurlaut bangunan Candi Borobudur. Pola aliran sungai ini beberapa ruas tampak berkelok (meandering) cukup tajam, merupakan indikasi adanya pengaruh tektonik. Aktivitas tektonik mampu mengubah morfologi, baik pengangkatan maupun penurunan yang akan

berakibat terhadap pembelokan alur sungai. Pengangkatan ini terlihat dari keberadaan struktur sesar pada lembah Sungai Progo. Sesar ini dapat diamati pada bagian utara dari Jembatan Sigug, Desa Bumiharjo yang memotong batuan breksi vulkanik di lembah Sungai Progo, dengan arah hampir N150°E atau timur laut-baratdaya (Gambar 9). Apabila ditarik garis lurus dengan Pegunungan Menoreh akan tampak adanya hubungan (kelurusan) antara sesar yang memotong pada Pegunungan Menoreh hingga lokasi tersebut.



Gambar 9. Lembah Sungai Progo yang mengalami pengangkatan akibat aktivitas tektonik di sebelah utara Jembatan Sigug, Desa Bumiharjo

Pada ruas Sungai Progo di sebelah timur Candi Pawon terdapat sesar-sesar yang memotong endapan rawa (lempung hitam) (Gambar 10). Hal ini menunjukkan bahwa struktur sesar yang terdapat pada daerah ini merupakan sesar aktif karena endapan rawa berumur Kuartar. Adanya sesar ini mengakibatkan endapan rawa yang berumur lebih tua letaknya berada pada ketinggian yang hampir sama dengan endapan rawa yang lebih muda. Pengangkatan endapan rawa ini menjadi bukti adanya aktivitas tektonik di Dataran Borobudur.



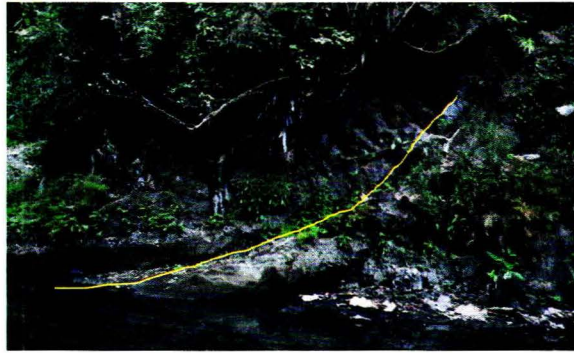
Gambar 10. Singkapan endapan rawa yang terpotong oleh struktur kekar, akibat sesar yang memotong batuan dasar Sungai Progo. Lokasi sebelah timur Candi Pawon

(Foto: Murwanto, 2012)

Sesar Sungai Sileng

Sesar naik Sileng memiliki arah relatif barat-timur dan terletak pada pinggir sungai. Zona sesarnya menyebabkan perubahan arah pada Sungai Sileng karena memiliki

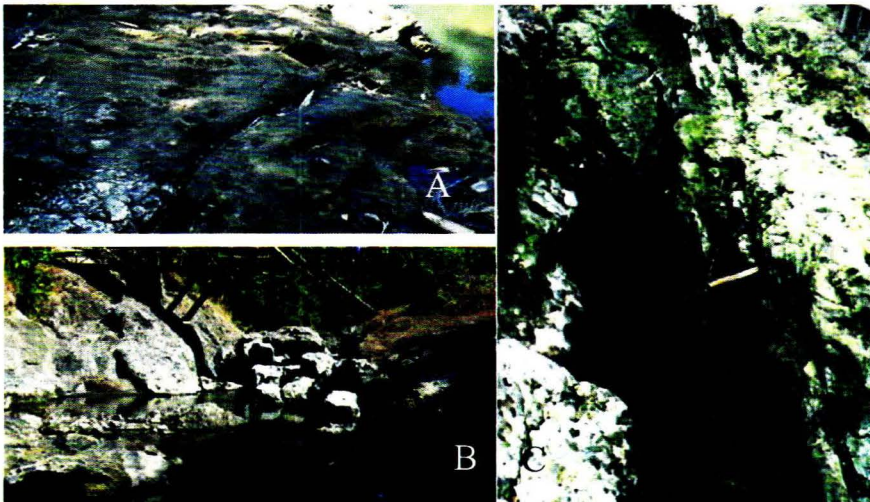
arah kelurusan yang sama dengan bidang sesarnya. Sesar ini merupakan sesar naik dengan bidang sesar N 102°E / 77°. Sesar ini dicirikan dengan bidang sesar yang hampir vertikal (lihat Gambar 11). Pada bidang sesarnya tidak ditemukan gores garis maka untuk penamaannya dilakukan pengambilan data struktur kekar karena pada daerah sekitar sesar ini ditemukan cukup banyak kekar-kekar baik yang terbentuk karena gaya kompresional maupun tensional.



Gambar 11. Endapan rawa (lempung hitam) di Sungai Sileng tersesarkan akibat aktivitas tektonik (sesar naik) (Foto : Murwanto, 2012)

Sesar Kaliduren

Pada Dusun Kaliduren ditemukan sesar yang memiliki arah relatif barat-timur. Zona sesarnya menyebabkan perubahan kelurusan sungai karena mengikuti kelurusan sesar tersebut. Sesar ini merupakan sesar mendatar kiri dengan bidang sesar N 101° E/ 75°. Sesar ini dicirikan dengan bidang sesarnya yang hampir vertikal dan menyebabkan ruas Sungai Sileng di dusun Kaliduren menjadi lurus (lihat Gambar 12). Sesar ini terdapat pada litologi breksi vulkanik yang dicirikan dengan perubahan kemiringan lapisan pada *footwall* dan *hangingwall*. Pada *hangingwall* didapatkan kemiringan lapisan yang lebih curam, hal ini dikarenakan terbentuknya *drag fold* yaitu lipatan yang terbentuk karena gerakan seretan.



Gambar 12.

A. Material Lempung hitam yang merupakan endapan rawa terpotong oleh sesar.

B. Breksi *Old Andesit Formation* yang terpotong oleh sesar.

C. Air asin yang muncul dalam bentuk mata air melalui struktur sesar akibat proses tektonik.

Pada bidang sesarnya tidak ditemukan gores garis, maka untuk penamaannya dilakukan pengambilan data struktur kekar, karena pada daerah sekitar sesar ini ditemukan cukup banyak kekar-kekar baik yang terbentuk akibat gaya kompresional maupun tensional.

Sesar Sungai Tangsi

Berdasarkan hasil interpretasi Nossin dan Voute(1986), arah aliran Sungai Tangsi di sebelah barat laut Dataran Borobudur dipengaruhi oleh struktur sesar. Struktur tersebut mengakibatkan *meandering* pada aliran Sungai Tangsi sebesar 90°. Pola kelurusan aliran Sungai Tangsi setelah terjadi pembelokan, dapat diikuti sampai pertemuan dengan Sungai Progo, dengan arah timur laut-barat daya. Pola kelurusan Sungai Tangsi dapat diikuti sampai sejauh 10 km, mulai dari Sungai Klantangan di bagian barat daya sampai Sungai Gending di bagian timur laut. Data pendukung struktur sesar di Dataran Borobudur adalah terdapatnya mata air panas dengan rasa asin muncul melalui kekar-kekar yang memotong satuan breksi vulkanik produk Gunungapi Sumbing. Mata air asin juga ditemukan di sebelah barat Desa Ngasinan, pada lembah Sungai Klantangan. Struktur kekar yang mengakibatkan munculnya mata air asin diduga sebagai akibat proses sekunder dari Sesar Tangsi.

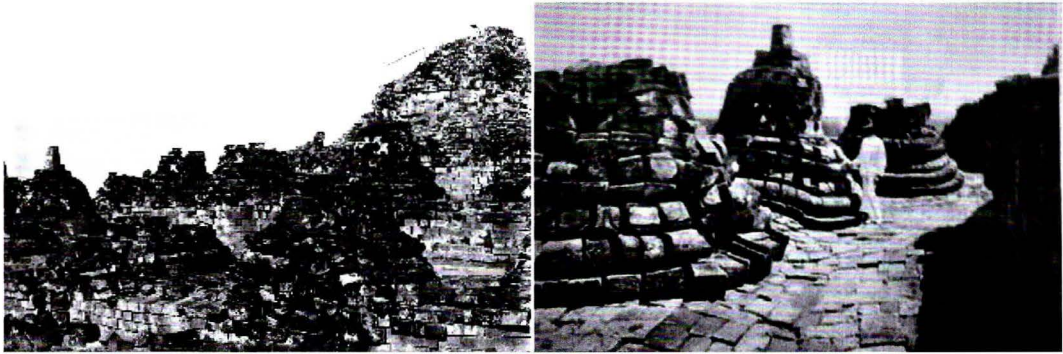
Pada sebelah utara jembatan Ringinanom, Sesar Tangsi memiliki arah relatif timurlaut-baratdaya dan zona sesarnya mengakibatkan perubahan alur sungai karena mengikuti kelurusan sesar. Sesar ini merupakan sesar mendatar kanan. Sesar ini dicirikan dengan bidang sesarnya yang hampir vertikal dan menyebabkan pada bagian Sungai Tangsialurnya lurus. Kelurusan sungai pada utara jembatan Ringinanom adalah N 020° E (lihat Gambar 13).



Gambar 13. Kelurusan di Sungai Tangsi utara jembatan Ringinanom
(Foto: Murwanto, 2012)

Data rekaman aktivitas tektonik di yang ada di Pegunungan Menoreh dan endapan kuarter penyusun Dataran Borobudur tidak hanya terekam dalam bentuk struktur sesar yg memotong batuan, tetapi juga pada bangunan Candi Borobudur. Foto-foto pada saat penemuan Candi Borobudur menunjukkan kondisi bangunan yang sangat rusak. Kerusakan bangunan tersebut bukan akibat dari aktivitas manusia tetapi dari adanya gempa tektonik. Hal ini dikarenakan bentuk dan kondisi kerusakan bangunan yang rusak, akibat bagian dasarnya yang bergoncang. Gambar 14. menunjukkan bagian dasar stupa yang melengkung

dan runtuhnya pada bagian puncak. Melengkungnya bagian dasar stupa ini dapat disebabkan akibat adanya proses likuifaksi pada batuan dasar bangunan candi saat terjadi gempa tektonik. Akibatnya tubuh bangunan mengalami pemerosotan/amblesan. Hal yang sama juga terjadi pada bangunan Candi Plaosan di Klaten, Jawa Tengah.



Gambar 14. Kerusakan bangunan Candi Borobudur saat pertama kali ditemukan, disebabkan oleh gempa tektonik. (Foto: Balai Konservasi Borobudur)

Gempa tektonik Daerah Istimewa Yogyakarta dan Jawa Tengah pada tahun 2006 juga telah merusak bangunan Candi Prambanan dan sekitarnya. Gempa tektonik ini juga dipicu oleh adanya pergerakan sesar di darat. Gempa tektonik dengan skala 5,9 SR dalam waktu 59 detik telah mampu merusak bangunan Candi Prambanan meskipun tidak semuanya runtuh, namun konstruksinya telah mengalami kerusakan (lihat Gambar 15). Hal ini merupakan gambaran yang dapat terjadi pula pada Candi Borobudur, dimana telah dibuktikan dengan adanya rekaman data aktivitas tektonik pada kawasan tersebut. Identifikasi potensi bencana gempabumi tektonik tersebut masih merupakan tahap awal, dan perlu dilakukan kajian lebih lanjut dengan berbagai metode pendukung. Hasil kajian tersebut diharapkan dapat digunakan sebagai dasar dalam penataan kawasan dan mitigasi bencana alam.

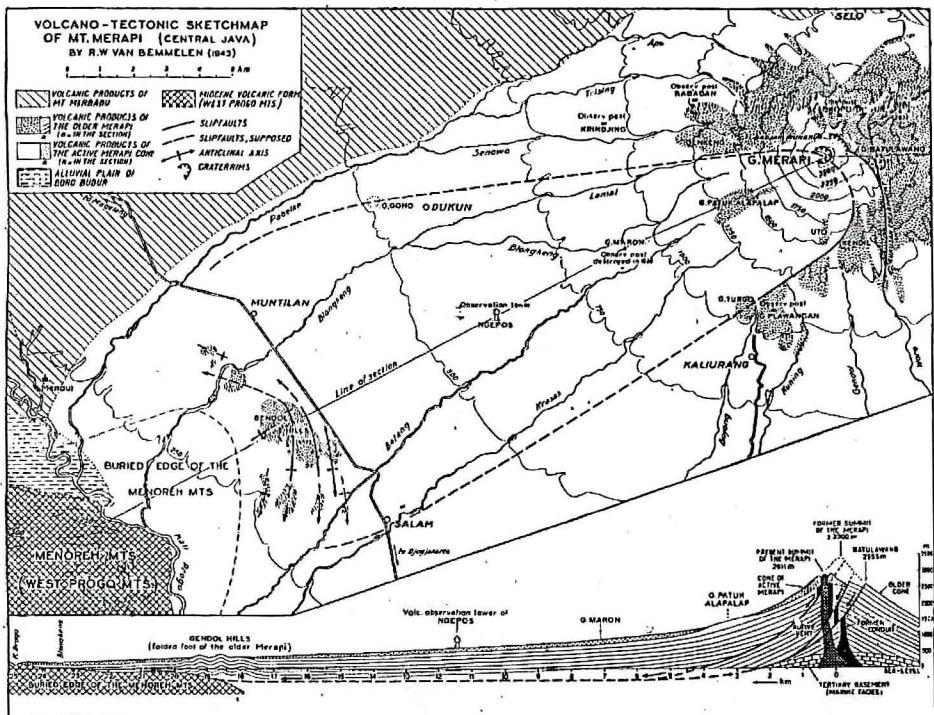


Gambar 15. Kerusakan bangunan Candi Prambanan akibat gempabumi tektonik DIY dan Jateng tahun 2006 (Foto: BPCB Jawa Tengah)

PEMBAHASAN

Bencana geologi ini dituliskan dalam prasasti Pucangan, yaitu tinggalan prasasti yang menerangkan secara jelas tentang adanya bencana, meskipun tidak secara langsung berkaitan dengan peristiwa letusan gunungapi yang menimbun situs-situs candi Hindu dan candi Budha di wilayah Jawa Tengah dan DIY, seperti yang banyak ditemukan pada akhir abad ke-20 seperti sekarang.

Prasasti pucangan juga dikenal dengan prasasti Kalkuta karena disimpan di museum Kalkuta India. Prasasti tersebut pertama kali dipublikasikan oleh H. Kern (1917), dalam sebuah kalimat prasasti yang berbunyi "*ri kālāning praḷāya ring yawadwipa i rikāng sakakāla 938 ri prahara haji wurawari masö mijil sangke lwaram, ekarnawa rūpanikāng sayawadwipa rikāng kāla*" artinya ketika terjadinya pralaya di Pulau Jawa pada tahun 938 Saka dari prahara Haji Wurawari ketika ia keluar dari Lwaram, seperti sebuah lautan keadaan seluruh Pulau Jawa pada saat itu. Keterangan ini memberi kesan bahwa Kerajaan Dharmawangsa ini dimusnahkan oleh Raja Wurawari. Diceritakan bahwa pada waktu berlangsungnya pesta perkawinan Airlangga dengan putra Raja Dharmawangsa, tiba-tiba kerajaan Dharmawangsa mengalami pralaya. Seluruh Jawa dikatakan bagaikan satu lautan. Raja dan para pembesar negara gugur. Kejadian tersebut terjadi pada tahun 938 S sewaktu Airlangga berusia 16 tahun dan dengan disertai oleh Narotama bersembunyi di hutan-hutan dan di gunung, diam bersama-sama para pertapa (Kartodirjo, dkk., 1977).

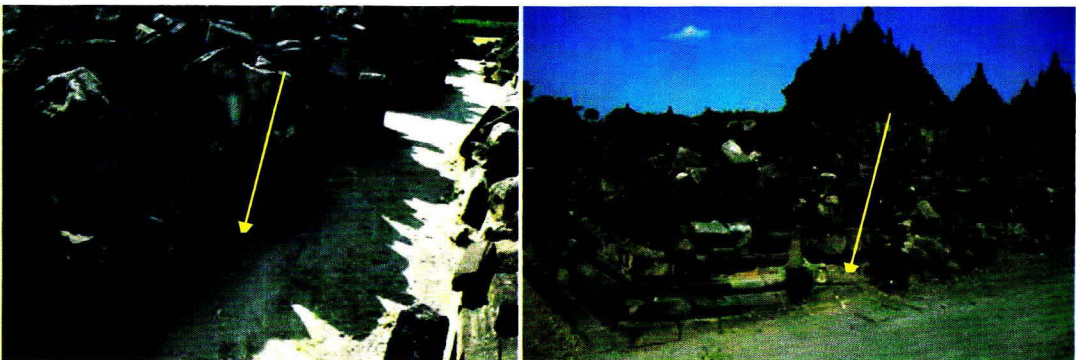


Gambar 16. Sketsa volkano-tektonik Gunung Merapi (Bemmelen, 1949)

Prahara tersebut oleh Bemmelen (1949), dikaitkan dengan peristiwa letusan hebat Gunung Merapi di tahun 1006 yang dikenal dengan hipotesa "*volcano tectonic gravitatie*". Peristiwa letusan kuat mengakibatkan sebagian puncak Gunung Merapi yang ketinggiannya mencapai 3300 mdpl, melorot ke arah baratdaya kemudian tertahan oleh Pegunungan Menoreh, sehingga mengakibatkan terbandungnya Sungai Progo dan terbentuknya Perbukitan Gendol. Terbandungnya Sungai Progo oleh material Merapi Tua mengakibatkan genangan luas di Dataran Kedu bagian selatan.

Hipotesis Bemmelen (1949) tersebut menurut penulis tidak sesuai dengan data sejarah dan ilmu geologi. Dari tinjauan sejarah banyak temuan di puncak-puncak bukit, berupa Candi Wukir, Candi Sari dan situs-situs lain yang berumur lebih tua dari tahun 1006 M, yakni pada masa Kerajaan Mataram Hindu (Prasasti Canggal) 654 S atau 732 M. Dari data geologi, batuan penyusun Perbukitan Gendol berupa batuan beku dan breksi gunungapi yang usianya jauh lebih tua dari tahun 1006 M, yakni batuan yang seumur dengan batuan penyusun Pegunungan Menoreh berumur tersier.

Pralaya yang tertulis dengan Prasasti Pucangan di tahun 938 S, seperti sebuah lautan keadaan Pulau Jawa saat itu bukan akibat letusan Gunung Merapi, akan tetapi penulis pastikan merupakan peristiwa tsunami yang diawali dengan gempa tektonik besar >8,5 SR. Gambarnya mirip dengan yang terjadi di Banda Aceh tahun 2004. Keyakinan penulis akan kejadian gempa tektonik kuat, didukung data kerusakan hampir semua bangunan candi-candi yang dibangun sebelum tahun 938 Saka (1016) di Jawa bagian tengah. Data geologi juga memperlihatkan jejak adanya likuifaksi pada batuan dasar bangunan candi saat gempa tektonik, mengakibatkan beberapa struktur bangunan candi mengalami pemerosotan/ amblesan seperti tampak pada Gambar.



Gambar 17. Fenomena likuifaksi pada Candi Plaosan

Data geologi pendukung lain adanya jejak gempa tektonik adalah struktur-struktur sesar yang memotong pada tebing dinding Pegunungan Menoreh. Sesar tersebut teraktivasi kembali hingga memotong batuan-batuan penyusun bentuklah Dataran Borobudur yang umurnya sangat muda Pleistosen-Holosen seperti sesar-sesar yang ditemukan pada alur-alur Sungai Progo, Sungai Tangsi, Sungai Sileng yang letaknya tidak jauh dari Candi

Borobudur. Proses tumbukan lempeng tektonik akan melepaskan energinya melalui aktivasi struktur sesar yang telah terbentuk sebelumnya, dan membentuk sesar-sesar besar akibat efek guncangan gempa yang sangat kuat.

Kejadian tersebut mampu memporak-porandakan semua bangunan candi dan meruntuhkan dinding tebing Pegunungan Menoreh. Peristiwa gempa tektonik besar yang diikuti gelombang tsunami di tahun 938 Saka, kemudian memicu terjadinya letusan gunungapi yang ada di sekitar Dataran Kedu dan Yogyakarta yakni gunung Merapi, Gunung Sumbing, Gunung Sindoro. Produk hasil letusannya berupa piroklastik aliran maupun piroklastik jatuhan “tepra” dan banjir lahar dingin. Materialnya sebagian menimbun bangunan-bangunan candi di lereng maupun dataran kaki sekitar gunung tersebut seperti juga dapat kita saksikan selama ini, seperti tertutupnya Candi Liangan di lereng Gunung Sindoro dan candi-candi Hindu dan Budha di lereng selatan dan baratdaya Gunung Merapi. Sementara Candi Borobudur dan Candi Pawon tidak tertutup karena dibangun diatas sebuah bukit pada saat itu.

KESIMPULAN

Berdasarkan berbagai kajian tentang adanya aktivitas vulkanik dan tektonik yang terdapat di wilayah Borobudur, maka dapat ditarik kesimpulan sebagai berikut:

1. Bencana vulkanik yang berpengaruh di Dataran Borobudur adalah tertutupnya bangunan candi oleh abu vulkanik bahkan dapat juga berupa material piroklastik jatuhan/tepra berupa pasir hingga kerikil. Gunung Merapi, Merbabu dan Sumbing merupakan gunungapi aktif dengan jarak yang tidak jauh dan berpotensi terjadi erupsi setiap saat.
2. Potensi bencana gempa tektonik di wilayah sekitar Candi Borobudur cukup tinggi, hal ini dibuktikan dengan ditemukannya struktur sesar aktif pada bentuklahan Dataran Borobudur, yakni: Sesar Progo, Sesar Sileng, Sesar Kaliduren, dan Sesar Tangsi. Struktur sesar tersebut berada di sekitar Candi Borobudur, mempunyai hubungan erat dengan struktur sesar yang memotong Pegunungan Menoreh. Apabila terjadi gempa tektonik besar dengan skala lebih dari 7,5 skala richter, maka sesar-sesar tersebut akan teraktivasi kembali, dan menimbulkan kerusakan bangunan candi maupun infrastruktur sekitarnya.

SARAN

Adapun saran dari makalah ini adalah bahwa sejarah bencana geologi berupa erupsi vulkanik dan gempa tektonik pernah mengakibatkan kerusakan bangunan Candi Borobudur dan perubahan lingkungan alam di sekitarnya. Di waktu mendatang bencana alam tersebut akan terulang kembali, maka diperlukan perhatian lebih lanjut berupa penataan kawasan berdasarkan peta pola struktur dan bencana geologi (tata ruang dan perkuatan struktur bangunan) sebagai upaya mitigasi bencana vulkanik dan gempa tektonik.

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Diskusi :

Pertanyaan 1. Mudji Sutrisno (Budayawan)



Terjadi perdebatan tentang apa yang menjadi penyebab kerusakan Candi Borobudur sebelum ditemukan oleh Raffles. Tadi Helmy Murwanto mengatakan yang menjadi penyebab adalah gempa tektonik sedangkan selama ini juga muncul pendapat bahwa yang menyebabkan kerusakan adalah erupsi gunung api. Bagaimana penjelasannya?

Jawaban : Helmy Murwanto

Dari bukti-bukti geologi yang ditemukan bahwa di sekitar Borobudur banyak ditemukan sesar sesar, bahkan pada batuan kuarter juga telah mengalami pensesaran sehingga tidak lagi datar. Bukti-bukti inilah yang menjadi dasar bahwa Candi Borobudur mengalami kerusakan akibat gempa tektonik. Kondisi ini juga mirip dengan kerusakan yang terjadi dengan candi-candi yang ada di Jawa Tengah seperti Prambanan yang juga mengalami kerusakan akibat gempa tektonik. Akibat gempa tektonik runtuhnya tidak jauh dari sumbernya. Gempa 2006 yang tidak sampai 6 SR sudah dapat menghancurkan rumah-rumah di sekitar Merapi. Apalagi gempa yang terjadi pada zaman dulu yang mungkin telah mengalami beberapa kali gempa. Selain itu gempa bantul menimbulkan kerusakan pada candi yang polanya hampir sama dengan yang terjadi di Borobudur.

Pertanyaan 2. Masanori Nagaoka (UNESCO Office, Jakarta)

Tadi dijelaskan bahwa Candi Borobudur dibagi menjadi 5 zona. Tetapi kenapa berbeda dengan yang diusulkan ke UNESCO yang hanya 2 zona?

Jawaban : Harry Widiyanto

Pembagian Borobudur menjadi 5 zona adalah berdasarkan aturan JICA yang dibuat tahun 1979. Sedangkan yang dikirimkan untuk diusulkan ke UNESCO hanya zona 1 dan zona 2. Jadi memang pembagian zonanya berbeda.



Pertanyaan 3. Yoshinori Iwasaki (Geo-Research Institute, Osaka, Jepang)

Bagaimana anda bisa menyimpulkan bahwa sesar terjadi di sepanjang sungai Progo? Apa bukti-bukti yang ada?

Jawaban : Helmy Murwanto

Sesar-sesar yang ada di sungai Progo tidak memanjang pada keseluruhan sungai, tapi setempat-setempat, sehingga pola-pola kelurusan pada sungai yang terlihat juga setempat-setempat.

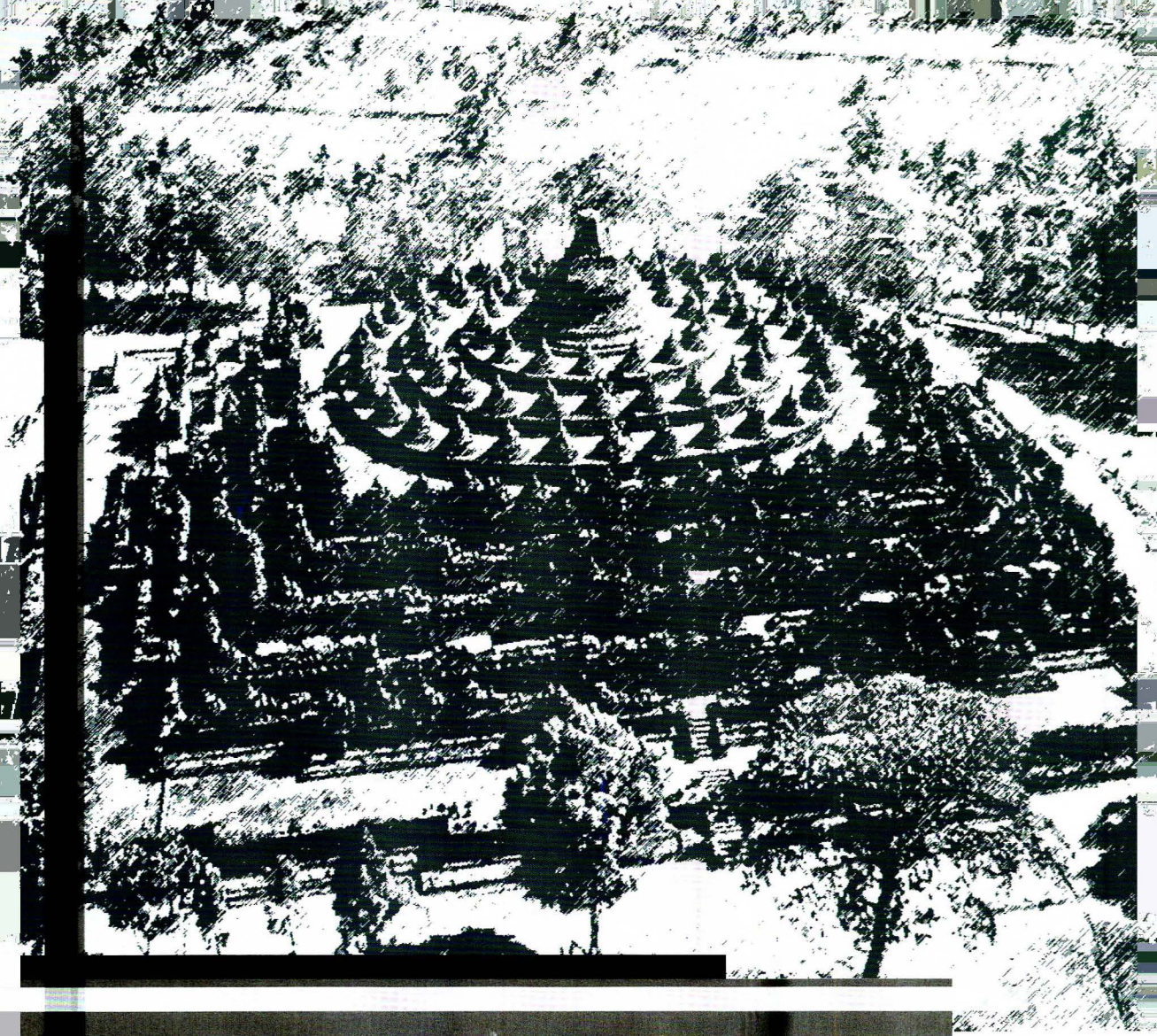
Tanggapan 1. Subagyo Pramumijoyo (Universitas Gadjah Mada)

Pola-pola lantai yang bergelombang ketika Candi Borobudur ditemukan mengindikasikan bahwa kerusakan yang terjadi adalah akibat gempa tektonik.



Tanggapan 2. Dwi Lestari (Universitas Gadjah Mada)

Dari titik-titik pengukuran yang dipasang sampai bedrock di sekitar Candi Borobudur, terlihat bahwa pergeseran yang terjadi adalah 2-3 cm dari tahun 2002-2003 dan 2-27 cm dari tahun 2002-2012. Dan pergeseran tersebut searah dengan pergerakan tektonik di Jawa. Tentunya hal ini juga mengindikasikan bahwa di sekitar Candi Borobudur terjadi aktivitas tektonik yang kemungkinan menjadi penyebab kerusakan yang terjadi pada Candi Borobudur pada masa lampau.



Borobudur Temple and Indonesian Culture

Borobudur Temple and The Ancient Javanese

Prof. Dr. Timbul Haryono, M. Sc

Introduction

Borobudur is the biggest Buddhist temple, a cultural achievement of ancient Javanese civilization. It was built on the summit of a hill around the eight century A.D. by Sailendra dynasty and up to now has been a subject of various scientific researches. Complexity of the structure and its religious concept behind the structure showing that the temple is a product of the high culture. Borobudur is very different compared to all other Buddhist monument. Borobudur is the largest Buddhist temple so far in Java which has its own characteristic. It was the product of the cultural achievement in early ninth century AD. Together with Candi Prambanan the monuments testify to Central Java's glorious past. However, the obvious fact is that Borobudur is much lower, in comparison to the width of its base, than any other old Javanese monument. Its present height is no more than 31.50 m; its width is 113 m from corner to corner and 123 m along the axes, including the projections. In original, the total height of the monument must have been about 42 meters. The original planning of Borobudur for the monument's base to be less wide and therefore steeper, because that part of the construction (which we now know as the 'broad processional walk') had not yet been built around it. It covered up the original base (foot).

It is very fortunate that Borobudur in its ruinous condition had drawn attention to The Dutch Government. The military engineer H.C. Cornelius in 1817 begun to investigate the temple ruins. Trees were cut down, shrubs burnt down, loose stones removed. By 1822 most of the ruin's general layout was known. It was not until 1835 when the galleries had been cleaned out to make most of Borobudur was open to the visitors. About the middle of the 19th century some had built a kind of a 'pavilion' on top of the destroyed main stupa just for refreshing place. Then an amateur painter, H.N. Sieburgh made notes and reports as well as drawings and paintings..

From 1849-1853 a technical draughtsman, F.C. Wilsen, assisted by G. Schönberg Müller, extensively surveyed Borobudur. About 1,000 reliefs were recorded. Together with architectural drawings they were reproduced as a companion to the first monograph on Borobudur, composed by C. Leemans, director of Leyden's Museum of Antiquities. In 1873, the wellknown photographer I. Van Kinsbergen made a reproductions of reliefs and statues in his glass negatives. Some of the galleries were cleaned by Van Kinsbergen and 200 well-preserved reliefs were discovered in the galleries. Then, Van Erp removed some of stones in the circular terraces.

In 1882 it was suggested to dismantle the whole building and to put the reliefs in a museum but it was not accepted. Very important discovery was in 1885 when Yzerman uncovered Borobudur's hidden base. It was known that there are reliefs carved at this hidden base. In 1890-1891 the hidden base was disclosed for photographic recording by

K. Cephas. Considering the danger of the temple from being collapses, Borobudur Committee was set up in 1900 chaired by Dr. J.L.A. Brandes in order to search for the way to protect the temple. Among the members are B.W. van de Kamer from the Department of Public Works and a young engineer officer named Lieutenant Th. Van Erp. At first, it was proposed to protect Borobudur from rains by overarching it with a pyramidally-shaped roof of galvanised sheet-iron. The rains have been Borobudur's greatest technical problem because rain water seeping down, penetrating the stone walls and floors. The wet walls offered a fertile soil for lichens and algae. Minerals from the central parts were transported by water to the outer surface intensifying processes of natural destruction. However, the idea to roof the temple was not accepted.

In 1907-1911, the first restoration of Borobudur was done by Van Erp. The stones of the circular terraces and the perforated stupas were dismantled for rebuilding. Two of the perforated stupas are left open to give a better impression of the Buddha inside. The fifth balustrade was broken down and then rebuilt over its full length. In certain parts many niches were rebuilt. Out of 432 niches, 151 were completed and the frames of 41 more were rebuilt. Only a few of the original 24 gateways could be fully restored. Many of the missing stones, especially the carving stones, the gargoyles and the head of statues, were not replaced by any new ones. This is not done in the reconstruction of ancient monuments for it is regarded as a '*falsification of the original documents*'. As A.J. Bernet Kempers stated: "Monumental architecture and sculpture of the Central Javanese period belong to the past. They should be carefully restored and reconstructed with authentic materials, and replaced in their original sites, but should never be mixed with deceiving *corpora alinea*". Visitor to any monument should know that what they see is real.

The second restoration was done by Indonesian Government with the help of UNESCO in 1973-1983. It was known that the main agent which make Borobudur in danger is rain water. The quadrangular terraces from the third level up to the seventh level was totally dismantled and strengthened with foundation. Drainage system was then built to prevent the rain water entered into the earth where the temple stand up.

Architectural Design and the Hidden Foot

The structure of the temple consists of a terraced building with five rectangular terraces, three oval terraces and a large stupa on top of these terraces. As the other monuments which generally can be divided into foot, body, and roof, the Borobudur temple has these three parts too, except it has no roof. Each part from the lowest to the top symbolizing the world of *kamadhatu*, *rupadhatu*, and *arupadhatu*. The foot for Borobudur temple is the lowest terrace termed as 'hidden foot' for it was covered by layers of stone. J. Dumarçay is of the opinion that the reliefs were covered because the monument was unstable. The hidden foot has a series of reliefs of *Mahakarmavibhanga*, an illustration of the Law of Cause and Effect. It is of great interest that above of these reliefs some sort Old

Javanese inscriptions were carved. It was assumed that these inscriptions might have been the instruction for the sculptors describe the themes of the panels.

Mahayana Buddhism possesses several texts which describe at length the effects of specific actions. One of the texts of Mahayana Buddhism is the (*Maha*) *Karmavibhanga* ('The great classification of actions') in which contains a detailed exposition of the working of *karma*. It is this text which is illustrated by the 160 reliefs of Borobudur's hidden base. Now the four panels of the reliefs at the southeastern corner were left opened to the visitors since 1940s. The panel of the relief is about 2 meters wide and 67 cm high following a format: first depict an action, then show its reward or punishment. The results of meritorious deeds as well as the negative results of wicked actions and attitudes were depicted. It can be classified into two parts.

The first parts (reliefs number 0.1-117) are depicting different examples of activities leading to identical results. The second parts (0.118-160) shows a variety of consequences resulting from one specific deed. The main categories are: acts leading to short life, a long life, much pain, little pain, misshapeness, grace, low birth, little property, great property, rebirth in one of the hells, rebirth as an animal, as a ghost, as a human being, *etc.* The series' second part features the favourable results of meritorious deeds such as: specific gifts, the spiritualized way of life of a wanderer, the adoration of sanctuaries, *etc.* There are 35 panels carved with 47 short inscriptions in Old Javanese script which seem to be a guide to the sculptors what scene had to be depicted. Or may be as guide to aid pilgrims in their interpretation. As shown at the southeastern corner we read '*virupa*', meaning "the ugly one". Originally all the panels of the hidden base had short inscriptions above them. Among the short inscriptions can be read as: *Vyapada* (the bad desire), *svargga* (the heaven), *ghanta* (bell), *cakravartti* (the universal ruler), *chatradana* (the gift of umbrella), *vastadana* (the gift of clothe), *anjali* (to pay homage), *virupa* (the ugly face), *pataka* (the flag). The script might come from the eight century and thus in accordance with that of Kayumwungan inscription of 842 Saka.

Some suggestions arise related to the meaning of the hidden foot. W.F. Stutterheim suggested that the enlarged foot represented a cakravala around the base of Mt. Meru. J.L. Moens is of other opinion that the extended base was built to hide the relief of Karmavibhanga. As have been noted earlier that the reliefs depict punishments in different hell such as Sanjiva hell, Raurava hell, Avici hell. Other are the depictions of heaven. A theory proposed that the reliefs were intentionally covered because of their rather gruesome appearance. However, as Dumarçay speculated that covering the wall meant to increase the first enclosing wall of Borobudur in order to enable sculptors to add another series of relief.

At the first gallery, on balustrade wall were carved relief of Jataka, while on the main wall were carved relief of Lalitavistara (upper series) and Avadana (lower series). The second gallery and the third gallery were carved a series of Gandavyuha relief on the main wall. At the circular terraces as the symbol of arupadhatu no relief was carved on.

Borobudur and Javanese culture

What is culture? Many definitions from many experts have been formulated, one of them said that culture consists of learned modes of behaviour and its material manifestations, socially transmitted from one generation to the next and from one society or individual to another. Culture system consists of three cultural subsystems as ideological, sociological and technological subsystem. Borobudur was built in the environment of the Javanese culture so it could not be separated from the Javanese people who built it. Culture has aspects of behaviour: make, use, deposition.

To build the temple there must be a management system including selecting the site, searching for the stone material, cutting and transporting the stone ready for next step of works, carving and finishing. Imagine that such complex work needs specialist labour. According to *silpasastra* there are divisions of labour according to the kind of job: the priest who will be the leader, the architect, the sculptor and other workers for stone working. In *Silpaprakasa* in India, it is mentioned about the kind of the soil, the kind of the site, how to select the site, how to test whether the soil is good or not for location of a temple as religious building. The priest is to lead the temple building since he knows about all of the work relating to the ideological as well as the technical aspect.

The stone material for the monument is volcanic stone from Mount Merapi through two big rivers Praga and Elo. The site in which Borobudur is located was chosen for special reasons. In its symbolic aspect, the location of Borobudur is just like the sacred place in India at the meeting place between the two rivers Ganga and Yamuna. Candi Borobudur is built near the meeting place of the two rivers Praga and Elo. Up until now Javanese people believed that the place where the two rivers met is regarded to be a sacred place. At special occasions the people took bath at these rivers. The site in which Borobudur is located is surrounded by the Menoreh mountainous region in the south and Mount Merapi (2911 m high), Merbabu (3142 m high) in the northeast, and Mount Sumbing (3371 m high) in the northwest. Except for Merapi these volcanoes are extinct. In the south the Menoreh range, just a few kilometres from Borobudur, acts as a barrier. People at the surrounding area of Borobudur believed that the silhouette of this mountain chain is the 'profile of Gunadharma', an architect of Borobudur.

Borobudur and Mandala

As has been known that the plan of the temple is the concentric circles and squares with the various Buddha statues on them. One theory supposed that in general the temple is representing a mandala. Mandala is a sacred diagram meant to enable believers to attain enlightenment. The mandala is basically a circle inscribed within a square, drawn on the ground with coloured powders or outlined with threads or, for convenience, drawn as a painting on cloth or paper. The oriented plan of the stupa is a *mandala*. The ritual of laying out a stupa plan is the same as that for setting up a mandala. The great Javanese stupa of Borobudur

is said to be a solid mandala. It embodies the mandala of the five Buddhas of Victory (*jina-buddha*), each of whom rules over a direction: Vairocana, “the Sun” or “the Brilliant”, is at the centre; Aksobhya, “the Unshakable”, is in the East; Ratnasambhava, “Jewel Birth”, is in the South; Amitabha, “Infinite Light”, is in the West; and Amoghasiddhi, “Attainment that is not Void”, is in the North. Stupa such as this, with the five *jina* Buddhas are expressions of *vajra-dhātu-mandala* (the Diamond World Mandala).

How to construct a *vajra-dhātu-mandala* is described in Vajrasekhara Sutra. It was explained by Vajrabodhi that the *mandala* has rectangular and circular shapes. The rectangular shape is for marking the boundaries of the *mandala*. The circular shape define the *vajra* circle and the five buddha circles. In this *mandala*, the radius of the central buddha circle is one third of the radius of the *vajra* circle. And the sizes of the other four buddha circles are placed tangentially to the central circle in four cardinal directions. Eight vajra lines are then to be drawn tangentially to these four circles. The creator of the *mandala* has options in selecting the number of the *bhagavats*, i.e., either 37 or 108 *bhagavats*.

In Borobudur there are 108 buddha statues in niches at each cardinal direction. Also, the radius of the dome (*anda*) of the central stupa is one third of the radius of the circular terrace in the ninth level. Moreover, the top view or the shape of the ballustrades from the first level up to the sixth level resembles the shape of the *vajra* lines as described by Vajrabodhi. There is indication of the fitness of *vajra-dhātu-mandala* and *garbha-dhātu-mandala* into Borobudur. Buddhism does not view *vajra-dhātu* and *garbha-dhātu-mandala* as two separate *mandalas*. They were regarded as two sides of the same coin. *Garbha-dhātu-mandala* is displaying a *mandala* of principle, while *vajra-dhātu-mandala* is displaying a *mandala* of knowledge.

The mandala is basically a circle inscribed within a square, drawn on the ground with coloured powders or outlined with threads or, for convenience, drawn as a painting on cloth or paper. The oriented plan of the stupa is a *mandala*. The ritual of laying out a stupa plan is the same as that for setting up a mandala. The great Javanese stupa of Borobudur is said to be a solid mandala. It embodies the mandala of the five Buddhas of Victory (*jina-buddha*), each of whom rules over a direction: Vairocana, “the Sun” or “the Brilliant”, is at the centre; Aksobhya, “the Unshakable”, is in the East; Ratnasambhava, “Jewel Birth”, is in the South; Amitabha, “Infinite Light”, is in the West; and Amoghasiddhi, “Attainment that is not Void”, is in the North. Stupa such as this, with the five *jina* Buddhas are expressions of *vajra-dhātu-mandala* (the Diamond World Mandala).

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lines are then to be drawn tangentially to these four circles. The creator of the *mandala* has options in selecting the number of the *bhagavats*, i.e., either 37 or 108 *bhagavats*.

What is found in Borobudur is that the number of buddha statues in niches at each cardinal direction are 108 statues. Also, the radius of the dome (*anda*) of the central stupa is one third of the radius of the circular terrace in the ninth level. Moreover, the top view or the shape of the balustrades from the first level up to the sixth level resembles the shape of the *vajra* lines as described by Vajrabodhi. There is indication of the fitness of *vajra-dhatu-mandala* and *garbha-dhatu-mandala* into Borobudur. Buddhism does not view *vajra-dhatu* and *garbha-dhatu-mandala* as two separate *mandalas*. They were regarded as two sides of the same coin. *Garbha-dhatu-mandala* is displaying a *mandala* of principle, while *vajra-dhatu-mandala* is displaying a *mandala* of knowledge. The *mandala* is basically a circle inscribed within a square, drawn on the ground with coloured powders or outlined with threads or, for convenience, drawn as a painting on cloth or paper. The oriented plan of the stupa is a *mandala*. The ritual of laying out a stupa plan is the same as that for setting up a *mandala*. The great Javanese stupa of Borobudur is said to be a solid *mandala*. It embodies the *mandala* of the five Buddhas of Victory (*jina-buddha*), each of whom rules over a direction: Vairocana, “the Sun” or “the Brilliant”, is at the centre; Aksobhya, “the Unshakable”, is in the East; Ratnasambhava, “Jewel Birth”, is in the South; Amitabha, “Infinite Light”, is in the West; and Amoghasiddhi, “Attainment that is not Void”, is in the North. Stupa such as this, with the five *jina* Buddhas are expressions of *vajra-dhātu-mandala* (the Diamond World *Mandala*).

How to construct a *vajra-dhātu-mandala* is described in Vajrasekhara Sutra. It was explained by Vajrabodhi that the *mandala* has rectangular and circular shapes. The rectangular shape is for marking the boundaries of the *mandala*. The circular shape defines the *vajra* circle and the five buddha circles. In this *mandala*, the radius of the central buddha circle is one third of the radius of the *vajra* circle. And the sizes of the other four buddha circles are placed tangentially to the central circle in four cardinal directions. Eight *vajra* lines are then to be drawn tangentially to these four circles. The creator of the *mandala* has options in selecting the number of the *bhagavats*, i.e., either 37 or 108 *bhagavats*.

Borobudur as Caitya Worship

Kathy Cheng Mei Ku is of the opinion that architecturally and iconographically, Borobudur is the product of caitya worship or the belief in the descent of Buddharaja Mitreya in Central Java. The worship was first established and promoted by Nagarjuna and Satavahana king in South India around the beginning of the third century A.D. Some of the reliefs on Borobudur are depicting caitya worship. Borobudur also demonstrates its unique Javanese interpretations of the beliefs and figures as stated in the Verification Sutra.

Talking about Borobudur can not be separated with two Buddhist temples, that are: Mendut and Pawon. These two temples seem to have been built in conjunction with Borobudur. It is probable that in the past, visitors to Borobudur went to Mendut and Pawon.

According to J.L. Moens, Mendut and Pawon were components of ceremony in which Buddhist rulers of Central Java were consecrated as cakravartin. Reliefs of cakravartins were depicted also at Borobudur who are seated with one leg pendent and the treasures: the elephant, the horse, the lady, the cakra, the minister.

Borobudur and Javanese life in the ninth century

The reliefs carved on Borobudur portray many aspects of daily life in Java. There are scenes on religious activities, economical aspect, technological aspect. Among the reliefs showing such activities are the construction and worship of the stupa, statues, temples and some other aspects of ritual. Picture of a farmer plowing his field, how the farmer bring the harvested rice to lumbung. Other relief showing the rats disturbing the rice field devoured a farmer's grain. Hunting and fishing activities with the equipment as still used by traditional fisherman. Craft making were depicted such as pottery making,

Sketchy picture on the performing arts in Ancient Java in the period of Borobudur were illustrated at the relief of Karmawibhangga, Lalitavistara, Gandavyuha such as dances as well as musical instruments. Based on the context of the reliefs it seems that early Javanese artists can be socially classified into two groups: artists of the upper class (royal family) and of the lower class. Artist of the upper class was illustrated in the reliefs as having beautiful costume and performed in front of Royal family. Such classification might be fit well also with information from the early inscriptions which mentioned '*agending i haji*' (group of musicians owned by the king) and '*agending ambaran*' (group of musicians of the lower class who performed by moving around from village to village). This second group is clearly stated in the inscriptions as '*menmen*'. It is interesting to note that in Wukajana inscription of the ninth century it was also mentioned that there was a group of female dancers who performed from one place to another place, i.e. '*rara mabhramana tinonton*' literally means 'girls (dancers) who walked around and were watched. Picture of this might be illustrated in the relief of Karmawibhangga (O.1) where in the market a female dancer was accompanied by musicians.

Many kinds of music instruments were also illustrated on the reliefs. There should be two kinds of instrument type: instruments of Indian type and of Javanese type. The first type is clearly shown from the context of the scene in that the instruments were played by kinara and kinari (the heavenly being) or played in front of the stupa for religious ceremony. While the Javanese instruments were played by ordinary people for the public. Fortunately enough that in some ancient Javanese inscriptions of the ninth century there are verbal descriptions on the name of the instruments. Indian music instrument is usually termed in Sanskrit words such as *wina*, *ravanahasta*, *pataha*, *mrdangga*, *vamsi*, *ganta*. The Javanese instruments usually named under the Javanese words such as *curing*, *brėkuk*, *bungkuk*, *rėgang*, *gong*.

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Borobudur dan Saya

Mudji Sutrisno SJ.

(Guru Besar STF Driyarkara & UI, Budayawan)

Ketika masih kanak, mendaki Borobudur adalah “lomba cepat berlari ke atas lalu turun lagi” bersama anak-anak sebaya umur. Siapa berlari cepat ke atas lalu turun kembali sebagai yang pertama maka dialah sang pemenang. Kami tidak hirau bahwa candi ini bisa menunjukkan “siapa dirinya” melalui pahatan relief serta panil-panilnya kalau mau berjalan setapak ditemani guru yang sudi berkisah mengenai candi dan perjalanan hidup Sidharta Gautama.

Ketika bersekolah dan berasrama di Seminari Menengah Mertoyudan Magelang, barulah saya temukan “guru” yang mengajak mencintai dan mengenal Borobudur. Waktu itu, sehelai daun pohon “bodhi yang bentuknya sama serupa dengan STUPA” ditunjukkan ke kami sambil membandingkan bentuk stupa Borobudur yang tepat sama dengan helai daun pohon bodhi tadi. Lalu dijelaskanlah dengan amat menarik barangkali renung-renung pembangun dan pendiri Borobudur menganalogikan atau menyatukan narasi Sidharta Gautama yang mendapatkan pencerahannya mengenai 4 kebenaran hidup dibawah pohon bodhi. Karena itulah stupa-stupa Borobudur yang dibatinkan pada kami didorong untuk mengunjungi candi demi rasa ingin tahu di hari libur nanti dengan sebuah pertanyaan: benarkah stupa-stupa candi Borobudur merupakan “helai-helai daun pohon bodhi”, pencerahannya Sidharta Gautama? Inilah guru budaya yang mengajak dan menanamkan pada kami dalam tindak laku pepatah yang berbunyi: “yang tidak mengenal akan tidak mampu menyayangi”.

Dari sanalah, sampai hari ini, ketika kecintaan pada Borobudur telah membawaku tidak hanya upaya mengenalnya dalam perbandingan dengan candi-candi budhis di Ayuthaya Thailand dan Angkor Watt di Kamboja namun pula membuatku mengajar dan menulis mengenai Budhisme, bahkan ketika di Kamakura Jepang mendalami perkembangannya dalam Budhisme-Zen setelah Budhisme dari India bergerak ke China lalu ke Jepang dalam perbandingan dengan yang di Asia Tenggara. Dari pandangan keluar tersembullah dorongan pandang ke dalam untuk menulis renung estetika religiositas Borobudur. RELIGIOSITAS adalah keruhanian atau spiritualitas, dalam arti kesadaran manusia yang mempercayai dalam lubuk hatinya bahwa nilai serta arah hidupnya dihubungkan dan ditentukan oleh relasinya yang damai dengan Yang Suci, Yang Ilahi. Religiositas dalam diri manusia adalah kemampuan pokok kebudayaan yang dalam menghayati kehidupan membuat keputusan berdasarkan nurani yang berdialog dengan Yang Ilahi. Religiositas ini merupakan “lawan” dari pelembagaan agama karena ia merupakan perasaan misterius dan mistikus saat orang dengan mudah dan peka mengalami bahwa Yang Ilahi itu indah mudah ditangkap melalui intuisi seni. Yang Ilahi juga “benar” karena bisa dimengerti dan bisa diucapkan dengan bahasa yang jelas. Yang Ilahi juga pasti “baik” kerana DIA bisa menghayati tingkah laku

yang baik kalau manusia bercermin pada Yang Ilahi itu. Dengan kata lain, religiositas adalah spiritualitas yang kepadanya manusia akan kembali saat ia mengalami krisis dalam tahap-tahap hidupnya karena kelemahan atau kejatuhan.

Sementara itu, ESTETIKA, yang kerap disempitkan dan direduksi hanya sebagai kesenian, sebenarnya punya cakupan makna yang lebih luas dan dalam, yaitu: kemampuan kreatif manusia dalam kebudayaannya. Kemampuan kreatif ini yang kemudian memberi bahasa-bahasa pengucapan mengenai keindahan. Apabila “inspirasi” dari religiositas, maka akan menjadi “estetika religius”. Bila sumber inspirasinya dari nilai-nilai kemanusiaan maka akan menjadi estetika kemanusiaan. Akan menjadi estetika perdamaian bila inspirasinya bersumber dari nilai perjuangan kedamaian ketika terjadi situasi konflik.

Maka, apabila Anda mengunjungi candi Borobudur dan mata budi serta mata hati Anda melihatnya dengan bingkai penghayatan religiositas, maka kita akan melihat Borobudur sebagai sebuah kitab suci yang terbuka untuk mengucapkan selamat datang serta selamat mengenal dalam bentuk “narasi ziarah religius yang menurut Budhisme melalui tahap-tahap hidup yang akan membawa manusia sampai ke nirwana atau moksha. Masuk ke gerbang pertama, lalu naik, mengelilinginya dengan jalan setapak hening, maka akan menatap kita pada relief-relief yang mengisahkan bagaimana Sidharta dalam pengembaraannya harus melalui tahap pertama yaitu “kamadhatu”, yakni, tahap hidup yang masih bersumber pada “hasrat” atau kama. Dalam tingkatan ini, manusia tidak bahagia dalam kenyataan hidupnya karena adanya “derita” atau “dukha”. Penyebab dukha adalah menuruti “kama” atau hasrat. Di kamadhatu ini terukir dalam relief-reliefnya kebenaran hidup budhis, bahwa hidup itu dukha. Dukha atau derita itu ada penyebabnya. Penyebabnya itu adalah “kama” atau hasrat manusia. Untuk menyelesaikan dukha inilah ditawarkan 8 jalan kebenaran yaitu mulai dari melihat secara benar, bicara dengan benar sampai akhirnya berdoa atau bersamadhi dengan benar.

Melangkah ke atas lagi, masuklah ke tahap “rupadhatu”. Dalam relief-relief ini tampil ekspresi seni manusia-manusia dengan hidupnya yang lebih bersahaja, menghayati kondisi bertubuh jasmani dalam situasi duniawi, namun sudah mulai menemukan pencerahan bahwa sumber derita itu adalah hasrat. Oleh karena masih di dunia dan bertubuh “rupa”, maka ia terus mesti berziarah menuju pencerahan dengan mengambil jarak dan berperilaku benar hingga bersamadhi benar pula. Tahap berikutnya adalah tahap “arupadhatu” atau “formless”. Inilah tahap kehidupan ketika orang mendekati nirwana dan memasukinya. Sidharta Gautama pada tahap ini, di puncak Borobudur, duduk hening bersamadhi dalam posisi lotus dalam kesahajaan polos sebagai “ekspresi tak berwujud”. Dia tidak lagi terikat baju-baju fisik karena sudah menguasai kama-nya, menguasainya yang paling naluri dari dirinya, dan memasuki tahap arupadhatu. Kita dapat melihat dengan mata indrawi, Sidharta bersamadhi dalam tingkatan tertinggi, hening “polos”, seakan sudah menirwana. Pokok ini sejalan dengan religiositas Budhisme itu sendiri, yang menunjukkan melalui tahapan-tahapan candi Borobudur, jalan setapak tahap demi tahap menuju nirwana justru dalam

realitas dunia yang dukha penuh kesengsaraan dengan cara meretas sumber kedukaan hidup yaitu hasrat atau kama. Moksha di tahap arupadhatu dengan ekspresi samadhinya Budha Gautama posisi “lotus” yaitu “mekarnya teratai di atas telaga dunia yang kotor berlumpur dukha”, itulah perlambang samadhi lotus nirwana. Saat sampai tahap arupadhatu, masuklah perjalanan manusia ke keadaan suci, moksha menuju nirwana dan yang fisik tidak ada lagi.

Untuk menutup tulisan ini, saya merenungi dalam bingkai yang sama yaitu estetika religisitas tentang perdebatan ditemukannya patung “Budha buruk rupa” atau yang dikenal sebagai “The Unfinished Budha”. Satu kelompok ahli-ahli berpendapat bahwa arca ini tertinggal sebagai yang “tidak selesai” ketika candi Borobudur didirikan dan dibangun di abad 8-9 Masehi sebagai candi Budhis. Kelompok lain berpendapat, bahwa fakta ini “tidaklah kebetulan ada”. Oleh karenanya, pertanyaan untuk maksud apa dan mengapa arca ini ada merupakan tugas atau pekerjaan rumah yang harus dijawab oleh para ahli arkeologi dengan membingkainya dalam “makna apa artinya”? Saya sendiri lebih menaruh hati pada pendapat estetis mengenai arca Budha buruk rupa ini. Mengapa? Dalam bingkai estetika dianut sebuah tesis estetika yang membuat “kontras tajam antara yang “indah” dan “yang buruk”. Justru untuk menonjolkan betapa estetika religius mengenai keindahan pengalaman “moksha” itulah harus dikontraskan dengan sebuah arca Budha Buruk Rupa. Apa maksudnya? Agar orang semakin merasakan intuitif bahwa yang “elok” dan yang “sempurna” ialah “The Finished Budha” akan semakin cemerlang indahnya dan eloknya manakala dihadapkan pada “yang buruk rupa”. Bukankah dalam konsensus akal sehat sehari-hari kita memakai pula bahasa penajaman dalam kontras? Sebutan “kerikil ini kecil” justru tajam muncul tertandaskan apabila dalam berhadap-hadapan dan perbandingan dengan kerikil-kerikil besar.

Refleksi di atas ingin saya bingkaikan dengan pertemuan ini bersama pokok-pokok renung sebagai berikut:

1. Posisi Borobudur dengan *Sang Hyang Kamahayanikan*
2. Mengapa Borobudur: dari stupa ke stupa?
3. Antara yang RUH dan yang fisik dari candi Borobudur.
4. BWCF (Borobudur Writers & Cultural Festival) bermaksud memberi ruh dikawasan ini.

The Old-Javanese Everyday Life In The Karmavibhaṅga Reliefs

Prof. Dr. Hariani Santiko

The Karmavibhanga Scenes from Borobudur

Borobudur is one of the remarkable Buddhist monument because of its size, its sculptural and its decorative richness. There is a total of 1460 narrative panels and 1212 decorative reliefs which cover the facades of the walls and balustrades of the monument and arranged as follows:

Wall of the hidden foot		Karmavibhaṅga	(160 panels)
First gallery	main wall	Lalitavistara	(120 panels)
		Jataka/Avadana	(120 panels)
	balustrade	Jataka/Avadana	(372 panels)
		Jataka/Avadana	(128 panels)
Second Gallery	main wall	Gandavyuha	(128 panels)
	balustrade	Jataka/Avadana	(100 panels)
Third Gallery	main wall	Gandavyuha	(88 panels)
	balustrade	Gandavyuha	(88 panels)
Fourth Gallery	main wall	Gandavyuha	(84 panels)
	balustrade	Gandavyuha (Bhadracari)	(72 panels)

(Soekmono 1976:19-20,32)

In this paper I give special attention to the reliefs which are depicted on “the hidden base “ of the Borobudur. These panels were rediscovered by Ijzerman in 1885 and in 1891 photographed by Kassian Cephas. N.J.Krom (1920), and Silvain Levy (1930) identified them as the stories taken from the Mahākarmavibhaṅga texts from Nepal and Tibet. In 1989 Jan Fontein studied these reliefs and comparing with two Karmavibhaṅga texts which were translated into Chinese in AD 582 AD (named as T 80), and in 980 AD (T 81) (Fontein 1989, Santiko 2012:5).

The Karmavibhaṅga deals with the Law of Cause and Effect, the Karmic Law, and is believed as one of the many sermons attributed to the Buddha himself. These reliefs should be intended to warn the believers about the good and bad results of acts performed by men, is considered applicable for everyone, whether king, aristocrat, priest, and commoner. Since the doctrine was very important for the people to obey the Karmic Law, the sculptors (the śilpīns) depicted the episodes for them to understand the doctrines easily. As a result from these stone panels reveal the amazing episodes of the early life in Java from ninth to tenth centuries AD.

The sculptors (the śilpīns) who carved the reliefs were the Javanese (the Indonesians), the evidence come from about 35 short inscriptions depicted on the wall of the reliefs as a kind of information to the śilpīns of what kind of episode they had to carve. These short inscriptions are written in Old-Javanese scripts in Sanskrit words without the nominal case-endings. The Indonesian śilpīns had no problem to understand the meaning of the words in question. For instance when they read the word “svārgga”, they will carve heaven according to their imagination. However, for the other people (the Indian śilpīns for instance) who understand the Sanskrit language would confuse whether they had to carve the people in heaven, or the situation of heaven, etcetera.

The Karmavibhaṅga text which is illustrated by the 160 reliefs contains a detailed explanation of the working of *karma*, the propitious results of the meritorious deeds as well as the negative results, of which actions and attitudes are depicted. The first 123 show various actions leading to one and the same result. While the remaining panels from 124 up to 160 demonstrate the many results that can follow from one kind of act.¹⁾ For instance in *paragraph V* of the Chinese Translation of Karmavibhaṅga (T 80) mentions 10 types of actions with the results for all beings in a rebirth as a person with an *ugly appearance* :

- 1) frequently act in anger
- 2) frequently harbour resentment
- 3) to be incincere in one's dealing with others
- 4) to vex and disturb all living beings
- 5) to treat one's parents without love and respect
- 6) to be disrespectful towards the wise and holy
- 7) to seize by violence the property and the means of livelihood of the wise and holy
- 8) to destroy the lamps of stupas and temples
- 9) to ridicule and despise ugly beings
- 10) to practice habitually bad behavior of a similar type (Fontein 1989:21-22).

There are two inscriptions on the upper part of the 21th panel of Borobudur mentioning “*virūpa*” means “ugly” and on panels 021c, 22c, 23c, 24c and 25c are shown “the ugly” persons²⁾



(Fig. 1) - 021 To be disrespectful towards the wise and the holy or frequently act in anger or frequently harbour resentment (?)



(Fig.2) - 024 To destroy the lamps of stupas and temples

The Old-Javanese Way of Life

As already mentioned that the *śilpins* tried to make episodes for the people to understand the Karma doctrine easily, so they depict the every-day life of the people on the panels. Bernet Kempers in 1976 studied on the everyday life of the Old-Javanese people from Borobudur reliefs. He compared the illustrations from Borobudur with the reliefs from other temples, from Central Java as well as from East-Java. He considered the Borobudur's sculptors had an important role in the way the illustrations were arranged (Bernet Kempers 1976, Rangkuti 1989:81). Not only the arrangement of the text but they also took liberties with the text, for instance on panel 094 we found the *garuda* and *naga* included in the paragraph XVI of Chinese text which mentions "ten types of action that result for all beings in a rebirth as a domestic animal". However in the paragraph we never find the rebirth as a garuda and a naga explicitly. It is not mentioned in the text what kind of acts merit a rebirth in the shape of those supernatural animals (Fontein 1989:43). Garuda was an important animal as a *vahana* (vehicle) of god Visnu, we find the garuda relief on the Rāmāyana relief on

Prambanan. However the combination of *garuda-naga* was very popular in a story of *Garudeya* in East-Javanese period (Fig.3).



(Fig.3)- 094 Rebirth as a Garuda and a Naga with men's torso

J.G. de Casparis was doing research on the Old-Javanese social-structure from the written sources, inscriptions as well as manuscripts, including the *kakawin* *Nagarakṛtagama* from Majapahit period. In the last mentioned manuscript was written the *caturwarna*, four classes in society. However, according to De Casparis, there were only 3 classes and the caste classifications were not so rigid as those found in India, and those social structures are:

1. The common people, the largest class in the society
2. The king, his family, and the stafs
3. The religious functions (De Casparis 1954:56)

As Th. Pigeaud adds the slave-class to the three classes of De Casparis, so there were four classes instead of three, i.e. the ruler, the religious men, the common people and the slave-class (Pigeaud 1968:165).

The Common people here I mean common people based on Sosial-status, as well as "commoners" according to Mahayana i.e. "those whose existenses are still trapped in their karma.

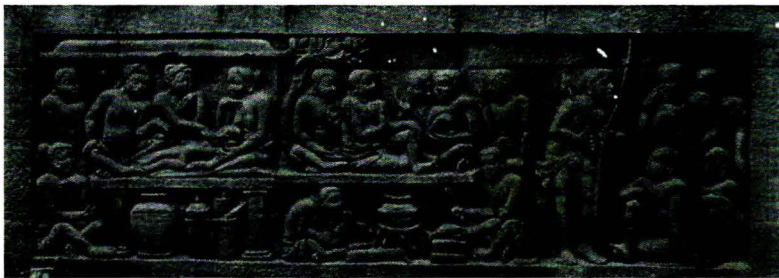
To identify the three classes of the community I wll show some panels starting with the first five panels of the Karmavibhaṅga. (Fig. 4, 5, 6, 7)

Figure 4 up to 7, are the first four panels of Karmavibhaṅga on Borobudur, actually there are five panels, but panel 4 is a little damage. These episodes represent paragraph I of T 80, mentioning "there are 10 types of actions that result for all beings in rebirth of short duration". We saw in episodes 2c, 3c, 5c, a little child die as a result of the people's bad conduct: on panel 01 the fishermen trap the fishes in a "susuk" and then put in a "tapis" on the men's shoulder, as for the hunter (02) he hold a bow and an arrow probably will go

for hunting. On panel 03 a woman is committed abortion. as on panel 05 the people are fighting, probably the illustration of what the paragraph means “to incite others to fight and harm one another”.



(Fig.4)- 01 Fishing, to kill living beings with one's own hand



(Fig.5)- 02 The hunter, to cook fish and the method of lighting fire



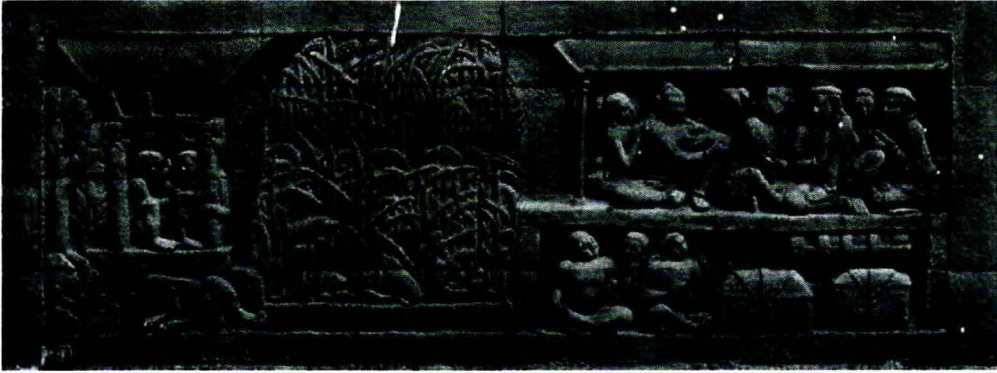
(Fig.6)- 03 Doing abortus to a certain woman



(Fig.7)- 05 To incite others to fight and harm one another

The description of life in Ancient Java on the stone sculptures show that the people of that time were an agrarian society. There were *paddy rice* as well as the *paddy gaga* were

shown on some panels. However the *paddy gaga* which was cultivated on dry field shown more frequently than the paddy rice. As they are to day mice were enemy of farmers (fig.8).



(Fig.8)- 065 When there is famine, the rich people are not pity the victims W
but to rejoice in their fate

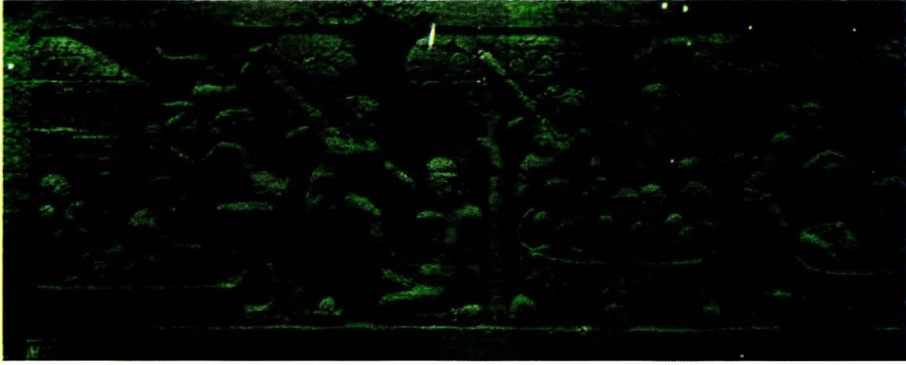
That episode is one of the representation of paragraph XI of T 80 mentioning “ten types of actions the result for all beings in rebirth as a person having few possessions”. The illustrations of the paragraph are shown on panel 060-065 (Fontein 1989:39).

The angry farmer tried to drive the rats from their holes by a lighted torch. However instead of punishing the rats, the farmers are considered guilty and plunged into Sanghata Hell. In Buddhism killing living beings known as “*ahimsa*” are forbidden (Bernet Kempers 1076:244-245, Fontein 1989:39). (Fig.9). The *spirits of ahimsa* are also found on panels 01-05, on the panels showing a child die as a result of people’s bad conducts, including hunting, fishing, to cook fish, to commit abortion, to kill living beings with one’s own hand (04), to incite others to fight and harm one another (fig.4,5,6,7).

To kill and torture a living creature was also prohibited in Buddhism, we can surmise from panels 086-092, 0109-0110, of how people will punished in Hell by killing and torturing animals and other living beings (fig 10 and fig 11).



(Fig.9)- 087 The people are being punished in Samghata Hell because of their dees to smoke rats out of their hole



(Fig.10) - 089 To boil turtles, they will have the same fate in Hell, to harm innocent woman he will be thrown head first to the burning house



(Fig.11) - 0109 People are boiling in an eifernal cauldron as a punishment for their activities as fishermen and as hunters

The episodes of ploughing, seedling in paddy fields or rice pounding are not depicted in the Karmavibhaṅga reliefs as were done in other temples such as Prambanan or Trawulan (Bernet Kempers 1976:245) Besides rice there are still crops and plants such as bananas, oranges, durian, breadfruit, mango, corn, wheat, etc (Yulianto 1989:163). A special and holy tree, the Kalpataru are depicted on the panel represent heaven (*Svārgga*) on panels 0101, 0102, 0126, 0130, 0137, 0147.

Fishing and hunting were also popular ways of living along with husbandry, looking after chicken, pigs (09) and fish breeding ponds. The reliefs also reveal the ways and habits of ancient Javanese communities, such as the method of lightning fires, cooking on earthen pots, nursing the sick, attending the dead, and other activities such like dancing, begging, even thievery (Santiko 1989:26).

In addition to everyday activities, work and customs, the reliefs also contain information of the social structure of ancient Javanese society. Sometimes it is not so easy to recognize the class of people on the reliefs, we can try to recognize them from the *clothes/*

dresses and the accessories they wear, and also from the things which accompany them (Inda Chitraninda 2012:27-46).

From panel 01-05, we see the clothes wear by the fishermen, the hunter and other people are very simple ones, i.e. short trousers reached their knees. These kind of clothes wore by the common men, sometimes they wore a kind of loin-cloth. As for the common women dressed the knee-length clothes with a belt, they do not wear accessories. We can see on panel 03 (Fig. 06).

The middle-class women usually wore ankle-length sarongs and a tiered belts, another on the hips studded with gems, in harmony with *the uncal* (pleated cloth), and the breast are bare. The jewellery they wear is not as quite elaborate as those wear by the king and his family, aristocrats and the wealthy people. Eventhough the clothes and jewelleries were similar, the differences of their status can be detected from the different raised areas (Fig.12 and Fig 13).



(Fig.12) - 069 To provide in the needs of the holy and the wise (paragraph XII)



(Fig.13) - 055 To pay respect to the brahmins and the ascetics (śramana)

As for Fig. 13 (055) is the representation of paragraph X, mentioning about “ten types of actions that result for all beings in rebirth as a person from the upper class” (Fountain 1989:29, 39). Panel 055c showing a happy life as a result of the good behavior on their former lives.

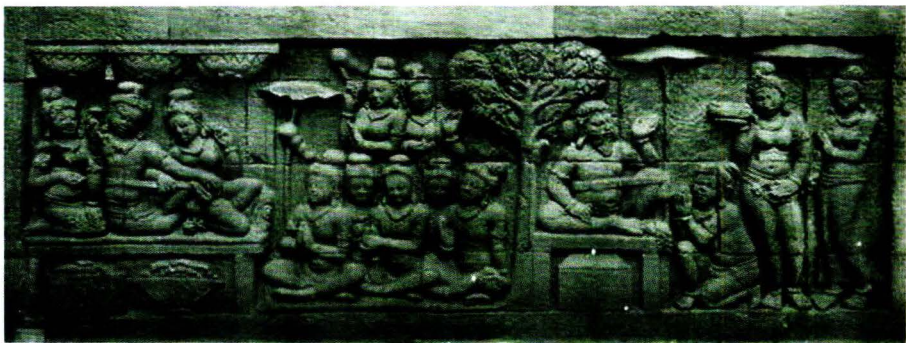
The religious figures, the Buddhist monks (the bhiksus) are pictured with a bald head, having a robe open on the right shoulder, sometimes holding a beggar bowl, a walking stick and a rosary. Besides the Buddhist monks there are other sages, i.e. the śramanas/rsis (the ascetics), maharsis, and the Siwait Brahmins. The śramanas have a long hair sometimes put as a knot on the heads. Usually they bring umbrellas (*chattras*). The maharsis/siddharsi³⁾ sometimes wearing turban or a kind of *jatamakuta* (the hair is done like a headdress). We can compare with the picture of the rsi in East-Javanese temples, for instance the two ascetics from the reliefs of Bubuksah and Gagangaking in Panataran temple, or the *tripaksa* (*rsi-saiva-sogata*)-reliefs from the story of Krsnayana depicted on the wall of the main temple of Panataran.

The Religious Activities

Candi Borobudur is the Buddhist temple, built by a Buddhist king Sailendra. However, from the Karmavibhanga panels we see many kind of sages, the Buddhist monks (the bhiksus), the śramanas/rsi, the maharsi/siddharsi, the brahmins (Sivait). There are many reliefs of these brahmins, they tied their hair, or making a knot or coil of hair on top of the heads. Or let the hair left in matted condition, like the hair of Siwa as yogin (Santiko 2009).

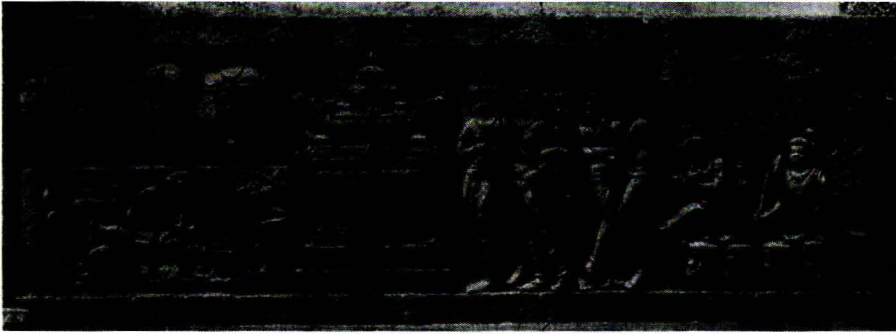
Their activities among others are giving lesson to disciples, discussion, giving advice and meditation. In the Rāmāyana kakawin (9nd century AD), the maharsi or siddharsi well known to be adept in all āgamas and olther śāstras and the knowledge of all kinds of offering. They lived in *patapans* in remote places.

The bhiksus gave valuable information on the religious beliefs and duties of the day, such as giving alms (*dāna*) to the monks and other holy men, to the poor and to other people. According to Buddhist teachings, giving *dāna* is one of the six *paramitās* which form *mahāmarga*, leading to the achievement of *Mahābodhi*. There are many episodes related to the *dāna*, some of the stones above the reliefs we found inscriptions, for instance on panel 0127 is written *chattradāna* means “gives of a parasol”, it represents the gift of a parasol to a Brahmin (fig 14)., “*Vastradāna*” means “gives of clothes” (0135), “*Bhajana dāna*” (0138), “*puspadāna*” means “gift of flower” (0152), “*mālādāna*” means “give of a bouquet” (Magetsari 1997:358).



(Fig.14) - 0127 “Chattradāna”, “gift of a parasol” to a seated Brahmin

To give alms (*dāna*) is a meritorious deed to be reborn in heaven (fig 15).



(Fig.15) - 0147 The scene in Heaven with a beautiful temple and kinnara-kinnari below a Kalpataru

In the Karmavibhaṅga episodes, there are temples depicted which resemble the candi Dieng, Gedongsanga and candi Plaosan/Sari in Central Java. The sacred buildings (temples) and the profane architecture (houses) have been published by Parmono Atmadi in 1979 and by Endang Sri Hardiati and Danang Priatmojo (2009).

Notes

- 1) According to N.J.Krom from panel 01-117 (not 123) show various actions producing one result, and the remaining panels are from 118 (not 124) -160
- 2) One panel usually consists of three or two scenes, we have to read from right-central-left (a-b-c)
- 3) Rsi here are ordinary ascetics such as Arjuna doing tapa in the story of Arjunawiwaha, as Maharesi/Siddhahesi usually are rsis with high spiritual wisdom

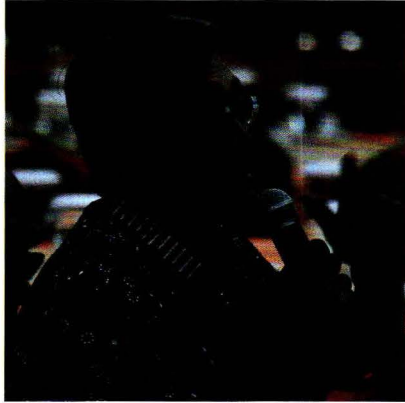
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Diskusi:

Pertanyaan Sutikno (Universitas Gadjah Mada)



Apa yang dapat disumbangkan oleh Candi Borobudur untuk kemajuan Bangsa Indonesia pada masa kini)

Jawaban : Timbul Haryono

Tiga titik waktu sering dipisahkan, yaitu masa dahulu, sekarang, dan akan datang. Ketika titik waktu disatukan maka dapat menjadikan Candi Borobudur sebagai referensi untuk masa depan. Adapun yang dimaksud dengan referensi pada masa lalu adalah *learning the past, to improve the future*. Karena budaya masa lampau memberikan suatu dasar dan identitas asli Bangsa Indonesia pada masa lalu. Masa lampau harus dianggap saling berhubungan. Konservasi Candi Borobudur

sebenarnya berusaha untuk mempertahankan nilai-nilai penting pada masa lalu yang diimplementasikan dalam bentuk arsitektural candi. Dalam hubungannya dengan pelestarian Candi Borobudur, kita harus bersikap tepung, dunung, dan srawung. Tepung berarti kenal, dunung berarti paham, dan srawung berarti berinteraksi. Akan tetapi perlu digarisbawahi bahwa pada saat kita mengimplementasikan srawung atau interaksi haruslah sesuai dengan kaidah pelestarian Candi Borobudur.

Jawaban : Mudji Sutrisno

Salah satu kontribusi dari Candi Borobudur untuk masa kini dapat dilihat pada pelaksanaan Borobudur Writers Festival yang diadakan tiap tahun di Borobudur. Festival tersebut bermaksud mengundang para penulis untuk berkontribusi dengan menulis tulisan bertema Candi Borobudur. Pada intinya, yang utama adalah Candi Borobudur harus dimanfaatkan sebesar-besarnya untuk pendidikan dan pembangunan karakter.

Jawaban : Hariani Santiko

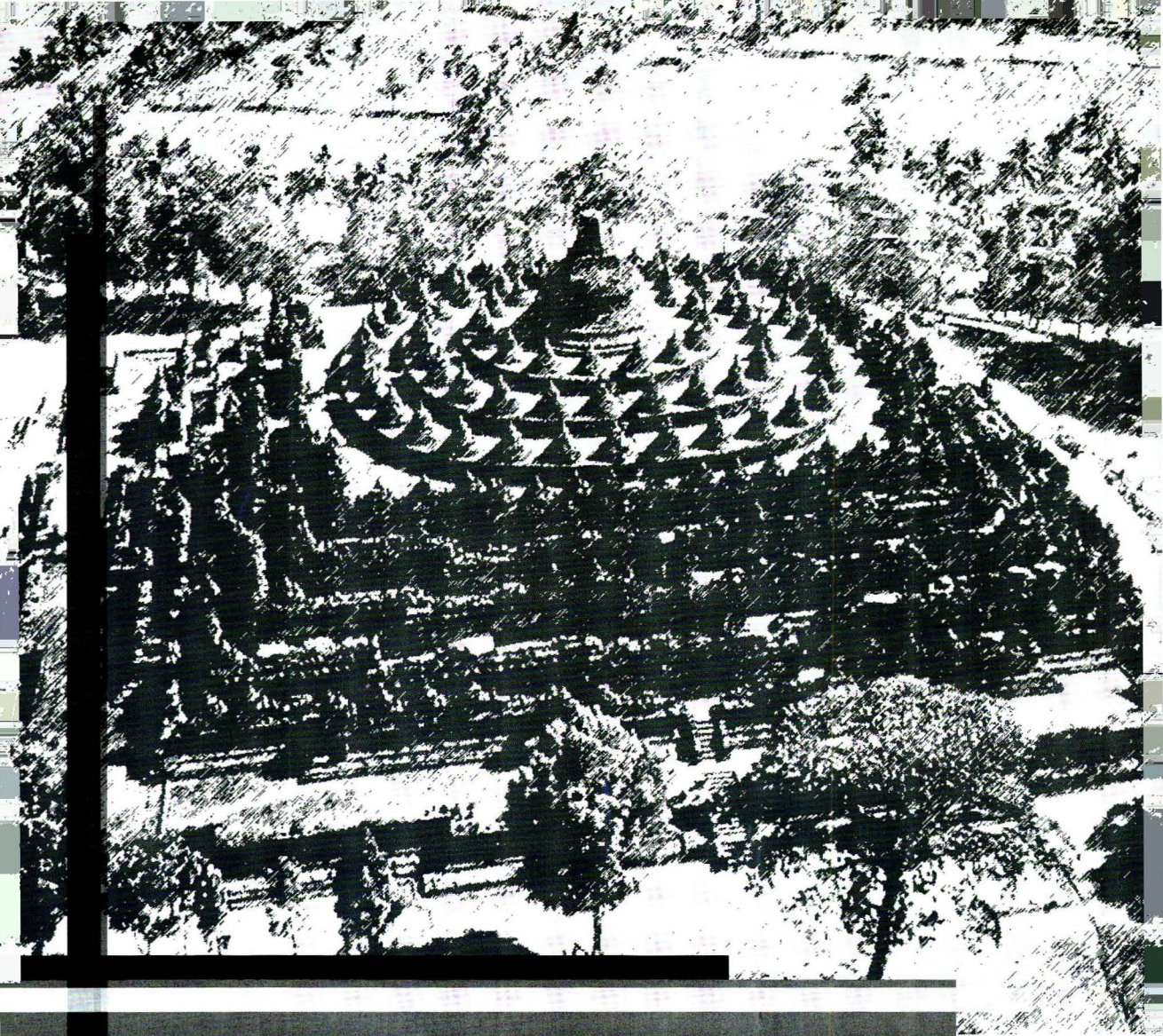
Apa yang digambarkan pada Candi Borobudur merupakan pendidikan bagi para generasi muda. Maka dari itu kita harus mengembangkan *sense of belonging* pada para generasi muda untuk melestarikan bangunan-bangunan candi yang lain.

Tanggapan 1. Masanori Nagaoka (UNESCO Office, Jakarta)

Sepanjang pengetahuan saya apabila diadakan seminar berskala internasional, bisa dipastikan bahasa yang digunakan adalah Bahasa Inggris. Tapi dalam seminar kali ini para ahli ada yang tidak menggunakan Bahasa Inggris. Hal ini sangat disayangkan karena para ahli luar negeri selain ingin menyampaikan ilmu yang baru juga berkeinginan untuk belajar dari pengalaman para ahli Indonesia, sehingga komunikasi dapat lancar.

Tanggapan 2. Esther Von Plehwe-Leisen

Selaku ahli dari Jerman, saya merasa senang untuk hadir di forum ini, terlebih lagi untuk mendengarkan penjelasan dari para ahli konservasi Candi Borobudur. Hal ini dikarenakan, sangat penting bagi kita untuk saling bertemu dan berdiskusi membahas isu-isu konservasi bangunan bersejarah. Kami melihat Candi Borobudur bukan hanya candi yang di buat dari batu, melainkan di dalamnya terdapat nilai-nilai penting kebudayaan pada masa lalu.

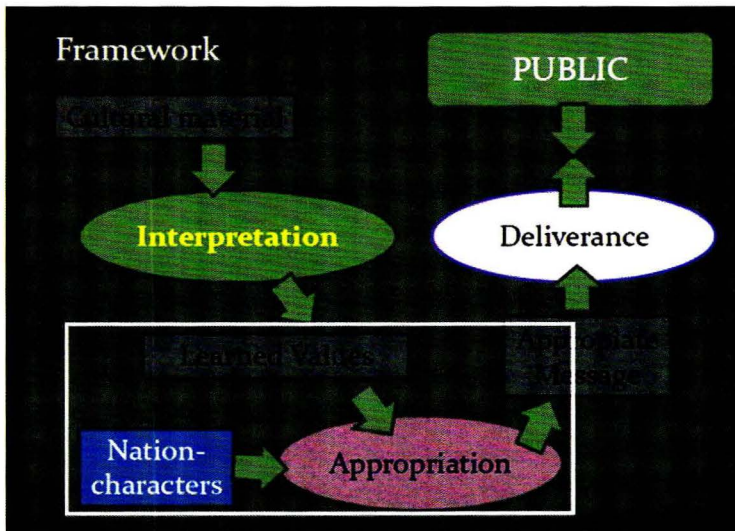


Borobudur Temple and Education

Borobudur and Nation – Character Building

Dr. Daud Aris Tanudirjo, M.A

- Borobudur has been admitted by the world as a masterpiece of human creative genius. Surely, it becomes cultural capital for Indonesian people and from which we can learn many good lessons. But, how ?



- As a nation-state, Indonesia has agreed to designate Pancasila as the foundation of the state, the way of life, ideology, and nation-characters.
- Therefore, talking about nation-character building one should refer to Pancasila which consists of 5 basic principles:
 1. Believe in One (Supreme) God
 2. Just and civilised Humanity
 3. Indonesian Unity (Nationalism)
 4. Democracy under the wise guidance of representative consultations
 5. Social Justice for all Indonesians
- There are many aspects of Borobudur that contained values which indeed can be regarded as manifestation of the five basic principles of Pancasila : from the reliefs to the mandala, from the structure to the cultural landscape
- Potentially, those can be used to strengthen the nation characters of Indonesia people

Borobudur



- Is a manifestation of the spiritual journey to pursue the Ultimate Being, i.e. **freedom from samsara and attain the nirvana.**
- This can be appropriated to the national spirit of Indonesia, i.e. **Freedom is a justified right for all human being** (UUD 1945 Mukadimah)



- The Karmawibhangga reliefs tell us the basic cause and effect law which can be used to control bad manners and to enhance our humanity. Of course, it needs to be contextualize to the modern world

Jataka avadana

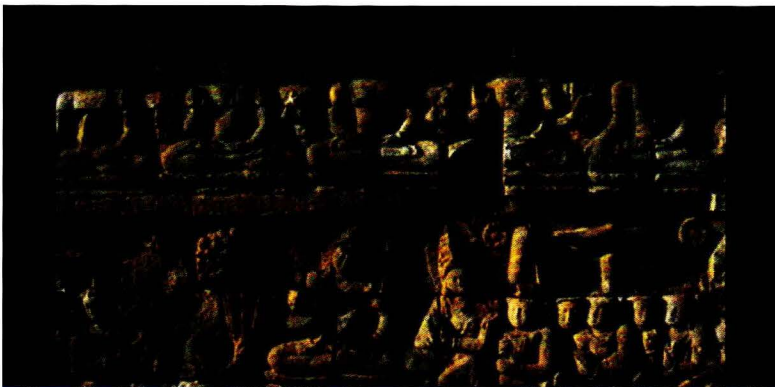


- Depict plenty of fables (short stories of animal or inanimate objects) that teach us universal moral lessons and wisdoms
- Those stories can potentially be selected and appropriated to explain and exemplify the basic principles Pancasila



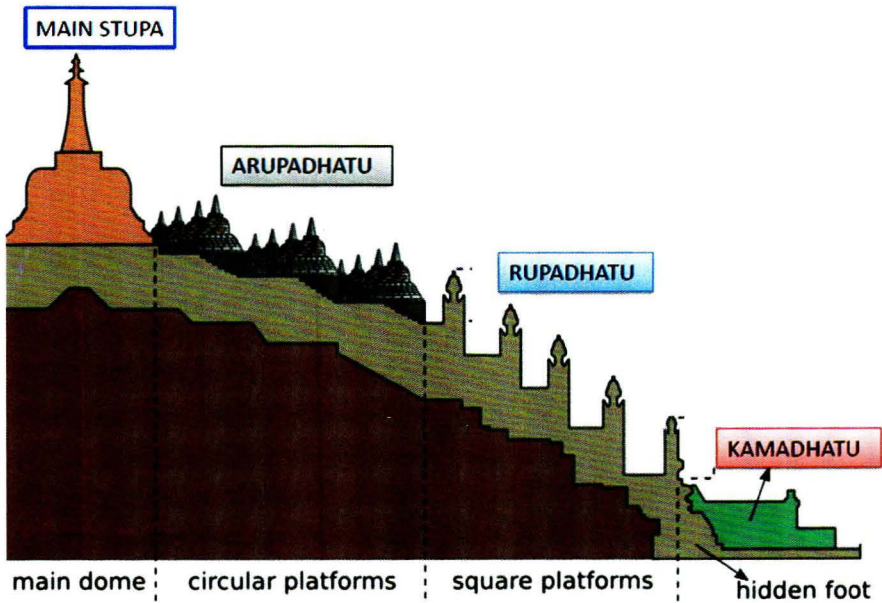
- Lalitavistara reliefs : the story of Sakyamuni also contains examples as well as discussion on the social relationship, leadership, and humanity in general.
- The reliefs are good resources to be explored, interpreted, and appropriated to help finding role models which are related to the implementation of Pancasila in daily life

Gandawiyuda

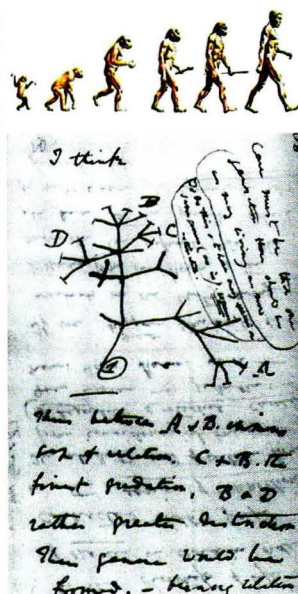
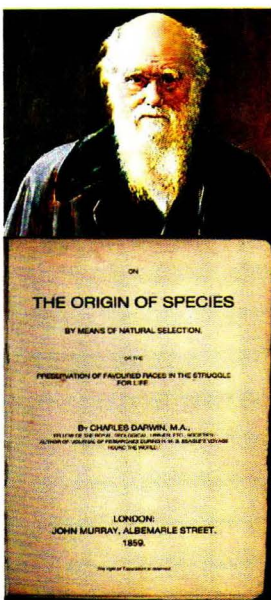


- Depicts the story of Sudhana in pursuit of enlightenment. He learned wisdoms from many sources and teachers.
- Rich in wisdoms which could enhance the harmonic relations between people – people, people – environment, and people – god. This has become one of the nation characters of Indonesia

- The Mandala Concept can be used as a model for interrelation between Central – Provincial – Local Governments, since Mandala illustrates the synergic interactions among central and peripheral powers to create a strong balance system of government
- Understanding this concept means strengthening the Nationalism principle of Pancasila



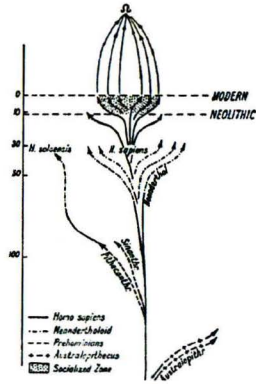
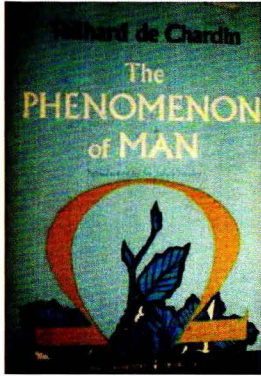
The entire structure teaches us on the ultimate aim of life, belief in God, and non-materialism which is in-line with Soekarno’s explanation of 1st principle of Pancasila
 For me, personally
 Borobudur is the most ancient and complete “Book of Evolution”



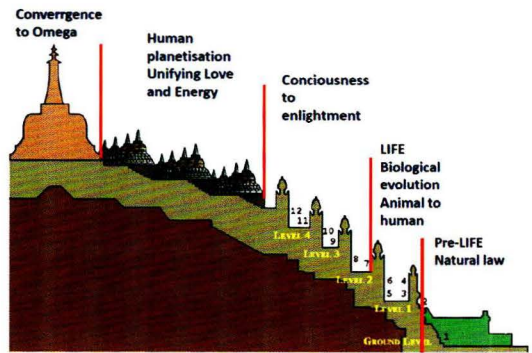
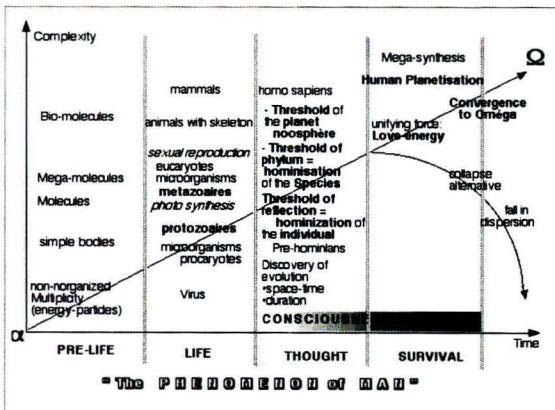
A Synthesis of physical biological Evolution of Charles Darwin and the humanity evolution of Teilherd de Chardin

Charles Darwin

Explain the physical evolution of life from single cell to culminate in the form of Human Beings through natural selection and adaptation



Teilhard de Chardin's hypothesis try to delineate the post modern human evolution After Homo sapiens, physical evolution is transformed to consciousness evolution of which the ultimate goals is the convergence to Omega (God/ Eternity)



The problem of Deliverance

- The good messages are hardly delivered properly and convincingly
- The message cannot be appreciated by public

1. Inappropriate Media
2. Fail to contextualize to present condition
3. Discontinuous
4. Resistency



Borobudur Temple and Nation Character Building

HY. Agus Murdiyastomo, M.Hum

Yogyakarta State University

A. Borobudur, a cultural heritage

According to Casparis (1950), Borobudur is a place for worshiping. This view is stated based on the inscription of *Karangtengah* and *Tri Tepusan*. Casparis predict that the founder of the temple is the Mataram King from dynasty of Syailendra named Samaratungga who built the temple in 824 AD. The building could be completed at the time of her daughter, Queen Pramodawardhani. It was estimated that the building process took a half century. Karangtengah inscriptions also mentioned about the bestowal of *sima* land (tax-free land) by Çrī Kahulunan (Pramudawardhani) to preserve *Kamulan* called Bhūmisambhāra. The term Kamulan itself derives from the word *mula* which means place of origins, sacred building to honor the ancestors, probably the ancestors of the dynasty Sailendra. Casparis predicts that *Bhūmi Sambhāra Bhudhārain* Sanskrit language means "a set of often levels of goodness of bodhisattva". This is the original name of Borobudur.

In this area, there are other Buddhist temples besides Borobudur which were found at the beginning of the 20th century. Also, it's found a Pawon temple which stretches in a straight line. Formerly, it was thought to be coincidence but the local fairy tale reveals that there was a paved road lined on both sides with balustrade that connects the three temples. It was not found any physical evidence of roads with stones and fence. This is probably just a myth but experts predict that there was a symbol of the unity of those three temples. The three temples (Borobudur-Pawon-Mendut) have similar architectural style and design. Also, they derive from the same period that reinforces the notion of a connection between the three temple rituals. There must be holy linkages but how the rituals are performed is not certain.

Borobudur has been restored several times such as in 1907-1911 and 1973-1983. In addition, Indonesian government has also paid attention to this building. Small-scale restoration was done since that moment, but it's not enough to provide complete protection. In the late 1960s, the government has made a request to the international community for a massive renovation to protect the monument. Indonesian government and UNESCO renovated the monument thoroughly in a large project between 1975 and 1982. Foundations of the building were reinforced and the entire 1,460 relief panels were cleaned. The restoration was done by dismantling the entire five square terraces and renovating drainage systems by embedding water channels into the monument. Filter and water-resistant layer was added. This colossal project involving 600 people to restore the monument cost a total of 6,901,243 U.S. dollars. After renovation, UNESCO put Borobudur into the World Heritage Site list in 1991 (<http://id.wikipedia.org/wiki/Borobudur>, accessed 7th November 2013)

B. Borobudur : A Tourism Object

After a massive renovation in 1973 which was supported by UNESCO, Borobudur became religious and pilgrimage center of Buddhism again. Once a year, Buddhists in Indonesia celebrate Vesak holy day, the day that commemorates the birth, death and enlightenment especially events that Siddhartha Gautama attained the highest wisdom of the Buddha Shakyamuni. Vesak ceremony was centered at three Buddhist temples by walking from Menduttowards Pawon and ending at Borobudur temple.

Instead of being the center of religious activity, Borobudur temple is the most visited tourist attraction, either by domestic or foreign tourists. In 1974, 260,000 travelers have visited the monument. 36,000 of them are foreign tourists. This number increased to 2.5 million visitors annually until the mid-1990s before the 1997 financial crisis. The development of an attraction is a positive impact on the economy of the surrounding communities. Local people earn a living from Borobudur by opening small businesses around Borobudur. However, a growing number of entrepreneurs often reduces the comfort of tourists. For example, souvenir hawkers who stalk travelers wherever they stepped in to offer his wares. Besides tourists who have been tired are still forced to walk down the aisle surrounding souvenir market. This condition annoys the visitors.

The increasing number of tourists is a positive thing but at the same time it creates a worry since more and more visitors means more burdens that must be held by Borobudur temple. Moreover, most of the domestic tourists have less awareness of the preservation of heritage buildings. They cannot bear not to touch the statue or relief available, although there are many warning signs not to touch anything, even vandalism action of scraping walls, reliefs, and statues are common. Destruction occurs when the peak of the Borobudur Temple was bombed in 1985 by an extreme Muslim group in which the doer had been caught and punished. To reduce the risk of damage, each visitor is assisted by a guide so that visitors are always in control.

C. Borobudur : Character values

The temple has philosophies embodied in the building level. While, the value of life can be learned from the story depicted through reliefs carved on the walls and balustrades. It was originated from the life of Siddhartha Gautama, but the value delivered is universal. Anyone can pick up and apply the appropriate life without disturbing religious faith they believe in.

1. Level of life

a. Kamadhatu

The foot of Borobudur temple represents Kamadhatu. The world is still dominated by "*kama*" or "low desire". This stage is covered by the arrangement of stone that allegedly made to strengthen the construction of the temple. The foot which is closed by additional structure consists of 160 panels of

Karmawibhangga story. Travelers can see a small part of *Karmawibhangga* panel in the southeast part of Borobudur Temple. The complete photo of *Karmawibhangga* can be seen in the Museum of *Karmawibhangga* at Borobudur temple complex.

b. Rupadhatu

The body of the temple is divided into four terraces which forms around aisle and is decorated 1,300 relief image, called Rupadhatu. Rupadhatu is the world that has been able to break the lust but it is still bound with manner and form. This level represents the nature between the subconscious and the universe. In this stage, there are some Buddha statues at the niches in the wall above the balustrade or breezeway. Originally, there were 432 Buddha statues in the niches along the outer side on the balustrade. On the balustrade, there is little difference in design that symbolizes the transition from the realm Kamadhatu towards the realm Rupadhatu; the lowest balustrade is crowned with jewel while four levels above the balustrade are crowned with small stupas. Part of the square terraces is rich with decoration and carved reliefs.

c. Arupadhatu

Unlike the hallways of Rupadhatu which is full of relief, the fifth to the seventh floor walls do not have relief. This level is called Arupadhatu (which means no tangible form). The floor map is circular. This level represents that people are free from all desires and bound forms and shapes but they have not reached nirvana. In the courtyard, there are 72 small stupas which are arranged in three rows that surround a large stupa as the main stupa. Buddha statues are placed inside perforated stupa as in captivity. The statues were still vaguely visible from outside. This clever design explain the concept of transition to a state of disembodied in which the Buddha statue exists but not visible.

The highest level that describes the lack of perfect form is symbolized in the form of largest and highest stupa. Stupa is described plain without the holes. The main stupa is blank which means highest wisdom. This consist ofreality, perfect silence and the absence of which the human soul is not bound desires, wishes, and shape and free from the cycle of *samsara* (Sumartono, 2009: 42).

2. Relief

a. Karmawibhangga

Karmawibhangga is carved on the walls of Borobudur temple but this relief is covered by the base of the temple structure. According to the symbolic meaning of the foot of the temple, the reliefs which decorate the walls of a hidden shelf illustrate the law of *karma*. *Karmawibhangga* is a script which describes the doctrine of *karma*, the cause and effect of good and evil. The relief is not only to

provide an overview of the human moral turpitude accompanied by penalties that will be obtained, but also human and reward of good deeds. Generally, the reliefs are the depiction of human life in the circle of birth - life - death (samsara) that never ends. According to Buddhism, this must be removed to perfection.

b. Lalitawistara

Lalitawistara is the story of the Buddha which is depicted through a relief along the corridor starting from the Buddha's descent from Tushita heaven and ends with the first sermon in the Deer Park near the city of Banaras. These reliefs line along the stairs on the south side, after a row exceeded the relief of 27 frames starting from the east side of the ladder. All of the 27 frames depict a busy situation both in heaven and in the world, as a preparation to welcome the presence of the Bodhisattvas as the latest incarnation of the Buddha. The reliefs depict the birth of the Buddha in the *arcapada* as a Prince of Siddhartha, the son of King Suddhodana and queen Maya of Kapilavastu affairs. The relief has 120 frames which ends with the first sermon and is symbolically expressed as a Screening Wheel of Dharma. The teachings of the Buddha is called dharma which also means "law", whereas dharma is represented as a wheel.

c. Jataka and Awadana

Jataka are stories about the Buddha before he was born as a Prince Siddhartha. The content is about good behaviors, such as self-sacrifice and helpful that distinguishes the Bodhisattvas with any other creature. Some Jataka stories present the story of a fable, the story involving animal characters that behave and think like humans. Indeed, the collection of service or good deeds is a preparation for the effort to reach perfect level.

Awadana is basically similar to Jataka. The actor is not the Bodhisattvas but other people and stories collected in the holy book of Diwyawadana which means noble action and the holy book of Awadana Awadanasataka or a hundred stories. At Borobudur temple, Awadana and Jataka are treated equally. This means that they are in the same row without being distinguished. The most well-known life of the Bodhisattvas is Jatakamala or a series of Jataka stories and Aryasura poet who lived in the 4th century AD

d. Gandawyuha

Gandawyuha is the story about Sudhana who wanders tirelessly in his effort to gain the highest knowledge of truth. This depiction is shown by a row of reliefs that decorate the walls of the hall 2. The 460 frames are based on Mahayana Buddhist scripture entitled Gandawyuha, and for the closing part is based on the story of another holy book, that is, Bhadracari. (<http://id.wikipedia.org/wiki/Borobudur>, accessed 7th November 2013)

D. Values Inheritance as Nation Character Building

Negative behavior performed by Indonesian people, either by students or public, as well as government officials exhibited on television has shown the occurrence of the moral depravity. For community groups who still adhere to moral values, it certainly raises deep concern. Moreover, the older generation thinks that the situation today is full of bad behavior. They miss situation in the past which is full of honesty and decency. The number of behaviors that show the moral depravity may possibly due to fault of the education system especially with the missing of character subjects in the curriculum. Formal educational institutions are only a high graduation rate oriented. It is possible that the high graduation rate on National Exam will be able to increase the prestige of the school. Thus, subjects which are not tested on National Exam are neglected including the lesson that contains a moral or character formation like a history lesson. With regard to this, education tends to be directed to achieve intellectual knowledge and ignore the spiritual, and social aspects.

Educational curriculum should include some lessons of good characters so that learners are equipped with understanding of how to act and behave. However, the competency-based curriculum does not include a lesson of good character. To overcome this, the School-Based Curriculum (nationally abbreviated as KTSP) is implemented. With this curriculum, schools gain the freedom to develop the material. However, does the material development include the elements of character building? In fact, learners' behavior still far from what is expected. They still do not perform good manner or in Javanese phrase often called "durung jawa". More over, the character values in this nation are declining nowadays. This can be seen from corruption that happens everywhere, fighting, intolerance action, anarchic, and even a murder case which is often showed in the media.

To face this reality, the education experts tries to find solutions by assuming that the character building should begin at an early age through formal and non-formal educational institutions, families and communities. In formal education, it is expected that the character educationis integrated in the lesson. The teaching and learning materials for Character education can be formulated into 18 characters such as religious, honesty, tolerance, discipline, care for the environment, social care, the curiosity, the spirit of nationalism, love of country, creative, hard working, independent, democratic, peace-loving, friendly, respect achievement, fond of reading, and responsibility (Center for Curriculum, National Education Department : 2010). If character education successfully integrate these items to the existing subjects, the students are expected to not only learn the theory of character (how to know)but also learn to behave with good character (how to do).

To produce learners who have good characters, the teacher's role becomes very important; therefore the teachers must be able to become a role model. A teacher

should be “digugu lan ditiru” (must be followed and imitated). They must be able to provide role models for students. Their behavior should reflect a figure that has good character both inside and outside of school. It certainly goes back to each individual. If the teachers want to follow the example given by Ki Hajar Dewantara that educates the cultural approach, the values will be embedded. (HY. Agus M, 2010).

Building the nation’s character is certainly not an easy task that can be accomplished in a short time. The result of what we do today can be seen many years later. The success of building a nation’s character is certainly not solely the responsibility of the school but also the families and communities. At school, learners acquire only a little theory and practice. The example that the students get is from outside of the school environment through the media, observation and direct experience which may give much bigger influence on the students. With regard to this, the development of the nation’s character cannot leave the role of public. Their participation is absolutely needed.

Borobudur as a monument contains the ancestral values such wisdom which is found in Karmawibhangga relief, Lalitawistara, Jataka and Awadana, and Gandawyuha. The Reliefs depicting about work ethic, good and bad deeds followed by punishment and reward is in line with the character that should be instilled on the Indonesian citizen. Unfortunately, the reliefs which contain the story with a good message is often illegible. Visitors usually only see and admire the beauty of the reliefs as a work of art and only a few people who are trying to understand what behind the beauty of the relief is. Therefore, the values depicted on Borobudur temple need to be socialized because that may become one of the nation’s means of building a character. With regard to this, the preservation of this monument is obligatory.

To develop Indonesian citizen who have character, the community is expected to have an insight about the broader culture. Borobudur should not only be seen as a religious building (Buddhism) but also as a cultural heritage which has universal positive values. Positive values of the relief that is depicted can be learned based on the teachings of religion that the students follow. Thus, a visit to Borobudur will not weaken the faith but rather to strengthen the faith to God Almighty.

Character education through formal education may utilize Borobudur Temple. By visiting the temple and giving an assignment to the students based on their level of education, the students will be able to examine and understand the messages conveyed through the existing relief. The Stories carved on the wall would be difficult to understand therefore the students need a guide who can explain the story and its meaning. In this case, the guide is supposed to master the material, like storyteller who tell a story or a puppeteer when performing. The tour guide that was accompanied by a teacher may also put emphasis on the moral messages so that learners can pick those messages, understand the values of life, and able to differentiate between the good and the bad

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Borobudur Temple As A Means In Educating The Community

Masanori Nagaoka, M.A

Operational Guideline of the WH Convention (2013)

Article 27

The States Parties to this Convention shall endeavor by all appropriate means, and in particular by educational and information programmes, to strengthen appreciation and respect by their peoples of the cultural and natural heritage defined in Articles 1 and 2 of the Convention.

Operational Guideline of the WH Convention (2013)

Article 5

To ensure that effective and active measures are taken for the protection, conservation and presentation of the cultural and natural heritage situated on its territory, each State Party to this Convention shall endeavor; (a) to adopt a general policy which aims to give the cultural and natural heritage a function in the life of the community and to integrate the protection of that heritage into comprehensive planning programmes;

World Heritage and Communities

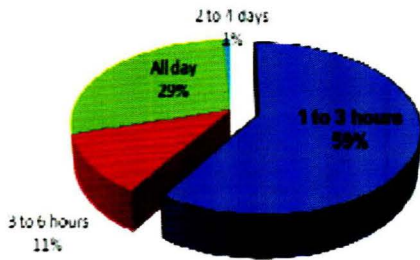
- to recognition of the role of communities to World Heritage
- for Community, adopted by the World Heritage Committee in 2007 at its 31st session in Christchurch, New Zealand:
 1. Heritage protection without community involvement is an 'invitation to fail'
 2. Coupling conservation and communities leads to best practice
 3. Conservation, capacity building, credibility and communication are all intrinsically linked to the idea of communitie
 4. Heritage protection, should, wherever possible, reconcile the needs of human communities

What is happening at the Borobudur WH Site?

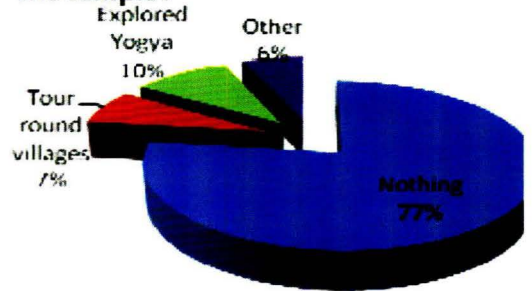
3 million tourists / year visit Borobudur

What is happening at the Borobudur WH Site?

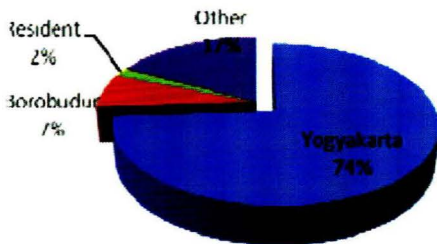
How long will you spend in the Borobudur area for your visit?



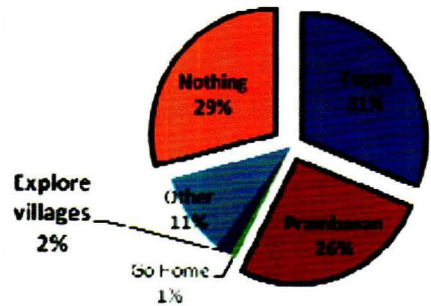
What did you do before you visited the temple?



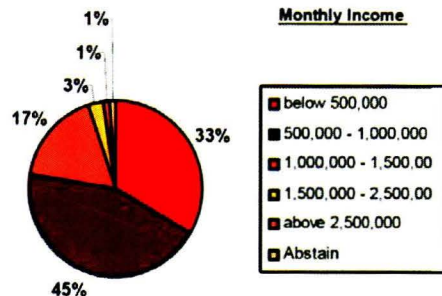
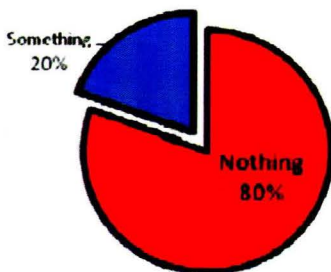
Where are you staying during your visit to Borobudur? Note: only 74% of respondents are staying in the region



What will you do after your visit to Borobudur?



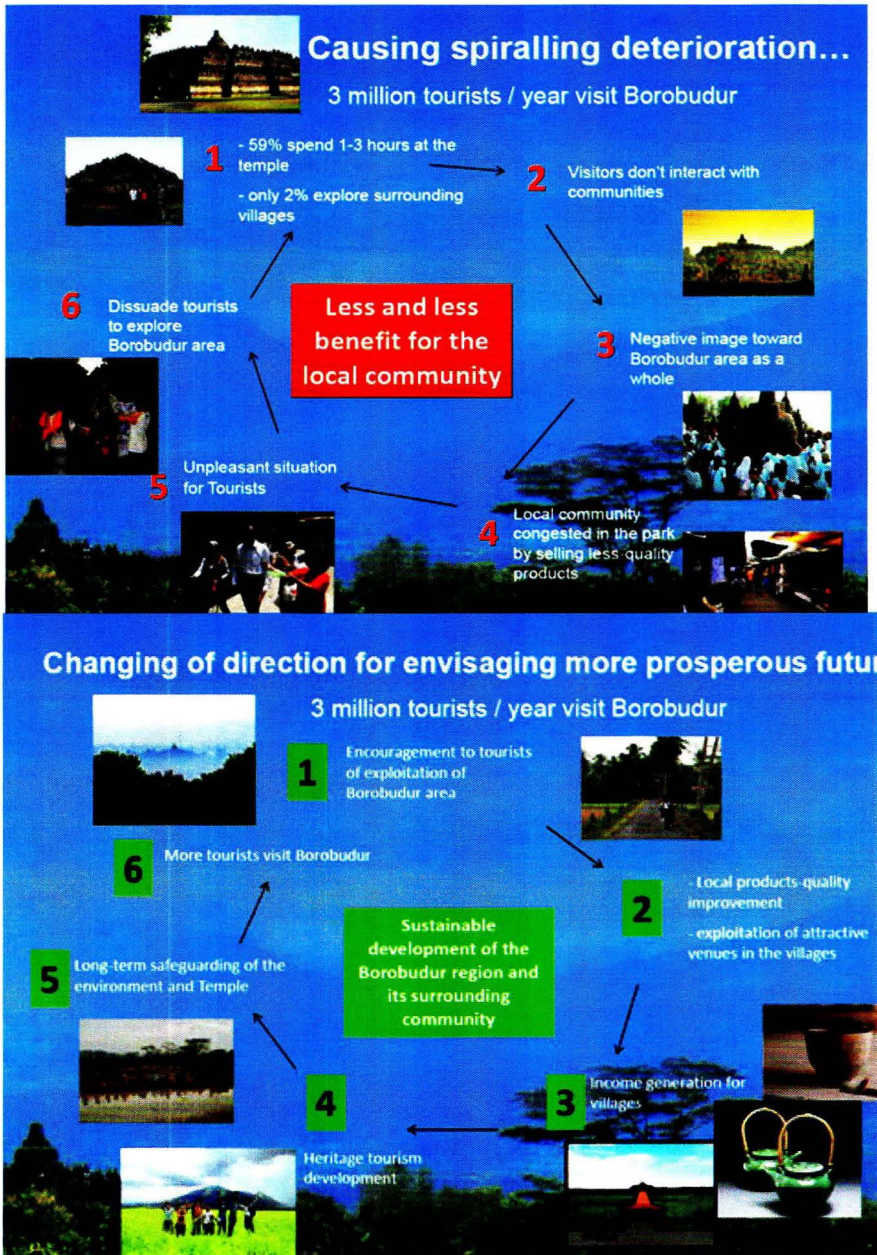
What do you know about the surrounding villages?



Visitors don't interact with communities or spend enough time in the Borobudur surrounding areas, thus allowing less benefited situation for the local communities.

Opportunities and challenges at the Borobudur Temple

- Lack of sustainable development in the area surrounding Borobudur.
- Tourists come to Borobudur from hubs like Yogyakarta without visiting the temple surrounds.
- Unrealized potential for the cultural and natural resources of the Borobudur area
- Borobudur Tourism Management Plan: Opportunities for cooperative solutions



Funded by:
Australian AID

Supported by:
Heritage, Culture, and Tourism

THE POWER of CULTURE

Bringing People Together at Borobudur

Project goal: to support the development of community livelihoods through the promotion of sustainable heritage tourism and the enhancement of creative industries

UNESCO PROJECT
Revitalization of Community Livelihoods Through Creative Industries and Heritage Tourism

OUR STRATEGIES

The people of Borobudur, the Indonesian authorities, and UNESCO will work closely together to implement the following strategies:

- Innovative Product Creation**
- Building Capacity**
- Market Expansion**

STRATEGI KAMI

Masyarakat Borobudur, Pemerintah Indonesia dan UNESCO bekerja sama mencapai kesuksesan misi ini melalui:

- Kreasi Produk yang Inovatif**
- Pengembangan Keahlian**
- Perluasan Pasar**



POTENTIAL
CREATIVE INDUSTRIES

- ❖ Borobudur has high potential for a vibrant ceramic based tourism industry to develop
- ❖ The rich volcanic soil around Borobudur is an important resource for the creation of unique and high quality ceramics
- ❖ The sustainable resource of the earth will be used to create innovative and unique ceramics.



STRENGTHENING CAPACITY
 A CERAMIC INDUSTRY

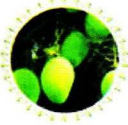
- ❖ From generation to generation communities around Borobudur have been well-known for their expertise and knowledge in ceramic craftsmanship.
- ❖ The UNESCO project will combine traditional knowledge with innovation in design and production techniques to create a new vibrant range of ceramic products
- ❖ Jenggala* will be a creative partner in the project helping to ensure that world class products are produced

* Jenggala is a ceramic based home industry located in Borobudur and well known for its unique design, high quality products and innovation.
www.jenggala.com



HARNESSING
 THE
NATURAL
 RESOURCES OF BOROBUDUR

- ❖ Borobudur's rich and fertile land supports a wide range of fresh and easily harvested fruits such as papaya
- ❖ The Borobudur area has high potential for the creation of new food based industries such as jam productions.
- ❖ The fresh and preservative free locally grown organic fruits can be used to create healthy and interesting products



DEVELOPING
 THE
JAM INDUSTRY

- ❖ UNESCO will organize training and production methods to community members in Borobudur
- ❖ The project will have support from KOU (Kilau Organik Pertama) CUISINE* as a creative partner and trainer
- ❖ The project will provide sustainable economic opportunities for local people, especially women.

HAND-MADE JAM & SNACKS
KOU™ CUISINE
EST. 2008

* KOU CUISINE is a jam producer from Liburd, Bali that produces high quality locally made products





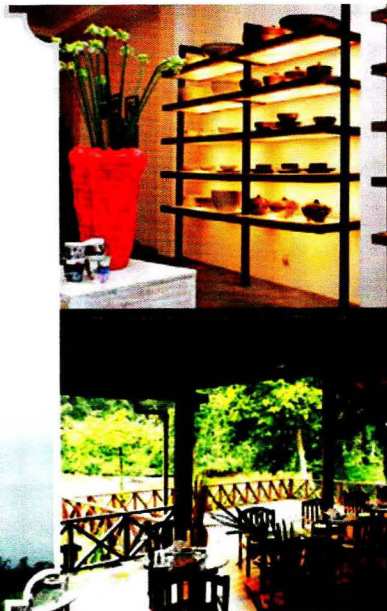
MARKET

EXPANSION

- ❖ The project will establish a gallery to market the locally made products and promote sustainable tourism
- ❖ The gallery will be located in Karanganyar Village about 1.8 km from the Borobudur Temple
- ❖ The gallery will be accessible by andong (local horse carriage) or by bicycle.

The GALLERY

- ❖ The Gallery will be constructed using recycled material and will be in the Javanese architectural traditional of the Borobudur region
- ❖ Visitors will be able to buy locally made products, snacks and drinks, while viewing the Borobudur temple
- ❖ The gallery will provide employment and training opportunities for local craftspeople and workers



The Future of Culture for Community Development

The potential for Culture for Development

Capitalizing on Culture for Development beyond 2015

World Culture in Development Forum in Bali, Indonesia in November 2013

Diskusi:

Pertanyaan 1. Retno Suratri (Kementerian Kehutanan)

- a. Bicara mengenai karakter bangsa, apa karakter bangsa Indonesia sebenarnya? Bagaimana sejarahnya? Dan bagaimana ke depannya? Karena saya tidak tahu karakter saya seperti apa?
- b. Dalam dunia keberagaman yang berkotak-kotak, Candi Borobudur adalah candi Buddha. Teman saya cerita pernah ke Candi Borobudur tapi temannya tidak mau naik candi alasannya karena bukan agamanya. Bagaimana kita mengambil nilai sebagai karakter bangsa dalam kontek keberagaman Indonesia yang berkotak-kotak tersebut?

Jawaban : Agus Murdyastomo

- a. Pusat Kurikulum Kemendikbud membuat 18 butir karakter dengan tujuan ingin membangun bangsa yang berkarakter, perilaku yang berkarakter positif. Maraknya aktivitas warga Indonesia yang destruktif, korupsi, akan menjadi sesuatu yang tidak berkarakter atau yang berkarakter negatif terlebih ketika semakin diekpos di media mengenai adegan-adegan kekerasan, pornoaksi, dan pornografi. Dari situlah maka pendidikan kita dikenal gagal dalam membina generasi yang berkarakter, selain itu karena kurikulum yang ada sekarang menghapus pelajaran Budi Pekerti. Muncul kurikulum baru yang menghilangkan pelajaran tersebut dan hasilnya negatif, sekarang solusi tersebut adalah dimunculkannya Pendidikan Karakter. Dalam pendidikan sekarang para pendidik hanya mengajarkan how to know tidak mengajarkan how to do.
- b. Diadakan pelatihan kepada para guru. Candi Borobudur menjadi sebuah laboratorium bagi saya, bagi mahasiswa saya. Sebagai mahasiswa fakultas Ilmu Sosial, di Candi Borobudur tidak hanya mengagumi tapi juga mencoba memahami kisah-kisah positif yang ada di Candi Borobudur. Misalnya pada relief Gandawyuha yang mencerminkan kerja keras, merupakan salah satu dari 18 butir karakter bangsa. Candi Borobudur sebagai obyek yang strategis dan 50% pengunjungnya adalah generasi muda. Candi Borobudur menyimpan nilai yang sifatnya universal.

Pertanyaan 2. Inajati Adrisijanti (Universitas Gadjah Mada)

- a. I think between your paper and the two papers, there is a link that Borobudur is a mean for education and also for tourism. I think that your effort about diversification for tourism, how the tourists could go to the villages. It is still very huge work for us, promote village tours. I think it can be done by cooperating with school, because the majority of domestic tourists who came to Borobudur are school children. It is truly a hard work but I appreciate the effort.
- b. How to convince people to go to other interesting places in Borobudur. It's not only for school an also for to travel agents to make a tour around Borobudur.



Jawaban : Masanori Nagaoka

- a. Definitely, the people come from Jogja because of the international dan domestic airport in Jogja. We find that more than 80% will be domestic people from Indonesia and less than 20% people from international, such as Australia, Japan, Korea, China, and Russia. That is because of infrastructure reason.
- b. How to combine tourist to explore outside Borobudur Archaeological Park. It's not really how to combine or to interact with people to pursuit them to the archaeological park. There is no good service, good place or good product that could be attract tourists to come back here, so we think to contribute outside the park. We just give a little bit of help and idea about what to do. And it requires discussion what could be the right thing to do.

Pertanyaan 3. Adrian Perkasa (Badan Pelestarian Pusaka Indonesia)

- a. Tentang pendidikan karakter, ketika di slide terakhir oleh Dr. Daud Aris Tanudirjo tentang bagaimana pesan yang baik ternyata susah disampaikan secara tepat dan meyakinkan kepada peserta didik di Indonesia. Apakah bisa dijelaskan lebih lanjut? Dan bagaimana cara Agus Murdiyastomo untuk menyampaikan hal tersebut kepada peserta didik? Bagaimana interpretasi nilai Candi Borobudur terhadap Pancasila? Kawan kita, apalagi di luar Jawa mereka susah menerima nilai universal Candi Borobudur untuk pendidikan. Apakah lebih baik ada dialog misalnya di Kinei. Anak-anak dari berbagai macam komunitas, India, Cina, mereka menginterpretasikan diri mereka sendiri bisa dengan roleplay, teater, pentas kesenian yang atraktif.
- b. Apakah ada perbandingan antara Indonesia dengan World Heritage di negara-negara Asia Selatan mengenai metode edukasi?



Jawaban : Daud Aris Tanudirjo

Memang benar untuk menambahkan mengenai karakter bangsa, kenapa saya merujuk ke Pancasila karena karakter bangsa Indonesia tidak ada rumusan yang jelas. Pancasila secara formal sudah ada di TAP MPR. Memang tidak mudah, seperti yang saya katakan, setelah interpretasi masing-masing yang berbeda, ada proses penyesuaian. Kita bersikap subyektif karena mengambil yang baik untuk membentuk karakter bangsa. Ada tahap pencocokan. Faktor resistensi juga berpotensi orang bisa menafsirkan hal yang lain. Mengarah ke media atau cara yang tidak tepat. Misalnya sering kali menunjukkan relief Karmawibhanga dengan teks kecil, hanya teks, dan tidak dicantumkan nilainya. Untuk generasi muda berbeda, untuk anak-anak juga berbeda. Harus dicari polanya. Persoalan dalam penyampaian, persoalan bersama.

Jawaban : Agus Murdiyastomo

Membangun karakter bangsa memerlukan proses bahkan bertahun-tahun. Hal yang lain, disampaikan persoalan-persoalan mengenai media. Misalnya di sekolah, guru-guru memasukkan 18 poin karakter ke semua mata pelajaran. Guru yang pertama harus

memiliki karakter, dengan perilakunya dapat menjadi contoh keseharian di dalam maupun di luar sekolah. Kemampuan berperilaku baik sangat tergantung pada masing-masing. Tinggal mencocokkan di relief Karamawibhanga dan relief lain. Media seperti apa untuk menyampaikan? Keteladanan yang penting, ketika seseorang menjadi anutan, maka bisa diteladani. Guru digugu dan ditiru, memang benar. Media yang paling sederhana. Di masyarakat pun, di keluarga sebagai ayah dan ibu dapat diteladani oleh anaknya. Jangan selingkuh di depan anaknya misalnya. Ini yg perlu kita contoh. Ajaran Budha untuk memotong karma supaya bangsa di masa depan mampu berperilaku baik, mampu bekerja keras dan berperilaku baik.

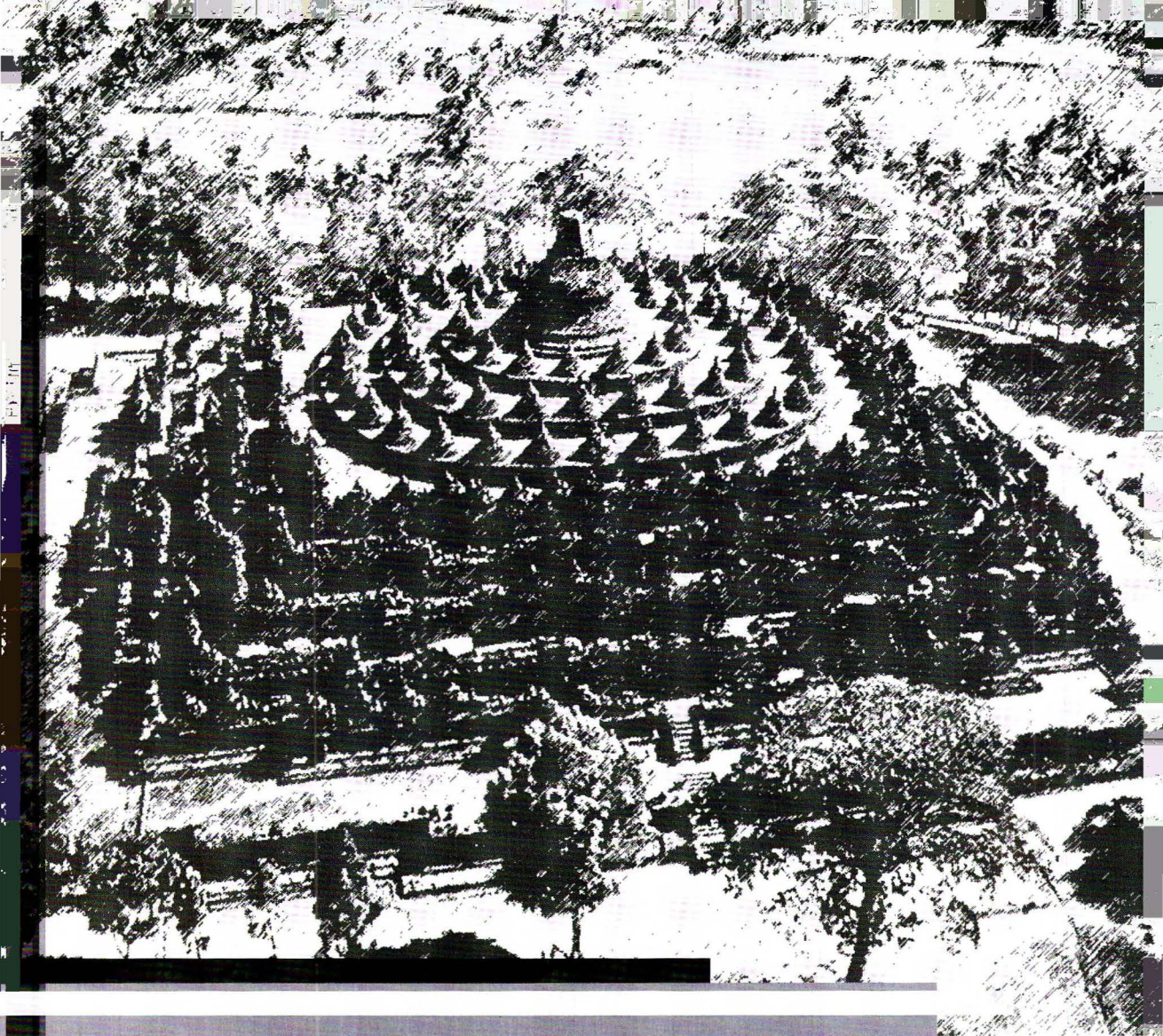
Media yang baik, misalnya di TV ada acara Upin Ipin dari Malaysia. Ada juga Kresna dari India. Kenapa kita tidak bisa membuatnya? Animator kita sangat canggih. Kartun-kartun di luar negeri dikerjakan oleh orang Indonesia tapi di Indonesia malah tidak muncul. Apa yang salah? Ada pesan moral, sangat baik dan sangat membantu untuk membentuk karakter bangsa. Dari karakter di Candi Borobudur, medianya apa? Misal pameran jangan hanya menjelaskan tentang fisiknya tapi juga nilai dideskripsikan. Bangsa kita tidak punya kebiasaan membaca, hanya melihat dan mendengarkan. Akan lebih baik jika ada visualnya.

Jawaban : Masanori Nagaoka

Program edukasi tidak hanya di Asia tapi juga di seluruh dunia. Bisa saya ceritakan mengenai program UNESCO yaitu:

- Young people untuk menjadi volunteer, national official dan international experts
- Promoting educational kit, selain teks juga terdapat CD dan film yang bisa diunduh di website UNESCO

Kami juga mempunyai ahli internasional dari Kamboja, Thailand dan bisa kami share nanti saat coffe break. Biasanya dengan para pemuda belajar tentang konservasi and arkeologi. Mungkin bisa dijelaskan lebih lanjut oleh para experts.



Borobudur Temple and Area Preservation

Penataan Ruang Cagar Budaya dalam Pengelolaan KSN Candi Borobudur

Ir. Firman Hotorangan Napitupulu, MURP

Latar Belakang

Dalam *reactive monitoring* UNESCO pada tahun 2007 khususnya tentang tata ruang, terdapat pertanyaan yang intinya bagaimana mengelola zona 1, zona 2, zona 3, zona 4 dan zona 5 berdasarkan zona JICA dan bagaimana mengelola kawasan Borobudur dimana terdapat ketidakjelasan pengelolaan antar pusat-daerah di ruang yang sama dengan kewenangan yang berbeda.

Pada pengajuan Candi Borobudur sebagai Warisan Dunia (*World Heritage*), Pemerintah Indonesia melampirkan zonasi JICA 1979 dalam pengaturan tata ruang Borobudur, tetapi setelah warisan dunia Borobudur ditetapkan pada tahun 1991, Pemerintah Indonesia mengeluarkan Keputusan Presiden Nomor 1 tahun 1992 tentang Taman Wisata yang salah satu isinya adalah tentang pembagian kewenangan pada instansi yang berbeda pada zona 1, zona 2 dan zona 3 Borobudur. Sehingga Keppres ini tidak relevan dengan *World Heritage Borobudur Compounds*.

Pertanyaan UNESCO dijawab dengan Tata Ruang Kawasan Strategis Nasional (KSN) Borobudur yang dibentuk berdasarkan amanat Undang-undang Nomor 26 tahun 2007 tentang Penataan Ruang. Salah satu isi dari Rancangan Peraturan Presiden tentang Kawasan Startegis Nasional Borobudur yang telah dibuat adalah tentang pembentukan Badan Pengelolaan Kawasan Borobudur, yang mana pengelolaannya dalam satu kesatuan.

Konsep Perijinan

Dalam KSN Borobudur akan dibuat arahan peraturan KSN, kemudian ditindaklanjuti Pemerintah Kabupaten Magelang dengan membuat Peraturan Zonasi. Arahan peraturan KSN dan Peraturan Zonasi Pemerintah kabupaten ini akan menjadi dasar dalam Perizinan Pemanfaatan Ruang/Pendirian Bangunan yang akan dikeluarkan oleh Bupati Magelang setelah mendapat masukan dari Tim Penasehat Pelestarian Kawasan.

Pengaturan Ruang Zona Inti

1. Aturan kegiatan dan penggunaan lahan

Tidak diijinkan untuk pemanfaatan apapun di dalam situs Candi Borobudur, Pawon dan Mendut, kecuali untuk kegiatan konservasi candi.

Pemanfaatan diijinkan untuk kegiatan *Tourist Information Centre*, pembibitan, penjualan tanaman/bunga, prasarana transportasi jalan lokal, jalur pedestrian, ruang terbuka yang berupa jalur hijau dan pulau jalan, pekarangan, sempadan/penyangga.

Pemanfaatan memerlukan ijin bersyarat dan terbatas untuk kegiatan dan pembangunan taman hiburan/plaza, museum, atraksi wisata dan sejenisnya, kios cinderamata, pos kesehatan, kantor balai/dinas, lapangan parkir umum.

2. Ketentuan pembangunan fisik

KDB 0%, KLB 0, KDH 0%, GSB 0, GSS 0, Tinggi bangunan 0 meter.

Ketentuan pembangunan fisik diharuskan Mengikuti kaidah pelestarian fisik yang termuat dalam arahan teknis zonasi.

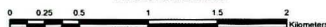
**LAMPIRAN II
PERATURAN PRESIDEN REPUBLIK INDONESIA
NOMOR
TANGGAL**

PETA RENCANA POLA RUANG KAWASAN BOROBUDUR DAN SEKITARNYA

PETA RENCANA POLA RUANG KAWASAN BOROBUDUR DAN SEKITARNYA

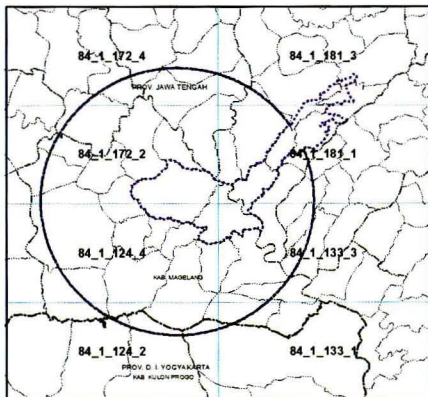
KETERANGAN

SKALA 1 : 25.000



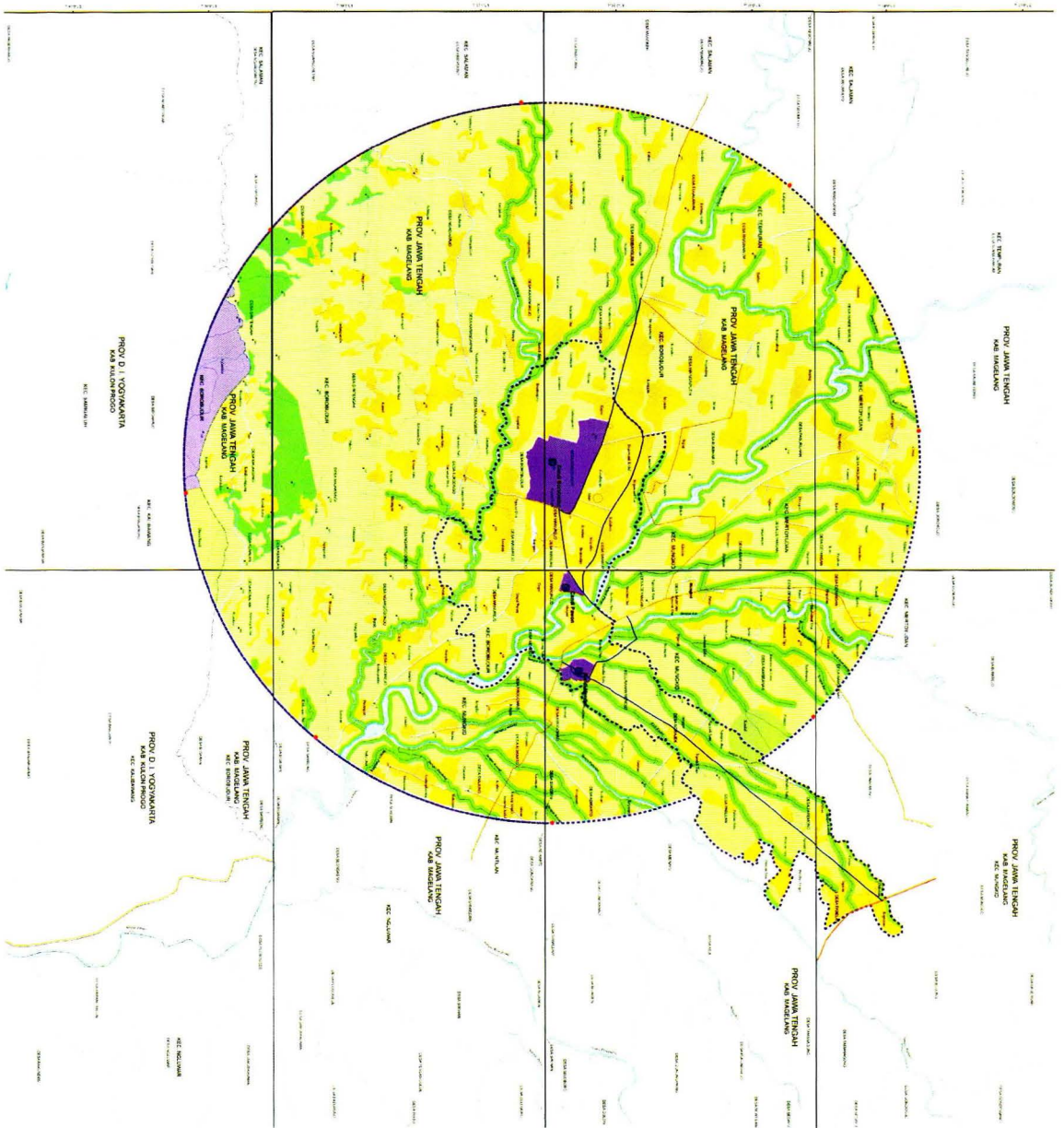
<p>Ibukota Pemerintahan</p> <ul style="list-style-type: none"> ⊙ Kantor Kabupaten ○ Kantor Kecamatan <p>Sistem Perkotaan</p> <ul style="list-style-type: none"> ⊙ PKL <p>Situs Purbakala</p> <ul style="list-style-type: none"> ● Candi <p>Batas Administrasi</p> <ul style="list-style-type: none"> --- Batas Provinsi --- Batas Kabupaten --- Batas Kecamatan --- Batas Desa 	<p>Jaringan Prasarana Transportasi</p> <ul style="list-style-type: none"> — Jalan Arteri Primer — Jalan Strategis Nasional — Jalan Kolektor Primer 2 — Jalan Lokal Primer <p>Unsur Lainnya</p> <ul style="list-style-type: none"> ~ Sungai ~ Sungai Musiman --- Sub Kawasan Pelestarian 1 (SP 1) --- Sub Kawasan Pelestarian 2 (SP 2) • Titik Tinggi • Titik Batas Koordinat Terluar KSN Borobudur 	<p>Rencana Pola Ruang</p> <ul style="list-style-type: none"> ■ Kawasan Situs Candi Termasuk Taman Candi ■ Kawasan Taman Wisata Alam ■ Kawasan Resapan Air ■ Kawasan Sempadan Sungai ■ Kawasan Sekitar Mata Air ■ Kawasan Hutan Rakyat ■ Kawasan Peruntukan Pertanian Termasuk Sawah Bekas Danau Purba ■ Kawasan Peruntukan Permukiman
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INDEKS PETA



SUMBER PETA :

1. Peta Rupa Bumi Skala 1 : 25.000 Tahun 1995, Badan Koordinasi Survey dan Pemetaan Nasional
2. Peta Rencana Pola Ruang, Rencana Tata Ruang Wilayah Kabupaten Magelang, BAPPEDA Kabupaten Magelang, Tahun 2011-2031
3. Peta Rencana Pola Ruang, Rencana Tata Ruang Wilayah Kabupaten Kulon Progo, BAPPEDA Kabupaten Kulon Progo, Tahun 2011-2031
4. Batas administrasi merupakan batas indikatif



Borobudur National Strategic Area Conservation: Heritage Saujana Management

Dr. Ir. Laretna T. Adhisakti, M.Arch

Pada awalnya hubungan antara Borobudur dan masyarakat tidak ada. Pada tahun 1955 masyarakat Internasional membantu Borobudur melalui UNESCO. Dalam konsep JICA tahun 1979, Taman Purbakala Borobudur memiliki 3 fungsi yaitu untuk preservasi candi, sebagai pusat penelitian arkeologi di Indonesia dan untuk diwariskan pada generasi muda pada masa yang akan datang. Pada tahun 1991, Borobudur temple compounds ditetapkan sebagai warisan dunia. Setelah itu ada pemikiran untuk pelibatan masyarakat, Tahun 2003 ada inisiatif dari masyarakat lokal. Dalam zonasi Borobudur telah ada pembagian kewenangan, dimana zona 3, 4 dan 5 merupakan kewenangan dari Pemerintah Daerah Magelang. Di zona inilah terdapat pusaka rakyat.

Ada 3 sudut pandang tentang candi Borobudur, yang pertama Borobudur sebagai Saujana Budaya (*cultural landscape*), kedua Borobudur untuk kepentingan pariwisata dan ketiga peran masyarakat lokal. Terkait dengan tersebut, Pusaka Indonesia terdiri dari Natural heritage, culture heritage dan Saujana Budaya (*cultural landscape*), Saujana Budaya (*cultural landscape*) adalah hubungan berbagai hal antara pusaka dan lingkungan alam, ekspresi masyarakat dalam mengelola lingkungan mereka. Saujana Budaya diartikan sebagai sejauh mata memandang.

1. Kawasan Strategis Nasional (KSN) Borobudur

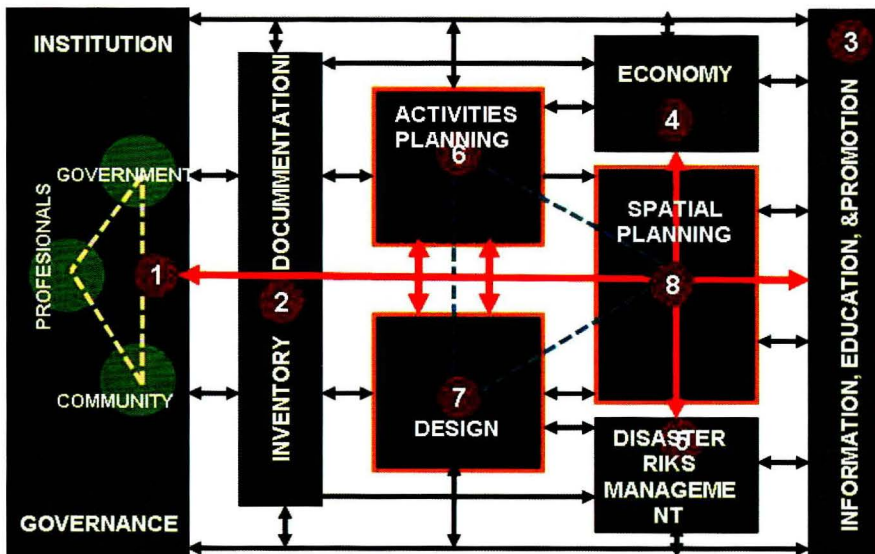
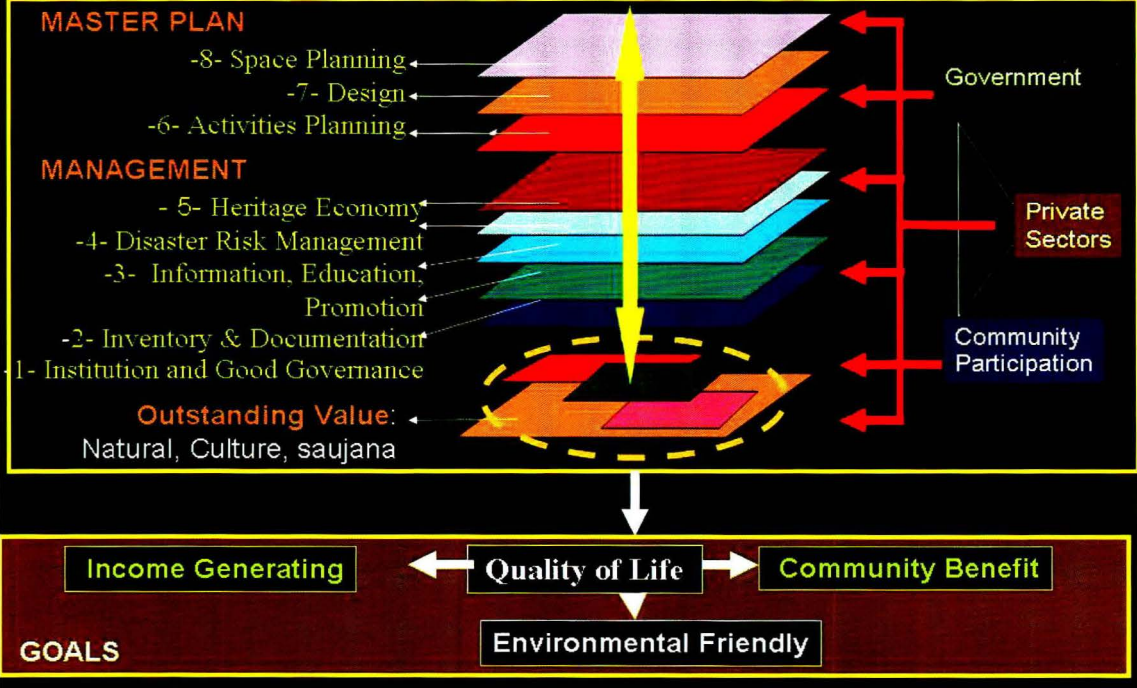
Berdasarkan Peraturan Pemerintah Nomor 26 Tahun 2008 tentang Tata Ruang Nasional yang merupakan implementasi dari Undang-Undang Nomor 26 Tahun 2007 tentang Penataan Ruang yang menjadi dasar Kawasan Warisan Dunia Borobudur menjadi Kawasan Strategis Nasional (KSN). Delineasi KSN Borobudur bertujuan untuk melindungi pemanfaatan ruang Warisan Dunia Borobudur, Mendut dan Pawon, membentuk zona pelindung (*buffer zone*) dan untuk mendukung pelestarian yang berciri pedesaan yang berbasis lahan pertanian dan bekas danau purba, Kawasan Strategis Nasional Borobudur menjadi dasar untuk membuat draft Peraturan Presiden tentang Pengelolaan Candi Borobudur

2. Manajemen Suajana budaya Borobudur

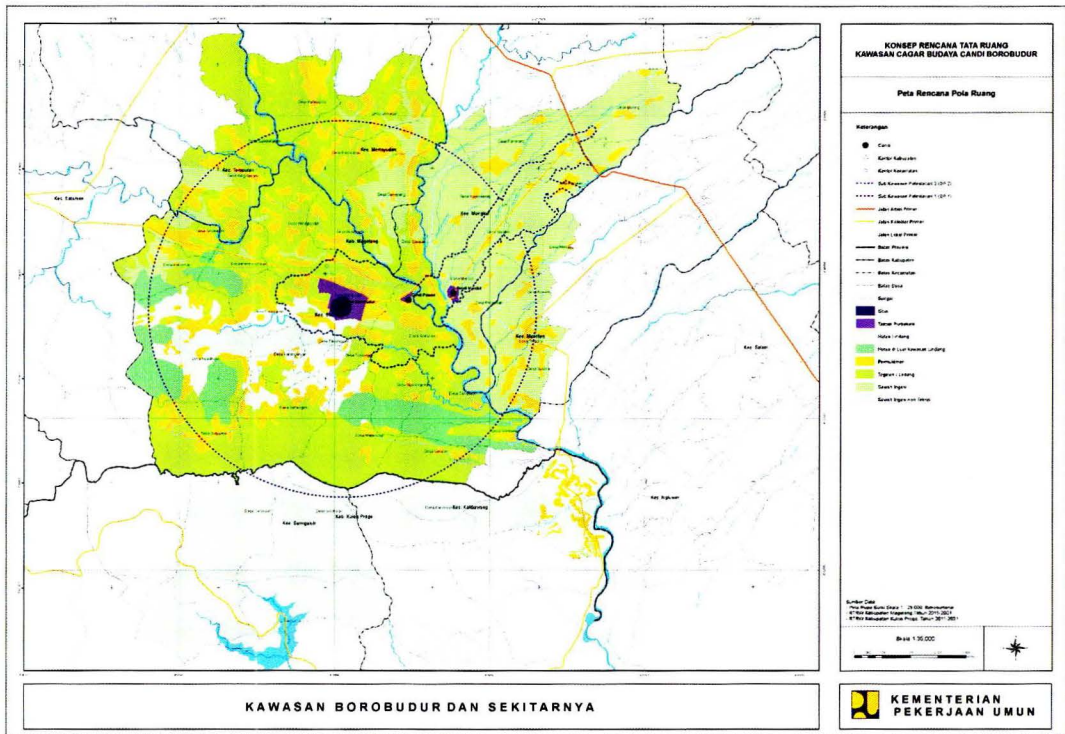
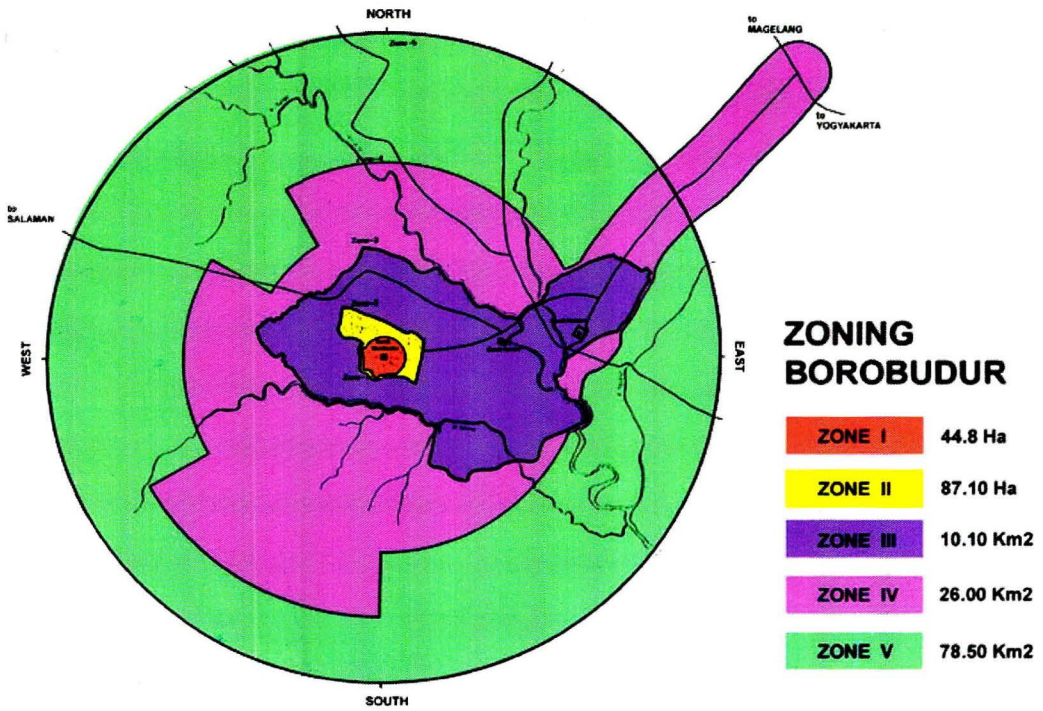
Beberapa hal yang perlu dilakukan adalah

- a. Lembaga dan Pemerintahan yang baik
- b. Inventaris dan Dokumentasi:
 - Update data dan informasi heritage (pusaka)
- c. Informasi, pendidikan dan promosi
- d. Ekonomi pusaka
- e. Manajemen bencana
- f. Perencanaan aktivitas
- g. Design (rancangan)
- h. Perencanaan ruang

INSTRUMENTS FOR FORMULATING THE MANAGEMENT PLAN OF HERITAGE SUAJANA (Adopted from Program of Heritage City Conservation in Indonesia, 2012)



Instrument for formulating Heritage Cities Management Plan that balance all aspects of the saujana including people, ecology, heritage and economy



Diskusi:

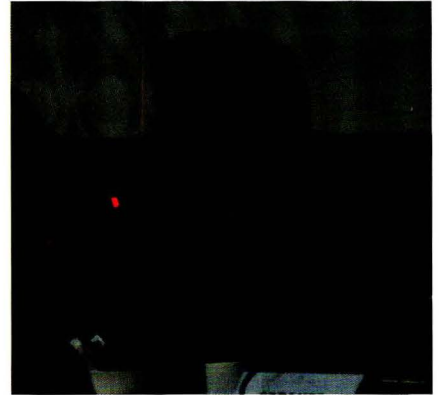
Pertanyaan 1. Daud Aris Tanudirja (Universitas Gadjah Mada)

Bagaimana mengelola Kawasan Borobudur di masa mendatang?

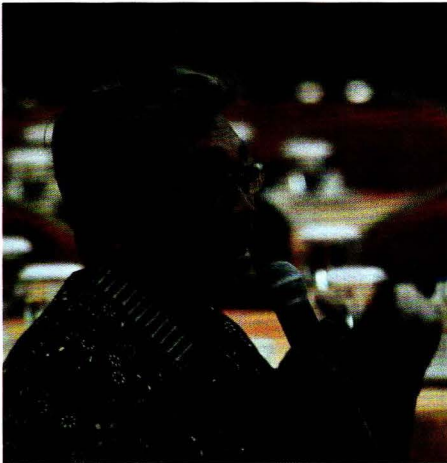
Jawaban : Firman Hotorangan Napitupulu

Untuk mengelola ke depan dilakukan dengan konsep Kawasan Strategis Nasional (KSN), yang bertujuan untuk mengatur regulasi yang ada di kawasan. Ada begitu banyak warisan dunia di Indonesia tetapi tidak ada satu pun lembaga yang mengelola kawasan warisan dunia secara khusus. Di KSN Borobudur, terdiri dari berbagai stakeholder dan pemerintah daerah terkait yang berkepenting untuk mengelola KSN. Untuk itu dalam pengelolaan

warisan dunia diperlukan lembaga khusus yang kemudian nanti untuk operasionalnya bisa didesentralisasi ke pemerintah daerah dan bekerjasama dengan masyarakat. Pemerintah pusat memfasilitasi infrastruktur untuk air bersih, jalan, sampah dan lain-lain serta pembangunan yang sesuai dengan pelestarian kawasan. Tanggung jawab ada di kementerian teknis. Pengelolaan kawasan menyangkut banyak kementerian terkait.



Pertanyaan 2. Sutikno (Universitas Gadjah Mada)



Bagaimana dengan pengelolaan Borobudur dan kawasan lain untuk kepentingan pendidikan

Jawaban : Laretna T. Adhisakti

Saya ada projek tentang kota heritage di Indoensia. Dalam proposal saya, akan dibuatkan heritage galeri, dengan segala informasi, dengan informasi kondisi dahulu dan akan datang. Akan dibuatkan program untuk mendukung itu, akan dilakukan tahap demi tahap, untuk menggabungkan semua informasi.

Yunus Arbi (Direktorat Internalisasi Nilai dan Diplomasi Budaya, Kemendikbud)

Seharusnya yang membahas ada dari pemerintah daerah, karena apa yang disampaikan menjadi sumber kekuatan daerah dalam membangun kawasan Borobudur. Dalam konteks warisan dunia, bagaimana di luar zona yang telah ditetapkan terjaga. Zona tersebut menjadi oteritas



daerah, jadi pemerintah harus jadi inisiator. Peran masyarakat sangat menentukan, pemerintah daerah harus mendorong hal itu

Jawaban : Laretna T. Adhisakti

Saya pikir tidak hanya pemerintah daerah tetapi semua stakeholder, semua sektor harus berpikir sama, kenapa kita selama ini sulit berkoordinasi dengan lain, hanya untuk ilmu dia sendiri. Padahal kita harus mengelola bersama. Semua sektor harus terlibat termasuk pengembangan masyarakat. Kita harus menginventaris dan mendokumentasi semua potensi yang ada.

Jawaban : Firman Hotorangan Napitupulu

Bupati Magelang harus diberi penghargaan, karena pemerintah daerah Magelang sudah menjaga ruang. Secara kualitas ruang, Borobudur masih memenuhi standar minimal yang terjaga dalam hal tertentu. Jadi artinya, pemerintah daerah sudah melakukan itu, tetapi belum ada aturan yang dapat memperkuat mereka untuk ikut terlibat memanfaatkan untuk kepentingan pemerintah daerah dan masyarakat. Salah satunya adalah pengaturan ruang itu sendiri. Dalam konsep tata ruang Kawasan Strategis Nasional (KSN) Borobudur, mengatur bagaimana pihak-pihak yang terkait dengan kawasan bisa bersinergi. Selebihnya harus ada lembaga yang mencoba menjadi semacam wasit. Di dalamnya ada program-program yang melibatkan banyak pihak, diperlukan program jangka panjang bahkan masyarakat dilibatkan. Siapa yang melaksanakan itu menjadi hal yang penting. Pemerintah daerah harus diberi apresiasi dan sering dilibatkan.

RECOMMENDATIONS

6th INTERNATIONAL EXPERTS MEETING ON BOROBUDUR 2013

I. Background

Borobudur Temple, Mendut Temple and Pawon Temple or often called as Borobudur Temple Compounds is a World Heritage Site number C 592 year 1991. Borobudur Temple has undergone two restorations. First restoration was conducted by Dutch East Indies government led by Th. van Erp (1907-1911) and second restoration was conducted by the government of Indonesia, assisted by UNESCO (1973-1983).

First restoration (1907 – 1911) has reconstructed level 8, 9, and 10 (terrace 1, 2, 3) with its 72 stupas and a main stupa. Meanwhile, the second restoration (1973 – 1983) has reconstructed level 3, 4, 5, 6, and 7 (floor 1, 2, 3, 4, and 5) with reinforced concrete, and repair in walls, and balustrades. Many disciplines approaches, such as archaeology, biology, chemistry, geology, geography, geomorphology, architecture, and civil engineering have created conservation method and technique to be applied to the temple's structure. Those are proved to control the damage and deterioration of Borobudur Temple until nowadays.

It is noted that the existence of Borobudur Temple is impacted by both external and internal factors. Borobudur is an open building type that makes it exposed to the environment. The problems are salt deposit in the relief wall and deterioration and damage in the stones, from physical, organic, and structural factors. In addition, development pressure in Borobudur area needs to be aware of. It is because the state of conservation of its surrounding area. Nevertheless, the potential threat of the temple's state of conservation must be addressed.

In the international experts meeting, many factors that are threatening Borobudur Temple is deeply discussed. It will produce applicable technique and method to be applied to control the damages in Borobudur Temple. In getting maximum result, experienced international scholars, technicians, and conservation experts are invited. Besides, national and scholars who has actively involved in the preservation of Borobudur Temple are also invited.

II. Considering :

A. Remarks from :

1. Director UNESCO Office Jakarta, represented by Mr. Masanori Nagaoka
2. Director General for Culture, Ministry of Education and Culture, Prof. Kacung Marijan, Ph.D.

B. Presentations from speakers :

1. Dr. Harry Widiyanto
2. Prof. Dr. Hans Leisen
3. Prof. Dr. Hariani Santiko
4. Prof. Dr. Timbul Haryono, M.Sc
5. Prof. Dr. Endang Tri Wahyuni, M.S
6. Prof. Dr. Sutikno
7. Prof. Dr. MudjiSutrisno
8. Dr. Toshiya Matsui
9. Dr. Ichita Shimoda
10. Dr. Daud ArisT anudirjo, M.A
11. Ir. Djoko Luknanto, M.Sc, Ph.D
12. Dr. Ir. Laretna T. Adhisakti, M.Arch.
13. Ir. Helmy Murwanto, M.Si
14. Ir. Firman Hotorangan Napitupulu, MURP
15. Agus Musdyastomo, M.Hum.
16. Iskandar M. Siregar, S.Si and Nahar Cahyandaru, S.Si

C. Discussions in the meeting

Problems identified are, as follow:

1. The capacity of human resources in managing Borobudur Temple is still limited;
2. Monitoring system for stability of Borobudur Temple and evaluation for geological condition in surrounding area are not optimal yet;
3. Visitors' appreciation for the preservation of Borobudur Temple is low;
4. There are many problems found in the management of Borobudur Temple.

Based on the problems and discussions, several follow up actions could be formulated as follow:

1. Human Resources Capacity

- a. The need to enrich and to build the human resource in Borobudur Temple by including involving staffs of Borobudur Conservation Office in cultural heritage management training both in Indonesia and abroad;

- b. The need to enhance the cooperation for capacity building with relevant institutions both in Indonesia and abroad, including developing conservation technique and method with universities and research centers.
2. Monitoring and Evaluation System and Conservation Development
 - a. The need to enhance the quality of monitoring and evaluation system for the state of conservation of Borobudur Temple and its surrounding area, routinely and continuously, that includes water seepage, structural stability of the temple and the supporting hill, development of the material deterioration phenomena, geological and geomorphology disaster;
 - b. The need to set up monitoring and evaluation system and its implementation for Borobudur National Strategic Area;
 - c. The need to develop and intensify the studies on conservation method and technique on material of Borobudur Temple.
 3. Visitors' Appreciation
 - a. The need to intensify the management capacity for innovation in promoting research study on values of Borobudur Temple and its surrounding area to actively raise visitors' appreciation;
 - b. The need to intensify the socializations for Indonesian Law Number 11 of 2010 concerning Cultural Property to the stakeholders of Borobudur Temple;
 - c. The need to train and develop the community to produce types, variations and qualified products, sold in Borobudur Temple, along with its packaging, space arrangement, and selling behavior.
 4. Management of Borobudur Temple
 - a. The need to urgently designate Borobudur Area as National Strategic Area and to be followed up and adapted for Cultural Property Area;
 - b. The need to urgently designate Borobudur World Heritage Management Board, which is in the form of integrated management system that involves various stakeholders;
 - c. Borobudur World Heritage Management Board should develop networking with other cultural heritage management board in Indonesia and abroad.

The recommendations of 6th International Experts Meeting on Borobudur will be followed up by year-to-year action plans by the managements of Borobudur Temple. The progress then will be presented on 7th International Experts Meeting on Borobudur, which will be held on 2018.

Magelang, 13 November 2013

Formulation Team:

1. Prof. Dr. Inajati Adrisijanti (Coordinator)
2. Dr. Laretna T. Adhisakti (Member)
3. Ir. Suprpto Siswosukarto, Ph. D (Member)
4. Helmi Murwanto, M.Si (Member)
5. Dwi Lestari, S.T, M.T (Member)
6. Drs. Marsis Sutopo, M. Si (Member)
7. Drs. Tri Hartono, M.Hum (Member)
8. Drs. Dukut Santoso (Member)
9. Drs. Hr. Sadirin (Member)
10. Ismijono (Member)
11. Iskandar M. Siregar, S.Si (Member)
12. Nahar Cahyandaru, S.Si (Member)
13. Panggah Ardiyansyah, S.S (Member)

Perpu
Jend