

**Preserving Borobudur's Narrative Relief Wall
of UNESCO Cultural World Heritage**

Hary GUNARTO

College of Asia Pacific Studies
Ritsumeikan Asia Pacific University

RCAPS Occasional Paper No.07-5

October 2007

Preserving Borobudur's Narrative Relief Wall of UNESCO Cultural World Heritage

Hary GUNARTO

Abstract

Borobudur temple in central part of Java Island of Indonesia is a UNESCO world heritage site and known as one of the Wonders of the World, besides the great-wall of China, Egyptian pyramid, Roman coliseum, Taj Mahal, and others. Considered as the biggest ancient Buddhist temple of the world, this famous shrine was built in the 8th century during the Golden Age of Sailendra dynasty in old-Mataram kingdom. This magnificent stepped pyramid style of volcanic stone monument has an overall height of 42 meters, and dimension of 123 x 123 meters with more than 2500 meters length of wall, full with narrative relief of Buddhist religious texts. This great monument was first discovered by Sir Thomas Stamford Raffles in 1814 after hidden and unknown for almost 10 centuries. In 1911, the first restoration was undergone, and then, another restoration was done under UNESCO's world heritage project in 1975. In addition, a digital archive is needed to preserve this cultural heritage from further destruction. With such technology, the original masterpieces will be preserved for the future, and at the same time it will be available to Internet community and tourists.

1. Introduction¹

World heritage is the legacy of physical artifacts around the world that are inherited from our past generations, and need to be maintained in the present and bestowed for the benefit of future generations. Due to various reasons such as climate change, natural disasters, wars, etc, these valuable world heritages are continuously destroyed from time to time. Natural heritage such as rain forests with its valuable flora and fauna, for example, are being damaged in one way or another because of very dry climate, because of huge number of tourists which comes to visit them, or as a result of other human activities for city planning and developments. Once those

¹ This paper is a reading material for the RCAPS Current Asia Pacific Seminar, held on October 10, 2007.

heritages are destroyed, they cannot be recovered or restored back to its present state. Therefore, it is important to preserve them for the benefits of our future generations.

World Heritage Convention was adopted by UNESCO in 1972 for both natural and cultural heritages to identify, protect, and preserve the world's cultural and natural treasures. The cultural and natural heritage covers the qualities and attributes of places that have aesthetic, historic, scientific or social value for past, present or future generations. Worldwide, there are currently 851 heritage sites located in 184 countries (state parties), as of July 2007. Of these, 660 are cultural, 166 are natural and 25 are mixed properties. All of these sites are classified into 5 geographic zones: Africa, Arab States (northern Africa and Middle East), Asia-Pacific (including Australia and Oceania), Europe and North America (USA and Canada), and Latin America & the Caribbean.

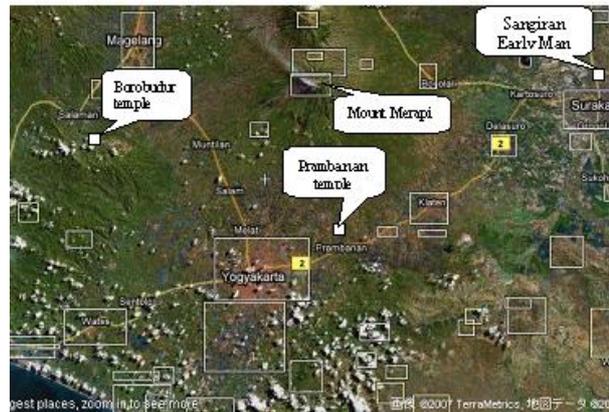
Both natural and cultural heritage treasures often involve with the past history of the region and serve as an important part for country's tourist industry nowadays. The basic criteria for world heritage are exceptional and universal in nature. These world heritage sites in general belong to all the peoples of the world, irrespective of the territory on which they are located. In Indonesia, natural and cultural world heritage sites include **Borobudur Temple Compounds** (1991), Komodo National Park (1991), **Prambanan Temple Compounds** (1991), Ujung Kulon National Park (1991), **Sangiran Early Man Site** (1996), Lorentz National Park (1999), and Tropical Rainforest Heritage of Sumatra (2004); number inside the parentheses represents the year when the site is recognized by UNESCO. Although these sites are located in Indonesia but they represents past history and culture of the region, especially in South East Asia zone.

2. Candi Borobudur

Candi Borobudur or Borobudur temple is one of the magnificent Buddhist monuments, located about 40 km north of Yogyakarta city in central part of Java island (see Figure 1). This colossal relic of Borobudur was built by Sailendra dynasty between 778 to 842 AD; 400 years before Cambodia's Angkor Wat and any other works on great European cathedrals were created. Little is known about its early history except that a huge workforce - sculptors, artists, statue and carving experts - must have been labored to move and carve tens thousands cubic meters of

volcanic stone and lava-rock. Therefore Borobudur temple is an outstanding cultural heritage and legacy and becomes major sources of Indonesian history and culture nowadays (Miksic and Tranchini, 1990).

Figure 1. Satellite Image of Borobudur's location: 7°36'27"S, 110°12'14"E



*Map: <http://wikimapia.org/#lat=-7.607808&lon=110.204201&z=10&l=0&m=a&v=2>

During 5 years of British rule in Indonesian archipelago, Sir Thomas Stanford Raffles first revealed the temple in 1814. He found the temple in wind condition and buried under volcanic ash. He ordered an archeologist, H.C. Cornelius to excavate and clear the site from undergrowth and do thorough investigation. More than 200 laborers were occupied for 45 days to uncover and remove earth, bushes, and trees which buried the historic temple. The temple was hidden for almost 10 centuries, most likely due to catastrophic eruption of Mount Merapi in the beginning of 11th century. Raffles, motivated by his admirer of history and culture of the country, laid the foundation for actual archeological research. Many theories and works were written on the subjects, including “The History of Java” by Raffles himself, “The Borobudur Monograph” by C. Leemans and J.F.G. Brumund, and many other publications (Dumarcay, 1978).

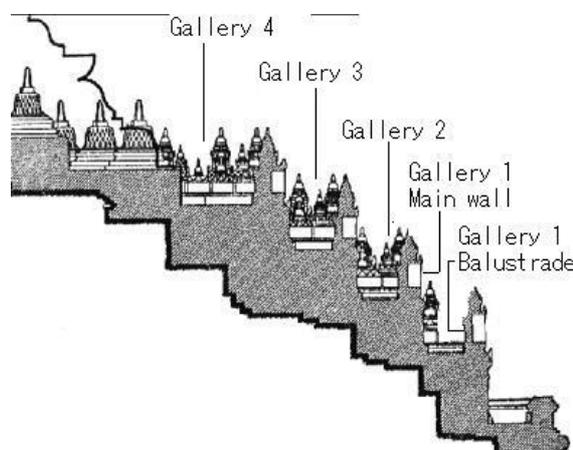
Many Buddhist temples were built and dedicated to Buddha in the need for peoples to make concrete worship and relationship to the God (Tamura, 2000). The word temple is derived from *templum*, the Latin word for a sacred place, or worship/ceremonial space. Around these the ceremonies of worship were elaborated, and in many societies the attendant priests became very powerful. Temples were often built in a magnificent size to accommodate all their priests and followers to gather and

worship. As Buddhist center, candi Borobudur was built as a single large stupa, and when viewed from above it takes the form of a giant tantric Buddhist mandala, with 123 m by 123 m in size. It is erected on a hill in the form of a stepped-pyramid of six rectangular levels, three circular sub-terraces and a central stupa forming the summit. The whole structure is in the form of a lotus, the sacred flower of Buddha (Krom, 1927). Some detail facts and figures of candi Borobudur is shown here:

- Monument size: 123 m by 123 m and 42 meter height
- Narrative relief: 1,460 panels and decorative relief: 1,212 panels
- Buddha Statues in open niches: 368 (originally 432) and 72 on top terraces
- Number of galleries: 4 (each has 2 wall panels: main wall and balustrade)
- Total length of visual panels: circa 2500 meters
- Total volume of stone used: circa 55,000 cubic meters
- Time to build: perhaps 66 years, and usage period: almost 200 years.

As one of major centers of Buddhist scholarship in South and South-East Asia during that time, Borobudur temple was built with an overwhelming mass of images and galleries on its walls depicting the activities of Gods (Swearer, 1995). There are almost 1,500 narrative panels illustrating the life of Buddha and Buddhist texts, the largest and most complete collection of Buddhist relief in the world. These religious illustrated texts consist of 6 different Mahayana Buddhist doctrines: Karmavibhanga, Lalitavistara, Jatakas, Avadanas, Gandavyuha, and Bhadrachari (Soekmono, 1976).

Figure 2. Location of narrative panels of the Buddhist texts



All of these six manuscripts are carved on 2500 meters long of stone inscriptions on 4 consecutive galleries' walls. The very first engraved image of the manuscripts starts from east gate on gallery 1 circulating to the left, following round 1, 2, 3, ..., 10, as shown in Table 1. For every Buddhist monks it is devotional practice in this way to proceed on their ritual ceremony during their Buddhist holy festival day (Vesak Day), and to walk around the galleries and terraces always turning to the left and keeping the edifice to the right while either chanting or meditating. In total, Borobodur temple represents the ten levels of a Bodhisattva's life which they must develop to become a perfect and full enlightenment of a Buddha (Primadi, 1998).

Table 1: All of 1460 Relief and Manuscripts

Round	Relief's Location	No. of Panels	Manuscripts
-	Hidden Basement	160	Karmavibanggas
-	Main wall of Gallery 0	1212	Decorative panels
1	Gallery 1, upper main wall	120	Lalitavistara
2	Gallery 1, lower main wall	120	Jatakas & Avadanas
3	Gallery 1 Balustrade, upper wall	372	Jatakas & Avadanas
4	Gallery 1 Balustrade, lower wall	128	Jatakas & Avadanas
5	Gallery 2 Balustrade	100	Jatakas & Avadanas
6	Gallery 2 main wall	128	Gandavyuha
7	Gallery 3 main wall	88	Gandavyuha
8	Gallery 3 Balustrade	88	Gandavyuha
9	Gallery 4 Balustrade	84	Gandavyuha
10	Gallery 4 main wall	72	Bhadracar i

On the highest terrace, arupadhatu level has no relief or decorations but has 3 sub-terraces (balcony), circular in shape with round walls: a circle without beginning or end. Here is the place of the seventy-two Vajrasattvas or Dhyani Buddhas tucked into small stupas. Each of the statues in the temple has a mudra (hand gesture/position of Buddha) indicating one of the four directions: east, with the mudra of calling the earth to witness (Bhumisparca mudra); south, with the hand position symbolizing of charity and blessing (Vara mudra); west, with the gesture of meditation (Dhyana mudra); north, the mudra of fearlessness (Abhaya mudra); and

the centre/zenith (Witarka and Dharmacakra mudra) with hand gesture of teaching (Marzuki and Heraty, 1982).

Karmavibhanga is the first manuscript describing the doctrine of cause and effect (karma) as well as good and evil (Moertjipto and Prasetyo, 1993). The pains of hell and the pleasure of heaven are illustrated on the Karmavibhanga manuscript. There are also praiseworthy activities that include charity and pilgrimage to sanctuaries, and their subsequent rewards on this relief. The complete series of 160 panels on Karmavibhanga relief is not visible as it is hidden and surrounded by broad base of stone walls. Only parts of the southeast temple wall were dismantled for visitors, which are represented by panel numbers: 19, 20, 21, and 22.

Lalitavistara is the second manuscript, and represents the life of Buddha Gautama from his birth until his first Sermon at Benares. The relief story of Lalitavistara starts from the glorious descent of the Lord Buddha from the Tushita heaven prior to Gautama's birth, and ends with his first sermon in the Deer Park in Benares. The most famous relief on the Lalitavistara story is the birth of Buddha as Prince Siddharta, son of King Suddhodana and Queen Maya at Lumbini park outside the Kapilavastu city (Nepal, in present-day). One full round on the first Gallery (upper main wall) was dedicated to this manuscript with total number of 120 panels.

The third script, Jatakamala or Garland of Jatakas, is a collection of poems consisting of 34 Jatakas. Based on manuscript written by Aryacara in the 4th century, these Jatakas contain stories on great deeds performed by Buddha (Bodhisattva) in his former lives, preparing for Buddhahood. These episodes of reincarnations serve as example of self-sacrifice. Similar to Jatakas, fourth script of Avadanas narrative is devoted for Buddha, but the main figure is not Bodhisattva (Prince Siddharta) himself. The saintly deeds in Avadanas are attributed to other legendary persons. Both Jatakas and Avadanas are treated in one and the same series of 720 relief panels.

The fifth and longest manuscript is described in Gandavyuha: gallery 2, 3, and 4. Gandavyuha, sometimes referred to as a Mahayana pilgrim's progress, describes Sudhana, son of a rich merchant, who meets several Bodhisattvas, in his aim to reach the highest wisdom. Two of these spiritual teachers of Bodhisattvas are Maitreya (future Buddha V) and Samantabhadra (the Lord of the Truth in Buddhism who

represents the practice and meditation of all Buddhas). A total of 388 panels represent the Gandavyuha text.

At last manuscript, Bhadrachari doctrine is represented in the 4th gallery. It comprises panels with the pledge of Sudhana to follow examples and teaching of the Bodhisattva Samantabhadra. The narrative panels on Bhadrachari end with the Sudhana's achievement of the Supreme Knowledge and the Ultimate Truth. All 72 panels on main wall of gallery 4 are dedicated for the Bhadrachari.

3. Restoration Efforts

During British administration in Indonesia between 1811 - 1815, Sir Thomas Stamford Raffles found Candi Borobudur (Borobudur temple) from its slumber for almost 1 millennium. Raffles, motivated with the temple mystery, started the groundwork for actual archeological survey and research works in 1814 right after its discovery. He commissioned H.C. Cornelius, an officer of the Royal Engineers, to institute further investigations. Later, in 1835, the structure and basic dimension of Borobudur were first investigated by Hartmann, and a German artist, A. Shaefer, made the first daguerreotype photos. Afterward, between 1849 to 1853, F.C. Wilsen together with Schonberg Mulder, was given the task by Dutch government to make drawings of all relief.

Leemans, as director of Leyden Museum of Antiquities, created first monographs of Borobudur temple in 1873, in cooperation with J.F.G. Brumund and Isidore van Kinsbergen. An important aspect of Borobudur relief hidden in the base of Candi was discovered by J.W. Ijzerman in 1885. In 1890 the concealed reliefs was entirely revealed and photographed by Indonesian Kasijan Cephas for documentary purposes. Later on, in 1900, J.L.A. Brandes formed a committee together with Theodoor van Erp, a Dutch army engineer officer, to restore the deteriorated conditions of this great monument. Actual renovation began in 1907 with 50,000 Dutch guilder of cost, which took 4 years of hard work until 1911 (Erp, 1931).

This 1907-1911 restoration was established to primarily focus on cleaning the sculptures, and excavating the grounds around the monument to find missing Buddha heads and hidden panel stones. The restoration project did not address and solve the drainage problem. Within few decades, the gallery walls were sagging and the relief showed signs of new cracks and deterioration. Theodoor van Erp used

concrete from which alkali salts and calcium hydroxide are leached and transported into the rest of the construction. This has caused some problems that a further thorough renovation is urgently needed (Soekmono, 1973).

UNESCO and Indonesian government undertook a complete overhaul of the monument in a big renovation project from 1975 to 1983. Under the chairmanship of R. Roseno and Soekmono, Indonesian engineer and archeologist, the northern and western balustrades were partly dismantled and restored. Many UN experts and archeologist in the field of stone preservation were also invited to solve the serious problem of damage to these relief and statues. The overall foundation was stabilized and all 1,460 panels were cleaned. The restoration involved the dismantling of the five square platforms/galleries and improved the drainage by embedding water channels into the monument (Parmono, 1988).

Preservation of Borobudur temple became national and international attentions in order to protect them from further natural destructions. One of possible solutions is through digital archive project effort. Such digital project may offer a virtual tour to provide all information about Borobudur as well as its valuable Buddhist text to public. The digital Borobudur archive may also attract people and tourists coming to visit Indonesia. Additionally, such digital Borobudur project will lead and guide to other heritage sites and temple research in the region. The implementation of digital Borobudur will be proposed and enhanced mainly by modern IT and web technology.

Figure 3. One of the corroded narrative panels on Lalitavistara



Figure 4. Lalitavistara Relief of Queen Maya (mother of Prince Siddharta)



4. Digital Archives and Virtual Reality Technology

Digital archive refers to an electronic collection of data records for any particular subject. The purpose of digital archiving on cultural heritage is to preserve and protect them and also to make the information available to the Internet audience. Therefore there are lots of basic IT technologies need to be considered and prepared in creating a digital archive, including the Internet infrastructure as basic means for data traffic on the digital archived database (Indonesian Department of Tourism, 2007).

Constructing digital heritage requires substantial resources in materials, knowledge, expertise, tools, and cost. Projects supported by governments and academics can only cover a small part of the world's heritage in both time and space dimensions. The preservation coverage problem is most serious in domains where sources of intellectual and cultural heritage may diminish or disappear over time. A central notion that helps resolve these issues is to facilitate global reach of digital technology to sources of valuable heritage. A proposed approach is to exploit non-institutional resources for wider participation and coverage in digital heritage effort (Gunarto, 2007). The approach attempts to replicate institutional digital heritage work by teaming up public resources and providing standard practice (Liu and Tseng, 2004).

Many digitization projects have been introduced around the world in recent years. In early 2004, Chinese government established a foundation and mission to protect and preserve the Great Wall of China that emanates from 3,000 years of history (Hylton, 2005). An image-based rendering (IBR) technique was also proposed to create virtual city images with the aid of omni-directional camera and special illumination

methods (Katsushi, Sakauchi, Kawasaki, and Sato, 2004). A virtual tour of the Beethoven Museum and Beethoven's life and music was funded recently by city office of Bonn. For candi Borobudur, a preliminary digitalization of the temple was started by Australian National University in 2002 (Greenhalgh and Limaye, 2002).

Based on the network infrastructure in Indonesia, the 'Digital Borobudur' project effort can be planned and scheduled further. The digital archives of Borobudur will be a digital library project on Borobudur temple in co-operation with Indonesian government and other partners. The digital archive effort will consist of two parts. The digital archive contains digital copies of all documents and objects in the Borobudur temple with metadata on the collection of the temple. Secondly, a digital Borobudur project will offer easy access to the whole collection and visualization facilities about Borobudur and its visual Buddhist manuscripts. Therefore, cyberweb access will allow and contribute to the global visibility and virtual tour of candi Borobudur.

In the last 2 decades, Cyberspace and Internet has emerged as global information infrastructure, as well as high-speed access in which the digital archive information is transmitted and received. Further development of digital archive is Virtual Reality (VR) technology that may be used as possible realization to support digital and virtual Borobudur. A real-time and interactive ability of this VR will give distinct features over three-dimensional images. Using VRML, person can control the position of the viewpoint and interact with a three dimensional Virtual Environment (VE) through the input devices, which are similarly designed to come close to the individual's natural communication. It also provides easier and safer alternative to reality, and it is cheaper to access and watch a computerized model than a real trip to the site. Quite often, many people use VRML to experience a real environment before they go to the actual site.

One problem in distributing VRML data is document watermarks in which browser and image processing software can detect easily (Venkataramana and Raj, 2007). Another issue in distributing digital objects is the granting of access rights to registered users all over the world ('pull technology'). Modern compression technologies and scalable coding can be applied here to limit the bandwidth usage during the transmission. More sophisticated model transformation approach that implements a preservation-centric view can be utilized in the proposed virtual

Borobudur (Triebsees and Borghoff, 2007). Such problems need to be solved in order to make the Digital Archive and VRML technology of Borobudur temple successful.

5. Summary

One of the UNESCO Cultural World Heritage sites is Borobudur temple located in central Java of Indonesia. Considered as the biggest ancient Buddhist shrine build in 8th century, this magnificent religious monument has size of 123 m x 123 m x 42 m, made of massive volcanic stone and full with relief wall. Total length of the reliefs is more than 2500 meters, and consists of 1460 narrative panels of Buddhist manuscripts, such as: Lalitavistara, Jataka, Avadana, Gandavyuha, and Bhadracari.

After long history of its existence for more than 12 centuries, the reliefs are slowly corroding and deteriorating that need world consideration. Volcanic ashes and ever-growth of tropical vegetation added to Borobudur's deterioration and decays. Digital Archive together with Virtual Reality Technology is one of the solutions to protect this valuable temple and its Buddhist visual/narrative texts from further destruction for the benefit of our future generation.

6. References

- Dumarcay, Jacques, 1978, *Borobudur*, Oxford University Press, Kuala Lumpur.
- Erp, Th. Van, 1931, *Beschrijving van Barabudur II*, Bouwkundige Beschrijving.
- Greenhalgh, Michael and Ajay Limaye, 2002, *A VRML model of Borobudur*, Australian National University, <http://rubens.anu.edu.au/htdocs/bycountry/indonesia/borobudur/>, accessed June 7th 2007.
- Gunarto, Hary, 2007, *Study of Borobudur and Digital Archive Project Plan*, Ritsumeikan Center for Asia Pacific Studies (RCAPS) Research Report, APU, April 2007, <http://www.gunarto.org>.
- Hylton, Eldon C., 2005, *China great wall digital cultural heritage*, Computers in Entertainment (CIE), pp.318, March 2005
- Indonesian Department of Tourism, <http://www.konservasiborobudur.org>, accessed on June 30th 2007.

- Katsushi Ikeuchi, Masao Sakauchi, Hiroshi Kawasaki, and Imari Sato, 2004, *Constructing Virtual Cities by Using Panoramic Images*, International Journal of Computer Vision, Vol. 53, No.3, pp. 237-247, March 2004
- Krom, N.J., 1927, *Barabudur: Archeological Description*, The Hague Martinus Nijhoff.
- Liu, Jyi-shane and Mu-Hsi Tseng, 2004, *Mediating team work for digital heritage archiving*, Proceedings of the 4th ACM/IEEE-CS joint conference on Digital libraries (JCDL '04), pp. 259-268, June 2004.
- Marzuki, Yazir and Toeti Heraty, 1982, *Borobudur*, Penerbit Djambatan, Jakarta.
- Miksic, John and Marcello Tranchini, 1990, *Borobudur: Golden Tales of the Buddhas*, Shambhala Pub., Boston.
- Moertjipto and Bambang Prasetyo, 1993, *Borobudur, Pawon dan Mendut*, Kanisius Publications, Yogyakarta.
- Parmono, Atmadi, 1988, *Some Architectural Design Principles of Temples in Java: A study through the buildings projection on the reliefs of Borobudur temple*. Yogyakarta: Gajah Mada University Press.
- Primadi, 1998, *Messages from Ancient Walls*, Penerbit ITB Pub., Bandung.
- Soekmono, 1973, *Satu Abad Usaha Penyelamatan Candi Borobudur*, Kanisius Publications, Yogyakarta.
- Soekmono, 1976, *Chandi Borobudur - A Monument of Mankind*, The Unesco Press, Paris.
- Swearer, Donald K., 1995, *The Buddhist World of Southeast Asia*, State University of New York Press.
- Tamura, Yoshiro, 2000, *Japanese Buddhism: A Cultural History*, Kosei Publishing Co., Tokyo.
- Triebsees, Thomas, Uwe M. Borghoff, 2007, *A Theory for Model-Based Transformation Applied to Computer-Supported Preservation in Digital Archives*, 14th Annual IEEE International Conference and Workshops on the Engineering of Computer-Based Systems (ECBS'07), pp. 359-370, March 2007.
- Venkataramana, A., P. Ananth Raj, 2007, *Image Watermarking Using Krawtchouk Moments*, International Conference on Computing: Theory and Applications (ICCTA'07), pp. 676-680, March 2007.