

THE TECHNICAL STUDY ON TAMANSARI AFTER THE EARTHQUAKE



Direktorat
dayaan

**DEPARTMENT OF CULTURE AND TOURISM
2007**

**Technical Study on Taman Sari Water Castle after the
Earthquake 27 May 2006**

DEPARTMENT OF CULTURE AND TOURISM

**The Archaeological Office of Yogyakarta
2007**

CHAPTER I

Introduction

The earthquake 27 May 2006 which struck Yogyakarta and some parts of Central Java caused damages on buildings. Not only houses and public buildings, the earthquake also destructed some culture heritage places. One of the heritage places was Taman Sari Water Castle.

The earthquake has ruined some old buildings in Taman Sari Water Castle. One the walls collapsed and hit one house near Taman Sari. Two were killed. The buildings in Taman Sari which have heavy damage after earthquake are Gapura Panggung, Gapuro Agung, Pulo Panembung, Pulo Kenanga, and Pogangan Peksi Beri. The buildings which suffered slight damage are Gerbang Carik, Gedong Madaran, Pemandian Umbulbinangun, Gedong Sekawan, Gedong Temanten, Sumur Gumuling etc.

The emergencies action had carried out in Taman Sari water castle on the damaged buildings and on structure which endanger the visitors and local community. The emergencies actions are implemented by the installation of supporting systems on the cracked buildings such as the gate in Pulo Kenanga.

Restoration on Taman Sari is needed considering the damages on its buildings after the earthquake can endanger the local communities. The restoration also can avoid some of the damaged buildings collapse. The restoration project on Taman Sari is preceded by technical study on its restoration after the earthquake.

The technical study is intended to analyze the intensity of the damages on some buildings in Taman Sari water castle complex after the earthquake.

The objectives of the technical study are:

1. To analyze the overall condition of the Culture Heritage Places of Taman Sari water castle after the earthquake
2. To analyze the intensity of the damage on the Culture Heritage Places of Taman Sari water castle after the earthquake
3. To formulate the concept of rehabilitation on the Culture Heritage Places of Taman Sari water castle after the earthquake
4. to formulate the budget plan on the rehabilitation project of the Culture Heritage Places of Taman Sari water castle after the earthquake

Based on the location this study is conducted in Kampung Taman, Patehan village, Kraton sub-district, Yogyakarta city. The Kampung Taman consists of three Rukun Warga, 8, 9 and 10. The location is limited by Taman street on the west, Polowijan street on the north, Nogosari street on the west and Nagan Lor street on the south.

The expected results of the study on Taman Sari water castle after earthquake are:

1. The guideline on the building restoration in Taman Sari water castle which covers targets, detail implementation works and the budget.
2. The concept and the plan of the environment management which covers buffer space, land use and monitoring
3. The concept and the plan of the management system and coordination on the conservation of Taman Sari water castle
4. The concept and the plan of research on Taman sari water castle which dealing with the data gathering, conservation efforts etc.
5. The concept and the plan of the use of Taman Sari water castle for the guide, local community and the visitor

Based on the consideration latter of Archaeological office of Yogyakarta no. 2306.A.3/BP3/DKP/2006 which concerns with the team of Technical study on Taman Sari after the earthquake, 18 December 2006, the team consists of:

- | | |
|---|---------------------------------|
| 1. Advisor | : KGPH Hadiwinoto |
| 2. Expert – Archaeology | : Prof. DR Timbul Haryono, Msc. |
| 3. Expert - Architecture | : DR. Laretna Adisakti |
| 4. Expert – Civil Engineer | : Ir. Houtma Prowoto, MT |
| 5. Expert – history | : Drs. Adaby Darban, SU |
| 6. Expert's assistance – Archaeology | : Sektiadi, SS |
| 7. Expert's assistance – Architecture | : Dyah Arnawati, ST |
| 8. Expert's assistance – Civil engineer | : Teguh Sudibyo, ST, MT |
| 9. Expert's assistance - History | : Ba'a Uddin, SS, M.Hum |
| 10. Team Leader | : Drs. Tri Hatono M.Hum |
| 11. Documentation and Reporting Coordinator | : Dra. Widiandari Budi Rahayu |
| 12. Documentation and Reporting | : Dedy Hariansyah, S.Kom |

13. Documentation and Reporting	: Edy Prasetyo
14. Surveyor – Archaeology	: Kayato Hardani, SS
15. Surveyor – Archaeology	: RA Retno Insur W.,SS
16. Surveyor – History	: Himawan Prasetyo, SS
17. Surveyor – History	: Sukaini, SS
18. Surveyor – Measurement	: Marsudi
19. Drawer	: Sri Widiastuti
20. Conservator	: Budi Rahayu
21. Conservator	: Tri Wahyu Handayani
23. Administration and logistic	: Damono,BA
24. Administration and logistic	: Budiasih Meida Nuraini
25. Labor	: 8 Persons

CHAPTER II

THE HISTORY OF TAMANSARI WATER CASTLE

The establishment of Taman Sari has a strong connection with the establishment of Yogyakarta palace. After Palihan Nagari which was followed by Giyanti treaty in 29 Rabiulakir 1680 Jw or 13 February 1755 AD, the Islamic Mataram kingdom was divided into two, Kasunan Surakarta which was ruled by the king of Sri Susuhunan Paku Buwono III and Kasultanan Yogyakarta which was ruled by the king of Sultan Hamengku Buwono I. From the facts above. Pangeran Mangkubumi (Sri Sultan Hamengku Buwono I) built a palace with its physical facilities. One of the facilities was Taman Sari water castle.

In *Babad Momana* and *Serat Rerenggan Kraton* is stated that Taman water castle was established by Sri Sultan Hamengku Buwono I's order. In Ehe 1684 Jw or 1758 AD, Raden Ronggo Prawirosentiko the regent of Madiun with other the regent Manca Praja had an order to prepare the logistic support and materials to built Taman Sari water castle. They were also ordered to prepare other palace facilities. The order is explained in the sengkalan *Catur Naga Rasa Tunggal* which means the responsibilities of supporting the king needs in *Serat Rerenggan* : “.....nyanggi raja pundhut, mirunggan karsa nata, iya sapraboting nagri, myang pepasren kang karya kingining driyo “. As the consequences, the regents will be permitted do not pay a tax or paosan every year (*linilinan datan nyanggi, paosan saben warsi*) because the regent of Madiun loyalty to Sri Sultan' struggle in 1749 AD to Giyanti treaty in 1755 AD.

Based the map which is designed by KRMT Poerbadiningrat in 1942 and then it is redrew by Mintoboedojo, Taman Sari water castle consists of 58 buildings. The buildings covers 40 gates and gedong, 8 water castle facilities (pools etc) and segaran with its facilities (pogangan, 6 water gates).

Taman Sari water castle is divided into three major areas, west complex (now it is very popular with the name Taman Sari), Segaran Pulogedong in the east side, and the canal which connect the Taman Sari and Segaran Pulogedong. The complex which is located between Gapura Pagelaran in the west to Segaran Pulo Gedong in the west side is described in *Serat Rerenggan Kraton* :

Miwah gedhong panggung inggil, ran pulo panggung segaran, tirta lir jladri ombake, kang nrajang margi magangan, sunung kreteg pesatan, yen pinesat karya laku, lelangen baita

In his report which is dated 26 October 1761, Nicholas Hartingh write that Sultan Hamengku Buwana I loves the glorious buildings which can support him to be a king. The Sultan orders to build water spouts, imitation hills and some canals. If the buildings are not match with his desire, he will demolish it. He will rebuild the buildings with new design. The establishment of the big and glorious buildins is very essential to show the status of Sultan Hamengku Buwana I as a great king.

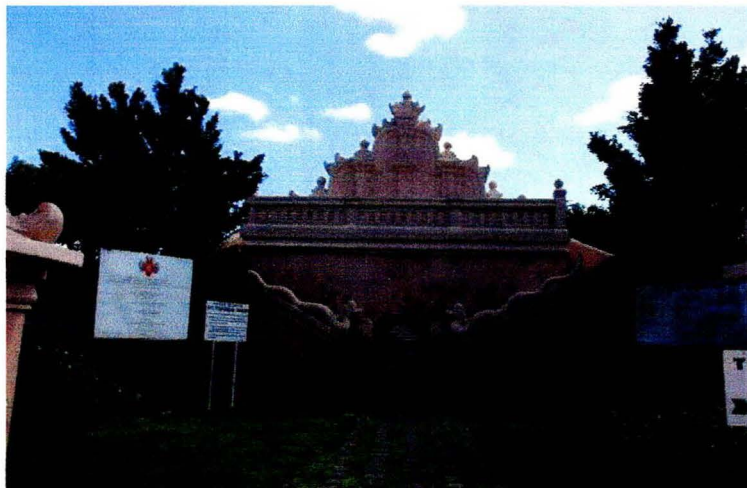
The decline of the Taman Sari's glorious was started when the Sultan Hamengku Buwono I passed away in 1792 AD. Taman Sari water castle, then renovated in the fist time when Sultan Hamengku Buwana VII ruled to the earthquake in 1867. The decreasing of the Taman Sari buildings occurs until now. When Hamengku Buwana VIII ruled, the ex garden and the segaran were used as a settlement for the Abdi Dalem using *ngindhung* and *magersari* system. In the recent days the settlement develops and reaches the west side of Gapura Agung, Pasareyan Ledoksari area and Sumur Gumuling.

CHAPTER III

THE DAMAGES ON SITE AFTER EARTHQUAKE

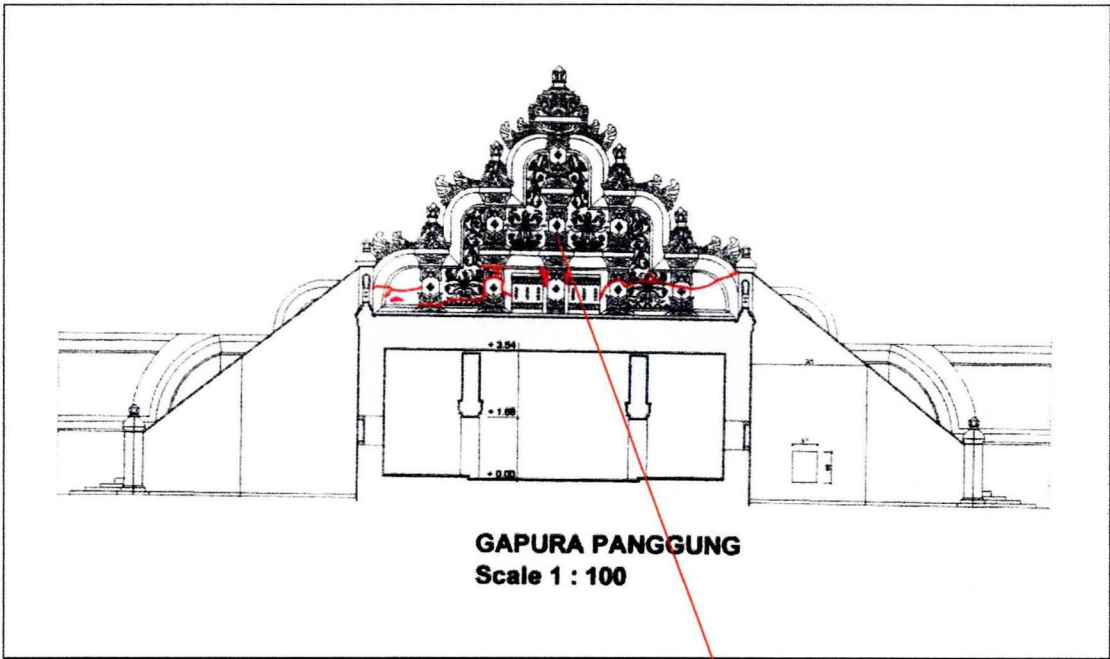
Taman Sari water castle has extensive damages structurally and non-structurally. The damages on Taman Sari water castle can be classified into three types, heavy, medium and slight damages.

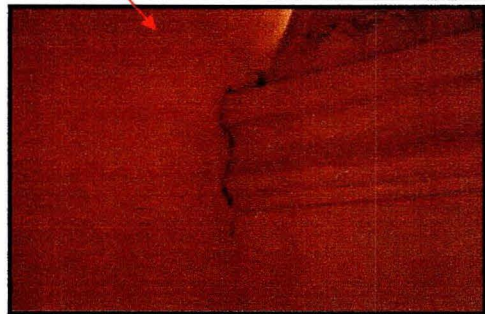
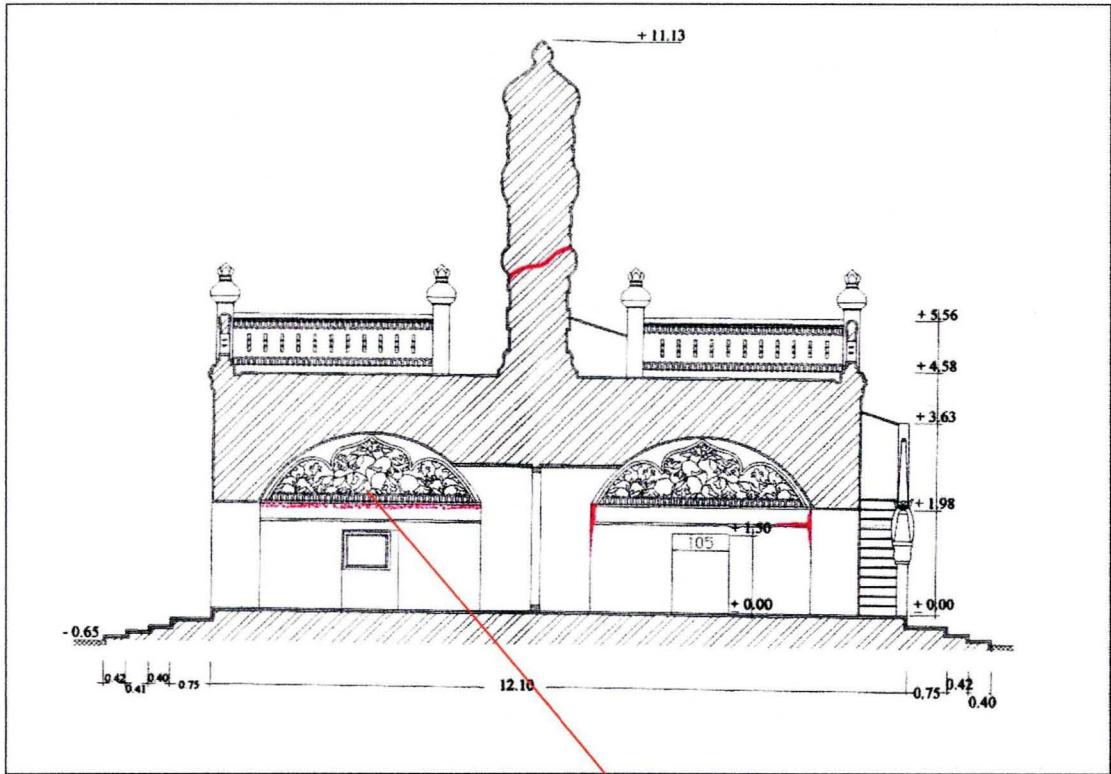
1. Gapura Panggung (Panggung Gate)



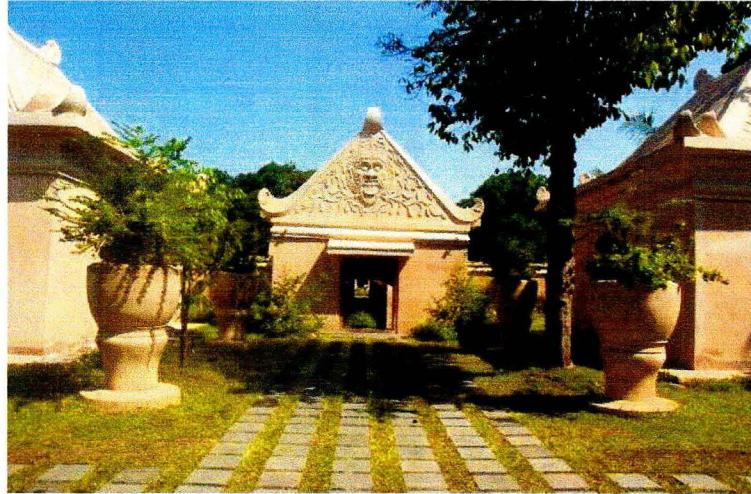
The Damages after the Earthquake

The damages after the earthquake are located on the walls of Gapura Panggung (Gapura gate) in the north and south of the entrance gate. There are some peeling on the cement layers. There are cracks (breaking cracks and micro cracks) on the walls and the roof. The cracks on the walls and on the top of the rooms' door especially the cracks which are located on the ornamented walls still in unstable condition. The locations of the cracks are explained in the picture bellow:



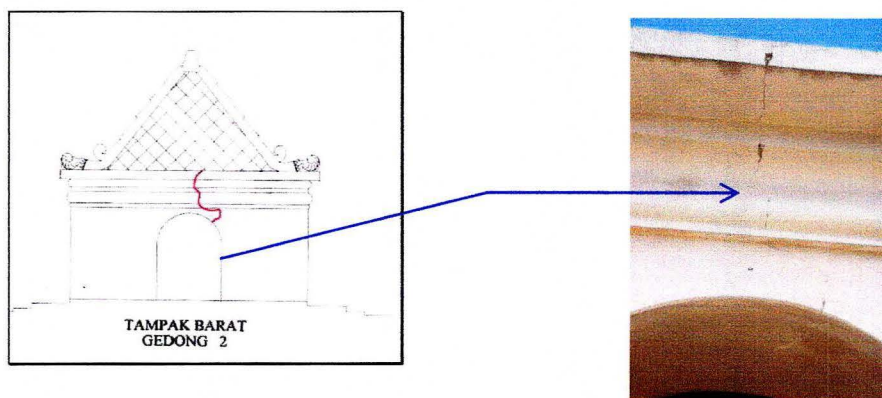


2. Gedong Sekawan

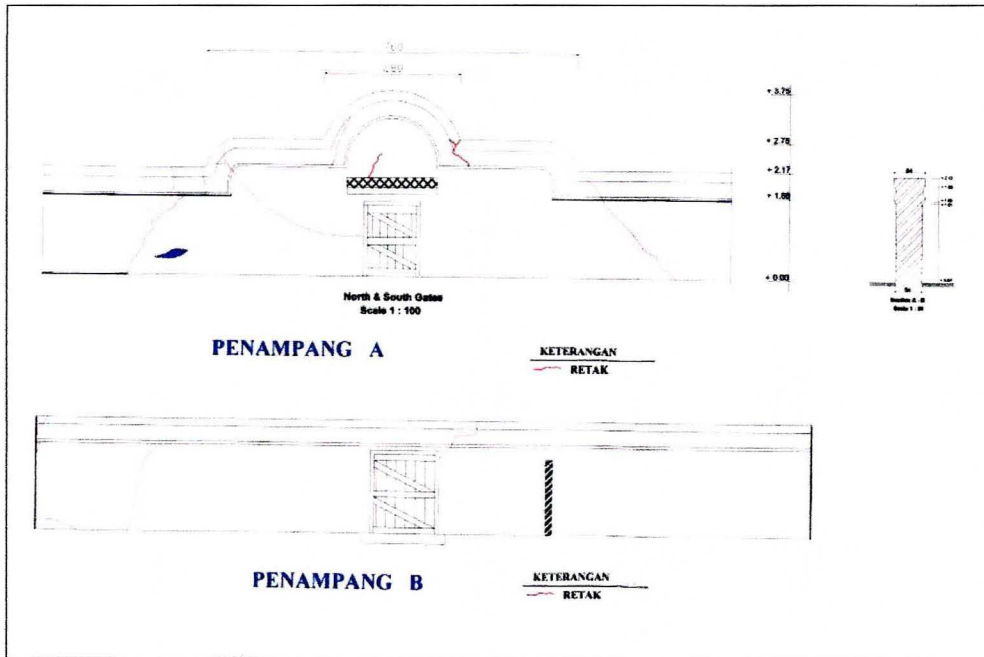


Damages after the Earthquake

The four buildings have some cracks on the upper wall of the entrance. The cracks are also found on the north and west fences. To observe whether the crack reaches the foundation or not, a test pit is conducted on the inner north and west fence. On the two locations, the walls are breaking while on the north, the upper wall inclines to the south direction. The vertical cracks also occur on the outside wall of Gedong Sekawan's fence wall (on the path to the Pogangan Peksi Beri). Observation states that the crack does not occur in the foundation structure.



Structure crack on the Gedong Sekawan



Cracks on the south inner fence structure of the Gedong Sekawan



Cracks on the north outer fence structure of the Gedong Sekawan



Cracks on the west inner fence structure of the Gedong Sekawan



Cracks on the west outer fence structure of the Gedong Sekawan

3. Gapura Agung



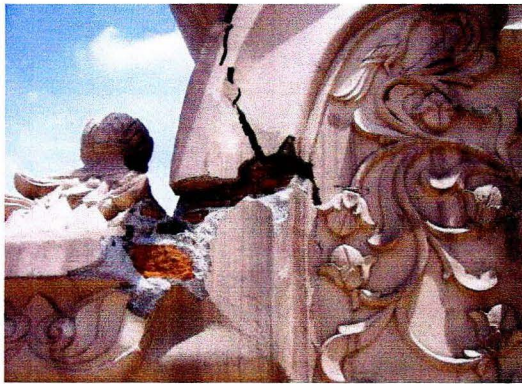
Gapura Agung before the earthquake

The Damages after the earthquake

The horizontal cracks can be found in the tympanum (gunungan). The crack has made its top ornament falls down. The earthquake also has made this building inclines to the west side. The damage which needs a serious concern is the structure damage which causes the damage of the top ornament.



The condition of the west gapura agung before the emergency action



The damage on the north inner wing's corner



The damage on the south outer wing's corner



The condition of the gapura agung after the emergency action

4. Pulo Kenanga



Pulo Kenanga before earthquake

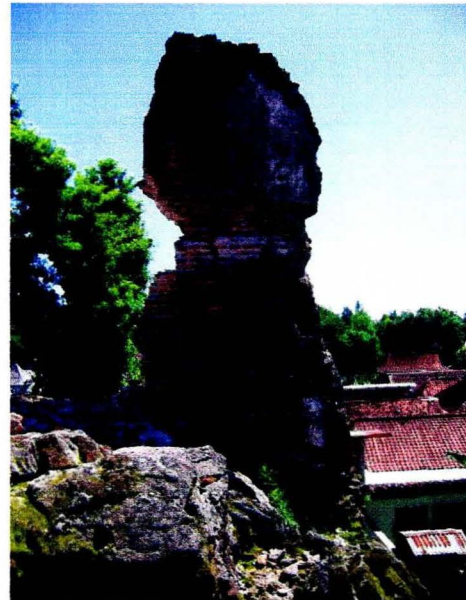


Pulo Kenanga after earthquake

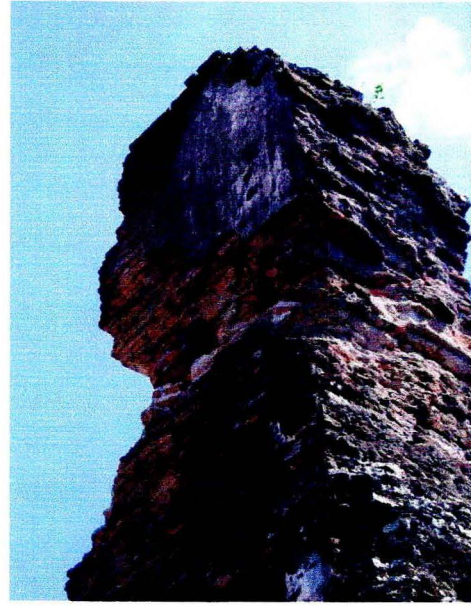
The Damages after the earthquake

Pulo Kenanga suffered extensive damage after the earthquake in 1867. The earthquake 27 May 2006 had made this building in a worsened condition. The worst damage is in the west part. The ruins of the past earthquake are mix with the ruins of the earthquake 27 May 2006. The structure damages which are caused by the earthquake in 1867 can be observed such as vertical cracks on the walls. To observe the damage on the foundation, an excavation on two location is conducted. The excavation is located in the southeast corner. The heavy damages occur on the upper wall of this corner. The result of the excavation can show that the foundation still in good condition.

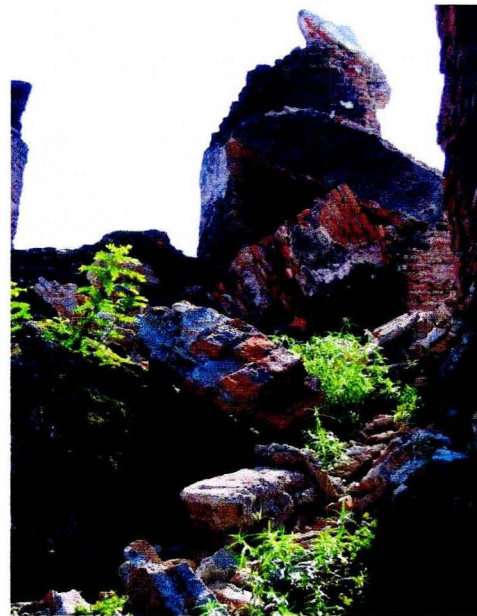
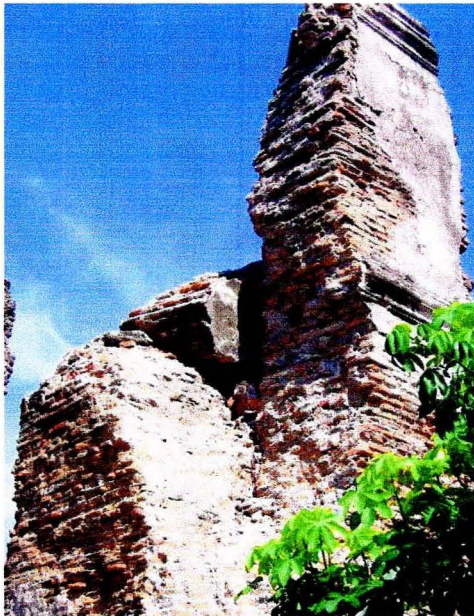
The earthquake on 27 May 2006 also causes damages on the south and north of the entrance gate. The damage on these parts are cracks on the upper wall.



The damage after the 27 May 2006 earthquake on southwest corner of Pulo Kenanga. The left picture - the damage is observed from outside view. The right picture – the damage is observed from the inside view



The detail of the dangerous broken structure of the remains
The left picture - from outside view. The right picture – from the inside view



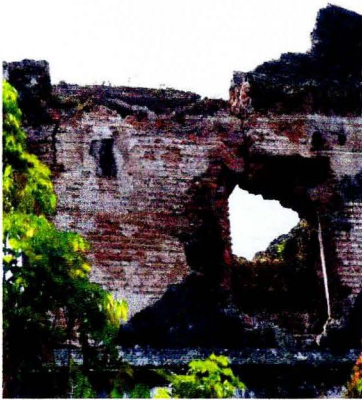
The damage in detail which can endanger people. The left picture - from outside view. The right picture – from the inside view



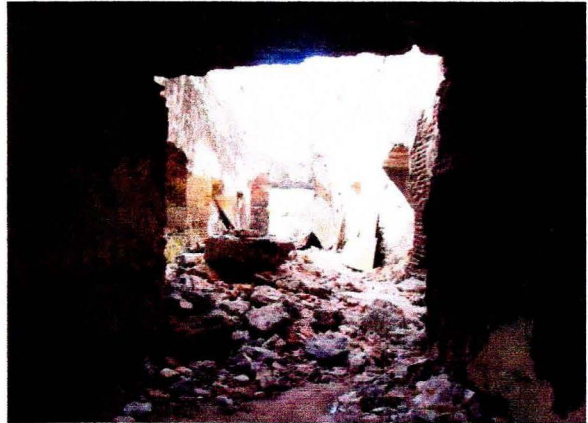
The condition of Pulo Kenanga from northeast view



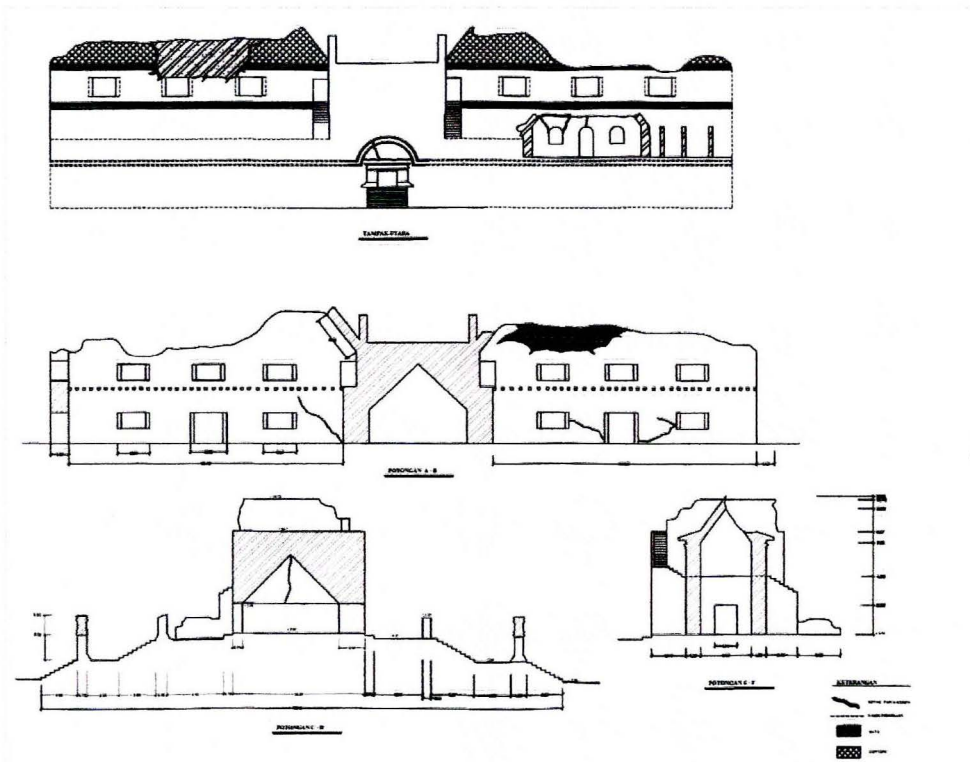
The condition of Pulo Kenanga from southwest view



Peeling on the upper wall, cracking on the walls near the window



The ruins of the roof



5. Gerbang Carik



Gerbang Carik from the north view

The Damages after the earthquake

Crack can be found on one of the north room in the west area. The crack directs to the roof. The west fence's wall of Gerbang carik suffers 20 m horizontal crack. The peeling is also founded on the bathroom' wall near the well.

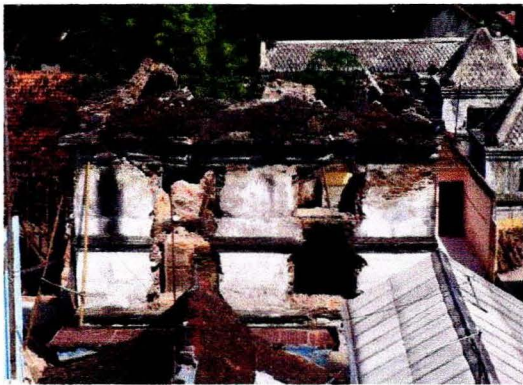
6. Pulo Panembung



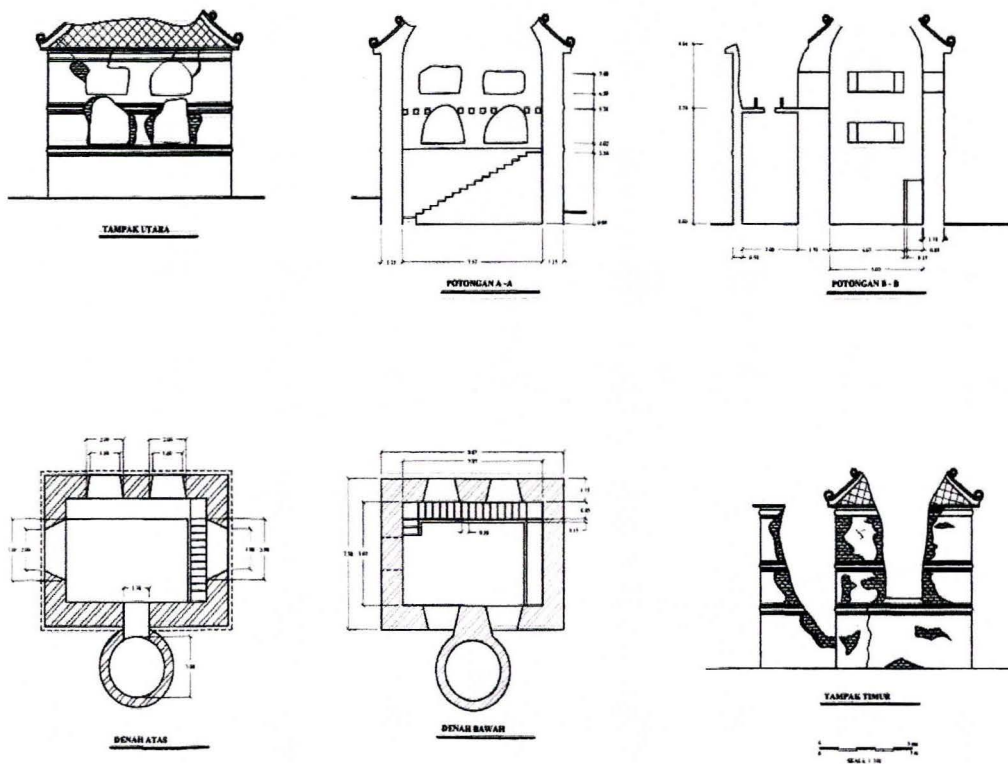
Pulo Panembung from the south and north view before the earthquake.

The Damages after the earthquake

Pulau Panembung is one of the buildings in Taman Sari water castle complex which suffered heavy damage after the earthquake. The resent condition can endanger people who live near the building. Some parts of the roof and the wall near the window collapse after the disaster. The damages reach 18,96 m3.



The condition of Pulo Panembung after the earthquake



7. Gedong Madaran

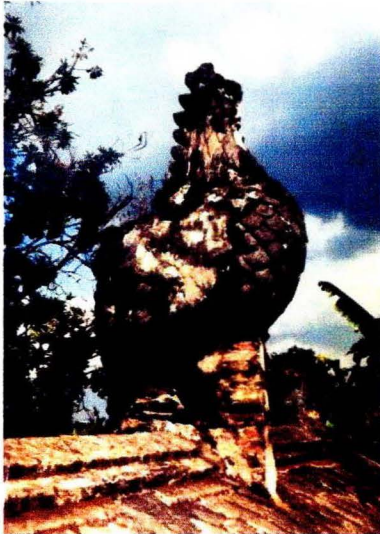
The Damages after the earthquake

Gedond Madaran only suffers slightly damage after the earthquake 27 May 2007. The damages can be classified into micro cracks and peeling on its wall.

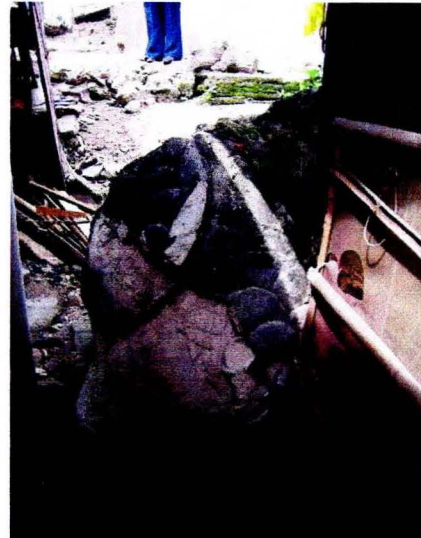
8. Pongangan Peksi Beri

The Damages after the earthquake

This ex quay building is totally damaged after the earthquake. The buildings which still stand are the terrace and the south wall. The damage's volume reaches 10 m^3 . The building with a bird ornament (*wuwungan*) (the ornament has already collapses when the earthquake on May strikes) suffered cracks. It is assumed that the cracks are old cracks. There are two kinds of cracks. They are cracks that cause the structure breaks and micro cracks. Peeling also occurs in this building. The volume reaches 6 m^2 .



The ornament of Peksi Beri before the earthquake



The collapsed Peksi Beri ornament in local people' yard

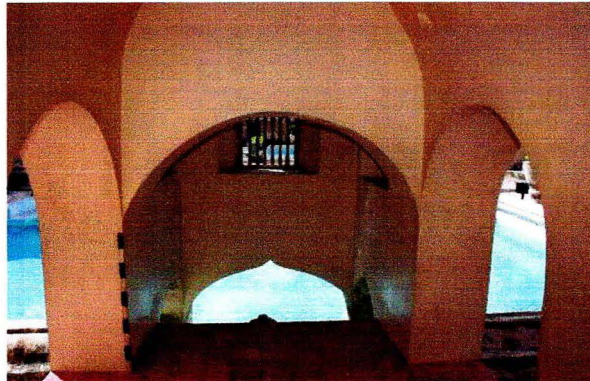


The collapsed pekxi beri in detail



Pongangan Peksi Beri from inside view

9. Pasiraman Umbul Binangun

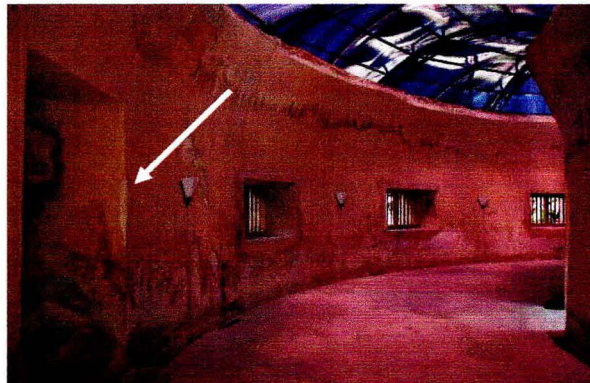


Crack on the wall

The Damages after the earthquake

The earthquake causes cracks on the pool's wall. The cracks measure 34 m on some parts. The south and south building's wall also crack. The cracking are located on the top on the wall and the wall which direct to the roof.

10. Sumur Gumuling

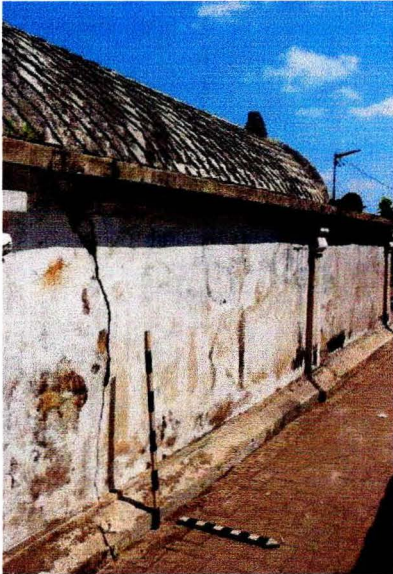


Crack on the Sumur Gumuling's top wall

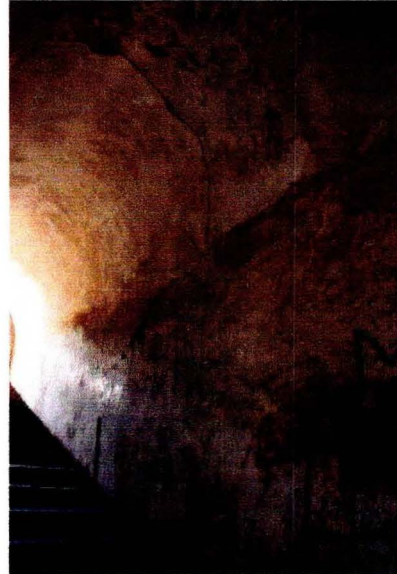
The Damages after the earthquake

The damage in this building is breaking on the second floor's wall. The earthquake also causes micro cracks which measure 9,95 m. Peeling on this building measures 105 m².

11. Urung-Urung



Crack on outside wall of the north entrance gate



Crack on the top part of urung-urung



Crack on the south side of urung-urung entrance gate's roof

The Damages after the earthquake

Urung-urung building, on the underground path also suffers from damage. The damages are located in the entrance and exit door. Its wall cracks and the right entrance door frame sinks 3,5 cm while the exit door frame sinks 1,5 cm. Between the urung-urung wall and the fence is wide apart 1 cm. The earthquake does not destroy the ventilation but its grills (42), one door fame are lost and one door fame in bad condition.

12. Fortress wall (on the north of Gedong Temanten and the entrance wall / on the north of Saka Tunggal mosque)



Fortress wall on the north of Gedong Temanten

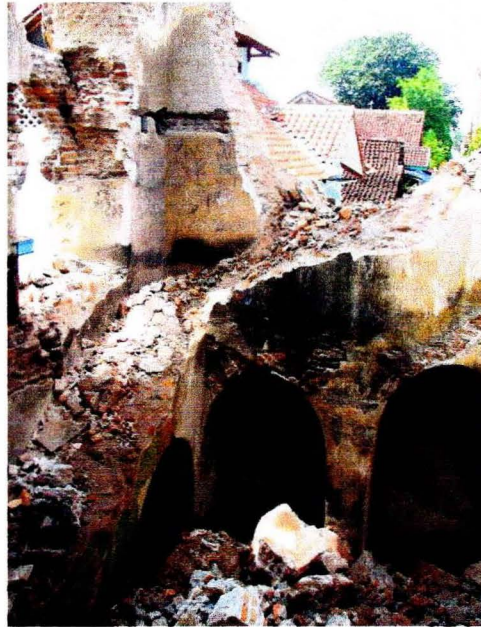
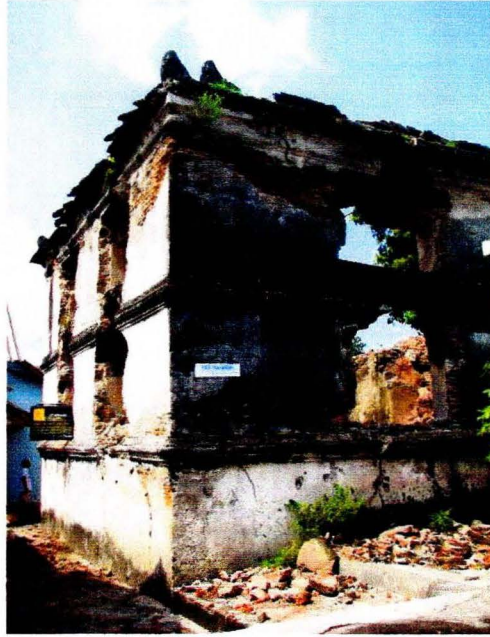
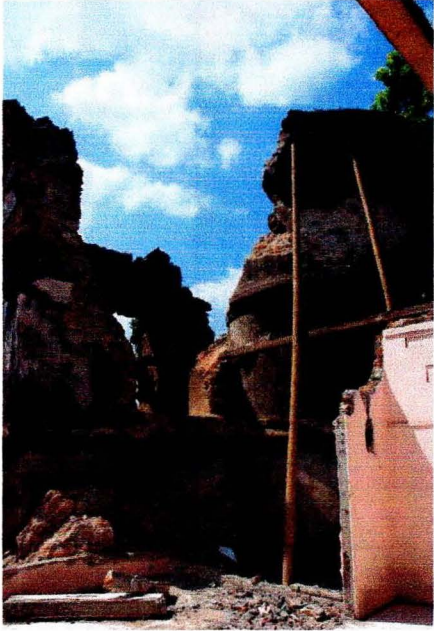


The condition of the wall on the north of Saka Tunggal mosque

The Damages after the earthquake

The wall on the north of Saka Tunggal mosque collapses after the earthquake ($1,064 \text{ m}^3$). The peeling of this building occurs in the south fence. The peeling measures $4,2 \text{ m}^2$. Wall breaking can be found in the fence which stretches to the south and north. The growth of algae and moss on the wall measures 8 m^2 .

The fence wall of Gedong Temanten yard breaks and collapses. The beaking wall measures $14,2 \text{ m}$ on some parts while the collapsed structure volume is $0,483 \text{ m}^3$. The wall also inclines to the south direction. The growth of algae on the wall is 26 m^2 while the growth moss is 15 m^2 . The peeling is conducted on the south cracked wall. It is conducted to observe the depth of the crack. The observation result states that the crack does not occur in the structure.



The structure damage on Pulo Panembung

CHAPTER IV

RECOVERY PLAN ON TAMANSARI SITE AFTER THE EARTHQUAKE

Resent day Taman Sari water castle can be conserved based on the its original condition. This statement is based on the consideration that conservation efforts is not only how to conserve the fabric but also the existence of settlement which has developed inside the site. The existence of the settlement and its development is one of the historic processes of Taman Sari site itself.

Kondisi material bangunan Situs Tamansarisudah tidak memenuhi syarat lagi untuk material bangunan sesuai dengan. Berdasarkan penelitian laboratorium hasil penelitian material atau bahan sebagai berikut.

The material condition in Taman Sari water castle is appropriate for the material building which is recommended by PUBI RI 1985. The results of the laboratory research on the material are stated bellow:

1 Brick Testing

a. Compression strength

Table 1: The Result of Compression Strength on Red Brick in Tamansari

No	The brick measurement		Width (mm ²)	Compression strength (N)	Compression stretch (MPa)	Compression stretch (average) (MPa)
	Length (mm)	Wide (mm)				
1	110	110	12100	76000	6.281	4.505
2	135	100	13500	64600	4.785	
3	130	120	15600	38100	2.442	
4	120	120	14400	54900	3.813	
5	110	110	12100	47100	3.893	
6	110	100	11000	52200	4.745	
7	100	100	10000	39500	3.950	
8	120	120	14400	59300	4.118	
9	115	115	13225	79900	6.042	
10	120	115	13800	68800	4.986	

Note : The testing result state that the average compression strength of brick is 4.505 N/mm² so the brick in Taman Sari level 25 category and does not fulfill the requirement as a building material.

b. Water absorption

Table 2: The result of water absorption testing of Taman Sari's brick

No	The weight of brick before heated (Gram)	The weight of brick after heated (Gram)	The weight of brick after submerged in the water (Gram)	The percentage of water which is absorbed by brick (P) (%)
1.	1222.5	1134	1429	26.014
2.	1283	1210	1532	26.612
3.	1273.5	1223	1532	25.266
4.	925	888	1118	25.901
5.	1472	1421	1715	20.690
6.	1770	1657	2080	25.528
7.	1303.5	1300	1571	20.846
8.	1054.5	967	1226	26.784
9.	1065	949	1212	27.713
10.	1157	1081	1360.5	25.856
Total				251.209
Average				25.121

Note: The good brick will absorb the water not more than 20 %. The percentage of water which is absorbed by Taman Sari's brick 25.121 % so the brick does not fulfill the requirement as a building material.

c. Level of Salinity

The level of salinity of a good quality brick is not more than 50 %. If the level of salinity of brick more than 50 %, the brick does not fulfill the requirement as a building material. The level of salinity testing does not show the white spot on 5 samples (Taman Sari's bricks), it means that the level of salinity of Taman Sari's brick is 0 % or it fulfills the requirement of a building material.

d. Form and Measurement Testing

The form and measurement testing on Taman Sari's brick shows that there are some variations on the brick's form and measurement but the module of most bricks is 6 (the thickness is 55 mm, the width is 110 mm and the length is 230 mm).

2. Mortar Testing

a. Compression strength

Table 3: The result of Compression strength testing on Mortar in Tamansari

No	The mortar measurement		Width (mm ²)	Maximum load (N)	Compression strength (N/mm ²)
	Length (mm)	Wide (mm)			
1	50	50	2500	3100	1.24
2	50	50	2500	2900	1.16
3	50	50	2500	2700	1.68
4	50	50	2500	1700	0.68
5	50	50	2500	1600	0.64
6	50	50	2500	4200	1.68
7	50	50	2500	800	0.32
8	50	50	2500	3500	1.4
9	50	50	2500	1300	0.52
10	50	50	2500	2700	1.08
11	50	50	2500	2300	0.92
12	50	50	2500	400	0.16
13	50	50	2500	3900	1.56
Total					12.44
Average					0.96

Note: The compression strength of the mortar should not less than 1/3 from the brick' compression strength. The testing result states that the compression strength of the mortar is 0.96 N/mm² and the compression strength of the brick is 4.505 N/mm², so the compression strength of the mortar not more than 1/3 from the brick' compression strength. The mortar does not fulfill the requirement of a building material.

b. Water absorption

Table 2: The result of water absorption testing of Mortar in Taman Sari

No	The weight of mortar before heated (Gram)	The weight of mortar after heated (Gram)	The weight of mortar after submerged in the water (Wb) (Gram)	The percentage of water which is absorbed by mortar (P) (%)
1.	112	110	130	18.18
2.	237	221	256	15.84
3.	310	291	362	24.40
4.	599	574	711	23.87
5.	473	461	543	17.79
6.	279	267	316	18.35
7.	229	217	274	26.27
8.	551	524	611	16.60
9.	120	113	143	26.55
10.	298	288	363	26.04
Total				213.89
Average				21.39

Note: The testing result shows that the average of water absorption of Mortar in Taman Sari is 21.39 %.

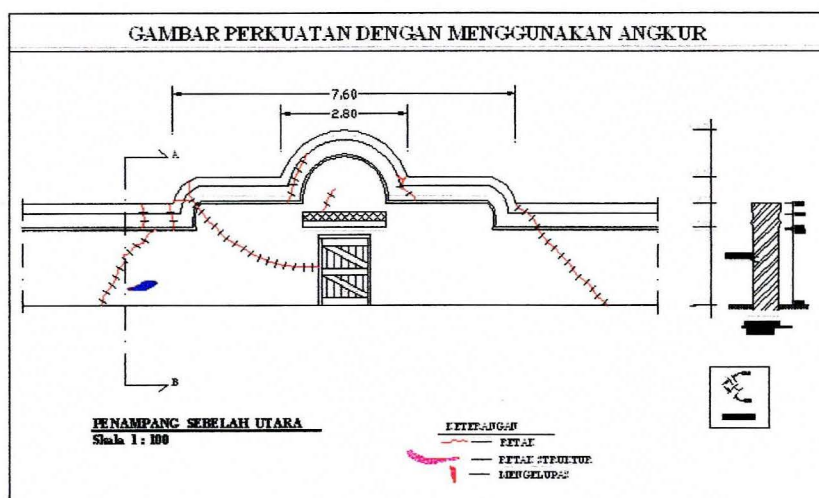
The recovery phase on damaged building in Taman Sari complex consists of three projects.

1. Rehabilitation and Conservation

The rehabilitation project covers the architectural rehabilitation and structure rehabilitation on the damaged culture heritage place by restoring the buildings without ignoring its form authenticity and stabilizing the structure of the culture heritage place concerning the damages without changing the construction. The works are injection, joining without dowel, joining with dowel, filling, replacement and preserving. The targets of these works are:

- The east mosque' fence
- The north side of Gedong Temanten
- The south fence of Gapura Panggung
- Gedong Sekawan on northwest side
- Gedong Sekawan on southwest side

- Gedong Sekawan on the northeast
- Gedong Sekawan on the southeast
- The north and west fence of Gedong Sekawan' yard
- Gerbang Carik fence
- Gedong Carik gate
- Gedong Madaran
- Pasiraman Umbul Binangun

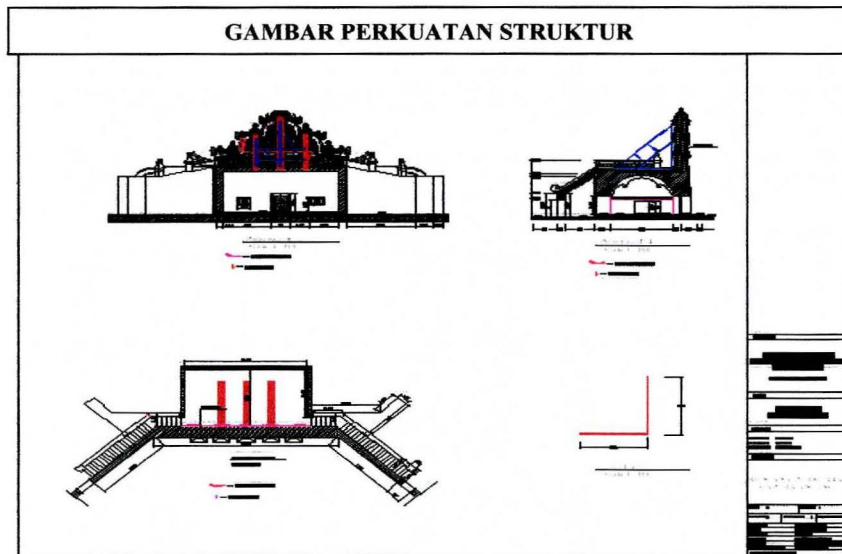


(Reinforcement using dowel)

2. Consolidation and conservation

The consolidation is aimed to reinforce the structure of culture heritage place. The earthquake has effected the strength of the structures. The addition of the permanents reinforcement or a new construction and foundation consolidation are implemented with some considerations of the building authenticity to preserve the historic and culture values. The targets of the works are:

- Gapura Agung
- Gapura Panggung
- Pulo Kenanga

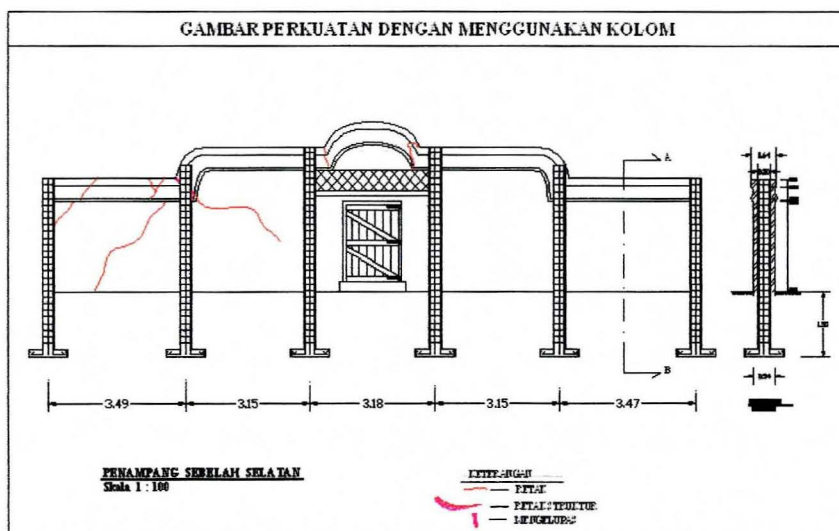


(Structure reinforcement)

3. Consolidation, reconstruction and conservation

Reconstruction is a project which is aimed to recover the architecture by restoring the fabric to the original form. The restoration is conducted by the remains analogy. While conservation is all attempts to preserve the culture heritage place and to avoid the deterioration of the material which can influences the building stability. The targets of the works are:

- Pongangan Peksi Beri
- Pulo Panembung
- Pagar benteng utara masjid



.(Reinforcement using column)

Buffer Space

The buffer space is created by clearing the new buildings which are located in the culture heritage place.

- (1) The new buildings which stick on the Taman Sari are demolished. On the disaster (earthquake) condition the new buildings will cause a bad effect to the weak structure of Taman Sari.
- (2) The creation of the buffer also concerns with the risk preparedness. The impact of the earthquake is that the building will collapse so that the buffer space is needed to avoid the danger of the collapsed building. The width of the buffer space is the same with the height of the building. In fact the new buildings near the Taman Sari Water do not fulfill the requirement of the buffer area.

Budget Planning

TOTAL ESTIMATIONI:

1. Pongangan Peksi Beri	Rp	159,250,000
2. Pulo Panembung	Rp	754,590,000
3. Pulo Kenanga	Rp	2,549,925,000
4. Gapura Agung and the Fence	Rp	445,740,000
5. Gedong Sekawan (4 buildings+fence)	Rp	1,134,720,000
6. Gapura Panggung and the Fence	Rp	375,540,000
7. Gedong Temanten (2 buildings) and the fence	Rp	328,430,000
8. Gedong Madaran and Gerbang arik	Rp	6.000.000
9. Buffer Space	Rp	5.637.750.000
TOTAL	Rp	11.391.945.000

CHAPTER V

RECOMMENDATION

Based on the technical study on Tamansari after the earthquake, some recommendations can be considered to implement. The recommendations are:

1. The rescue of the collapsed buildings and the nearly collapsed buildings are needed considering the aftershocks that may happen. The restoration is conducted using traditional materials and technical construction if it is possible.
2. A comprehensive master plan is basic need in conserving the site considering the significant, the community's aspiration and the result of the studies. These matters will facilitate a well-organized implementation. The socialization to the public to increase the public awareness is part of conservation of this site.
3. A need of revision on SK Mendikbud No. 157/M/1998 dated 1 July 1998 which concern with determining the site and Culture Heritage place in Yogyakarta special province dealing with the boundary of Tamansari site. It states that Tamansari includes Kampung Taman. It should be revised that Tamansari includes Kampung Taman, Kampung Ngadisuryan and Kampung Suryoputran. This revision is based on the original condition of Tamansari.
4. A need of conservation board to manage Tamansari which consists of governmental institution and NGOs who have a big concern in Tamansari preservation. Yogyakarta Palace will become the coordinator as the owner of Tamansari.

Yogyakarta, March 2007

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