

BHUTAN

Wangduephodrang Dzong Seriously Damaged by Fire

A tragic fire accident on June 24, 2012 led to the loss of one of the most important and historic heritage sites in Bhutan, the Wangduephodrang Dzong. It is one of the historically and architecturally most significant dzongs (Buddhist fortified monasteries) found in the Himalayas. Fortunately, all the precious nangtens (relics) were saved. In the meantime, considerable funds have been provided for the reconstruction of the Dzong. The Ministry of Home and Cultural Affairs of Bhutan undertook a detailed documentation and assessment of the condition of the remaining structure of the Dzong from July 5, 2012 onwards. A comprehensive report on the findings of the survey was prepared and



Wangduephodrang Dzong, the fire of June 24, 2012
(photo: Dawa Knight)

submitted to the government. According to the Ministry of Home and Cultural Affairs the main objective of this project is to rebuild Wangduephodrang Dzong to its former appearance incorporating state-of-the-art technology in terms of disaster resilience measures and traditional architecture (see also <http://www.mohca.gov.bt/?p=6206>).

The reconstruction works began in January 2014 and are expected to be completed within five years. Below is the above-mentioned report by the Division for Conservation of Heritage Sites (Department of Culture, Ministry of Home & Cultural Affairs, Royal Government of Bhutan), published October 15, 2012.



The ruins of Wangduephodrang Dzong after the fire
(photos: Yeshey Dorji, Choki Gyeltshen)

WANGDUEPHODRANG DZONG

(Concise Version)

**Survey for Remaining Structure of
Wangduephodrang Dzong
After June 24, 2012 fire**

15 October 2012

Division for Conservation of Heritage Sites
Department of Culture
Ministry of Home & Cultural Affairs
Royal Government of Bhutan

BREIF SURVEY REPORT OF WANGDUEPHODRANG DZONG - Following June 24, 2012 Fire

BRIEF SURVEY REPORT FOR REMAINING STRUCTURE OF WANGDUEPHODRANG DZONG - following June 24, 2012 Fire

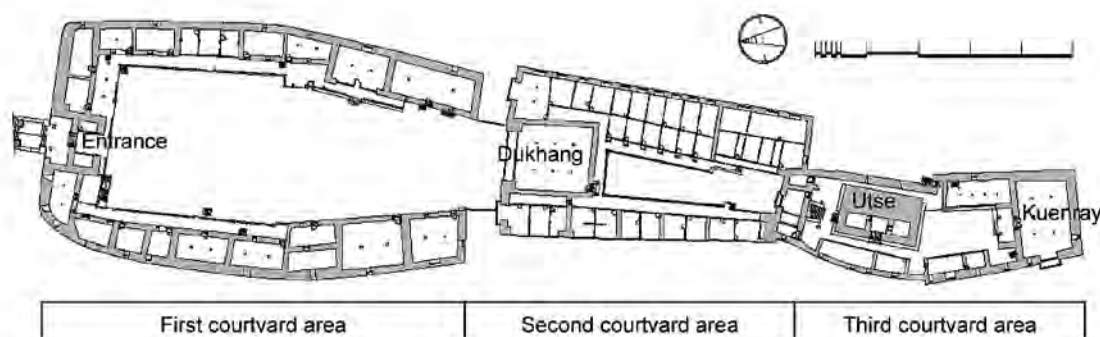
1. Wangduephodrang Dzong Fire

The fire which engulfed the entire Wangduephodrang Dzong on 24th June 2012 had started from the Census office, which was located on the first floor of the eastern *shabkhor* building surrounding the first courtyard area of the Dzong. According to the Royal Bhutan Police's investigation report, the fire started around 16:30 hrs due to electric short-circuits.

2. Description of the Survey

On receiving the instructions from His Excellency the Prime Minister of Bhutan to execute a detail survey of the remaining structure of Wangduephodrang Dzong, the Ministry of Home and Cultural Affairs deputed a team from the Division for Conservation of Heritage Sites (DCHS) under the Department of Culture to carry out the survey works. The team from the DCHS surveyed the Dzong as per the following schedule:

- Survey of the 1st Courtyard Area (Dzongkhag Administrative)
From 5th to 9th July 2012
- Survey of the 2nd Courtyard Area (Rabdey – Dukhang and drasha)
From 24th to 25th July 2012
- Survey of the 3rd Courtyard Area (Rabdey - Utse and Kuenray)
From 20th to 23rd August 2012



Purpose and Methodology of the Survey

The survey was carried out to document the condition of the remaining structure of the Dzong following the fire. This documentation would serve as the preliminary information to determine the possible extent of retaining and reusing the remaining structure while preparing the reconstruction master plan of Wangduephodrang Dzong. Thus, the survey focused on the following two areas:

1. To identify the heritage value of the remaining structure.

The survey focused on identifying the original and the subsequent phases of construction that had taken place as and when the Dzong was renovated in the past. The process of identification was carried out by diligently observing the remaining structure in relation to the available literatures and visual records on the Dzong. This

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study enables to determine which parts of the remaining structure should be given more priority in the context of retaining them for its heritage value.

2. To document the condition of the remaining structure and assess the extent of damages sustained by the structure.

All the damaged and the collapsed portion of the walls were documented to understand the physical damages caused by the fire to the structure. The condition of the remaining wooden members including ceiling timber components, which are inserted into the walls, were also surveyed to check traces of the residual burning, which eventually would contribute to weakening the walls due to continued exposure to heat from the residual fire. In the areas where the wooden components do not show any sign of residual burning, the chances are that the stone and earthen wall in this area will be less affected by heat.

3. Study on Heritage Value – I (Literatures & visual records)

Summary of Chronology of Wangduephodrang Dzong

- 1638 Construction (3rd courtyard)
- 1683 Extension (1st & 2nd courtyard, upper stories of Utse)
- 1767 Renovation
- 1783 Sketches by Samuel Davis
- 1837 Fire
- 1897 Earthquake
- 1905 Photographs by J.C. White
- 1952 Renovation (Kuenray, Dukhang, 1st courtyard)
- 1983 Renovation (2nd & 3rd courtyard)

Comparative Study of Visual Records

The sketches of Wangduephodrang Dzong drawn by Samuel Davis in 1783 and the photographs taken by John C White in 1905 allow us to compare the state of the Dzong before and after the two disasters in 1837 and 1897.

1. The structure flanking the entrance tower at the Level-3 were stone masonry walls prior to the disasters.
2. The *gorikha* and *gomang-rabsel* on the front façade of the entrance tower, which existed in 1783, were closed by stone masonry wall leaving a narrow entrance door before 1905.
3. The projected structure on the west façade which had existed before the disasters can no longer be seen in the photograph of 1905.
4. The existing front façade walls are part of the original extension undertaken by Gyalsay Tenzin Rabgye. (This can be confirmed from the two small holes at the northeast corner of the front façade, right below the *khemar*, which can be seen in the sketch of 1783, the photograph of 1905 and on the existing northeast walls of front façade.)

Two photographs of John C White taken in 1905 showing the inner façade view of the first courtyard are informative with regard to understanding the alterations undertaken during the renovation in 1952 and 1983. Despite major replacement of wooden components, no major change on the inner façade walls of the first courtyard can be found except for the following two areas:

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1. Both the walls adjacent to Dukhang building has been altered with the addition of the second floor.
2. It is likely that the front façade of the current Chamkhang (Level-1 of Area 01h) was constructed of rammed earth wall earlier instead of the present *ecra* wall.



A sketch drawn by Samuel Davis in 1783



A photograph taken by JC White in 1905



A photograph taken in 2010

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A photograph of the first courtyard (facing Dukhang building) taken in 1905



A photograph of the first courtyard (facing Dukhang building) taken in 2010

A photograph of the first courtyard (facing entrance) taken in 1905



A photograph of the first courtyard (facing entrance) taken in 2012



4. Study on Heritage Value – II (Findings during the survey)

Beside the information acquired from literatures and visual records, the following survey findings provide more insight to the past renovation works undertaken on Wangduephodrang Dzong. Some of the extracts of these findings are as follows:

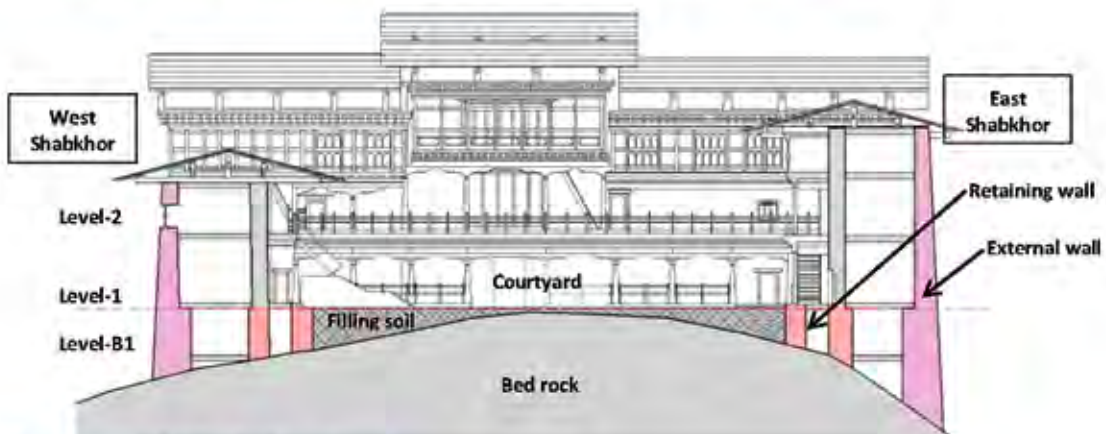
Rammed earth wall at the first courtyard

Although the walls of this Dzong are mainly of stone masonry, significant amount of rammed earth walls can be found at the eastern *shabkhor* (facing Dangchu River) of the first courtyard area, which is part of the original extension work undertaken by Gyalsay Tenzin Rabgay.

The mixed construction of rammed earth wall and stone masonry wall should be understood as efficient application of suitable materials for appropriate area. Assuming that acquiring a huge amount of stones was the major challenge for Dzong construction, use of stone might have been reserved for building up crucial and important areas, such external wall and retaining wall.



Rammed earth wall (indicated in yellow) and stone masonry wall at the Level-1



Cross-section for the first courtyard area

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It is important to note that use of different construction materials can be observed in some of the other ancient Dzongs in Bhutan. For example, Drukgyal Dzong and the ruin Dzong in Chubjakha, Paro has some of the inner walls constructed of rammed earth. A comparative study among the Dzongs in Bhutan could assist in providing more clarity to the use of different construction materials within an overall structure.



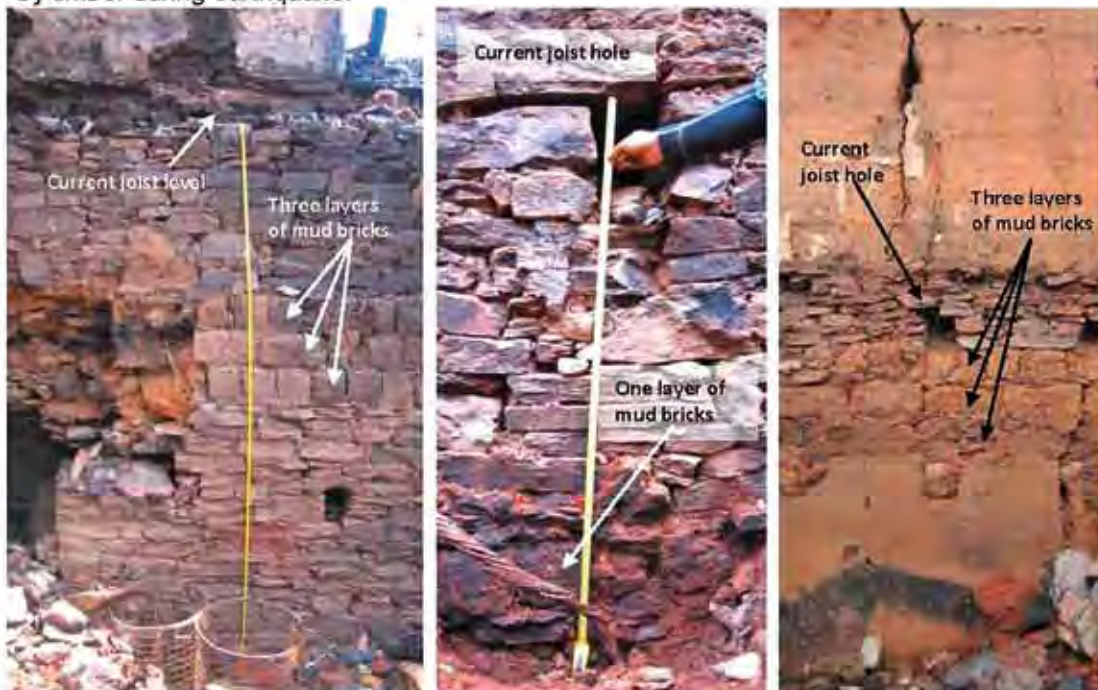
Inner wall of Drugyal Dzong, Paro



Inner wall of Chubjakha Dzong, Paro

Use of Mud bricks

The inner surfaces of the front façade walls of the first courtyard, which are of stone masonry are observed with a few vertical layers of mud bricks (*parchung*). Since the front façade walls are part of the original construction (as mentioned earlier in page 2), these *parchung* must have existed since the original construction. It has been observed that *parchung* layers are mainly around the area where the earlier joists were inserted. This insertion of *parchung* is assumed to make it easy to replace chams, or to reduce damage on the stone wall caused by timber during earthquake.

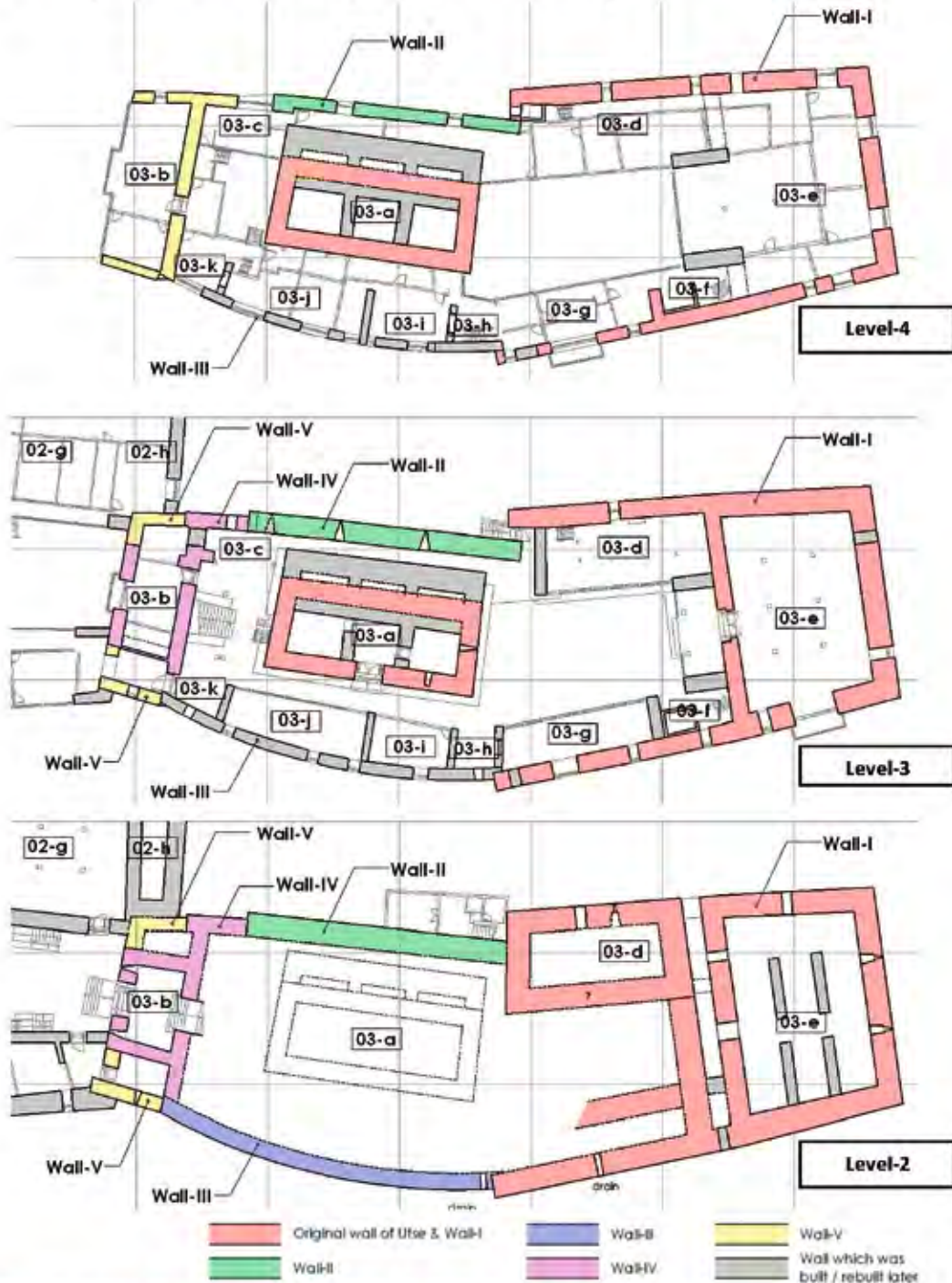


(Left) Inner surface of the front façade stone wall for Area01j
 (Middle) Inner surface of the front façade stone wall for Area01b
 (Right) The rammed earth wall on the opposite side of the wall in pic40

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Different phases of construction at the third courtyard

The *shabkhor* building around the third courtyard provides evidence to assume that parts of the *shabkhor* building were constructed at least in three different phases or period, which has taken place from 1638 to 1683, as shown in the drawing below.



Different phases of wall construction (Wall-I to Wall-V) at the third courtyard area

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5. Survey of Damages

The fire has extensively damaged the Dzong. While the majority of the masonry walls remain standing, almost all the timber components have been destroyed. The damages have been documented on the attached drawing.

Damage caused by failed lintel

The majority of the damage to the walls was caused by failure of the wooden lintels over windows and doors, these lintels were severely burnt and therefore provided very little support to walls above. Such damages are common in all the three courtyard areas. In most cases, where lintels located on the upper wall were completely burnt, the entire wall above the lintel collapsed, this usually triggered further collapse of nearby walls. On the other hand, where lintels located on the lower wall were completely burnt, the collapse of stone wall above the lintel were generally partial with formation of an arch or semi-dome shape damage.



(Left) Collapse of stone wall above a lintel with formation of arch – Area01m at Level-1

(Middle) Collapse of stone wall above a lintel with formation of semi dome – Area01l at Level-1

(Right) Collapse of entire stone wall above a lintel – Area02c at Level-2

Heat Damage

All internal walls above the courtyard levels show signs of heat damage, with many visible hairline cracks or fragmentation of individual stones. The extent of this damage varies with location, presumably correlating with the intensity of the fire.

Wooden Components

Nearly all wooden components above the courtyard levels have entirely burnt to ash. There is very little timber remaining among the debris. However, few rooms survived at the Level-1 of the second courtyard area particularly to the western side.

The floors over the basements sustained local damage due to fire or falling debris. For instance, the floor of Kuenray at the third courtyard area has failed.

Generally, it is expected that there will be minimum to no damage to the walls below the courtyards, where the floors were not affected by the fire.

Mud Plaster

Mud plaster, which previously covered all internal walls, was missing in large areas. However, in some locations the plaster remained almost entirely intact or in large patches. This suggests either a different quality of plaster or a different intensity of the fire at these locations.

Mud Mortar

The mud mortar of the stonework has become very hard. These properties are very similar to that of fired clay, suggesting that the fire has hardened the mortar, however no mortar from before the fire was available for comparison.

6. Way Forward

Wangduephodrang Dzong is one of the most important heritage buildings in Bhutan. This Dzong is not only important due to its historical and religious significance aspect, but also from the fact that this dzong is an irreplaceable information source for Bhutanese architecture. Out of the Dzongs built by Zhabdrung Ngawang Namgyal, Wangduephodrang Dzong has provided us the best evidence to study the chronology of construction, which could be the main foundation to understand the architectural characteristics and medieval history of Bhutan.

Therefore, it is very crucial to carefully determine which part of the remaining Dzong structure should be retained and reused while reconstructing the Dzong especially from the structural stability aspect and the heritage value of the structure. In addition to the above, it is also important to look into cost and time factor for the reconstruction of the overall Dzong structure especially in the context of avoiding total reconstruction of walls which are structurally stable.

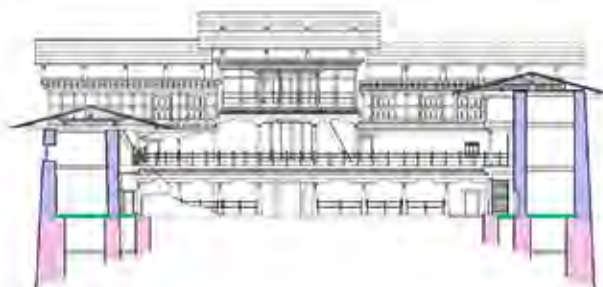
In exercising the Royal Government of Bhutan's plan to have two World Heritage sites in Bhutan in the 10th FYP period, Wangduephodrang Dzong together with four other Dzongs in Bhutan (Punakha Dzong, Paro Dzong, Trongsa Dzong and Dagana Dzong) has been put up on the Tentative List of the World Heritage sites in Bhutan since March 2012. These five Dzongs have been submitted as a serial heritage sites under the title "Dzongs: the centre of temporal and religious authorities". The Tentative List is a part of the preliminary procedure for nominating the sites to the World Heritage. Therefore, the reconstruction of Wangduephodrang Dzong should also take into consideration that there is minimal loss of heritage values associated to this particular Dzong, and also the loss of overall "outstanding universal values" of the five Dzongs as a serial heritage site.

Proposed walls to be retained

Taking the heritage value of each wall, which has been examined, in the earlier chapters into account, the following walls are identified to be retained and reused for the reconstruction of the Dzong:

- **Walls below the courtyards**

The external walls below the courtyard levels show no signs of bulging or major damages. The fire has minimally affected the walls located below the courtyards, as it is evident from the state of wooden floorings of the ground floors, most of which have remained after the fire. Reuse of the walls with minor repair at this level is also recommendable from financial aspect. The stone masonry work for the current walls below the courtyard levels is roughly estimated of 14,000 cubic-meters, which is almost equivalent with the walls above the courtyard levels.



Estimate for amount of wall

Above the courtyard levels (blue):
 For the first courtyard area= 4,358 m³
 For the second courtyard area = 5,078 m³
 For the third courtyard area = 4,124 m³

Below the courtyard levels (red):
 For the first courtyard area= 6,057 m³
 For the second courtyard area = 4,336 m³
 For the third courtyard area = 3,569 m³

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- External walls of the ground floors

Most of the external walls of the ground floor level except which had been reconstructed in the past are also reusable, though minor repair is required.

- Rammed earth walls around the first courtyard area

Rammed earth wall at the first courtyard area is expected of the extension work in 1683. As it will be served for a future study on medieval construction especially when compared with other Dzongs and buildings which were built of a mixture of construction materials, it is highly recommended to retain these rammed earth walls. Although the walls of the Level-1 have been deteriorated by fire-fighting water and subsequent rain, the rammed earth walls on the Level-B1, which is in good condition, should be maintained.

- Walls of the original Utse

As the original wall of Utse is the most significant part of this Dzong, appropriate measures should be taken to reuse this wall. Despite the sign of damage on stones which shows peeling off the surface of stone, it is expected that core of the wall is intact.



(Left) Eastern external wall of the first courtyard area: The ground floor level downward (below the khemar) is in good condition

(Middle) Rammed earth wall at Level – B1 located between Area01b & 01c

(Right) Utse

6.2 Way Forward

Prior to planning the reconstruction of Wangduephodrang Dzong, the following measures are highly recommended to be undertaken:

- Inviting international experts

The structural evaluation from international organization such as ICOMOS (International Council on Monuments and Sites, an advisory body to UNESCO) and its Scientific Committees is highly recommended to assist Bhutan to further strategize the nomination of Wangduephodrang Dzong to the World Heritage List.

It is also recommended to obtain a second opinion from such international experts with regard to the structural stability of the existing walls of Wangduephodrang Dzong. Furthermore, international experts recommendation can be sought on seismic and fire prevention measures to be put in place while reconstructing the Dzong.

- Establish comprehensive system for fire prevention in traditional buildings

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On reviewing the fire of Wangduephodrang Dzong, it is highly recommended that fire prevention measures and facilities should be studied justifying the pros and cons of implementing these measures.

For instance, it is highly recommended that alternate non-flammable material be used for the construction of lintel for doors and windows in the light of reducing major damages that are caused by the failure of wooden lintel during and after a fire. However, it may not be required to extend the use non-flammable materials to the overall frames of door and window, as the amount of wood used for these frames does not cause considerable damage to the overall structure in case of a fire.

Similarly, although it was observed that the flammable roofing material (traditional wooden shingle) made the fire bigger, there is high possibility that the fire could have spread over much faster if the roofing material was of non-flammable material. Non flammable material obstructs the natural flow of highly heated and expanding air thereby causing the fire to move in the horizontal direction below the roof in a remarkable speed.

Furthermore, such fire prevention measures should be incorporated effectively along with establishing a thorough fire fighting mechanism and system. For instance, installation of fire walls which would obstruct a fire spreading over the structure will effectively function only when a fire-fighting plan is well collaborated with the location of the fire wall.

- **Material tests for scientific study of traditional construction techniques and materials**
In most of the cases, disasters usually assist to review and examine the structural context and the performance of a building. The existing ruins of Wangduephodrang Dzong is one of the most potential site that can assist to understand Bhutanese stone masonry structure and rammed earth structure by undertaking necessary scientific study at the earliest. It is necessary to extract specimens for test from the remaining walls, which will be destroyed, for reconstruction purpose.

- **Seismic resistance measures**
It is of utmost importance that the effective seismic resilient measures are incorporated during the reconstruction of Wangduephodrang Dzong. Although the Division for Conservation of Heritage Sites under the Department of Culture is undertaking the structural analysis of Bhutanese traditional building with a group of Japanese experts, further consultation with the international experts could be undertaken to get more recommendations in the field of incorporating seismic resilient features in the traditional construction techniques and materials of Bhutan.