

PEMA GATSHEL DZONG CONSTRUCTION PROJECT (2012 - 2020)



Heritage Sites and Archaeology Division
Department of Culture and Dzongkha Development
Ministry of Home Affairs
Royal Government of Bhutan

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1 INTRODUCTION

1.1 BRIEF BACKGROUND OF THE PROJECT

Dzongs have played significant roles in the history of Bhutan as well as in daily lives of the Bhutanese people. Over the ages Dzongs have been used as the centre for administration and monk body of the Dzongkhag whereby standing out to be the most important building in the Dzongkhag. Dzongs are also seen as an important identity for the Dzongkhag. Pemagatshel Dzongkhag is one of the few dzongkhags in the country that does not have a structure which architecturally and culturally represents a Dzong. After many surveys on geophysical characteristics, water sources, human settlements, etc. the site was identified at Denchi under Shumar gewog. Pemagatshel Dzong construction project was initiated in the 10th FYP, and the project has spanned over three plan periods; 10th, 11th and 12th FYP's.

The establishment of a Dzong will greatly enhance the significance of the Dzongkhag. It will also serve and improve Dzongkhag's civil and religious administrations and functions by replacing the existing building which has severe space problems and barely has the status of a Dzong and its operations. The main objective of the project was to construct a Dzong which is to be an administrative center for the Dzongkhag with a design reflecting the finest interpretation of traditional Bhutanese architecture in the modern context.

1.2 OUTLINE OF THE PROJECT

Project Title	: Pemagatshel Dzong Construction Project
Location of the Project	: Denchi, Pemagatshel
Main activities of the Project:	Preparation of design and drawings
	: Tendering to consultants and contractors (suppliers)
	: Construction of the Dzong
	: Overall site development works

Implementing agency	:	Department of Culture and Dzongkha Development, Ministry of Home Affairs in close coordination with Pemagatshel Dzongkhag.
Funding Agency	:	Royal Government of Bhutan
	:	Government of India
Total Approved Budget	:	Nu. 715 million
	:	Nu. 530 million (Government of India)
	:	Nu. 185 million (Royal Government of Bhutan)
Total Expenditure	:	Nu. 672.451 million (for the works implemented by the Department of Culture)
	:	Additional budget of Nu. 44.236 million in addition to the remaining Nu. 42.549 million has been utilized by the Dzongkhag for the procurement of Nangtens, furnishing and interior works, installation of HVAC and other remaining works.
Project Duration	:	July 2012- December 2020 (9.5 years)
Handing taking	:	Officially handed over to the Dzongkhag in October 2021.

1.3 PROJECT MANAGEMENT

1.3.1 Executing Agency of the Project:

The Ministry of Home Affairs was the main executing agency of the project. Under the chairmanship of the secretary of the Ministry of Home and Cultural Affairs, Pemagatshel Dzong construction project steering committee is responsible for discharging administrative, technical, financial and organizational duties of the project. The steering committee comprised the following:

Chairman:

Tshering Dorji, Secretary for Ministry of Home Affairs

[2014 - 2015]

Dasho Sonam Tenzin, Secretary for Ministry of Home Affairs

[2015 - 2016]

Dasho Sonam Topgay, Secretary for Ministry of Home Affairs

[2016 - 2020]

Other members:

Director General/Director, Department of Culture and Dzongkha Development

Dzongdag, Pemagatshel Dzongkhag

Representative, Gross National Happiness Commission

Representative, Ministry of Finance

Representative, Department of Forest and Park Services or NRDCL

Head, Heritage Sites and Archaeology Division

Project Manager, Pemagatshel Dzong Construction Project

1.3.2 Implementing agency

The Heritage Sites and Archaeology Division (HSAD) was the main implementing agency of the project. Under the division, an implementing team was formed for effective implementation of the works as follow:

Project Manager

- Kinley Wangchuk : 2012-2014
- Lhaten Dorji : 2014-2021

Project Architect:

- Pema : 2012-2014
- Jamyang Singye Namgyel : 2015-2019

Project Engineer:

- Kencho Tseten : 2012-2016
- Tshering Choki : 2017-2018
- Damcho Penjor : 2016-2020

- Tshering Namgay : 2019-2020

Project Accountant:

- Late Karma Dorji : 2012-2020
- Tshering Dorji : 2020

Consultancy Service for design and periodic supervision

- Bhutan Architectural Services and Infrastructural Consultancy (BASIC)

1.3.3 Project Objectives:

1. To construct a Dzong which is to be an administrative and monastic center for the Dzongkhag with a design reflecting finest interpretation of Bhutanese traditional architecture in modern context.
2. Improve and enhance administrative and religious functions in the Dzongkhag

1.3.4 Scope of works

The scope of the work for the project includes the following activities:

1. Preparation of Design and Drawings (Architectural, Structural and electrical)
2. Preparation of BoQ and Estimates.
3. Construction of the Dzong complex including fixtures and finishes
4. Publication of the project report

2 INCEPTION OF THE PROJECT (DESIGN AND DRAWINGS)

2.1 HISTORICAL TIMELINE OF THE PROJECT



2.2 LOCATION

The site of an area of 6.5 acres is located at new Denchi town which is 19 km away from the old Pemagatshel town. The site is identified as per the new town planning of Denchi land and it is acquired from the public for the Dzong construction. The Dzong site is strategically located within the overall town plan.



Figure 1. Site location (Google image)



Figure 2. Master plan (MoWHS)



Figure 3. Conceptual Plan

2.3 AREA PROGRAMING (SPACE SPECIFICATION FOR DZONG)

The area and spatial needs were determined after extensive discussions with the Dzongkhag in alignment with the HR plan for the Dzongkhag. Initially, the proposed space requirements focused on establishing the Dzong as primarily an administrative headquarters for the Dzongkhag, with accommodations for only 5 monks from the Rabdhey and a lhakhang to serve the planned new town at Denchi. Subsequently, the space requirements for the monks expanded to 50 individuals, including the incorporation of an Utse within the new Dzong, with the overarching goal of consolidating both the Dzongkhag administration and Rabdhey facilities in the Dzong complex.

Space specification & minimum area requirement

Sl.no	UNITS	SPACES	Optimum Area (m ²)	REMARKS
1	Secretarial Unit	Dasho Dzongda office with toilet attached	60	* incl. of lounge
		PA and messenger for Dzongda (incl. waiting area)	30	has to be provided next to Dzongda
2	Administration Unit	Dasho Dzongrab's office with toilet attached	40	
		Procurement Officer	20	
		Admin. Assistant (3nos.)	15	
		Store Keeper	12	
		Library (incl. of space for librarian)	50	* common library
		Store for Procurement	30	
3	Finance Unit	Accounts Officer	20	
		Budget Officer	20	
		Account assistance	50	
		store	20	
4	Auditing	Internal Auditor	20	
		Room for Auditing	20	
5	Planning Unit	Planning Officer 1	20	
		Planning officer 2	20	
		Assistant Statistical Investigator	20	
6	Disaster Unit	Disaster Focal person	20	
		Store	15	

Sl.no	UNITS	SPACES	Optimum Area (m ²)	REMARKS
7	Human Resource	Human Resource Officer	20	
	Unit	Assistant Human Resource Officer (2nos)	15	
		Adm. Assistant	12	
8	Legal Unit	Assistant Legal Officer	15	
9	Cultural unit	Cultural officer	20	
		Assistant	12	
		Store	25	
10	Environ. Unit	Environment Officer	20	
11	Election Unit	Election Officer 1	20	
		Election Officer 2	20	
		Electoral Registration Officer	15	
		Delamination Assistant/Clerk	12	
		Store	30	
12	Revenue Unit	Revenue Inspector	20	
		Revenue Section	25	
13	ICT Unit	ICT Officer	20	
		ICT Technical Associate	15	
		Server room	20	
14	Education Unit	Education Officer	20	
		Asst. Education Officer (3nos.)	30	
		Office Assistant	15	
15	Health Unit	Health Officer	20	
		Asst. Health Officer	12	
16	Civil Registration	Civil Registration and Census Officer	20	
		Admin. Assistant (2 nos.)	25	
17	Land record Unit	Dzongkhag Land Registrar	20	
		Land Record Assistant	12	
		Surveyor	12	
Sl.no	UNITS	SPACES	Optimum Area (m ²)	REMARKS
		Store	20	

18	Agriculture, Forest & Livestock Unit	Dzongkhag Agriculture Officer	20	
		Assistant Agriculture Officer	25	
		Dzongkhag Forestry Officer	20	
		Assistant Forestry Officer	25	
		Dzongkhag Livestock Officer	20	
		Assistant livestock Officer	25	
		Store	20	
19	Engineering Unit	Dzongkhag Engineer (Civil)	20	
		Deputy executive Engineer	15	
		Engineer	12	
		Assistant/Jr. Engineer (Civil) 12 nos.	60	
		Assistant/Jr. Engineer (Electrical) 2 nos.	15	
		Building Inspector	12	
		Surveyor	12	
		Technician (9 nos.)	36	
		Store keeper	12	
		Store	25	
20	Police Unit	Office for Police SP with toilet attached	30	
		Police general Office	50	
		Store	20	
21	Tshogdu Unit	Office for DYT Chairman with attached toilet	30	DYT hall
		Secretary to Chairman (<i>incl. of waiting area</i>)	20	
		store	20	
Sl.no	UNITS	SPACES	Optimum Area (m²)	REMARKS
22	Common Hall	DYT hall	200	* Should have easy access
		Dzongkhag Conference room	100	Should be centrally located

23	Common Reception	Gorago	60	* Main entrance to the Dzong
		Dispatching/Reception	20	* One for each entrance if there is more than one entrance
		PABX	20	
		Electrical room	15	
		Security	15	
24	Others	Dzongkhag General Store	90	
		WC Male (<i>incl. of wash area</i>)	15 each	* Should provide Adequate no. of WC's as per standards on each floor
		WC female (<i>incl. of wash area</i>)	15 each	
		Canteen (<i>incl. Store and Kitchen</i>)	80	
25	Rabdhey	Lhankhang	90	should be provided in the Utse
		Room for a Lopen (<i>incl. of bedroom and sitting</i>)	40	* Include a small pantry also
		Room for a Koenyer/kangjub	12	
		Rooms for 18 monks (<i>9 rooms- 1 room 2 monks</i>)	108	* 12 sqm. For each room
		Dining (<i>inclusive of washing area</i>)	40	* for all the monks residing in the Dzong
		Kitchen (<i>incl. of store and washing area</i>)	30	
		Toilets (<i>incl. of Bathing space</i>)	15 each	* Adequate nos. for 20 monks

Note: The area provided for each space is the minimum area required and actual area may vary depending upon the design of the building but the area provided should not be less than the specified area

2.4 DESIGN PROPOSAL

2.4.1 Tendering procedure for outsourcing design works

The work for preparing design and drawings was outsourced to a local architectural firm through open tendering procedure and the following 3 firms participated in the bid:

- i. PRCS (Progressive Research & Consultancy Services)
- ii. BASIC (Bhutan Architectural Services & Infrastructural Consulting)
- iii. CCBA (Christopher Charles Benninger Architects Pvt. Ltd)

The evaluation of concept design (technical proposal) was carried out in two stages as stated below:

Stage 1 - Evaluation by the technical team from the Department of Culture

Stage 2 - Evaluation by the High-Level Committee mainly comprising of the following:

- Dasho Penden Wangchuk, Hon'ble Secretary, Ministry of Home and Cultural Affairs
- Dasho Dr. Sonam Tenzin, Hon'ble Secretary, Ministry of Works and Human Settlement
- Dasho Karma Tshetrim, Hon'ble Secretary, Gross National Happiness Commission Secretariat

Among the three aforementioned firms, only two successfully advanced to the second stage presentation before the High-Level Committee. A copy of the presentation of the concept by each firm is attached as annexure.

To emphasize the design aspect, the evaluation criteria was adjusted, with 70% of the weightage assigned to the technical proposal and 30% to the financial proposal. This adjustment received special approval from the Ministry of Finance.

The work for design and drawings have been awarded to the Bhutan Architectural Services and Infrastructure Consulting (BASICS) upon scoring highest in the evaluation.

2.5 INITIAL DESIGN

Originally, the concept for the new Dzong primarily centered on serving as the administrative headquarters for the Dzongkhag, accommodating space for five monks from the Rabdhey, and featuring a lhakhang to meet the needs of the planned new town at Denchi. The primary focus of the new Dzong's spaces was intended for Dzongkhag administration, with the anticipation that the old Dzong would undergo renovation and be entrusted to the Dzongkhag Rabdhey.

Therefore, in the initial architectural design, there was no specific central structure designated as an Utse; instead, a lhakhang was positioned towards the rear of the Dzong complex. The right and left wings of the complex were interconnected by the Zerey.

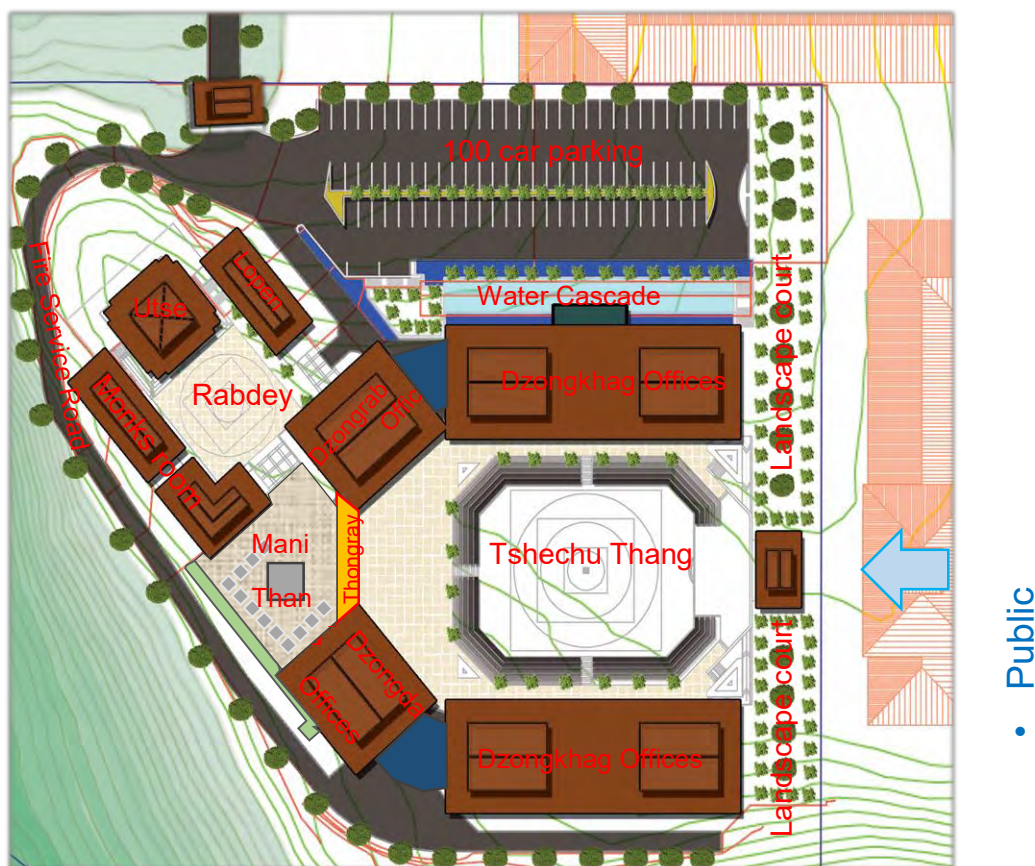


Figure 4. First design layout plan



Figure 5. 3D view of first design of dzong complex

2.6 REVISED DESIGN

In November 2012, both the Dzongkhag and the Zhung Dratshang made formal requests to the Ministry for an expansion of the space designated for the Rabdhey monks in the new Dzong. They also sought the inclusion of an Utse in the design of the new Dzong, with the aim of consolidating both the Dzongkhag administration and the Rabdhey monks under one roof. The revised drawings for the new Pemagatshel Dzong was subsequently presented and discussed during the Project Steering Committee meeting held on March 16, 2014. It was also submitted to the Hon'ble Minister for Home Affairs for further guidance and directives. The proposed height of the Utse in the revised design measures 24.862 meters from ground level. In terms of functionality, this revised Utse comprises four floors, with each of the upper three floors having a height of 4 meters, while the ground floor stands at 6 meters in height. To address the challenges posed by the steep gradient of the land, the proposed Utse is elevated by 6.862 meters from ground level, necessitating the inclusion of two underground floors with a height of 3 meters each, which was filled and integrated into the structure.



Figure 6. 3D view of revised design



Figure 7. 3D view of revised design

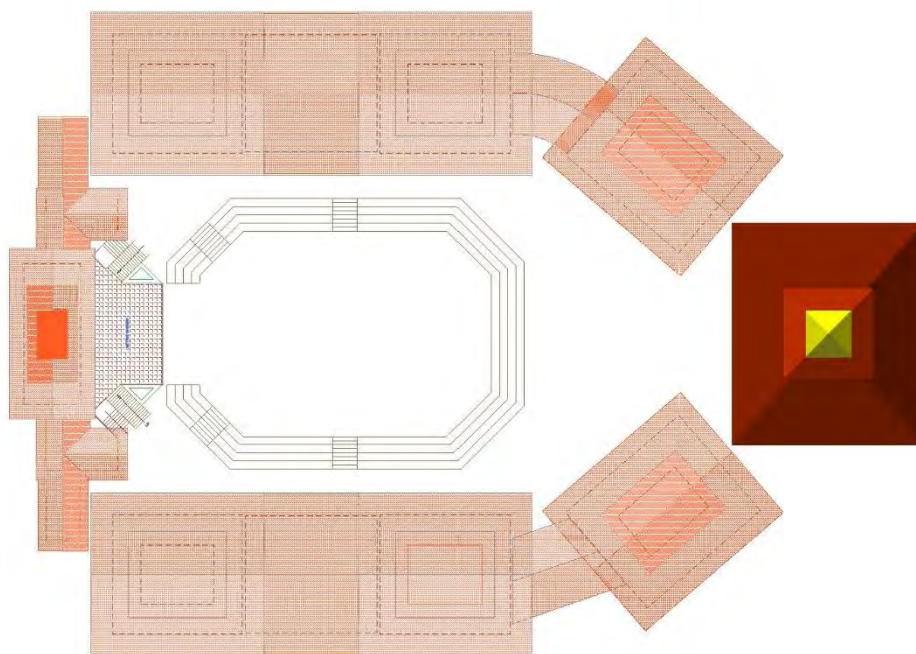


Figure 8. Layout plan of main dzong complex

2.7 DESIGN FEATURES OF THE DZONG

The primary emphasis in designing the Pema Gatshel Dzong was to create a Dzong that embodies the essence of the 21st century and reflect a harmonious blend of modern construction technology using modern materials and incorporation of essential Bhutanese architectural elements. This included the utilization of contemporary materials such as concrete and steel, the integration of sustainable design principles that align with the site and climatic conditions, and the implementation of crucial safety systems. These measures were deemed essential for safeguarding and preserving any heritage structure from natural calamities as well as fire and earthquake.

Besides these modern features in the Dzong, the traditional features like the courtyard system, the multi-tier floating roofs and tapering walls were also incorporated.

Site condition and Urban setting

The Dzong is strategically located and the design and layout is meticulously planned that harmonizes seamlessly with the town planning of Denchi. This impressive structure, characterized by its substantial size and distinctive architectural style, exudes grandeur and prominence.



Figure 9. Layout of the dzong complex



Figure 10. Layout of the dzong complex with respect to Denchi town

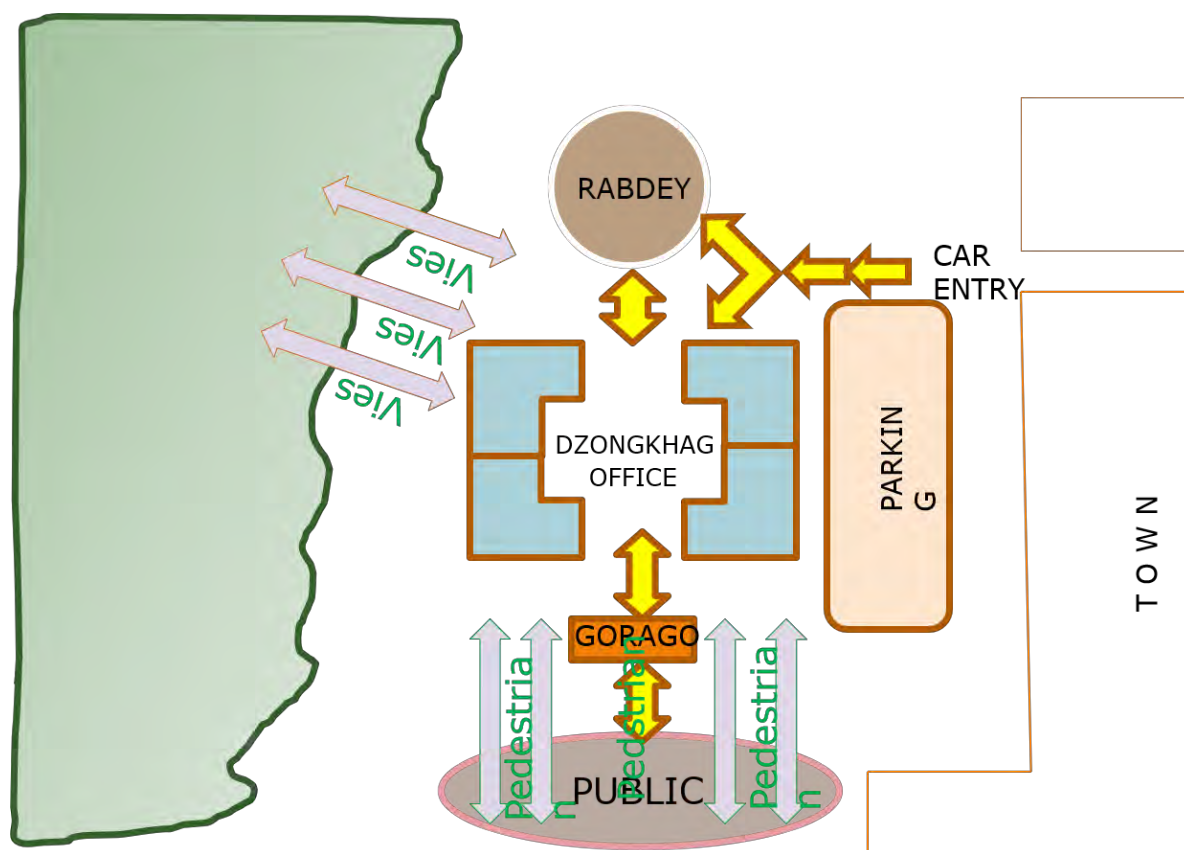


Figure 11. Space zoning of the Dzong.

Sustainable design

Considering Pema Gatshel's warm climate especially during summers, there has been meticulous attention given to the construction of energy-efficient buildings. The primary focus has been on incorporating thick walls and strategically orienting the buildings away from direct sunlight.

Furthermore, the architectural design includes a thoughtful passive design for the atrium, primarily aimed at maximizing natural light and ventilation, thereby reducing energy consumption. Atriums have been designed in 4 of the biggest blocks in the complex. Block A and B has an atrium spanning 5.7 meters by 6.5 meters and runs all the way to the attic floor from the ground floor. The purpose of this atrium is to aid in the circulation of hot air during the summer. Further, this design facilitates the upward movement of hot air during the summer months, which can help with the cooling of the building. Similarly, Block C and E are the longest blocks in the complex and have 2 atriums located in one block spanning 5 meters by 7 meters and runs to the attic floor from the ground floor.

Overall, the inclusion of these atriums in the complex's design is intended to enhance natural ventilation and cooling, especially during the hot summer months, by allowing hot air to rise and escape through the atriums, thus creating a more comfortable and energy-efficient environment within the buildings

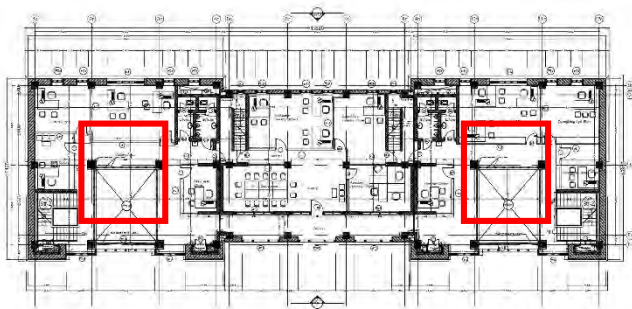


Figure 12. Floor plans of Block C with two atriums



Figure 13. Atrium in block A.

Accessibility

One of the biggest challenges in heritage buildings in Bhutan is the accessibility for differently abled people. Since most of the Dzongs were built mainly for defensive purpose, the need for ramps and comfortable pathways and stairways was not

considered. The main entrance (gorago) into the Pema Gatshel dzong has two ramps on both sides of the main entrance, designed specifically to cater to the needs of differently abled people. Another important aspect to consider is the incorporation of a minimum of two staircases within each block. This measure would prove invaluable in emergency situations, ensuring the safety and efficient evacuation of occupants when needed.

3 IMPLEMENTATION ON SITE

3.1 CONSTRUCTION PHASES: OVERALL



Figure 14. 2012-site clearing



Figure 15. Construction site in 2013



Figure 16. 2014- Construction site in 2014



Figure 17. construction site in 2015



Figure 18. construction site in 2016



Figure 19. Construction site in 2017



Figure 20. Construction site in 2018



Figure 21. Construction site in 2019



Figure 227. Construction site in 2020



Figure 23. View from west

3.2 PHOTOGRAPHIC DOCUMENTATION OF THE DZONG COMPLEX

Overall view of Pemagatshel Dzong complex

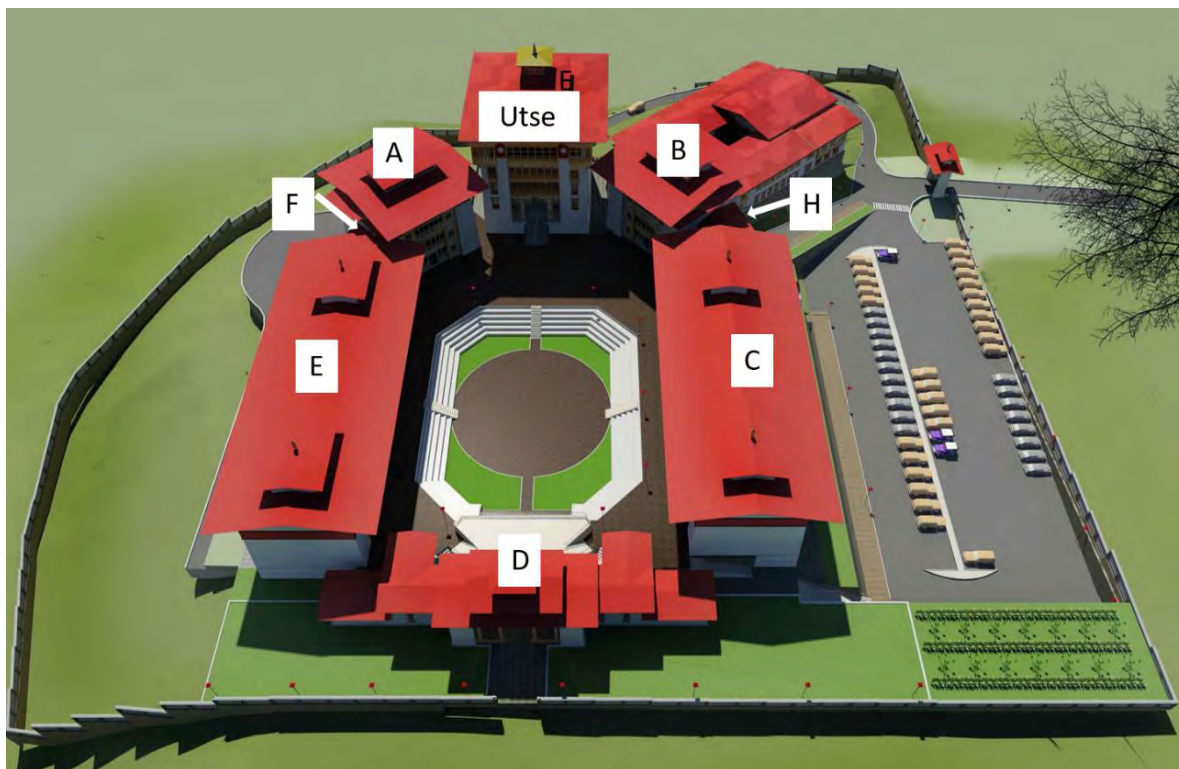


Figure 24. 3 D view of proposal



Figure 25. Overall view of Dzong from west



Figure 26. Front View of Utse, Block A & B from block D



Figure 27. View of Block from left C, D & E from Utse



Figure 28. Night view from west

3.3 ELECTRICAL REPORT OF THE DZONG

Executive Summary

The electrical work undertaken for the Pema Gatshel dzong was conducted in accordance with established protocols, utilizing high-quality electrical equipment and materials. This approach was adopted primarily to safeguard the dzong against potential electrical issues in the future.

We executed the wiring using High-Density Polyethylene (HDPE) concealed wiring, employing standard wire sizes and ensuring the installation of control gears with appropriate ratings. In addition, we implemented LED lighting fixtures, along with modular switches and sockets, to enhance illumination and simplify maintenance procedures.

We installed Low Voltage panels to facilitate the swift shutdown of electric power in the event of faults or emergencies. These panels not only aid in seamless operation but also streamline maintenance efforts. Further, extensive testing was conducted on the installed electrical system to guarantee its reliability and robustness, reducing the need for frequent maintenance.

Wiring

We have implemented High-Density Polyethylene (HDPE) concealed wiring for the Pema Gatshel Dzong project. To ensure safe and efficient electrical connections,

Flame-Retardant Low Smoke (FRLS) cables were employed, conforming to standard cable sizes for light points, power points, and switchboards. It's crucial to emphasize that individual cables were dedicated to each light point, power point, and switchboard without resorting to looping or tapping from a single source.



Figure 1. HDPE conduit layout and wiring for the dzong.

Selecting the correct cable size holds paramount importance. If the cable size is too small, it risks melting due to the substantial current passing through it. Conversely, if the cable size is excessively large, it could potentially harm electrical appliances by subjecting them to excessive current flow. Additionally, oversized cables result in increased voltage drops, energy losses, and cost implications. In this essence, we have carried out the careful choice of cable size to ensure both the safety of the electrical system and the protection of connected appliances, while also minimizing energy losses and associated expenses.

SWITCHES AND SOCKETS

We have employed Type D modular switches and sockets for our electrical installation. Within the switchboards, we have utilized 6/10-ampere switches, and for power outlets, we have chosen 20-ampere switches and sockets. The adoption of modular switches and sockets offers several advantages. These include enhanced switching properties, such as easy maintenance, ensuring efficient and hassle-free upkeep of the electrical system.



Figure 2. Modular switches installed for the dzong.

Lighting Fixtures

The drawings initially specified CFL and incandescent lighting fixtures, but we have deviated from this plan by opting for the installation of LED lighting fixtures throughout all structures. This change was implemented to achieve several benefits, including reduced energy consumption and improved illumination quality.

Furthermore, special attention was given to the aesthetics of the installation. The lighting fixtures were seamlessly integrated with the structures, ensuring that they do not stand out conspicuously. This design approach not only conceals the lighting elements but also guarantees even and effective room illumination.



Figure 3. Lighting fixtures installed inside the office rooms.



Figure 4. Lighting fixtures installed for the toilets and restrooms.

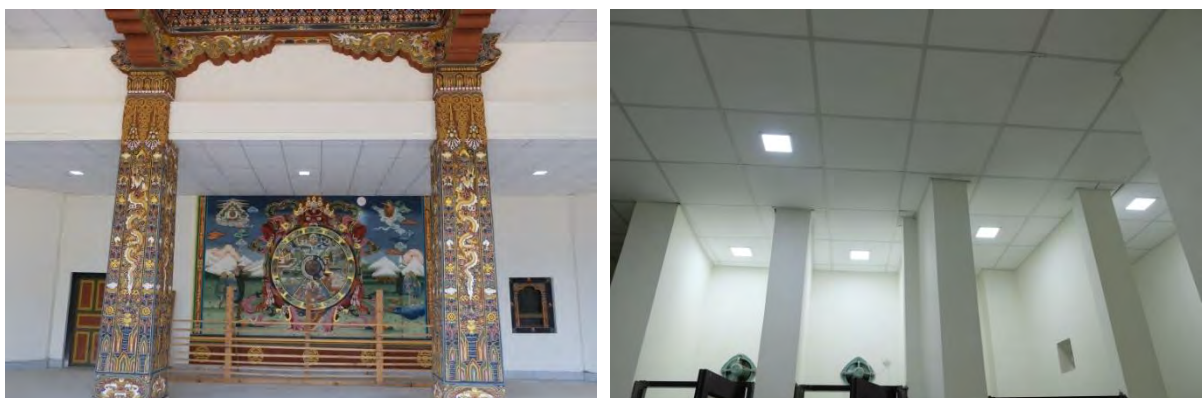


Figure 5. Lighting fixtures installed for the along the corridors.

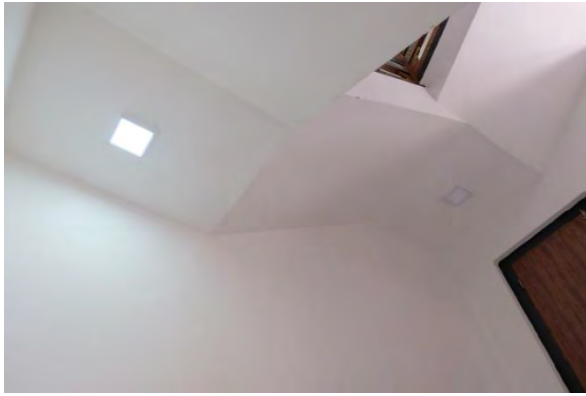


Figure 6. Lighting fixtures installed for the staircase.



Figure 7. Lighting fixtures installed for the lhakhang areas.

Control Gears

We have implemented high-quality control gears, such as MCB (Miniature Circuit Breakers) and MCCB (Molded Case Circuit Breakers), which possess exceptional sensitivity to minor electrical faults. The selection of control gear ratings aligns precisely with the calculated electrical load, and we have opted for C-curve control gears.

The significance of matching control gear ratings with the calculated load lies in their ability to promptly trip off the electrical system when fault currents surpass the rated current. Suboptimal choices, such as using lower-rated control gears, result in frequent tripping, while overrated ones delay response times and require substantial fault currents.



Figure 8. Distribution boards and controls gears installed for the

Furthermore, the durability and resilience of these high-quality control gears are notable attributes. They withstand fault currents without succumbing to damage, thanks to their ultimate short circuit breaking capacity and operating short circuit breaking capacity. This ensures that they can swiftly resume normal operation after a fault event without impairment.

Outdoor Illumination

The initial design provided by the consultant did not include a dedicated outdoor illumination plan. Instead, it featured streetlights placed around the dzong for outdoor lighting. Additionally, the design incorporated halogen floodlights mounted on the ceiling to accentuate the courtyard and a few at ground level to highlight the dzong. In response, we undertook a redesign of the outdoor illumination system. We opted for LED floodlights emitting a warm white output. This adjustment was made to ensure the proper highlighting of the dzong while harmonizing the lamp's color temperature with the intricate architectural features and paintings adorning the dzong's exterior.



Figure 9. Outdoor illumination and courtyard lighting for the dzong.

Main Power Control System and Power Distribution

The Main Control Panel Board has been strategically installed within the electrical room situated in block D. This central control panel serves as the hub from which

power is distributed to the dedicated Low Voltage panels, ensuring a streamlined process for emergency power shutdowns.

It's important to note that each Main Control Panel Board is equipped with Molded Case Circuit Breakers (MCCB) that feature microprocessor-based controllers. These advanced controllers enhance the precision and efficiency of the electrical system's operation.



Figure 10. Low Voltage panels for the respective blocks on the ground

Subsequently, the power is directed from the Main Control Panel to the respective Low Voltage panels, which in turn supply power to the respective distribution boards located within each block. This hierarchical arrangement optimizes the control and distribution of electrical power throughout the installation.



Figure 11. Low Voltage panels for the respective blocks on the basement floor.

Earthing

Earthing and grounding are vital safeguards against the aforementioned issues. Plate earthing procedures have been implemented at the Pema Gatshel Dzong to redirect excessive current into the ground, thereby protecting the equipment.

In this process, a pit of 3 meters in depth and 1.5 meters in diameter is excavated. Within this pit, a specialized earthing plate measuring 60cm by 60cm by 6.35mm is

submerged into a solution consisting of salt and carbon colloids. Once the plate is positioned vertically in the ground, the pit is filled with a layered mixture of salt and charcoal (carbon), demarcated into specific zones. An earthing wire is connected from the plate to the electrical system to provide a pathway for excess current to dissipate into the ground. The mixture is then covered with porous soil to allow water to permeate down to the plates, forming an ideal colloidal solution that acts as a proficient conductor for excess current.

Three plate earthing installations have been established across the dzong, strategically placed near block D, beneath the Utse, and towards block C. Furthermore, lightning arrestors have been installed for three taller blocks (C, E, and Utse) to protect against lightning strikes.

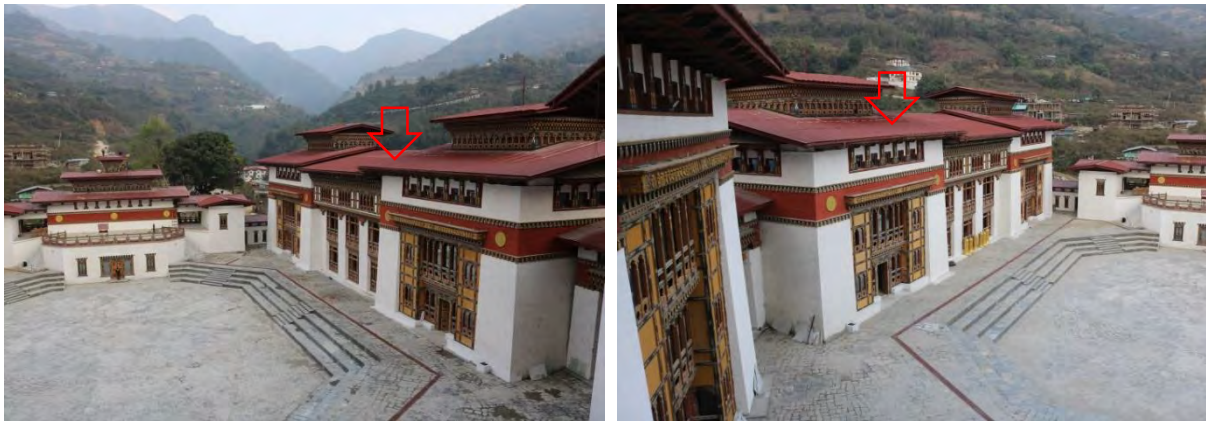


Figure 12. Lightning arrestor installed for block C and E.

To assess the effectiveness of the earthing system, a joint team from Bhutan Power Corporation (BPC) and the project conducted an earth test, yielding positive results. The earth reading measured less than 8 ohms, in accordance with Bhutan Power Corporation's standards for building earth rating.



Figure 13. Copper earthing wire running through the electrical duct.

Cable Trench and Duct

Cable trenches have been meticulously constructed to accommodate the distribution cables that run from the main Low Voltage (LV) panel to the individual LV panels.

These cable trenches serve a dual purpose: they not only facilitate convenient maintenance but also provide crucial protection to the cables, shielding them from potential damage.

Additionally, electrical ducts have been strategically installed to further enhance the ease of future maintenance. This comprehensive infrastructure ensures the long-term reliability and accessibility of the electrical system.



Figure 14. Trench for distribution cables and earthing wire.

Testing and Commissioning of the Electrical System

We formally requested Bhutan Power Corporation (BPC) to handle the service cable connection to our Main Control Panel Board (MCPB). Subsequently, the connection process, as well as thorough testing, was meticulously executed in collaboration with our project team, Dzongkhag officials, and BPC representatives. A battery of tests was conducted, encompassing an insulation resistance test utilizing a megger, earthing test, earth continuity test, and a short circuit test. These tests were applied comprehensively to all cables, including the service cable, outgoing cables, and wiring cables, as well as to power outlets and distribution boards.

Furthermore, adjustments were made to the insulation resistance (IR) ratings of the Molded Case Circuit Breakers (MCCB) within the transformer and the main MCCB controller within the MCPB, ensuring optimal performance.



Figure 15. Testing of transformer and crimping of the main cable.

Lastly, the meter for the entire dzong was meticulously tested and affixed near the transformer, ensuring accurate measurement and monitoring of electrical consumption.

Conclusion

The electrical work carried out at the Pema Gatshel Dzong reflects a commitment to excellence and a dedication to ensuring a safe, efficient, and reliable electrical system. Our approach was anchored in adhering to industry standards and utilizing high-quality materials and equipment to protect the dzong from potential electrical issues in the future. We meticulously designed and executed wiring using HDPE concealed wiring and standardized cable sizes, prioritizing safety and efficiency. The careful selection of control gears and switches, including modular components, aimed to enhance both functionality and ease of maintenance.

The transition to LED lighting fixtures not only reduced energy consumption but also improved illumination while harmonizing with the architectural aesthetics. The introduction of outdoor LED floodlights further enhanced the dzong's visual appeal and safety. The Main Control Panel Board and Low Voltage panels, equipped with MCCBs and microprocessor-based controllers, provide efficient power distribution and emergency shutdown capabilities.

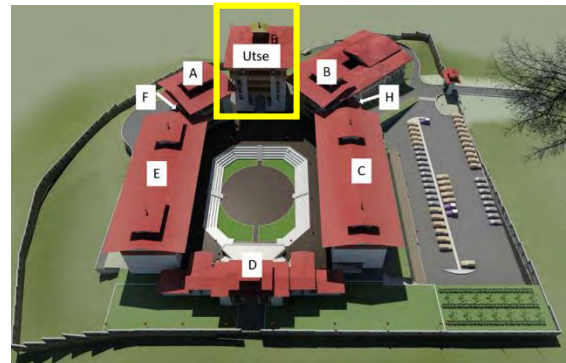
Our commitment to safety extended to comprehensive earthing and grounding measures, including plate earthing and lightning arrestors, ensuring equipment protection and compliance with industry norms. The establishment of cable trenches and electrical ducts promotes accessibility and cable protection, while meticulous testing and commissioning, in collaboration with Bhutan Power Corporation, guarantee system reliability.

In essence, this comprehensive electrical installation project stands as a testament to our dedication to quality, safety, and efficiency, serving to preserve the cultural and historical significance of the Pema Gatshel Dzong for generations to come.

4 BLOCKS DETAIL

4.1 UTSE

This structure is located between Block A and Block B. Utse is the tallest building in the Dzong complex and is 5 storied. The structure will be used for religious purposes and will house different lhakhangs in each floor. The construction of Utse began in 2016 and was successfully completed by December 2020. Following are the detail of each floor:



1. Basement : store (7 rooms)
2. Ground floor : Kuenray (120monks) + torkhang
3. First Floor : Goenkhang (2 nos) + torkhang
4. Second Floor: Lhamoi Lhakhang + torkhang
5. Third Floor : Guru Lhakhang + torkhang

Photographic documentation:



Figure 29. Site preparation: 2016



Figure 30. Foundation work: 2017



Figure 31. basement floors :2018



Figure 32. Superstructure: 2019



Figure 33. Utse - 2020

Interior view of the Utse



Figure 34. First floor



Figure 358. Main entrance to Kuenrey



Figure 36. Hall for lhakhang in 2nd & 3rd Floor



Figure 37. Interior traditional cornices



Figure 38. First floor corridor

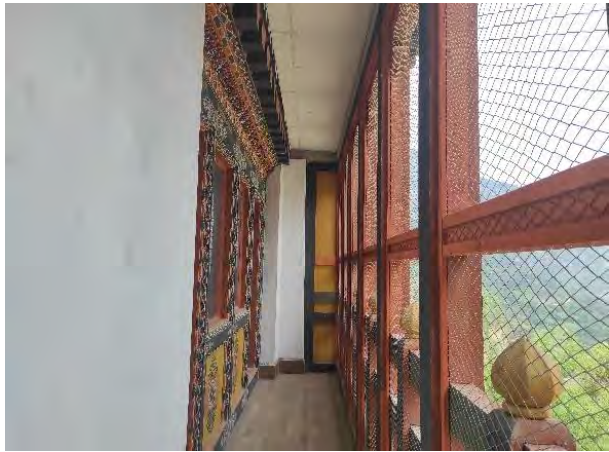


Figure 39. Space between rabsey and Namda Gosum



Figure 40. Main entrance towards the Utse



Figure 41. Stair case and traditional railings



Figure 42. Circumambulation path around the Utse

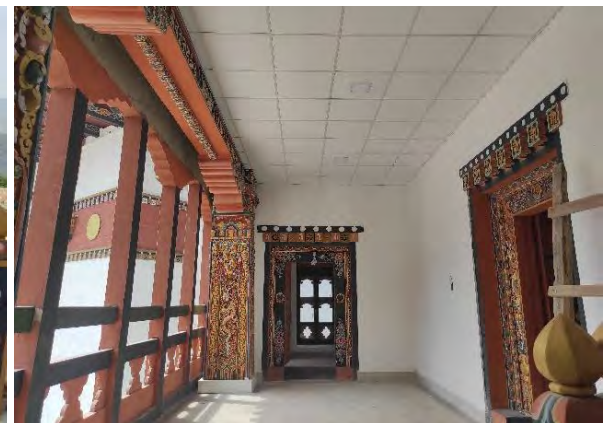


Figure 43. Corridor in the entrance area



Figure 44. Cement carving on kachen



Figure 45. FRP cladding



Figure 46. Dragon carved on the zhu by cement mortar



Figure 47. Lion mask above main door of Kuenray.



Figure 48. Pantry in the torkhang room



Figure 49. Toilet in the first floor

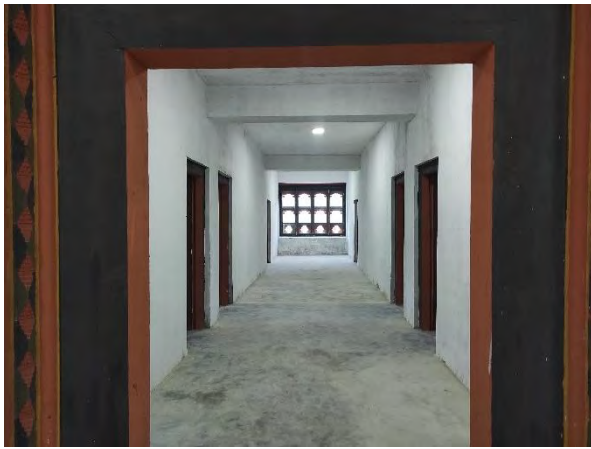


Figure 50. Basement corridor



Figure 51. Basement room



Figure 52. Second floor of the Utse

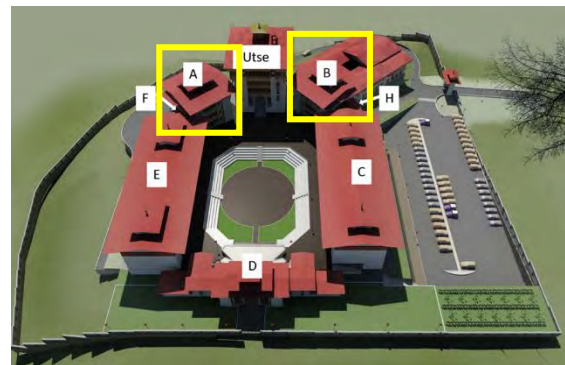


Figure 53. Front rabsey of the Utse

4.2 BLOCK A & B

Block A is located between Block E and the Utse toward the south direction. The four-storied building will be used as an administrative block and it will house the office of the Dzongdag, head of Dzongkhag.

Block B is located between Block C and the Utse toward the north direction. The four-storied building will be used by the Rabdhey and it will house the residents of Venerable Lam Neten and offices for the Rabdhey.



Block A:

- Ground Floor/First Floor/Second floor : 4 Office room & 2-unit toilet in each floor
- Third Floor : 4 rooms & 2-unit toilet

Block B:

- Ground floor : 3 (Bedroom + kitchen+ living room + toilet) for 3 lopens
- First Floor : 3 (Bedroom + kitchen+ living room + toilet) for 3 lopens
- Second floor : 2 (Bedroom + choesham + kitchen + living room + toilet) for Lam Neten and Umze
- Third Floor : Four room + 2-unit toilet

Photographic documentation:



Figure 54. Block A



Figure 55. Block B



Figure 56. False ceiling



Figure 57. Jadang Tazi



Figure 58. Chandelier Light in Block A



Figure 59. Wash Room



Figure 60. Step finishing with marble



Figure 61. Atrium



Figure 62. Space for waiting room



Figure 63. Stair case



Figure 64. Pantry

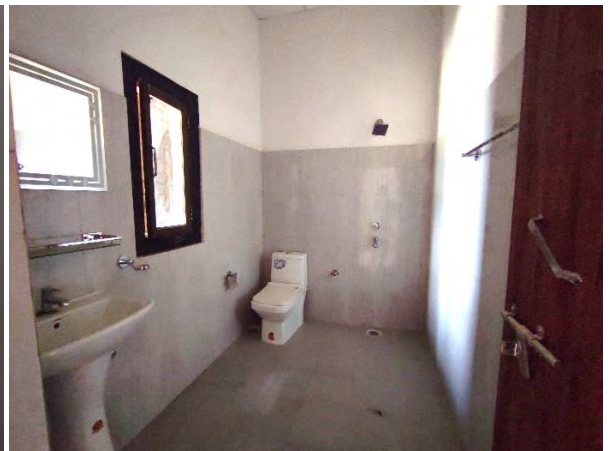


Figure 65. Wash room



Figure 66. Atrium



Figure 67. Aluminum partition

4.3 BLOCK C & E

Block C is located between block B and block D in the north side of the gallery ground whereas Block E is located between block D and A towards south side of the gallery ground. These two buildings are largest structures and have space for offices. Considering its size and future use, the emergency exit route is incorporated in these two buildings.



Block C:

1. Basement : 6 store room & 2-unit toilet
2. Ground floor : 8 office room, Canteen (kitchen, store & dining room) & toilet (2 unit)
3. First floor : 11 office room & 1 mini conference room, toilet (2 unit)
4. Second floor : DT hall, 2 office space and 3 waiting area, toilet (2 unit)

Block E:

1. Basement : 7 store room & 2-unit toilet
2. Ground floor : 12 office room & toilet (2 units)
3. First floor : 11 office room & toilet (2 units)
4. Second floor : 7 office room, Dzongkhag conference hall (117 people), toilet (2 units)

Photographic documentation:



Figure 68. Block C



Figure 69. Block E



Figure 70. False ceiling in atrium



Figure 71. Jada Tazi around the edge of Atrium



Figure 72. Dzongkhag Tshogdu hall



Figure 73. Hall

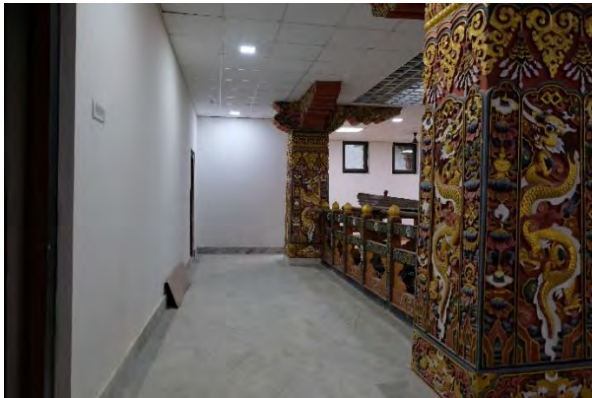


Figure 74. Corridor around the atrium



Figure 75. Space for office



Figure 76. GRC cornices



Figure 77. Aluminum partition



Figure 78. Canteen space in block C.

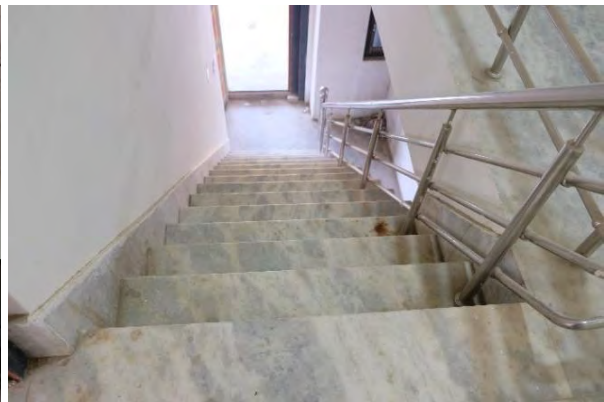


Figure 79. Emergency exit

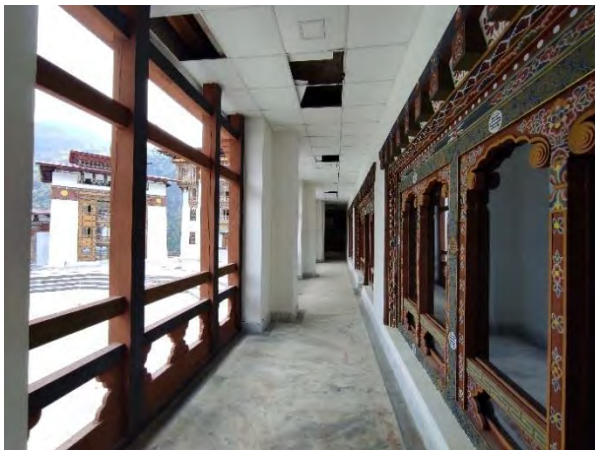


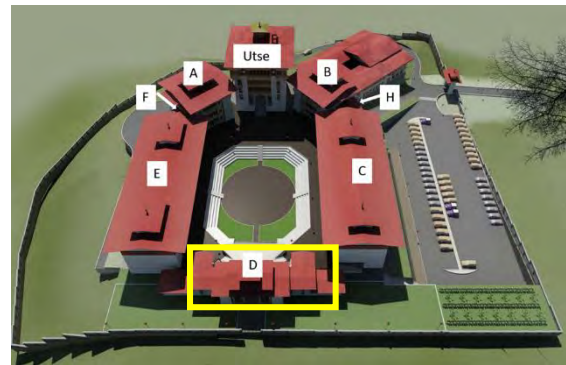
Figure 80. Corridor



Figure 81. Aluminum partition

4.4 BLOCK D

This structure is located right at the entry to the Dzong. The building is a two storied RCC framed structure enclosed by the CRM walls. This building serves as the primary entry point to the Dzong, featuring both a standard footpath and a ramp to accommodate differently abled individuals.



Inside the structure, there are rooms designated for security personnel and a central control room responsible for managing the electricity throughout the entire Dzong complex.

1. Ground floor : Main entrance area, 2 normal entrance and 2 ramp paths for differently abled people, public toilets for male and female, mask dance preparation hall
2. First floor : VIP gallery space during Tshechu, toilets for male and female and 1 store room.

Photographic documentation



Figure 82. Front view



Figure 83. View from Utse



Figure 84. Kilkhor on the ceiling of Gorago



Figure 85. Debri at the gorago



Figure 86. Wash room in Block D



Figure 87. Ramp for differently abled people



Figure 88. Steel railings



Figure 89. Corridor and room on the left side



Figure 90. Male toilet

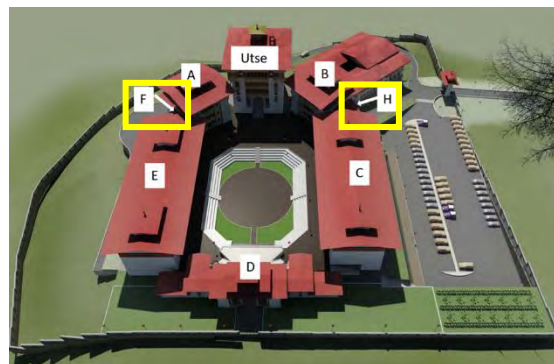


Figure 91. Interior view of the toilet

4.5 BLOCK F & H

Block H is located between block B and C and is the entrance to the dzong from the north east side. Motor vehicle can enter inside dzong through block H.

Block F is located between block A and E and it is for outdoor meetings space and waiting area outside dzong.



Photographic documentation:

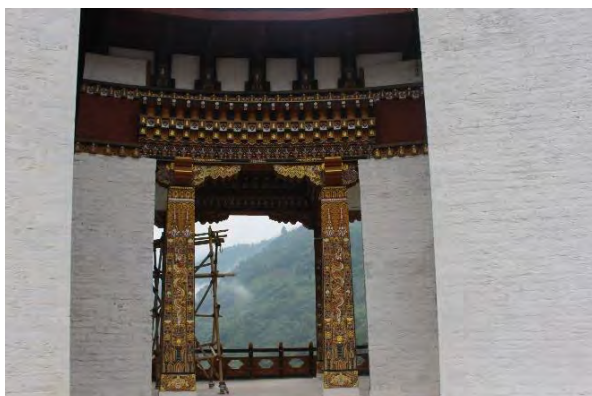


Figure 92. Block F

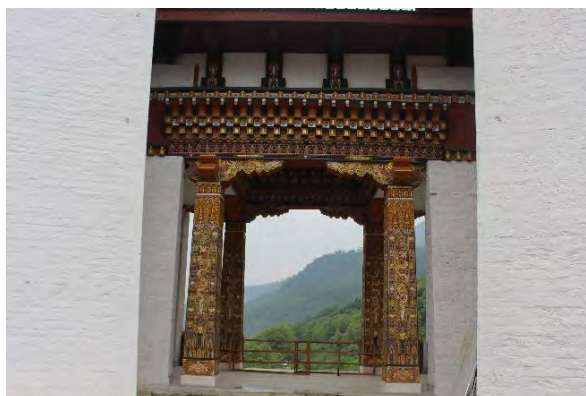


Figure 93. Block H

4.6 GALLERY/ DOCHEY

Gallery & dochey is located in the middle of the Dzong complex fully enclosed by the dzong structure. The Gallery and Dochey is paved with dry flat stones/doleps. Underneath the Dochey, huge pipes have been installed for the proper drainage system. An underground trench has been incorporated for laying of UGI cables and fire hydrant pipes.



Photographic documentation:



Figure 94. View of the Gallery & Dochey from Uutse

5 ISSUES AND CHALLENGES

5.1 CHANGE IN DESIGN

The initial design of the Dzong was conceived as a modern exemplar, serving both administrative and religious functions of the Dzongkhag. Like other Dzongs across the country, it was intended to accommodate administrative and religious bodies.

However, the design of Pema Gatsel Dzong placed a greater emphasis on administrative functions for the Dzongkhag. It included a lhakhang with residential space for one lam (spiritual leader) and 20 monks. Notably, it did not feature a central tower known as the Utse. This decision was influenced by the fact that Pemagatshel Rabdhey already had its central hub at Yongla goenpa and the old Dzong. Both of these locations were equipped with essential facilities such as drasha and Kuenray. Additionally, when the Dzongkhag administration eventually relocates, the plan was to renovate and hand over the old Dzong to the Rabdhey for additional space. Consequently, the government believed that the religious body of the Dzongkhag had ample space at two existing locations, obviating the need for additional space.

The design underwent discussions and consultations with both the Rabdhey and the Dzongkhag administration before reaching a final iteration.

However, in 2013, the government decided to revisit the design. The revised plan was adjusted to accommodate more monks (50 in total) and to include the Utse in response to requests from the Dzongkhag and the Zhung Dratshang. This revised design was subsequently presented to the Lhengye Zhungtshog, primarily due to considerations regarding the height of the Utse. These design changes resulted in increased project costs and an extension of the project timeline.

5.2 COST - ESCALATION AND EXTENSION OF PROJECT TIME LINE

The project was planned as part of the 10th FYP program under the Project Tied Assistance (PTA) grant funded by the Government of India (GoI). However, the project got spilled over to the 11th and 12th FYP. The initial budget approved for the project was Nu. 250 in the 10th FYP but it got spilled for 11th FYP due to delay in the implementation with total allocated budget of Nu.231 million (Nu. 81 million in 10th FYP and Nu.150 million in 11th FYP). The initial budget was proposed and approved based

on Chukha Dzong Construction Project, and also with the proposal of allocating lesser space to Dzongkhag Rabdhey and the Dzong was expected to be used mainly for the District Administration.

The implementation of the project was scheduled to start from the beginning of the year 2009 (start of the 10th FYP) and however, got delayed due to issues related to land acquisition for the construction of the Dzong. Thus, implementation of the project on site could be started only from July, 2012 which is towards the end of the 10th FYP. Subsequently, the design and drawings could be completed only in June, 2013. The delay in the implementation of the Project led to the escalation in the cost over the time, and besides, the actual cost of the project could be realized only after the completion of the design and drawings. In addition, the changes in the design which mainly includes the addition of the Utse and more space for the Rabdhey have also resulted in additional cost for the project. The approximate total cost estimate with the revised design has become Nu.530 million in the 11th FYP.

The overall budget of the Project had to be revised from the initial estimate of Nu. 461 million (after completing the design and drawings) to Nu. 530 million with increase in the scope of work after incorporation of the revised design and drawings. The Government of India approved the budget in line with the revised cost estimate for the 11th FYP under PTA grant during the 3rd Plan talks held on 14th September, 2014.

During the 6th Steering Committee Meeting, it was discussed that the project would require an additional budget of Nu. 185 million to complete and also the timeline of the project completion needs to be extended till June, 2020). Accordingly, the Steering Committee approved the requirement of additional budget and extension of project timeline.

Further, in order to expedite the project completion, the Steering Committee decided that the remaining works will be divided between the Department of Culture and the Dzongkhag Administration:

Phase – I: To be implemented by the **Department of Culture** and to be completed by June, 2020 and handed over to the Dzongkhag Administration for the remaining works

- *Completion of Block A, B, C, D, E, F, G, H and Utse with all fittings and fixtures (inclusive paintings both interior and exterior) including the dochey area*

Phase – II: To be implemented by the **Dzongkhag Administration** accordingly to fiscal planning:

- *Construction of the Drasha*
- *Site development works*
- *Nangten installation (Sertog and Gyeltshen) with debri works for the Utse*
- *Installation of fire alarm and detection system*
- *Installation of firefighting system*
- *Installation of internet server*

This was mutually agreed between the Department of Culture and the Dzongkhag Administration. It was also agreed that the Dzong will be handed over to the Dzongkhag Administration by June, 2020 and accordingly, the Dzongkhag Administration will continue with the remaining works from July, 2020. The Department of Culture started preparing for completion of the works by June, 2020 following the decision of the Steering Committee.

Due to the COVID-19 situation in India (nationwide lockdown imposed on India from April- June, 2020), the materials could not reach the site on time. The materials were mainly meant for the finishing works including roofing sheets and the materials reached the site only in the month of July and August. Therefore, the project could not be completed by June, 2020 whereby extending it to December, 2020. However, the Department of Culture took up additional works (which was delegated to the Dzongkhag Administration) and completed as listed below:

- *Construction retaining walls which were included in the site development works*
- *Fabrication of sertog (2 nos) and Gyeltshen (6 nos) which was included in the Nangtens*
- *Installation of fire alarm and detection system*

The Dzong was finally handed over to the Dzongkhag Administration in October 2021.

5.3 THE DISTANT SITE LOCATION AND UNAVAILABILITY OF THE SKILLED WORKERS

Given that the project site is situated at a considerable distance from well-established towns, the acquisition of materials has posed significant challenges for the project management. This difficulty has been further aggravated by the subpar road conditions, resulting in delays in delivering materials to the site and consequently impeding the progress of the work.

Another major hurdle faced by the project pertains to the recruitment and retention of skilled workers. The construction requirements for this project necessitate a substantial number of skilled laborers proficient in various tasks such as RCC (Reinforced Concrete Construction) work, aluminum partition installation, false ceiling installation, as well as marble and tile flooring. Finding and retaining such skilled workers has proven to be an arduous task for the Project Management team.

6 CONCLUSION

The overall establishment of the Pema Gatshel Dzong marks a milestone for the Dzongkhag with the sustenance and the continuity of the secular system of governance in the country as an integral component of our cultural heritage. It houses both the administrative and the religious center for the Dzongkhag with better facilities and improved services. The planning of the Denchi town with the Dzong further helps in the development of the town greatly enhancing the significant of the Dzongkhag and marks the pride and identity of the people from Pema Gatshel.

The Dzong complex although monumental with the incorporation of green and sustainable design, still instills the old values and promotes the traditional architectural heritage and serves as an exemplary version of a new Dzong.



Figure 95,96,97,98,99. Images of the statues inside the Utse.

7 ANNEXURE

Annexure I - Architectural Drawings