

**Towards a systematic approach to preserving historic buildings
A case study for the maintenance and restoration of the Kaaba during the Islamic Era**

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Abstract:

The treatment of historical buildings represents challenges for those who are concerned with conservation. The difficulty lies in how to apply the treatment without destroying the old components and the original design of the building. The treatment processes take place by classifying the type and the value of the building, then the evaluation of the deterioration level determines the level of intervention.

The Arabian Peninsula is characterized by the existence of many archaeological and historical sites that attract the attention of many local and international organizations concerned with the preservation of the urban heritage. The Holy Mosque and the Kaaba are considered one of the most prominent landmarks. The Kaaba is classified as a historical building according to Cullan's classification for its high historical value, and its association with important events and characters. Moreover, it has a spiritual meaning and power over the Muslims as it is their Qibla towards which they pray to Allah.

The study aims to measure the consistency of the level of intervention with the level of deterioration that took place on the Kaaba. In addition, it pinpoints the kind of treatment that took place on the Kaaba during the Islamic Era. The historical approach was used in collecting data. Analysis and re-evaluation were accomplished by following the modern approach in the conservation of historical buildings. The study concluded that most of the intervention and deterioration levels are consistent.

Keywords:

Systematic Approach

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Kaaba

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1- Introduction:

The Holy Kaaba represents a special importance to all Muslims everywhere. It is the Qibla to which the Muslims direct themselves five times a day to perform their prayers from all parts of the world. It has enjoyed a special place among the Arabs since Islam, and has undergone numerous maintenance and renovation operations in order to preserve the religious and archaeological value given by the Arabian Peninsula citizens before and during the Islamic era.

According to the approach followed in the classification of valuable buildings, it is possible to classify the archaeological value of the Holy Kaaba within the first class because the date of its construction goes back to the pre-modern times. As the Qibla of the Muslims, the Kaaba is an expression of power in addition to its artistic value represented in the Islamic motifs covering parts of the interior walls, doors and mezzanine. It is also linked to many important historical events; most notably, its construction by the Prophet Abraham

with the help of his son Ishmael thousands of years ago.

The research is directed towards studying and analyzing the relationship between the causes of deterioration and intervention that occurred to the Holy Kaaba during the Islamic era and the extent of the changes brought about by these operations in the building's form and characteristics. The research also illustrates the impact of the approach, which is evident in the maintenance of the building, in affecting its form and original components, along with assessing the restoration operations in accordance with the modern approach evident in maintaining the archeological buildings.

The research provides a clarification on the concept and importance of maintenance to the historic buildings, and the need for their completion without compromising the original components and form of the building as much as possible. Furthermore, this research provides an explanation about the causes of the historic buildings' deterioration and the restoration levels

consistent with the type and level of damage to the historic building.

In general, the current research exposes the extent of the statistically significant relationship between the exaggeration in the Kaaba restoration operations and the changes that have occurred to the Kaaba's form and components during the Islamic era.

Furthermore, the research aims to study the impact of the approach taken in the restoration operations that were conducted to preserve the Kaaba. In addition to studying the extent of its impact on the original components and form of the building, it also contributes to developing assessments and proposals that can be applied to maintain the valuable historic buildings that have been recently discovered in some regions of Saudi Arabia. This also serves to achieve one of the most important objectives of Saudi Vision 2030 represented in the revival of the national, Arab, and Islamic heritage sites and their registration in the World Heritage List.

2- Previous Studies:

2.1 The Modern Approach followed in the Assessment, Maintenance and Restoration of Archaeological Buildings:

The preservation work levels concerning the valuable archaeological building (Figure 1) are divided into four levels:

- a) First Level: It refers to the building materials and here, there are five categories. Maintenance aims to prolong the lifespan of the building materials and is divided into two parts: the expected preventive or corrective maintenance and the sudden maintenance. Preservation aims to provide maintenance to what is intended to be preserved, so that it remains in its same original condition by reducing the restorations made to the building as much as possible and protecting the building materials from decay. Deterioration Prevention helps in controlling the internal building's environment and preventing arson and vandalism. Restoration includes removing the additions and restoring the building to its natural state. Consolidation ensures the safety of the structure from decay or damage.
- b) Second Level: Reconstruction restores the original form of the building by assembling parts or rebuilding or moving the building to another location. Remodeling restores the original characteristics of the building by recreating the building from the extraneous elements that have been added to it after a long time from its establishment. Completion

is the integration of the missing parts of the building to complete the visual image. Saving involves disassembling the building as a whole or divided into several parts and then transport them to a more suitable new location. Finally, Replacement for the building occurs in the event of a building's collapse or the invalidity of the materials for the new functions of the building.

- c) Third Level: It includes the operations that relate to the building's functions. Adaptive Reuse, refers to converting the functionality of a particular building into another function, while making the necessary modifications. Development, i.e. operations not related to the building's condition, aims to improve the building to meet the functional needs and the rise in the activity levels. Rehabilitation relates to the deteriorated buildings as a result of natural and abnormal factors that hindered the building's functional performance. Renovation includes the organic and spiritual renovation of the building and the surrounding area, as well as the re-embodiment of the internal and external spaces and the strengthening of the structure. Lastly, Improvement aims to make an extension for the building, while maintaining the roads and construction materials, or establish a modern building in the same area to fit with the increased functional requirements.
- d) Fourth Level: It includes the development and radical change work, while keeping the external facades, establishing a modern building annexed to the building or a yard around the building using the new building materials.

The reasons behind the deterioration of the valuable buildings is its lifespan, which usually causes the physical deterioration for building's materials and structure (First and Second Levels). In addition, the natural factors of erosion, climate and groundwater, geological factors, and human factors from accidents, fires, lack of knowledge in preservation and development, negligence and vandalism contribute to deterioration. Both natural and human factors usually cause a physical deterioration in the building's materials and structure, and a functional deterioration (First, Second and Third Levels), along with the emergence of stressors on the building as a result of change in the type and intensity of the users, which is considered a functional deterioration (Third Level) (Figure 2).

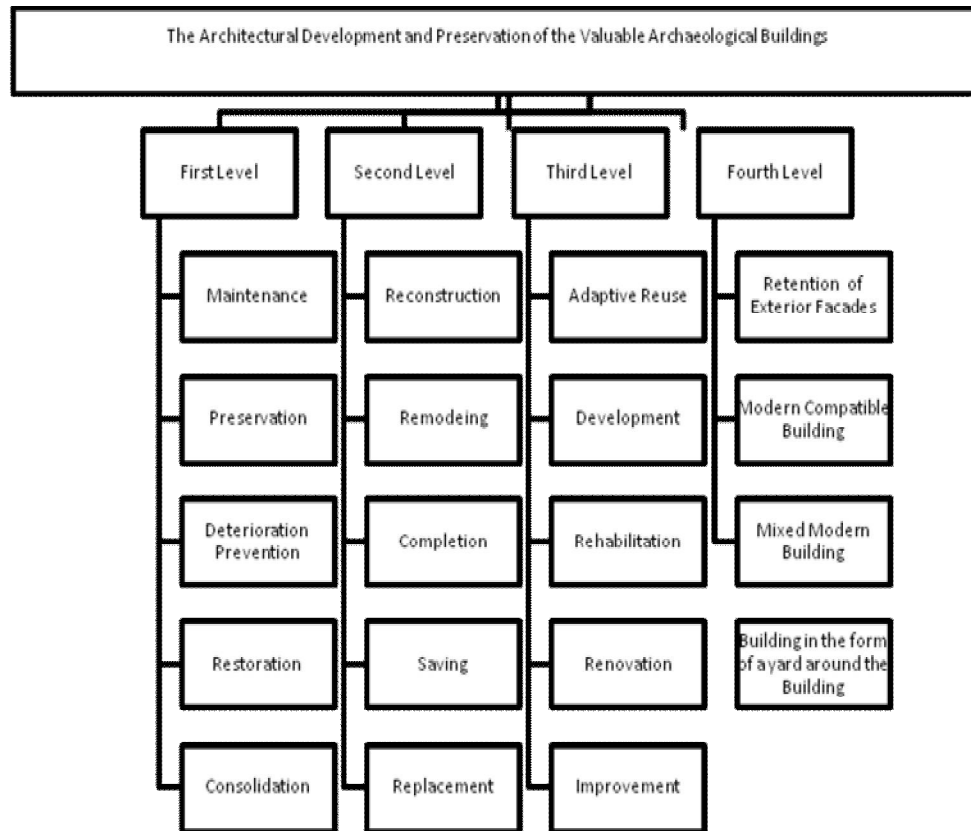


Figure 1: Intervention and preservation Levels

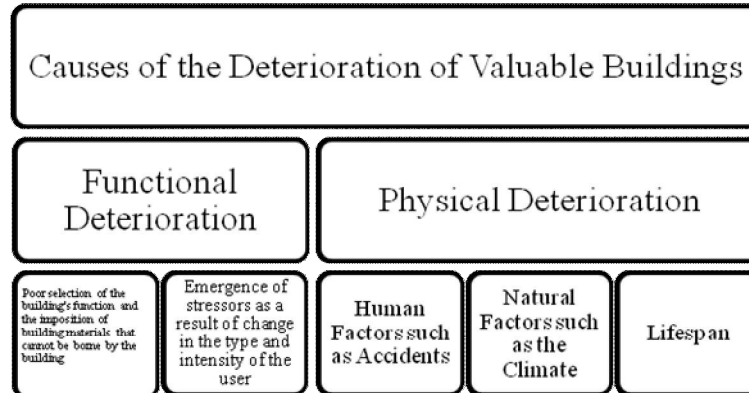


Figure 2: Causes of the Deterioration of the Valuable Buildings

The building's physical state affects the intervention level. The building may be wholly or partly dilapidated thus requiring the intervention and restoration of the building by one of the operations described in (the Second Level) or using the addition and change method under (the Third Level) of the intervention levels as needed. However, if the building is subject to negative effects, this calls for intervention on (the First Level) or the use of the development method under (the Third Level). If the building was in good condition both internally and externally, it is possible to use some of the methods of (the Third Level), and if the building only remains in good

condition externally, it is likely to use the repair methods on the (Third, Fourth and Fifth Levels) as needed.

The intervention objectives are limited to five objectives that influence the determination of (the preservation work) level, and it may aim to protect the landmark and maintain its original features. This requires preservation work on the (first level), while in case of the restoration of the building's original features, the preservation work will be restricted to the (second level). If the objective is to rehabilitate the building, the preservation work will be performed on the (third level). If the objective is to protect and maintain

the exterior facades, then the preservation work performed on the (fourth level) will be used, and the preservation operations on the (fifth level) will be used in case of desiring horizontal expansion and extending the building.

The preservation work that can be done are diversified, and the most important of which is the replacement of the deteriorated parts with similar ones. This action is taken to make changes using the preservation methods on (the first level). Among the preservation works is the re-establishment of the entire building to become an image of what it used to be, and so one of the

preservation methods on (the second level) will be used. Other preservation work that can be done is finding the spaces for additional activities and reformulating these spaces, and so one of the preservation methods on (the third level) will be used.

The reasons behind the deterioration , The building's physical state , the intervention objectives and The preservation work that can be done are the factors that Determine the Intervention Levels in the Valuable Buildings (Figure 3)

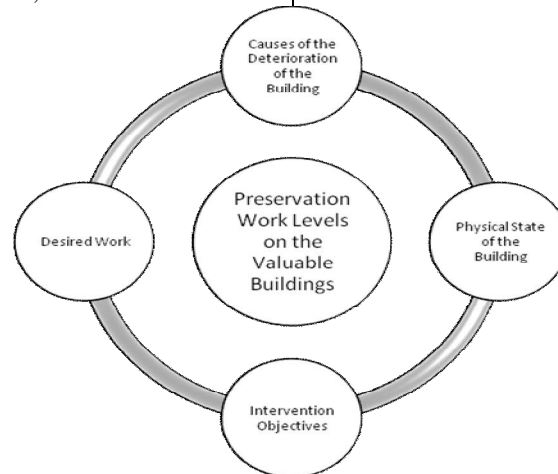


Figure 3: Determinants of the Intervention Levels in the Valuable Buildings value

2.2 Historical Development of the Holy Kaaba during the Islamic Era:

The Holy Kaaba is the first mosque to be set up for people according to the Islamic belief, as stated in the Quran: “The first mosque that God assigned to men was in Bakka. It is a blessed one and a guide for all people”. It is a building that is almost located in the center of the Grand Mosque, in the shape of a cube, where the length of each side with a door and its opposite side is 12 meters, while the length of each side with the gutter and its opposite side is 10 meters. Each of the four corners has different names, namely the black corner, the Al-Shami corner, the Yemeni corner, and the Iraqi corner. There is pure gold gutter located at the top

of the northern wall and the gutter pours into Hijr Ismael(Hatim). The Kaaba has one door with a length of 318 cm, width of 171 cm, and height of 222 cm (Figure 4). The ceiling is based on three wooden gold-plated pillars. In the corner of the Kaaba from the inside, there is a narrow staircase that gives access to the roof and surrounds the bottom of the Kaaba's wall from the outside on three sides except the one of the Hijr, and a socle built of marble called Al-Shazrawan to strengthen the wall of the Kaaba, as indicated by Ibn Taymiyyah, saying: "Al-Shazrawan is not part of the mosque, but it is made as a pillar for the mosque"¹(Figure 5).

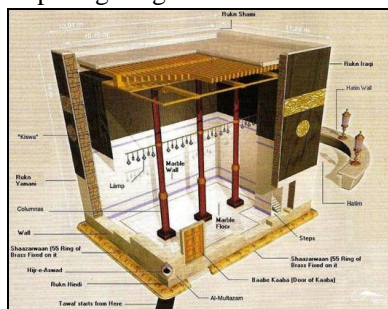


Figure 4. The Architecture of The Kaaba

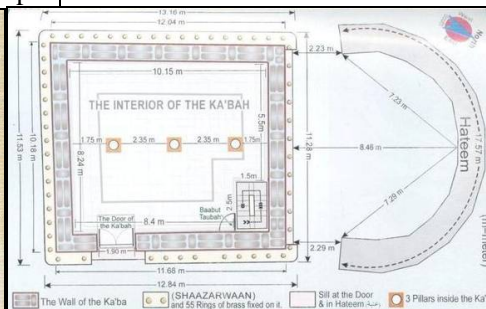


Figure 5. The Dimension of The Kaaba

<https://www.slideshare.net/KiranMusharraf/kaaba-49233119>

Before the Islamic era, the Mosque, since its inception by the Prophet Ibrahim (peace be upon him), includes the current area of the Kaaba in addition to the Hijr area (Figure 6). Afterwards, when the Mosque was burned and its construction weakened, it was hit by a torrent causing further structural weakness. This prompted people to seize what was inside the Grand Mosque, which in turn, prompted Quraish to rebuild it again. When it was rebuilt, six cubits of the Hijr were left untouched and the length was cut down by seven cubits so it became 30 cubits, due to the lack of sufficient funds to complete the construction. The height was increased by nine cubits so it reached 18 cubits, and the door raised by 4 cubits and one span. Then, the construction level was changed from the inside to fit the height of the door and a ceiling supported by 4 pillars was added. A ladder was placed from inside to enable them to climb to the roof when the need arises, and a gutter was added on its roof to drain rainwater (Figure 7).

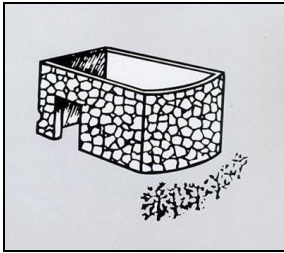


Figure 6. Inception By The Prophet Ibrahim
(Islamic monuments in Mecca , Alharthi, Nasir 2009)

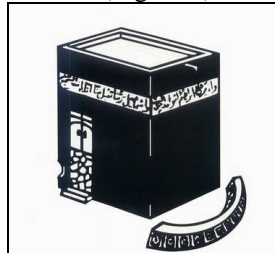


Figure 7. Kaaba After Rebuilding By Quraish
(Islamic monuments in Mecca , Alharthi, Nasir 2009)

After the beginning of the Islamic era in the year 64 AH, on Saturday, the third of Rabea Al-Awwal, the Kaaba was burned after being shelled by a catapult. The walls were cracked and the black stone was burned, forcing Abdullah bin Al-Zubair to demolish and rebuild it in the form that has been described by the Prophet (peace be upon him) to his wife Aisha: "The Messenger of Allah peace be upon him said: "Your people rebuilt the House smaller. Had it not been for the fact that your people are not far from the time of Shirk, I would add what was left outside of it. If your people think about rebuilding it afterwards, let me show you what they left out of it" and he showed her around seven cubits. He tied the black stone with a silver belt after it had been cracked by the fire and he built the Al-Shazrawan based on the Foundation of our Prophet Abraham (peace be upon him) to strengthen it and tied the ropes of its Kiswah with rings, adding the portholes to provide natural lighting. He also made its door with 2 shutters after it was with a single one. He added another door and made the direction of the gutter to the Hijr after it was towards Hittin (Figure 8).

In 73 AH Abdullah Bin Al-Zubair was killed, and Al-Hajjaj bin Yusuf Al-Thaqafi entered Mecca and notified the Caliph Abd al- Malik bin Marwan that Ibn al-Zubair had added to the Mosque and he added another door. He asked him to return the Mosque back to what it was in the Jahiliyyah days, and the Caliph agreed to it (Figure 9).

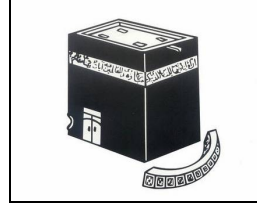


Figure 8. Rebuilding by Bin Al-Zubair
(Islamic monuments in Mecca , Alharthi, Nasir 2009)

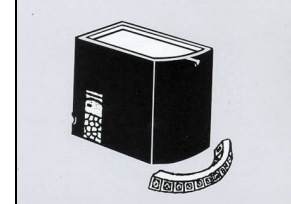


Figure 9. Rebuilding by Al-Hajjaj
(Islamic monuments in Mecca , Alharthi, Nasir 2009)

Then, after the year 200 AH, the Kaaba Gatekeepers removed the mosaics on the Kaaba's roof surface because it was leaking rainwater to the inside so they sealed the roof with plaster and marble and returned the mosaic as it was.

In 240 AH, based on the letters sent from the Kaaba Gatekeepers, Al-Mutawakkil Ala Allah decided to maintain the Kaaba's marble floor and walls, replacing the silver on both corners of the Kaaba with gold and replacing the lower threshold wood with new teak wood.

Then, in 542 AH, the roof of the Kaaba was damaged, so Al-Muqtafi li-Amr Allah reconstructed the Kaaba's ceiling, the Al-Shazrawan and the internal staircase.

Then in 816 AH, Al-Mu'ayyad Abi Al-Nasr maintained the marble roof of the Kaaba and replaced the portholes wood and the internal staircase of the Kaaba and changed one of the damaged portholes.

In 825 AH, Sayf Al-Din Brisbay changed the wood in the Kaaba's roof, which was used to install the rings that were attached to the Kaaba Kiswah. In 826 AH, he changed the marble of the Kaaba's walls and returned the pillar located opposite to the door to its main position after it was removed from its place, and supported it with iron and plaster plates.

Then in 931 AH Ibrahim Pasha repaired the roof after a board was broken, and in 959 AH Sultan Suleiman Khan repaired the roof again.

Then in 1040 AH, during the reign of Sultan Murad Khan, a great flood hit the Kaaba, flooding the interior space and weakened its structure (Figure10). This prompted the Sultan to demolish it and then rebuild its walls and ceiling, the internal stairs, and the second roof. The columns were returned to their position after their maintenance and the black stone was re-tightened with a silver belt. Furthermore, in 1073 AH and 1109 AH, the Kaaba's ceiling was rebuilt after the

breakage of the wooden boards and the internal staircase restored in 1109 AH.



Figure 10. Kaaba Deterioration After a Great Flood During the Reign of Sultan Murad Khan (Islamic monuments in Mecca , Alharthi, Nasir 2009)

In 1316 AH during the reign of Al- Sharif Aoun Al-Rafiq, a foul smell emerged inside the Kaaba due to washing water and rain pooling on the roof. The stagnant water was drained and the roof was restored.

In 1332 AH during the reign of Al-Sharif Hussein bin Aoun, cracks appeared in the pillars due to exposure to the Kaaba's washing water and the floods and the pillars were restored.

In 1375 AH, cracks and protrusions developed in the Kaaba walls. King Abdul Aziz reinforced the upper roof of the Kaaba with a reinforced mantle underneath to attach the four walls to each other, repairing the lower roof and interior walls and

replacing the wooden staircase with a circular aluminum ladder.

In 1401 AH, during the reign of King Fahd, there was a cracking in the marble floor of the Kaaba so it was repaired, the insulation material was added, and the slope ratio was adjusted. As was the case in 1416 AH, there was damage in the ceiling wood, columns and walls, weakness of the stones cohesion (Figure 11), and the foundations under the Kaaba's level were exposed to fungi and termites. The repair was conducted on the Kaaba's walls ; in addition to changing its marble and the Al-Shazrawan marble and reinforcing the columns' bases. The most important restoration operations carried out during the Islamic era were summarized in the following (table1).

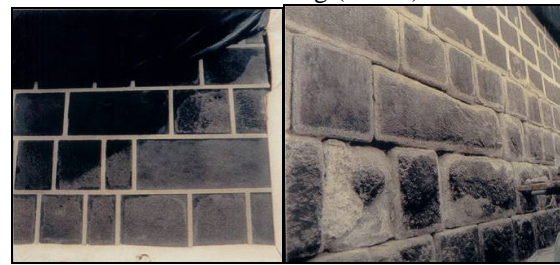


Figure 11. Kaaba's Walls Before and After The Maintenance

(Islamic monuments in Mecca, Alharthi, Nasir 2009)

Table 1. restoration operations carried out during the Islamic era

Date	Causes	Deterioration	Repair
64 AH Abdullah bin Al-Zubair	Fire	The wooden pillars in the walls were burnt, the black stone was burnt and cracked, the walls were broken and their stones fell.	Demolition of Kaaba to zero level. The foundations of Kaaba were detected and evaluated to be incursive into the Hijr area about six cubits and a span. The extra area of Hijr was added and the foundation was laid on it (an increase in Kaaba). The gypsum was brought from Sana'a and the stones for the construction were taken off the same place from which the stones were taken off in the previous restoration. The two jambs of the Kaaba's door were put on the pillar, which on the Al-Shazrawan, thus increasing the length of the door from the original height of the threshold to the level of the Al-Shazrawan level, making it with two shutters instead of only one shutter. Another door with the same dimensions was added in the wall opposite the wall in which the old door was located. The Black Stone was tied with a silver belt, a staircase was built inside from the Al-Shami corner to the roof. The direction of the gutter was changed towards the Stone, and its height was increased by nine cubits, whereas the number of pillars inside was

			reduced to 3 instead of 6. Four portholes made of marble were used for the ceiling to provide natural lighting.
74 AH Al-Hajjaj bin Yusuf Al-Thaqafi through an order issued by Abdul Malik bin Marwan	Reconstruction to what it was, after the additions made by Ibn Al-Zubair	The addition that was introduced into the Kaaba from the Hija's side includes the addition of a new door on the west side opposite the old door and the change in the height of the original door opening.	Demolition of the additions that were added inside the Kaaba from the Hija side: blocking the western door that was added; blocking the door opening from the bottom of four cubits and a span; changing the step inside the Kaaba leading to the roof and changing the Kaaba's door.
200 AH Kaaba Gatekeepers	End of its lifespan	Mosaics on the floor of the roof leaks water upon rainfall	Mosaics were taken off. The ceiling was sealed with cooked plaster and marble, and then the mosaics were returned.
240 AH Al-Mutawakkil Ala Allah	Stressors due to intensity of use	Marble on the Kaaba's floor was broken and some marble on the walls came loose. The threshold of the lower door which consists of two pieces of teak were shabby and worn out.	The silver on the corners of the Kaaba was removed and replaced with gold. The gold on the other corners was removed and reshaped to match the new shape and then it was installed again. The wobbling marble was taken off and re-installed with a synthetic plaster. The dyes on the ceiling were removed and the engraved marble in the ceiling was covered with a thin layer of gold. The wood of the door's bottom threshold was taken off and replaced with new teak wood and covered with the silver that was on the ceiling.
542 AH Al-Muqtafi li-Amr Allah	End of its lifespan	The roof of the Kaaba was worn out.	The ceiling, the staircase inside it and part of the Al-Shazrawan were reconstructed.
816 AH Al-Mu'ayyad Abi Al-Nasr	End of its lifespan	The existence of some parts in the Kaaba's roof from which the rain accumulates and drips down to the bottom. Some of them are near the portholes made for light. The wood applied above the porthole that holds the high construction on the roof of the Grand Mosque was damaged. The porthole, of the northern corner, was broken. Some of the wooden stairs of the Kaaba were broken.	The positions were fixed by plaster after taking off their marble and returning it back to its place and replacing parts of it with new ones. The wood of the portholes was changed and then the reconstruction took place upon it except for the porthole that follows the Kaaba's door, whose wood was not changed. The broken porthole of the northern corner was changed and the broken wood of the stairs were repaired.
825 AH Brisbay		Wood in the Kaaba's roof, prepared for tying its Kiswah, has been destroyed and taken off.	They were replaced with new wood, in which new iron rings that hold the Kaaba's Kiswah, were installed.
826 AH Brisbay		The marble between the western wall of the Kaaba and the cylinders and some marble in the Kaaba walls were taken off. The wooden cylinder in front of the door inside the Kaaba was removed from its position as much as a cubit and a span, When exposing the cylinder above it, it was found under	The floor marble was reinstalled to its original state with plaster. The wall marble was repaired and returned to its place. Three sheets of iron, connected to the joist above them, were fixed to the column and were placed below it. The plaster was dissolved and put under the column. They were tightened with extreme perfection.

		the joist and the joist was not leaning against it.	
931 AH Ibrahim Pasha		There was a break in a piece of wood in the ceiling	They put an iron collar on the broken part, and filled the place that was broken with sand and plaster.
959 AH Sultan Suleiman Khan		There was a defect in the Kaaba's ceiling caused by the breakage of some wood	The broken wood was replaced by ceiling and roof tiles as they were with extreme perfection.
1020 AH Sultan Ahmed Khan		The Kaaba walls were cracked	A belt was made for it and it has been tightened by it.
1040 AH Murad Khan	A great flood that entered the Kaaba from its door and reached half of its wall	The Al-Shami wall of the Grand Mosque, parts of the Eastern and Western walls and the roof step fell	They proceeded to transfer the stones that fell from the Kaaba; as they cut stones from Jabal Al-Shibikah and demolished the rest of the Kaaba's walls. They took out two of the three pillars that have the ceiling wood tubs on them and they found them intact except for the head of one of them following the floor, which was eroded. They kept the intact tubs and threw away the ones they found worn out with the worn-out mosque's wood. They brought the tubs of the first ceiling from Jeddah; which is the mast of a ship. They took off the door threshold and the Al-Shazrawan stones and the stone in the Yemeni corner, and broke the ceiling of Kaaba and threw the foundation of the Shami wall and parts of the western wall and put the threshold of the lower door adjacent to the Al-Shazrawan. They repaired the intact wood taken from the Mosque and returned the three pillars and the bases made of Shibiki stones as a replacement of the parts that were cut off from the bottom of the pillars and they poured lead into them. They re-pasted the black stone and tightened it with a silver belt. They brought the second ceiling wood and installed it, mounted the staircase of the roof, and installed the gutter of Kaaba. They covered the surface of Kaaba with its marble and installed the Al-Shazrawan. They replaced ten broken marbles with new ones. They repaired the Kaaba stairs and changed one of its steps.
1073 AH Murad Khan	Erosion	A piece of wood in the ceiling of Kaaba was broken	The roof was exposed, the broken wood was removed and the ceiling was reconstructed.
1109 AH Murad Khan	Erosion	A piece of wood in the ceiling was broken	They took out the broken ceiling and changed the staircase to the roof, making seven marble stairs in it and the rest were made of teak wood.
1316 AH Al-Sharif Aoun Al-Rafiq	Rain water that fell and reached inside of Kaaba and remained in it	A bad foul smell emerged inside Kaaba, due to the destruction of the Kaaba's roof and the destruction of marble tiles on the roof of Kaaba	They removed the stagnant water and the dirt and made a paste of lime mortar, egg and cement to fill the cracks and fix the ceiling.

1332 AH Al-Sharif bin Ali bin Mohammed bin Aoun	The Kaaba washing water and the floods that reached inside the Kaaba	The bottom of the three wooden pillars had chunks and cracks.	Wood was placed along the bottom of each pillar and fixed to it with nails with extreme perfection.
1375 AH King Abdul Aziz	Aging	Erosion of most of the Kaaba's wood. The presence of cracks, chunks and protrusions in the northern and western walls	Removing the upper roof of the Kaaba and building a reinforced roof instead. A reinforced mantle was built to surround the four walls under the upper roof. The lower ceiling remained on its structural status while changing the damaged wood and replacing them with new ones. The marble cover surrounding the inner wall was restored and reinstalled. The wooden staircase inside the Kaaba was replaced with a metal circular staircase consisting of 50 steps.
1401 AH King Fahd	The presence of moisture and dew around the Black Stone after the leakage of the washing water into the Kaaba from the marble floor of the highest point above the Black Stone	The corrosion of the nails holding the Black Stone, the crumbling of the material fixing it, and the cracking of the marble inside it.	The Kaaba's marble was replaced while considering the placement of the lead insulation, filling the broken marbles with the melted lead, and adjusting the slope ratio of the water flow.
1416 AH King Fahd	The wood in the inner wall of Kaaba was affected by the termites, fungi and moisture. The fillings between the stones and the internal separators lining the wall of Kaaba were affected. The foundation was checked to identify the need to let the repair reach the depth of the foundation.	Damage in the wood of the ceiling and the columns bearing it. Weakness of the stone cohesion. Damage and weak cohesion of the mixture. Great damage in the wooden beams in the wall. Walls under the land level of Kaaba and the foundations were greatly affected by the negative effects that appeared on the walls.	The Kaaba's ceiling, bearing columns and all its tiles were removed. The walls composing the inner body of the Kaaba were dismantled after being numbered. The outer wall of Kaaba was exposed and there were no structural defects as the removed stones were cleaned. The filling stones were removed, cleaned, dried and returned with a high-cohesive material by automatic injection. Afterwards the stones of the inner facade were returned from the bottom to the top so that each stone is placed in its place according to its numbering after cleaning it and filling the joints with a highly powerful mixture. The floor of Kaaba was drilled to the depth of the Tawaaf level (2.2). Restoration and cleaning of the stones between half a meter and three quarters of a meter below the level of the Kaaba. Wooden pieces of the roof and columns were replaced with new ones, and stainless steel heads were placed on the sides of the beams and the columns that form points of bearing. The old rock bases of the columns were replaced with reinforced concrete bases, isolated by a moisture-proof insulating layer. A layer of insulation material was placed above the wooden roof and a layer of light concrete was placed above it to protect it. The marble of the old Al- Shazrawan marble has been changed with a new one like the shape and type of the old one.

1. Methodology

This research deals with the analysis of the elements of the approach used in all the restoration operations under this study including assessing the amount of change in the building's formal properties and its original components through the preservation matrix that was derived from similar studies, and after reviewing the various documents such as books, newspapers and certified magazines, and extracting the historical data required for the restoration operations under the study; in addition to collecting and analyzing them to find out the impact of the restoration approach according to the building's original components and form. The restoration operations under the study are 19 restoration operations, all of which were performed for the Holy Kaaba during the Islamic era. They have been selected according to the following:

1. A physical or functional deterioration must have occurred to the building prior to the restoration operation under the study, which means excluding the restoration operations that occurred for reasons other than those mentioned above.
2. The causes for the deterioration and the restoration method must have been mentioned in the reliable historical references.
3. Both the deterioration which occurred and the restoration that followed must be within the temporal boundaries of the research (during the Islamic era).

The study follows the descriptive analytical method. As the data was analyzed using the Preservation Matrix (Table 2), which was inspired by a number of studies concerning the preservation of the architectural heritage and the design of a practical methodology for assessing the restoration operations, its objectives and the relationship between the extent and the causes of deterioration with the restoration operation that followed.

The designed strategy works on assessing the restoration operation performed to the buildings of a historical nature according to one of four different levels, and then comparing them with the extent of deterioration incurred by the building. After assessing the type and size of deterioration at the four different levels, the result can be achieved by comparing the deterioration level with the intervention level through the following equation:

Intervention Level – Deterioration Level (Figure 12)

1. Intervention Level - Deterioration Level = Zero \Rightarrow indicates the suitability of the work performed for the building and its incurred deterioration at the time.
2. Intervention Level - Deterioration Level \neq Zero \Rightarrow indicates the unsuitability of the work performed for the building and its incurred deterioration at the time.

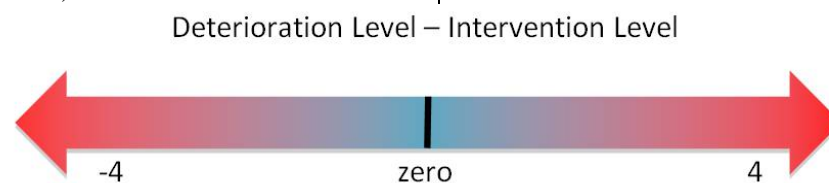


Figure 12. Equation Measuring The Suitability Of Restoration For The Deterioration Level

The researcher performed the previous calculation on all the restoration operation under the study to find a course showing the relationship between the deterioration level and the intervention level within the temporal boundaries of the research. Also, a calculation of the average of the intervention level and the deterioration level for the operations under the study have been done and performed the same calculation to reach a general conclusion for the research.

2. Discussion

First, the data and information obtained were classified into one of the four preservation determinants (deterioration causes, intervention objectives, building's physical state, completed work). The determinants were classified according to their impact on the building to one of the four levels, according to the proposed methodology that was designed in advance in preparation for the assessment and analysis of its data (Table 3).

Table 2. Preservation Matrix

	First Level Related to the Building Materials	Second Level Related to Structure	Third Level Related to Building Functions	Fourth Level A new addition
	Maintenance Preservation Deterioration Prevention Restoration Consolidation	Reconstruction Remodeling Recreate Integration Saving Replacement	Adaptive reuse Development Rehabilitation renovation Improvement	A yard around the building Contemporary Extension Facade Retention
Intervention Objectives				
Protection and Retention				
Restoration of the original features rehabilitate the building				
Protection and maintenance of external facades				
Horizontal extension and expansion				
The Building's Physical State				
Wholly or partially dilapidated				
Under negative effects				
In good condition internally and externally				
In good condition externally only				
Causes for the deterioration of the building				
The building lifespan				
Natural factors				
Human factors				
Emergence of stressors as a result of change in the type and intensity of the user				
Completed Works				
Replacement of deteriorated parts with similar ones				
Reconstruction of the entire building to become an image of what it used to be				
Avoiding the reconstruction of the building in the same original manner				
Reformulation of spaces				
Making a clear separation between old and modern works in interior design				
Using modern methods and techniques in construction				

Table 3. Classification of the Four Preservation Determinants

Year	Deterioration Causes	Intervention Objective	Building's Physical State	Completed Work
64 AH	Human Factors - Fire Reconstruction (Second Level - Completion)	Horizontal extension and expansion (Fifth Level) Restoration of the original features (Second Level)	Partially dilapidated (Second Level)	- Reformulation of spaces. (Third Level) Rehabilitation
74 AH	Human Factors – Lack of knowledge in development and preservation	Restoration of the original features (Second Level)	In a good condition, internally and externally (Third Level)	- Remodeling. (Second Level)

200 AH	End of Lifespan (First Level)	Protection and retention of the whole building (First Level)	Under negative effects (First Level)	- Replacement the deteriorated parts with similar ones. (First Level)
240 AH	End of Lifespan (First Level)	Protection and retention of the whole building (First Level)	Under negative effects (First Level)	- Replacement of the deteriorated parts with similar ones. (First Level)
542 AH	End of Lifespan (First Level)	Protection and retention of the whole building (First Level)	Under negative effects (First Level)	- Replacement of the deteriorated parts with similar ones. (First Level) Consolidation
816 AH	End of lifespan (Second Level)	Restoration of the original features (Second Level)	Partially dilapidated (Second Level)	- Replacement of the deteriorated parts with similar ones. (First Level) Maintenance
825 AH	End of Lifespan (First Level)	Protection and retention of the whole building (First Level)	Under negative effects (First Level)	- Replacement of the deteriorated parts with similar ones. (First Level) Maintenance
826 AH	End of Lifespan (Second Level)	Restoration of the original features (Second Level)	Wholly or partially dilapidated (Second Level)	- Replacement of the deteriorated parts with similar ones (First Level) Consolidation
931 AH	End of Lifespan (Second Level)	Protection and retention of the whole landmark (First Level)	Wholly or partially dilapidated (Second Level)	- Replacement of the deteriorated parts with similar ones. (First Level) Maintenance
959 AH	Human factors – Lack of knowledge in preservation and development (First Level)	Protection and retention of the whole building (First Level)	Wholly or partially dilapidated (Second Level)	- Replacement of the deteriorated parts with similar ones. (First Level) Restoration
1020 AH	End of Lifespan (Second Level)	Restoring the original features (Second Level)	Wholly or partially dilapidated (Second Level)	- Replacement of the deteriorated parts with similar ones. (First Level) Preservation
1040 AH	Natural Factors - Erosion (Second Level)	Restoration of the original features (Second Level)	Wholly or partially dilapidated (Second Level)	- Reconstruction of the entire building and rebuilding it to become an image of what it used to be. (Second Level) Reconstruction
1073 AH	End of Lifespan (First Level)	Protection and retention of the whole building (First Level)	Partially dilapidated (Second Level)	- Replacement of the deteriorated parts with similar ones. (First Level) Restoration
1109 AH	End of Lifespan (First Level)	Protection and retention of the whole building (First Level)	Partially dilapidated (Second Level)	- Replacement of the deteriorated parts with similar ones. (First Level) Preservation

1316 AH	Natural Factors - Erosion (First Level)	Protection and retention of the whole building (First Level)	Under negative effects (First Level)	- Replacement of the deteriorated parts with similar ones. (First Level) Preservation
1332 AH	Human - natural factors (First Level)	Protection and retention of the whole building (First Level)	Under negative effects (First Level)	-Replacement of the deteriorated parts with similar ones. (First Level) Consolidation
1375 AH	End of lifespan (Second Level)	Rehabilitation (Third Level)	Partially dilapidated (Second Level)	- Change and addition in the form (addition of contemporary formations) (Third Level)
1401 AH	Human factors (First Level)	Protection and retention of the whole building (First Level)	Under negative effects (First Level)	-Replacement of the deteriorated parts with similar ones. (First Level) Deterioration prevention
1416 AH	Natural Factors – Natural Forces (Second Level)	Restoration of the original features (Third Level)	Under negative effects (First Level)	- Reconstruction of the entire building and rebuilding it to become an image of what it used to be. (Third Level) Rehabilitation

The cause of deterioration for all operations was assessed and it was determined that for most of them the deterioration was caused by lifespan, while in some other cases it was caused by human factors such as fire and ignorance in conservation and development. In a few cases, the reason was natural factors such as floods and rain. Figure 13 shows the frequency percentage for each of these three factors.

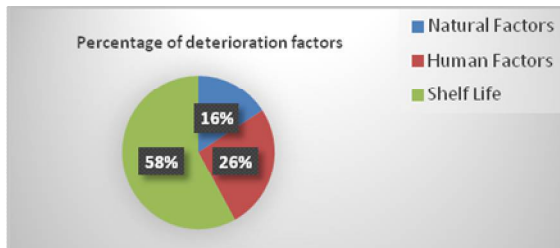


Figure 13. The Frequency Percentage of The Three Factors

The physical condition of the building after each deterioration was evaluated. The study found that in all cases of deterioration caused by the lifespan of the building, the building condition was one of the following:

- Wholly or partially dilapidated in (7) cases. The intervention objective in all these cases varied; Protection and retention of the whole building in (3) cases, restoration of the original features in (3) cases, rehabilitate the building in one case occurred in the year 1375 AH.
- Under negative effects in (3) cases, the

intervention objective in all these cases was protection and retention of the whole building.

The completed works all were similar. It was at the first level of intervention which replaced the deteriorated elements with new similar elements, except for case number (17) where a change and addition in the form was attempted by adding additional contemporary formations.

In the case of deterioration caused by human factors, the building was:

- Wholly or partially dilapidated in (2) cases, the intervention objective varied; Protection and retention of the whole building in (1) case by replacing the deteriorated elements with new similar elements. Horizontal extension and expansion in the first case by reformulation of spaces.
- Under negative effects in (1) case, the intervention objective replaced the deteriorated elements with new similar elements
- In a good condition, internally and externally in (1) case, the intervention objective was protection and retention of the whole building by remodeling the building.

In the case of deterioration caused by natural factors, the building was:

- Wholly or partially dilapidated in (1) case. The intervention objective was restoration of the original features by replacing the deteriorated elements with new similar elements. Horizontal extension and expansion in the first case by

reformulation of spaces by reconstruction of the entire building to become an image of what it used to be.

- Under negative effects in (2) cases, the intervention objective varied; Protection and retention of the whole building in (1) case by replacing the deteriorated elements with new similar elements and restoration of the original features in (1) case by reconstruction of the entire building and rebuilding it to become an

image of what it used to be.

Based on the above, it was concluded that, in most cases under study the deterioration level varied between the second and third levels by 58%. The percentage of preservation works in the second and third levels did not exceed 26%. In other words, it could be said there was a deterioration at the first level of 42%, while the intervention at the first level achieved 74% (Figure 14).

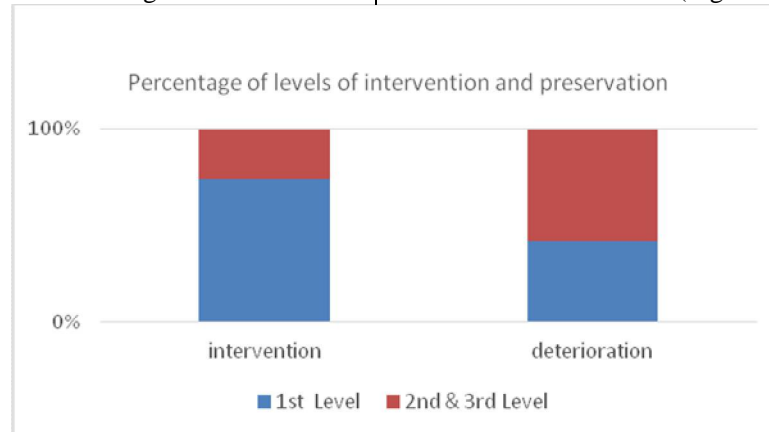


Figure 14

The cases of over-maintenance are summarized in three operations, Numbers 1,17 and 19, in which the deterioration occurred due to human factors, natural factors and due to the lifespan. The over-maintenance in (1) operation which is reformulation of spaces, was due to a desire to act based on the prophetic commandment at that time. It was an exceptional case. It was not subject to radical interference by the authorities and bodies responsible for the Holy Mosque. The other two cases were caused by natural factors and lifespan. In both cases, modern building techniques were used which could attribute to over-maintenance.

3. Results and Recommendations:

The results showed that after assessing the levels of the four determinants (the Determinants of the Intervention Levels in the Valuable Buildings), the minimal intervention principle was achieved in many of the operations that have been studied by a percentage of 42.11% of the total operations. The operations recorded 15.78% of the exaggeration in the restoration with the increase in the intervention level over the deterioration level. The balance between the deterioration level and the preservation level was achieved by 42.11% as well. Based on this result, the principle of minimal intervention has been achieved. The Over-maintenance due to non-human factors occurred when modern preservation and restoration techniques were used. The result shows that there

is some deficiency in the application of the methods of preservation of architectural heritage according to the approach suggested by the study. One of the main reasons for this may be the sacredness of the place, taking advice, caution when conducting repairs and dealing with the situation with total transparency, clarity and concern by the authorities and bodies responsible for the Grand Mosque and the Holy Kaaba during the period under the study.

It was revealed through the theoretical study and through the tracking of the phases and procedures of the restoration operations carried out on the Kaaba that all the causes of deterioration that happened to Kaaba were due to a physical deterioration caused by one of the three basic factors; the human factors, the natural factors and the lifespan of the building. The impact on the safety of the structure and the original building materials of the building varied. This means that there has never been any functional deterioration to Kaaba during the period under the study. Therefore, when devising a plan to preserve the buildings of historic value in the study area, it is essential that this plan be based on taking these factors into account and avoiding their negative effects as much as possible. The study also found that the deterioration caused by human factors and natural factors is usually followed by variable levels of intervention, which commensurate with the amount of the damage caused by these factors. The deterioration resulting from the building's

lifespan factor is usually followed by interventions on the First Level. It is worth mentioning that a single intervention on the Third level was made due to the deterioration resulting from the lifespan of the building (number 17) because of using

modern techniques in restoring the ceiling as mentioned in this paper's previous studies. Figure 15 illustrates these factors and their subsequent impacts.

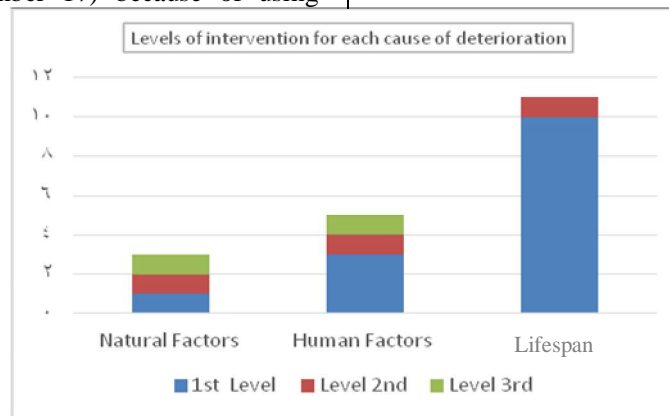


Figure 15.

From the above, the most important missing elements of previous preservation methods could be occurred and followed by the preservation institutions, which might contribute to changing the actual reality in the experiment of preserving the architectural heritage according to Saudi Vision 2030. This, in turn, may enable the development of a plan afterwards to support the preservation methods of the architectural and urban heritage in the region in accordance with a clear and locally acceptable methodology. These elements were identified based on the shortage that emerged in the preservation methods of the architectural heritage in the Holy Kaaba experiment after the application of the proposed approach.

Most of the deterioration factors that occurred during the study period are due to the lifespan and this is one of the most important observations of this study. It can also be an indication of the importance of developing a future plan organized

and supported by electronic programs and contribute to the periodic registration of the building condition and details of any intervention operations Which was conducted on the building, this may facilitate the design of prevention maintenance plans that help to protect the building and reduce processes of deterioration due to lifespan .

In general, when the deterioration and the intervention level have been compared, (Figure 16) it become clear that the minimal intervention printable has been achieved in most of this study restoration operations, when average deterioration and intervention levels was calculated to verify the result of the main question was formulated in the study (intervention level – deterioration level), the result was (0.21), which illustrate that the restoration process that took place on the Kaaba during the Islamic period Was generally oriented towards achieving the principle of minimal intervention in the preservation of historical buildings.

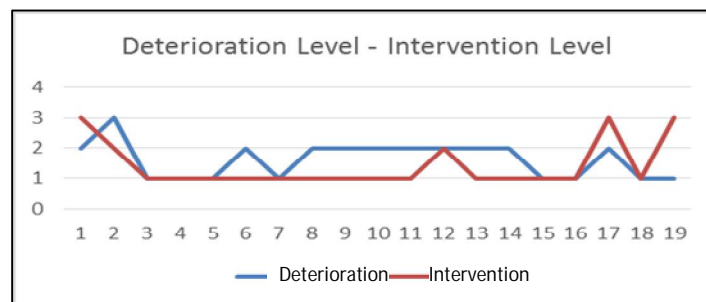


Figure 16.

3- Conclusion:

- The minimal intervention principle was achieved in a large number of the operations that have been studied.

- Causes of deterioration that happened to Kaaba were due to a physical deterioration caused by one of the three basic Factors, lifespan, human factors and natural factors.

- There has never been any functional deterioration to Kaaba during the period under the study.
- The deterioration caused by human factors and natural factors is usually followed by variable levels of intervention.
- In most of operations under the study, the deterioration caused by lifespan.
- Deterioration resulting from the building's Lifespan factor usually is followed by interventions on the First Level.
- The Over-maintenance due to non-human factors occurred when modern preservation and restoration techniques were used.
- By this study, it become clear that there was some deficiency in the application of architectural heritage preservation methods according to the approach suggested
- Weak relationship between the exaggeration in the Kaaba restoration operations and the changes that have occurred to the Kaaba's form and components during the Islamic era.
- This study contributes in the formulation of conservation matrix, which formed the theoretical basis for dealing with the conservation of architectural heritage. to become the base for the analysis, classification and evaluation for the operations under the study
- a systematic approach that can be applied to maintain the valuable historic buildings that have been recently discovered in some regions of Saudi Arabia to contribute in achieving one of the most important objectives of Saudi Vision 2030 represented in the revival of the national historical buildings.
- the impact of the approach taken in the restoration operations that were conducted to preserve the Kaaba might be a good base for similar future studies.

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