

Damage analysis of “ smail Bey” case study bath structure:

Table 7.16: Damage analysis of “ smail Bey” case study bath structure, “Cell A”

| Damage Analysis of "Ismail Bey Bath" | | | | | | | | | | |
|--------------------------------------|-------------------------------|---|----------------------------------|------------------------------------|--|---|------------------------------|--|---------------------|---------------------|
| Damaged Part Number | Damaged Parts of Case Studies | Quality of Masonry | Construction Characteristics | | | General Description | Cracking and Instability | | | |
| | | | Structural Discontinuities | Degradation of structural elements | Conditions | | Physical Damage | Geometrical Modifications | Loss of verticality | General Description |
| Cell "A" | | <p>A</p> <p>B</p> <p>C</p> <p>Qualitative methods of for evaluation is rated, "C" in vertical, out of plane and in plane actions.</p> <p>In detail cell "A"; not squared stones with bricks were used. Leaves of the masonry were not good bonded and rows between them were constructed irregularly.</p> | <p>Fig:1,2</p> <p>Fig: 3,4,5</p> | <p>Fig: All</p> <p>Fig: 3,4,5</p> | <p>Between the masonry walls there is a consistency of the structure. Also there are sockets for timber tie rods however timber material was deteriorated in a time manner. As well there is a big deterioration of stone wall construction.</p> | <p>Fig: All</p> <p>Fig: 3,4,5</p> <p>Fig: All</p> <p>Fig: 1,2</p> | <p>Fig: 7</p> <p>Fig:1,5</p> | <p>Probably there were a cracks on this cell. However they were compensated in previous maintenance works. Outer leaves of the masonry structures in deteriorated. And some part of the structure in collapsed. The empty socket for timber ties and thinner stone walls weaken the structure. The total structure of the dome and part of the stone slab was collapsed. In figure 1: Between two masonry walls arch structure was collapsed. The structure was weak for horizontal loads. In figure 2: The construction of the masonry wall was in a low quality. The wall fabric is chaotic. Diatone stones are not used inside of the masonry. In figure 3,4,5: The wall layer on timber beam sockets wall broken down. In figure 6: Thin and damaged arch with collapsed dome. In figure 7: Whole of the dome was collapsed. In figure 8: The outer leaves of the arch were sperated and it became very thin weak for the vertical and horizontal loads.</p> | | |

Table 7.17: Damage analysis of “smail Bey” case study bath structure, “Cell B”






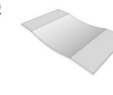

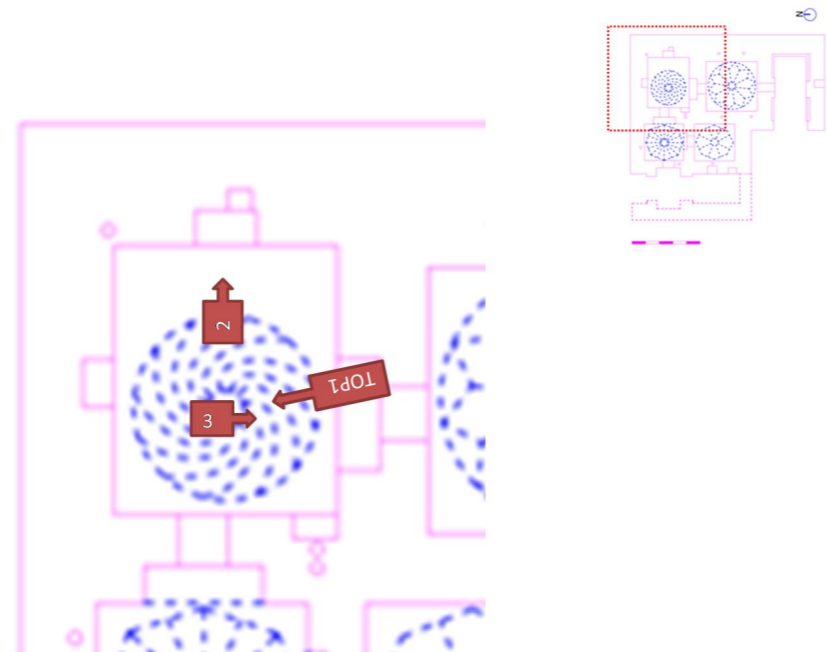
| Damage Analysis of "Ismail Bey Bath" | | | | | | | | | | |
|--------------------------------------|--|---|---|---|---|--|---|---|---------------------|---|
| Damaged Part Number | Damaged Parts of Case Studies | Quality of Masonry | Construction Characteristics | | | General Description | Cracking and Instability | | | General Description |
| | | | Structural Discontinuities | Degradation of structural elements | Conditions | | Physical Damage | Geometrical Modifications | Loss of verticality | |
| Cell "B" |  | <p>A</p> <p>B</p> <p>C</p> <p>Qualitative methods of for evaluation is rated, "C" in vertical, out of plane and in plane actions.</p> <p>In detail cell "B"; not squared stones with bricks were used. Leaves of the masonry were not good bonded and rows between them were constructed irregularly. However there is an enforcement for linearity of bricks between the stones.</p> | <p>Fig: 2,3</p>  | <p>Fig: All</p>  |  | <p>The slab of the bath was built with stone material on the top of the brick archs. Short coloums were used for supporting brick arches also the stone slab structure. In figure 1, remnant of the short coloum is seen. In figure 2, the possible connection part of the stone slab is seen.</p> | <p>Fig: All</p>  | <p>Fig: 2</p>  | | <p>Outer leaves of the masonry structures was built recently in maintenance works. Therefore there is not any clue for the cracks and collapses of the masonry walls. Trace of the short coloums were seen. In figure 3, bottom of the arch was damaged. However there is not any instability problems like cracks on this arch and its around.</p> |
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Table 7.18: Damage analysis of “ smail Bey” case study bath structure, “Cell C”

| Damage Analysis of "Ismail Bey Bath" | | | | | | | | | | |
|--------------------------------------|-------------------------------|--|------------------------------|------------------------------------|------------|--|-----------------|---------------------------|---------------------|---|
| Damaged Part Number | Damaged Parts of Case Studies | Quality of Masonry | Construction Characteristics | | | Cracking and Instability | | | | |
| | | | Structural Discontinuities | Degradation of structural elements | Conditions | General Description | Physical Damage | Geometrical Modifications | Loss of verticality | General Description |
| Cell "C" | | <p>A</p> <p>B</p> <p>C</p> <p>Qualitative methods of for evaluation is rated, "C" in vertical, out of plane and in plane actions.</p> <p>In detail cell "C"; not squared stones with bricks were used. Leaves of the masonry were not good bonded and rows between them were constructed irregularly.</p> | <p>Fig: 4,5,6,7</p> | <p>Fig: All</p> | | <p>Between the masonry walls there is a consistency of the structure. Brick constructed tie beams were used inside the walls. The domes were built up on brick tiles. There is lighting holes on the top of the domes.</p> | <p>Fig: 1,2</p> | <p>Fig: 4,6,7</p> | | <p>In figure 1,2,5: Cracks on the domes are seen outside of the building. Top of the dome the opening was damaged and some parts were collapsed.</p> <p>In figure 3: In some parts of the dome structure is repaired in the previous maintenance applications. In figure 4,6: Inside of the cell structure in some of the parts outer leaf of the masonry wall is seperated. In figure 7: Stone slab of the structure is collapsed. The short coloums which are supported the arch structure as well the stone slab are seen.</p> |
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Table 7.19: Damage analysis of “ smail Bey” case study bath structure, “Cell D”















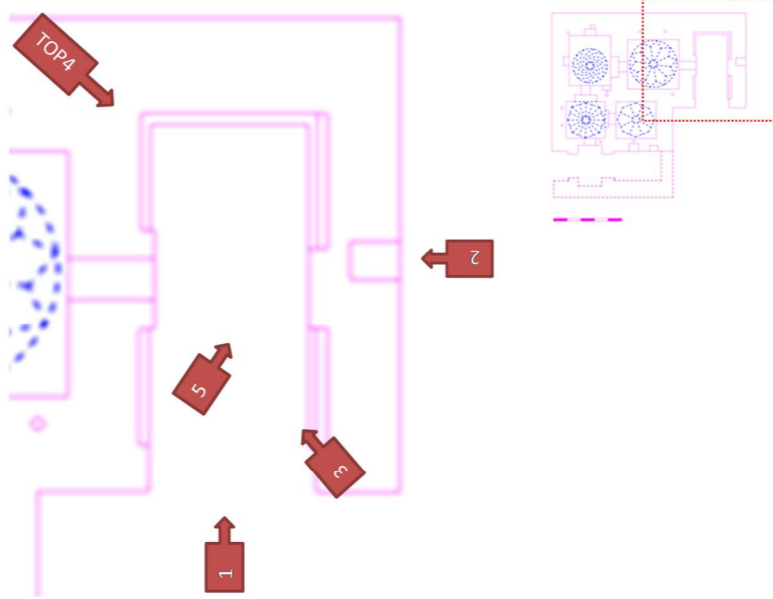
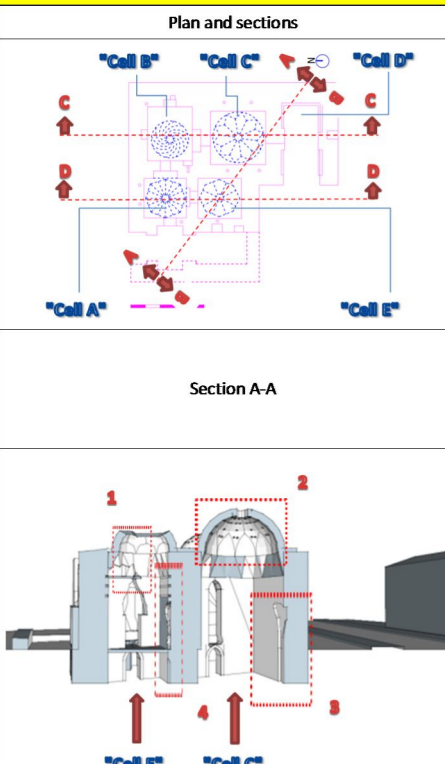


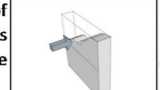

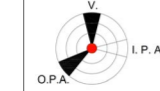

| Damage Analysis of "Ismail Bey Bath" | | | | | | | | | | | |
|--------------------------------------|---|---|---|--|---|--|---|--|--|---|--|
| Damaged Part Number | Damaged Parts of Case Studies | Quality of Masonry | Construction Characteristics | | | Cracking and Instability | | | | | |
| | | | Structural Discontinuities | Degradation of structural elements | Conditions | General Description | Physical Damage | Geometrical Modifications | Loss of verticality | General Description | |
| Cell "D" |  | <p>A</p> <p>B</p> <p>C</p> <p>Qualitative methods of for evaluation is rated, "C" in vertical, out of plane and in plane actions.</p> <p>In detail cell "D"; not squared stones with bricks were used. Leaves of the masonry were not good bonded and rows between them were constructed irregularly.</p> | Fig: 1  | Fig: All  |  | Between the masonry walls there is a consistency of the structure. Also there are sockets for timber tie rods however timber material was deteriorated in a time manner. The vault structure is built up on brick material. On the top of this structure stone and mortar is used to fill the vault structure. There is recently built outer leaf for the masonry wall in the previous maintenance operations. | Fig:1,3,4  | Fig: 1,3,4  | | Probably there were many cracks on this cell. However they were compensated in previous maintenance works. However half of the masonry is seen without any maintenance. In figure 1: The outer leaves of the masonry wall is collapsed. Inner leaf is seen with timber sockets. This part of the building is unstable for any type of action. In figure 2,5: Between this cell and the outer furnace area there is a passage which is partly collapsed. Also the half of the stone slab is collapsed. In figure 3,4: On the top of the vault structure there are big cracks which will cause an instability problems of the vault and attached walls. | |
| |   | |   | | Fig:1  | Fig:1  | | | Fig: 1  | Fig: 2,3,5  | |
| | | |  | | | | | | | | |

Table 7.20: Damage analysis of “ smail Bey” case study bath structure, “Cell E”

| Damage Analysis of "Ismail Bey Bath" | | | | | | | | | | |
|--------------------------------------|-------------------------------|---|------------------------------|------------------------------------|------------|--|--------------------------|---------------------------|---------------------|--|
| Damaged Part Number | Damaged Parts of Case Studies | Quality of Masonry | Construction Characteristics | | | General Description | Cracking and Instability | | | |
| | | | Structural Discontinuities | Degradation of structural elements | Conditions | | Physical Damage | Geometrical Modifications | Loss of verticality | General Description |
| Cell "E" | | <p>A</p> <p>B</p> <p>C</p> <p>Qualitative methods of for evaluation is rated, "C" in vertical, out of plane and in plane actions.</p> <p>In detail cell "E"; not squared stones with bricks were used. Leaves of the masonry were not good bonded and rows between them were constructed irregularly.</p> | <p>Fig: All</p> | <p>Fig: All</p> | | <p>Between the masonry walls there is a consistency of the structure. Also there are sockets for timber tie rods however timber material was deteriorated in a time manner. Transitional elements were built up of bricks with stone infillings.</p> | <p>Fig: 3,5</p> | <p>Fig: All</p> | | <p>In figure 1,2: Timber tie beam sockets are seen in some part of the structure. There is one big crack coming from the top of the wall which is connect to the next cell's dome structure. In figure 3: The big crack is seen on the top of the masonry structure which is connected to the adjacent cell structure's dome. In figure 4: Inner leaf of the masonry structure is collapsed on the top of the wall. Therefore in that part, the masonry wall is very thin and it is unstable to any type of action. In figure 5: The big crack which is started from the top of the adjacent cell dome to the top of the wall.</p> |
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Collapsed analysis of “ smail Bey” case study bath structure:

Table 7.21: Collapsed analysis of “ smail Bey” case study bath structure, Section A-A

| Collapse Analysis of Critical Damaged Parts of "Ismail Bey" bath | | | | | | | |
|--|---|---|---|--|----------------------------------|--|--|
| Plan and sections | | Details | | | | | |
| Section A-A | | Detail 1 | | Detail 2 | | | |
| Symbolic Description of Action Analysis | Symbolic Collapse Mechanism | Description of Collapse Analysis | Symbolic Description of Action Analysis | Symbolic Collapse Mechanism | Description of Collapse Analysis | | |
|  |  | <p>Detail 1; has a big damage on integrity of its arch structure. Also there is a crack on the top of its arch. The masonry wall which constitute the arch is very thin. This detail is high risk of vertical actions because of its loss of structural integrity and collapsed of its top. In addition on its top the dome is collapsed. And there is a critical long crack is continues through the dome to other dome. If this arch unit is collapsed there is possibility for it to join of kinematic chain with the big crack between the domes.</p> |  | <p>Detail 2; dome has a damage on its top and critical line between tension and compression. The perimeter walls of the dome are thick. However the perimeter walls have big damages on their outer layer. Some parts of the outer layers are collapsed. And also there is a big crack on the dome and continue through the masonry walls and the next cell. Folding mechanism of dome is formed by bending the outer walls through the out of plane action and in plane action.</p> | | | |
| |  | <p>Detail 3; In "cell C" inside leaf of the masonry wall was collapsed. The shape of the collapsed part was irregular because of irregular pattern of stone masonry. Therefore thinner part of the masonry wall makes the wall structure weaker. The collapsed of the inside cell leaf has two reasons. First one is; outer vertical deflection. Outside leaf of the masonry wall under pressure. Therefore inside of the leaf pushed away from the wall. Second one is; weak conection between the masonry leaves and the reversal of the external leaves.</p> |  | <p>Detail 4; In "cell E" the corruption inside leaf of the masonry was better condition rather than "cell C". However the void timber tie beams socket weaken the masonry structure. Therefore inner leaf of the wall structure or the total wall will be started to collapse in three different type.</p> | | | |
| |  | | <p>Very high risk of collapse if this element under the seismic forces.</p> |  | | | |
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CHAPTER 7: CASE STUDIES

Table 7.22: Collapsed analysis of “ smail Bey” case study bath structure, Section B-B / C-C / D-D

| Section B-B | Detail 5 | | | Detail 6 | | |
|-------------|---|-----------------------------|--|---|-----------------------------|--|
| | Symbolic Description of Action Analysis | Symbolic Collapse Mechanism | Description of Collapse Analysis | Symbolic Description of Action Analysis | Symbolic Collapse Mechanism | Description of Collapse Analysis |
| | <p>Very high risk of collapse if this element under the seismic forces.</p> | | <p>Detail 5; The dome is collapsed. The bearing walls of the dome deteriorated. In the area of transitional elements, inner leaf of the masonry is collapsed and the masonry wall became thin. In addition the empty timber tie beam sockets weaken whole the masonry wall.</p> | <p>Very high risk of collapse if this element under the seismic forces.</p> | | <p>Detail 6; This corruption of the inside leaf of the masonry wall is the continuity of detail 3. The shape of the corruption is very deep and irregular. The irregular collapse shape of the stone masonry occurs because of the irregular pattern of stones. The masonry wall became very thin in that area. The outer and inner leaf of the masonry is collapsed. And the bearing capacity of the masonry is weakened. The collapsed reason of inside cell and inner masonry leaves have two reason. First one is; outer vertical deflection. Outside leaf of the masonry wall under pressure. Therefore inside of the leaf pushed away from the wall. Second one is; weak conection between the masonry leaves and the reversal of the external leaves.</p> |
| Section C-C | Detail 7 | | | Detail 8 | | |
| | <p>Very high risk of collapse if this element under the seismic forces.</p> | | <p>Detail 7; The vault structure had big cracks on it. The collapse mechanism is visible outside the structure. The possible collapse of the vault will be assumed in two mechanisms. In the first collapsed is done with four hinged mechanism. In the second one, the collapsed is done with four hinged mechanism however bearing masonry walls are detached from the structure.</p> | <p>Very high risk of collapse if this element under the seismic forces.</p> | | <p>Detail 8; The stone slab which one is covered the furnace area was collapsed. In addition adjacent masonry wall which was supported the vault structure was deteriorated. This was weaken masonry wall structure. The assumption of the collapsed of the masonry wall mechanism is occured with detached of outer layers.</p> |
| Section D-D | Detail 9 | | | Detail 10 | | |
| | <p>Very high risk of collapse if this element under the seismic forces.</p> | | <p>Detail 9; The masonry wall was maintained in the previous consolidation projects. However the connection arch of two wall was collapsed. Therefore the wall is not supported against the out of plane actions. The assumed collapse of the masonry wall is done with two saperated hinged leaves masonry mechanism. In addition empty timber tie beam sockets weaken the inside of the cell masonry leaf.</p> | <p>Very high risk of collapse if this element under the seismic forces.</p> | | <p>Detail 10; The part of the masonry wall was maintained in the previous consolidation projects. However sosome parts of the wall left in its original status. The part of the wall was deteriorated and inside and outside leaves was broken down. The wall is very weak for vertical and out of plane actions.</p> |