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Impact of Electrical Energy Sources on Historical Buildings

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ABSTRACT

"Efflorescence"; sometimes called "Watering and Flowering" is a natural phenomena that happens to masonry surfaces due to humidity, salts, water content, and other weathering conditions. "Efflorescence" is considered a common knowledge among the building community. The research has observed the formation of "Efflorescence" around electrical wiring extensions and other electrical energy sources that are installed over lime stone walls of historical buildings. Such observation is unfamiliar to the construction engineering community, and highlights the necessity to investigate and address the impact of electrical energy sources on historical buildings to the community of architects and restoration specialists. The research introduces investigation of such problem on six historical buildings as selected case studies from Egypt that were built with lime stone, where "Efflorescence" around electrical conduits, fans, and sound speakers installed over their stone walls were clearly spotted by naked eyes

Keywords: *"Efflorescence", Electrical Wiring, Electrical Energy, Conduits, Outlets, Stone Walls, Masonry Surfaces*

INTRODUCTION

"Efflorescence" that usually happens to masonry surfaces due to humidity, salts, water content, and other weathering conditions, - is considered a common knowledge among the field of construction engineering and the building community. The research has observed the formation of "Efflorescence" especially around electrical wiring extensions and other electrical energy sources that are installed over lime stone walls of historical buildings.

LITERATURE REVIEW

Literature in this research paper is not investigating common "Lime Stone" deterioration problems, neither "Efflorescence" phenomena due to water, humidity or dampness of masonry surfaces[1]. The research is not discussing early or architectural aspects of historical buildings under study for the purpose of highlighting changes, or modifications of their architectural spaces due to restoration projects either. Literature in this research paper focuses only on investigating the impact of installing electrical wiring extensions and other electrical energy sources on masonry walls of historical buildings

RESEARCH GOAL

The goal of this research paper is to address the occurrence of "Efflorescence" observed due to the installation of electrical energy sources (Like lighting fixtures, sound outlets, surveillance networks, wiring extensions, fans, and other electrical works over surfaces of lime stone wall masonry in historical buildings), in order to provide restoration architects and specialists with a solution to such phenomena. As for the protection of heritage; it is assumed that the restoration process of old buildings should end with restoring the old building with minimum possible changes in its; condition, look and feel, and not causing an extra damage due to added items of the restoration process

[1] "Lime Stone" deteriorations are defined by the "GSA U.S. General Services Administration", that was established by President "Harry Truman" on (July 1, 1949), for administrating the work of the US Federal Government concerning preserving building materials, used in old US public buildings. According to the classification of the GSA agency; deterioration of "Lime Stone" may happen due to several factors including weathering, and erosion. Such deterioration happens in the form of: Staining, Crumbling, Chipping, Cracking, Detachment, [1]Flaking, Peeling, Dampness, Spalling, and Efflorescence [1]

RESEARCH SCOPE

Research in this paper focuses only on investigating the impact of electrical wiring extensions and other electrical energy sources installed on masonry walls of historical buildings. Introducing solutions to "Efflorescence" due to humidity, water, and salts contained in masonry are not within the scope of this research paper. Since such issue is extensively discussed in other researches and "Efflorescence due to humidity and water in masonry is a phenomena that is regarded as a common knowledge among the field of construction and buildings

Moreover, research in this paper is not intended for the purpose of suggesting solutions to "Efflorescence" due to humidity and water in masonry, as there are many companies in USA, Canada, Europe, and other places in the world specialized in building maintenance who provide treatments to "Efflorescence" due to humidity and water in masonry

METHOD

- The research starts with an overview about "Efflorescence" as a common knowledge among the field of construction and natural phenomena that typically happens in buildings after being built[2]. At first, the overview explains "Efflorescence" by introducing two modern buildings existing in two different geographic locations with opposite climatic conditions. One building exists in a country with an extremely cold weather, and the other in a country with a hot climate. Then, the overview proceeds into discussing the porous nature of lime stone, and the propagation of water and humidity through its pores outwards to the surface of masonry.
- Afterwards, the research investigates the formation of "Efflorescence" due to the existence of electrical energy sources on stone walls of historical buildings according to the following criteria

Sample Selection Criteria:

- The research selected historical buildings from Egypt that were built with lime stone where "Efflorescence" around electrical conduits, fans, and sound speakers installed over their stone walls were clearly spotted by naked eyes
- The research ensured that selected case studies under investigation should be more than two buildings. Since the possibility of regarding the formation of "Efflorescence" as a result of the existence of electrical energy sources over stone masonry walls, - cannot be considered a mere co-incidence, if such impact is repeatedly spotted in six different historical buildings at once
- It is ensured that the six buildings under study were selected from different geographic locations in Egypt that are quietly apart from each other, and that they were not built in the same era, nor sharing the same age. This is for the purpose of eliminating the factor of humidity that might be contained in their stone walls masonry, similar soil conditions, or the possibility of the formation of "Efflorescence" due to their underground water levels, and not due to the impact of electrical energy sources
- Selected case studies are: (1) the "Zulfikar" a.k.a "Ghattas" Mosque, (2) "Prince Timraz Ahmadi" a.k.a "Sidi Bahlul" Mosque, (3) "Sheikh Sadat" House, (4) "Mustafa Fadil" Pasha Mosque, (5) "Sheikh Saleh Abu Hadid" Mosque, and (6) "Hassan Pasha Taher" Mosque.
- The research also ensured that all selected buildings were part of the "Historic Cairo" Restoration national Project (HCRP) that is initiated by the government of Egypt in (1999) to restore "Old Cairo". The project was funded by several worldwide heritage organizations including "UNESCO". In the technical specifications of restoration works; contractors were restricted to install various electrical wiring extensions over (and not embedded inside) old walls that were built with lime stone, unless otherwise, (And in very rare cases), when there is no other option but to extend electrical wiring extensions inside grouted wall crevices.

[2] A briefing is introduced under the overview section of this research paper that explains Efflorescence" due to humidity and water in masonry. This briefing is intended for those who might not be familiar with such phenomena, or working outside the field of construction and buildings. This briefing is also to differentiate between "Efflorescence" that happens due to impact of installing electrical wiring extensions and other electrical energy sources over masonry walls of historical buildings which represents the case under investigation by this research paper.

DISCUSSION

Overview

"Efflorescence", [3] due to humidity and water contained in masonry is the formation of white crystalline or powder spots over masonry surfaces. Building materials of masonry services like bricks, stones, mortar, cement, or stucco, usually contain minerals, natural salts, and an amount of water in their mixture. After a building surface is built; salts remain for a while inside the masonry until water coming from different sources like rain, sprinklers, sanitary leaks, from inside the material, or other sources, - penetrates these materials.

Once this happens; salts contained in such materials start to go out to their surface through pores on these materials, causing the appearance of white crystalline or powder–like spots on their outer surfaces. [2], [3]

Examples of buildings affected by "Efflorescence" and illustrated in the following figures (1), and (2), are selected from two separate locations with a different, and almost opposite weather conditions; the first one is located in an area with extreme cold weather, and the other is in a country with a hot climate.

The two building examples show that "Efflorescence" may happen to masonry surfaces regardless weather conditions; however, a hot climate may accelerate the appearance of "Efflorescence", since such phenomena is closely related to the movement and evaporation of water in masonry. Figure (1) shows "Efflorescence" on the exterior walls of a modern building in "Canada" with its external walls made of bricks. [4]:

Figure (2) shows "Efflorescence" on the interior walls of a modern apartment in "Egypt" with its interior walls also made of bricks. [5]:

Figure2. Shows "Efflorescence" on the interior walls of a modern apartment in Egypt, Shows the effect almost reaching the top of the bathroom walls from

[3] "Efflorescence" is a French word means "To Flower Out", the phenomena is also called "Salting and Flowering". "Salting" on masonry services is in most cases white, grey, yellow, or brown in color. Salts contained in these materials are mostly a mixture of sodium, calcium, chlorides, nitrates, vanadium, chromium, molybde-num, and other natural materials like silica [2], [3], [4]

[4] "Canada" is characterized by its extreme cold weather, as in some places, and during the winter, the temperature decreases to (-45 C^0)

[5] "Egypt" is characterized by its hot weather, as in some places, and during the summer, temperatures may reach (+45 C^0)

the side facing the corridor. Middle: Shows "Efflorescence" affecting both walls of the apartment corridor leading to bedrooms and living area. Shows "Efflorescence" affecting the wall separating the Bathroom form the bedroom. Reference: [Researcher]

In figure (2), it is noticed that interior walls that are closer to water sources and humidity coming from the bathroom are more affected by "Efflorescence" than those located at further distances, however, water sources are not limited to kitchens or bathrooms as domestic wet areas; water may still come from the soil beneath; passing through concrete foundations to penetrate walls of apartments, especially those allocated in buildings ground floors.

The Porous Nature of "Lime Stone"

"Lime Stone" is a type of stone that belongs to the "Sedimentary rocks" family [6], it is characterized by its white, grey, or yellow grain surface, it is usually composed of a mixture of "Calcium Carbonate", and "Magnesium" salts. It is also considered as a "Fossil" formed type of rocks. [5], [6]

"Lime Stone" has wider pores than bricks and is more sensitive to water and moisture. When moisture contained inside the stone evaporates; salts and alkaline substances move through stone capillaries to its surface causing "Efflorescence". In figure (3); although the stone wall is treated to prevent "Efflorescence" by adding special "Water-based" solvents to seal the stone; white salt is still spotted in the newly treated cement grouts, and on different parts of the stone wall surface area. Moreover, it seems that there is a material of a metallic nature behind the stone wall, because spots of rust are also seen on its surface. The porous nature of the "Lime Stone" wall has caused the rust in the metallic material behind to migrate through its pores until it appeared on its surface.

"Efflorescence" caused by factors related to humidity and water contained in masonry is a common knowledge among the field of construction engineering and the building community. Yet "Efflorescence" is also observed around electrical sources placed on, or inside masonry works.

[6] "Sedimentary rocks" are formed by accumulated tiny fossils of shells of aquatic creatures, silica, minerals, calcified mud, and other natural materials that are carried by wind; to form a stack of layers above each other, that became strongly intact by the effect of time and erosion

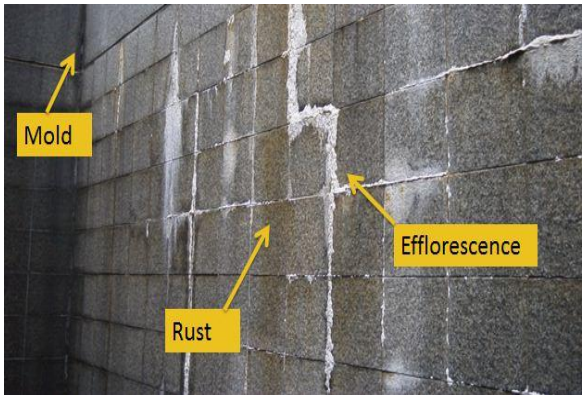

Figure3. Shows spots of salt in the newly treated cement grouts, and on different areas of the stone wall together with rust, although the wall is treated by a special "Water-Based" Solvents to prevent "Efflorescence". Reference: [7]

"Efflorescence" on Masonry Walls Due to Electrical Wiring Extensions

In the following figure (4), "Efflorescence" is spotted around the "Electric Panel" [7] placed over an entrance lobby brick wall of a modern apartment in a multistory residential building, located in Cairo, Egypt. The later was completely built in mid seventies of the twentieth century. Observation in figure (4) implies to the accumulation of "Efflorescence" on the wall mainly due to the near presence of an electrical source of energy

Figure4. Shows the accumulation of "Efflorescence" on the wall due to the near presence of an Electrical source of energy. Reference: [Researcher]

Figure (5), also shows "Efflorescence" accumulated under a painted ceiling of the saloon in the same apartment presented above.

[7] The "Electric Panel" is also known as "Distribution board", "Panel Board", or "Breaker Panel", it is an electrical supply board system that distributes and divides the power of electricity into different parts and/or interior spaces of buildings. In domestic spaces; this electrical supply board is usually placed in the entrance lobby, and enclosed in a box with an access cover.

"Efflorescence" formed around electrical conduits [8] embedded in the grouted [9] crevices [10] that are leading to the ceiling chandelier. The accumulated salts beneath caused the paint to crack[11].

Figure5. Shows "Efflorescence" accumulated under a painted ceiling of the saloon in the same apartment presented above. "Efflorescence" formed around electrical conduits that are embedded In the grouted crevices leading to the ceiling chandelier. Reference: [Researcher]

"Efflorescence" on Walls of Historical Buildings

- In general, "Efflorescence" may happen twice in historical buildings; the first "Efflorescence" is a natural process that usually happens during the time, and/or directly after the building was built. The second one may happen due to many factors related to the course of time, the effect of different weathering conditions, and changes in soil water table levels. [12] However, one of the most influential factors for the causes of the second "Efflorescence" is the technical defaults that happen during the restoration process of historical buildings

The "Historic Cairo" Restoration Project (HCRP)

- According to "UNESCO" [13], "Egypt" is an open museum holding one of the largest and most diverse world heritages; with her great; ancient Egyptian, Greek, Roman civilizations, and "Medieval Islamic Heritage" [14]. The later also known as "Old Cairo", or "Qahirat Al-Moez", is located in central Cairo around the old walled city with its famous "Citadel" [15]. This large campus is characterized by containing in its zone hundreds of mosques, tombs, madrasas (Schools), mansions, caravanserais, and fortifications, dating back to various Islamic eras in Egypt [8], [9]

The "Historic Cairo" Restoration Project (HCRP), is a project initiated by the government of Egypt in (1999) to restore "Old Cairo". The project was funded by several worldwide

[8] "Conduits" are pipes made for protecting electrical wires; they may be embedded inside walls and underground infrastructures to protect extended long electrical cables. "Conduits" are usually made of plastics, rubber, or metals

[9] A "Grout" is a lite cement mortar mixture of concrete, water, and sand. It is sometimes called "White cement", it is used to fill gaps, cavities, and crevices in walls, between tiles, and joints in buildings

[10] "Crevices" are small holes and/or channels that are grooved in walls to embed electrical wiring, sometimes sanitary pipelines, and network cabling extensions. "Crevices" are also the gaps between tiles and narrow joints in buildings

[11] "Efflorescence" affects enameled paints; however, using "Water proof" paints are not an ultimate solution to the problem. They may reduce "Efflorescence" but still cannot prevent it from happening.

[12] There are several factors related to the course of time, and weathering conditions that cause "Efflorescence". For example: missing, loose, or cracked building parts like; coping, missing tiles, broken rain water, blocked gully traps, and sanitary pipes. "Efflorescence" may also happen due to open joints in stone works, cracked mortar, deteriorated surrounding site conditions, vegetation, leaves, and surrounding tree roots blocking rain gutters, or damaging the building foundations, defective window cills, parts of interior and/or exterior walls resting on ground without damp proofing courses, basement floor(s) are deep below ground level, growth of creeping vegetation that increase dampness over walls, and decay of timber frames and beams carrying upper floors at their joint connections with stone works masonry [10]

[13] The "United Nations Educational, Scientific and Cultural Organization" (UNESCO) proclaimed "Historic Cairo" as the world's oldest Islamic Heritage site, and "The centre of the Islamic world

[14] "Medieval Islamic Heritage" has reached its golden age in the 14th century

[15] "Citadel of Cairo", also known as " The Saladin Citadel", was built in (1762) by king "Saldin" ruler of the "Ayyubid Dynasty" over a high hill in "Mokatam" area at the center of Cairo. He then, surrounded the citadel with walls, in order to defend the city from the crusaders. Afterwards, the large iconic "Mohamad Aly" mosque was built in (1860) inside the citadel campus by "Khedive Ismail", a ruler of Egypt during the Ottoman period

heritage organizations including "UNESCO". Tenders were bid nationally to local contractors. For every old Islamic monument; restoration works included adding electrical wiring extensions, lighting fixtures, sound outlets, surveillance networks, and other electrical works.

In technical specifications; contractors were restricted to install various electrical wiring extensions over (and not embedded inside) old walls built with lime stone, unless otherwise, (And in very rare cases), when there is no other option but to extend electrical wiring extensions inside grouted wall crevices.

1.1. Progressive Case Studies of "Efflorescence" on Lime Stone Walls of Historical Buildings Due to Electrical Wiring Extensions

"Efflorescence" due to the impact of electrical energy on masonry is not limited to contemporary buildings that were built in the twentieth century, like the case of "Cairo" apartment presented in figures (4), and (5).

It is also observed that "Efflorescence" due to the impact of electrical energy happens to historical buildings too

The Case of "Zulfikar" a.k.a "Ghattas" Mosque

Location and History

"Zulfikar", also known as "Ghattas" [16] mosque was built in (1680) during the age of the "Ottoman" empire by prince "Zulfikar" who was responsible for the administration of Muslim pilgrimage for more than eleven times in the era of "Hamza Pasha", the mosque is located in "Al-Lboudah" district, at the end of "Darb Al-Jmames" st., with its direction towards "Ismail Pasha" st. and facing "El-Sayeda Zainab" [17] shrine and mosque at the other end of "Darb Al-Jmames" st., Cairo, Egypt [11]

Figure6. Shows prince "Zulfikar" mosque located in "Al-Lboudah" district, at the end of "Darb Al-Jmames" st. facing "El-Sayeda Zainab" shrine and mosque, Cairo, Egypt. Reference: [Researcher]

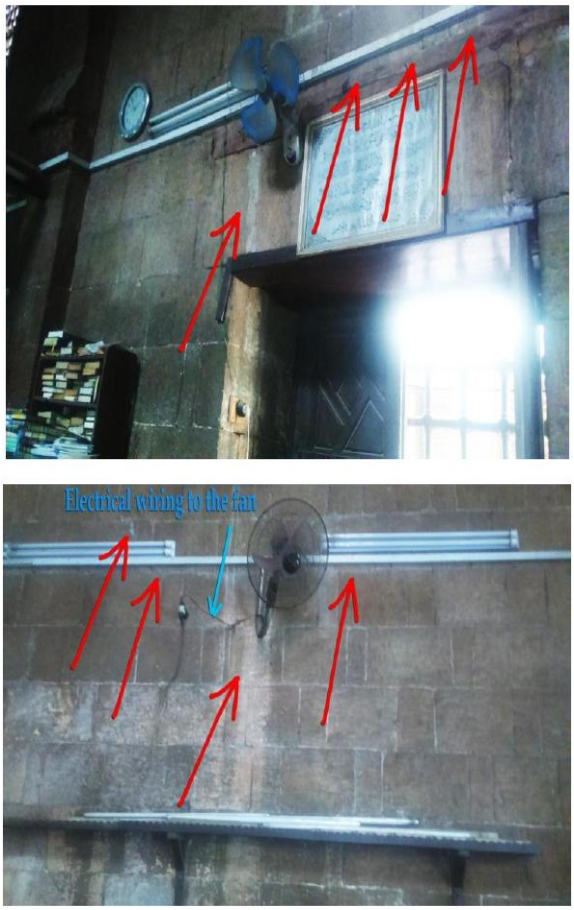

Figure7. Top and Bottom pictures are showing "Efflorescence" forming around plastic conduits, and fans installed over lime stone walls of the prayer hall inside prince "Zulfikar" mosque, Reference: [Researcher]

Observations of "Efflorescence" due to Electrical Energy Sources:

The following figure (7) shows "Efflorescence" forming around plastic conduits, and fans

[16] "Ghattas "; is the Arabic translation of the word "Diver", or the one who dives in rivers and seas

[17] "El-Sayyida Zaynab"; is the sister of "Hassan" and "Hussain", and the granddaughter of the messenger of Islam prophet "Mohamed" (PBU), she is the daughter of "Ali Ben-Abi-Talib" who was the cousin and son-in-law of the prophet (PBU). "Ali Ben Abi-Talib" married to the prophet's daughter "Fatma", and appointed as the fourth caliph of Islam after the death of the three former caliphs, and major companions of the prophet (PBU); "Abu Bakr El-Sedik", "Omar Ebn El-Khatab" and "Osman Ebn-Affan"

installed over lime stone walls of the prayer hall inside prince "Zulfikar" mosque

The Case of "Prince Timraz Ahmadi" a.k.a "Sidi Bahlul" Mosque

Location and History

"Prince Timraz Ahmadi" also known as "Sidi Bahlul" Mosque is an Islamic monument located at; Al Hanafi St. Near "El-Sayeda Zainab" shrine, Cairo, Egypt. The mosque was built in (1471) during the "Circassians - Mamlouki" period who ruled Egypt between (1382) and (1516), - by one of their eminent princes called "Timraz Al-Ahmadi". [12]

Figure8. Shows "Prince Timraz Ahmadi" mosque located at; Al Hanafi St. Near "El-Sayeda Zainab" shrine, Cairo, Egypt. Reference: [13]

Observations of "Efflorescence" due to Electrical Energy Sources

The top, middle, and bottom (Zoom in) pictures in figure (9) show "Efflorescence" forming around plastic conduits, and fans installed over lime stone walls of the prayer hall inside "Prince Timraz Ahmadi" mosque. Also, Figure (10) is showing "Efflorescence" forming around the fan and sound speaker installed over the "Mihrab" [18] area of its prayer hall

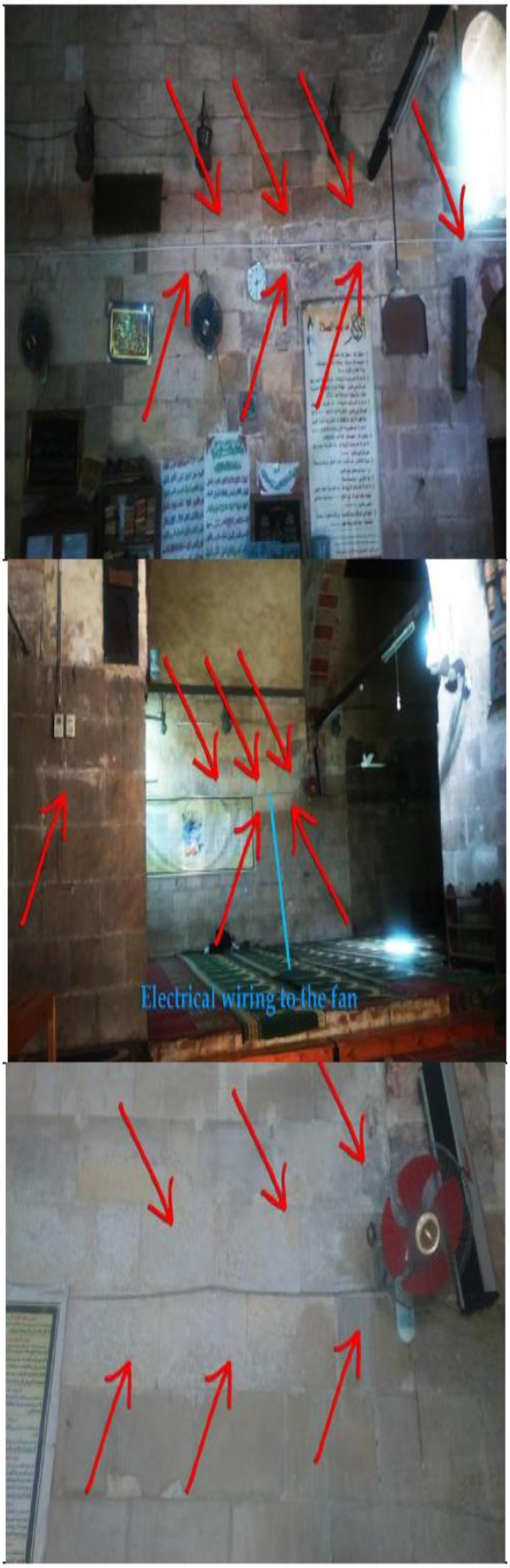

Figure9. Top, middle, and bottom (Zoom in) pictures, are showing "Efflorescence" forming around plastic conduits, and fans installed over lime stone walls of the prayer hall inside "Prince Timraz Ahmadi" mosque. Reference: [Researcher].

[18] "Mihrab" is an Arabic word describing a semicircular recess in one of the walls of the mosque's prayer hall, it is found in every mosque for the purpose of defining the direction of the "Qibla" which points to the "Kaaba" in the city of "Mecca", Saudi Arabia, where all Muslims around the world face when they do their daily prayers

Figure10. Left, Right, Show "Efflorescence" forming around the fan and sound speaker installed over the "Mihrab" area of the "Prince Timraz Ahmadi" mosque Prayer hall. Reference: [Researcher]

The Case of "Sheikh Sadat" House

Location and History

Located in the new "Helmiya" area, in "Sayeda Zeinab", Cairo, Egypt, is the house of "Sheikh Abu El-Anwar Al-Sadat" [19], vice-president of the Cairo "Diwan" [20] during the "Ottoman" period, and the "Napoleon Bonaparte's" campaign in Egypt and Syria between (1798) and (1801) [14], [15]

Figure11. Shows the house of "Sheikh Abu El-Anwar Al-Sadat" Located in the new "Helmiya" area, in "Sayeda Zeinab", Cairo, Egypt. Reference: [Researcher]

[19] "Sheikh Al-Sadat" was a high ranked governmental official, a great religious scholar, a wealthy merchandiser, and a revolutionist who played a great role in creating and leading the resistance of the first Cairo revolution in (1798) against the "Bonaparte's" campaign. Another famous person with a similar name is "Anwar El-Sadat"; a former president of Egypt, who ruled between (1970) and (1981), and a Noble prize winner for his initiating a peace treaty after the (1973) Sixth of October war between Egypt and Israel.

[20] "Diwan" is a Persian word that is used as a title for a high rank government official. The word is also used to describe the governmental organization responsible for administrating the country

Figure12. Top, Middle, Bottom pictures are showing "Effloresсence" forming around sound speakers, and electrical lanterns inside the "Haramlek", and also around wiring extensions embedded inside the wall crevices of the surveillance control room at the ground floor of the house of "Sheikh Abu El-Anwar Al-Sadat". Reference: [Researcher]

Observations of "Effloresсence" due to Electrical Energy Sources

The top, middle, and bottom pictures in figure (12): show "Effloresсence" forming around sound speakers, and electrical lanterns inside the "Haramlek" [21], and also around wiring extensions embedded inside the wall crevices of the surveillance control room at the ground floor

[21] The "Haramlek" is a large room dedicated for women in old Islamic houses specially mansions, where women had their own rooms, courtyards, and special zones, (Sometimes called women headquarters). Windows of such "Haramleks" usually look at these open courtyards that were made for women to feel free and enjoy their privacy, so that they cannot be seen by guests, visitors, or intruders in the house

of the house of "Sheikh Abu El-Anwar Al-Sadat". Figure (13) Is also showing "Efflorescence" forming around installed electrical lanterns inside the house staircase.

Figure13. Is also showing "Efflorescence" forming around installed electrical lanterns inside the "Sheikh Abu El-Anwar Al-Sadat" staircase. Reference: [Researcher]

Figure14. Shows the "Mustafa Fadıl" Pasha mosque that is located in "Darb Al-Jmames" st. branched of "Port Said" st. In "El-Sayeda Zainab" area, Cairo, Egypt. Reference: [18]

The case of "Mustafa Fadil" Pasha Mosque

Location and History

"Mustafa Fadıl" Pasha was an Ottoman-Egyptian prince during the ruler ship of "Muhammad Ali" [22]. His mosque is located in "Darb Al-Jmames" st. branched of "Port Said" st. In "El-Sayeda Zainab" area, Cairo, Egypt.

[22] "Mustafa Fadıl" Pasha was nominated for the position of the prince of Egypt as the successor of his brother "Isma'il" Pasha. But the Ottoman Sultan "Abdülaziz" changed the law to keep the succession in the line of the "Khedives" and not from brother to brother. This situation led him to leave Egypt and move to Paris where he started an opposition against the Sultanate

The mosque was originally built in (1336) by a "Mamlouki" prince called "Bashtak al-Nasiri" who lived during the "Mamlouki dynasty" (494) years before "Mustafa Fadıl" Pasha was born. The mosque remained with the name of its original founder "Bashtak al-Nasiri", known as "Bashtak Mosque" [23] until (1860), when "Mustafa Fadıl" Pasha's mother ordered to renovate the mosque, and rename it after her son's name during the "Muhammad Ali" dynasty [24]. [16], [17]

Figure15. Shows the formation of "Efflorescence" around sound speakers installed over the lime stone walls of the "Mustafa Fadıl" Pasha mosque entrance lobby. Reference: [Researcher]

Observations of "Efflorescence" due to Electrical Energy Sources

Figure (15) is showing the formation of "Efflorescence" around sound speakers installed over the lime stone walls of the "Mustafa Fadıl" Pasha mosque entrance lobby. The "Efflorescence" is clearly affecting the wall "Mokarnasat" [25]carrying the entrance lobby dome

The Case of "Sheikh Saleh Abu Hadid" Mosque

Location and History

"Sheikh Saleh Abu Hadid" mosque is located in the street of the "National Assembly" building, on the left of the "Salik" street, and on the side of "Sidi Abu Al-Azaym" mosque, Cairo, Egypt. The mosque was built in (1280) by the "Khedive Isma'il" Pasha of the "Mohamad Ali" dynasty in the memory of a great Sufi [26] "Walli" [27] called "Sheikh Saleh Abu Hadid". [19].

[23] The mosque was also known among the people who live in its surrounding area as "Mohamad Refaat" mosque, after the name of one the most famous "Quran Reciters" in the Islamic world, who lived between (1882) and (1950)

[24] "Mohamad Ali" was an Ottoman ruler of Egypt and Sudan from the 19th to almost the middle of the 20th century. He was recognized among Egyptians as the founder of modern Egypt

[25] "Muqarnasat" is a Persian word describing a series of cellular geometrical structures like that of a "Honey comb". The "Muqarnas" pattern was extensively used by Islamic architects for the purpose of solving the structural problems of the corner of domes and vaults. "Mokarnasat" were used to lift domes of mosques entrances, and other spaces

[26] "Sufism" is a sort of Islamic practice deviated from the pure and original Islam that was practiced by early Muslims, "Sufism" is commonly known in western scholarly as "Islamic mysticism". Followers of "Sufism" have developed their own rituals, practices, and ceremonies. They believe in the existence of hidden ways or methods in Islam through which someone may become a saint, with the capacity of doing miracles and/or supernatural missions, as a divine reward for their exhausting themselves in serving God, and obeying his commandments specifically through following these mystical ways.

[27] A "Walli" is a religious rank and title that is developed in "Sufism" for describing a saint with miracles; a "Walli" is an Arabic word means: a friend of God, or someone who is protected and supported by God to a degree that nobody can defeat. Muslims who believe in "Sufism" have developed a belief system that is a mix of Islamic practice and mystical folklore. This cult has its impact on the architecture of many ancient mosques in; Egypt, many places in African Islamic countries, some parts in the Arab world, and extensively in "Persia"; recently known as "Iran". People who believe in the existence of such "Wallis" glorify them to the extent that they put them in a rank that is almost equivalent to God's prophets and messengers of the "Abrahamic" religions. They even believe that "Wallis" who are already dead may still have the power to communicate and carry peoples wishes to God. So they tended to put their graves and shrines in their mosques, or build mosques specifically for hosting their graves, and for the purpose of glorifying their memories; the same way the "Khedive Isma'il" Pasha of the "Mohamad Ali" dynasty decided to build the "Sheikh Saleh Abu Hadid" mosque

Figure16. Shows the "Sheikh Saleh Abu Hadid" mosque that is located in the street of the "National Assembly" building, on the left of the "Salik" street, and on the side of "Sidi Abu Al-Azaym" mosque, Cairo, Egypt. Reference: [19]

Figure17. Top and Bottom (Zoom in) pictures are showing the formation of "Efflorescence" around plastic conduits extended over the walls of the "Sheikh Saleh Abu Hadid" Mosque prayer hall. Reference: [Researcher]

Observations of "Efflorescence" due to Electrical Energy Sources

The top and bottom (Zoom in) pictures of figure (17) are showing the formation of "Efflorescence" around plastic conduits extended over the walls of the "Sheikh Saleh Abu Hadid" Mosque prayer hall.

The Case of "Hassan Pasha Taher" Mosque

Location and History

Located in "Berket El Fiel" Street next to the remains of the "Sabil-Kuttab" of "Ahmed Effendi Salim", in "El-Sayeda Zainab" area, Cairo, Egypt; the mosque was built in (1809) by two high military officials; "Hasan Pasha Taher" and his brother "Abdin Bey Taher", during the "Mohamad Ali" dynasty [20]

Figure18. Shows the "Hassan Pasha Taher" Mosque that is located in "Berket El Fiel" Street next to the remains of the "Sabil-Kuttab" of "Ahmed Effendi Salim", In "El-Sayeda Zainab" area, Cairo, Egypt. Reference: [21]

Observations of "Efflorescence" due to Electrical Energy Sources

The top and bottom pictures of figure (19) are showing the formation of "Efflorescence" around bare electrical wiring extended to fans over the walls of the mosque prayer hall. Also, the left and right pictures of figure (20) are showing the formation of "Efflorescence" around the fan installed at the "Mihrab", and around a series of electrical panels found in "Hassan Pasha Taher" Mosque electromechanical room.

Figure19. Top and Bottom Pictures are showing the formation of "Efflorescence" around bare electrical wiring extended to fans over the walls of "Hassan Pasha Taher" Mosque prayer hall. Reference: [Researcher]

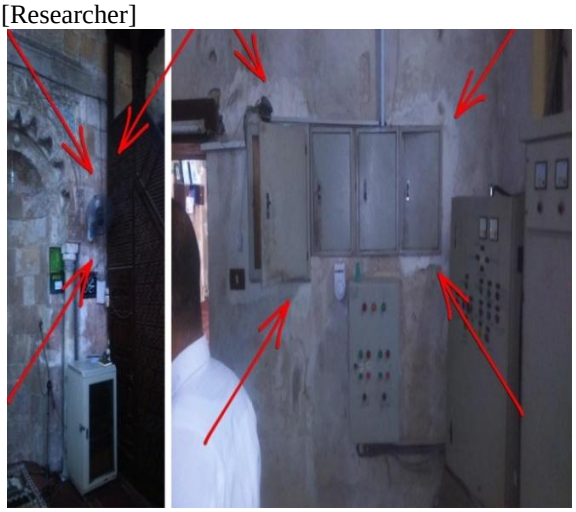

Figure20. Left and right pictures are showing the formation of "Efflorescence" around the fan installed at the "Mihrab", and around a series of electrical panels that are found in "Hassan Pasha Taher" Mosque electromechanical room. Reference: [Researcher]

RESULTS

Research findings implies that "Efflorescence" in masonry surface may not only happen due to humidity, salt, water content, weathering conditions, and other factors that are commonly known among the field of construction engineering, but may also happen due to impact of energy sources installed over such masonry surfaces. And since the goal of restoration projects is to protect historical buildings, and to restore them to their original state without causing any damage that cannot be reversed; All possible measures (According to "Best Practices") should be cautiously taken in consideration when selecting and installing additional items like various electrical sources, and that problems generated by adding electrical source items as part of the restoration works should be completely eliminated, or at least minimized; as the restoration works process is assumed to protect, preserve, or improve a current state of a historical building as much as possible, and not to participate in causing more damage to it

CONCLUSION

"Efflorescence"; or "Watering and Flowering"; a natural phenomena that happens to masonry surfaces is considered a common knowledge among the field of construction engineering and the building community.

Yet, the formation of "Efflorescence" especially around electrical wiring extensions and other electrical energy sources that are installed over lime stone walls of historical buildings is a phenomena that is unfamiliar to the construction engineering community. This in turn, leads to the necessity for addressing such issue to the electrical engineering community as another factor causing "Efflorescence"

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[28]"The Supreme Council of Antiquities (SCA)" is the national Egyptian governmental organization that is responsible for the preservation of Egyptian archeology and heritage. The organization has gone

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