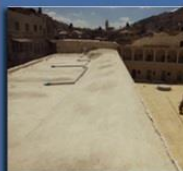
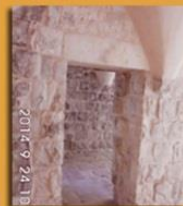
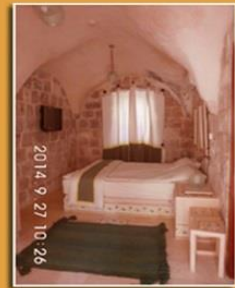
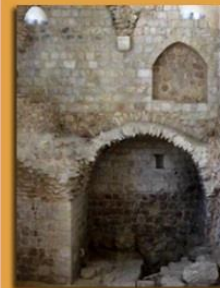




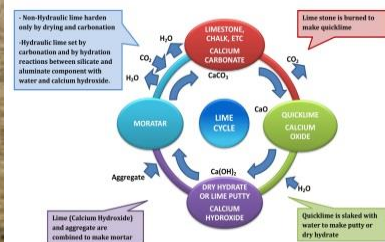
Maintenance Manual And Preservation Plan Of

Khan Alwakaleh Complex





GLOSSARY OF IMPORTANT DEFINITIONS



Lime

“Lime is the material produced from burning of limestone and its subsequent ‘slaking’ with water. It can combined with aggregate and water to produce a mortar or plaster, or diluted with water to be used for limewashing” (Ellis, 2002). Lime is produced by burning limestone (Calcium Carbonate or Calcite, CaCO_3) in a Kiln at temperatures in excess of 850°C . This drives off Carbon dioxide held within the lime to produce calcium oxide (CaO), a highly reactive solid known as ‘quicklime’ or ‘lump lime’. ‘Slaking’ of the calcium oxide with water results in a highly exothermic reaction (a reaction that produce heat) to produce lime (Calcium hydroxide (Ca(OH)_2)), an anhydrous (free of water) material termed slaked lime, hydrated lime or Portlandie. Quicklime or hydrated lime is mixed with aggregate and water to form mortar; alternatively the addition of excess of water during slaking produce lime putty (Snow and Torney, 2014) Lime is used in traditional buildings and is recommended to be used in historic site interventions (modifications, renovation, and *maintenance*) (Ellis, 2002). Lime allows building to breath (it allows liquids to move out of the walls and does not allow liquid to be absorbed back inside the structure).

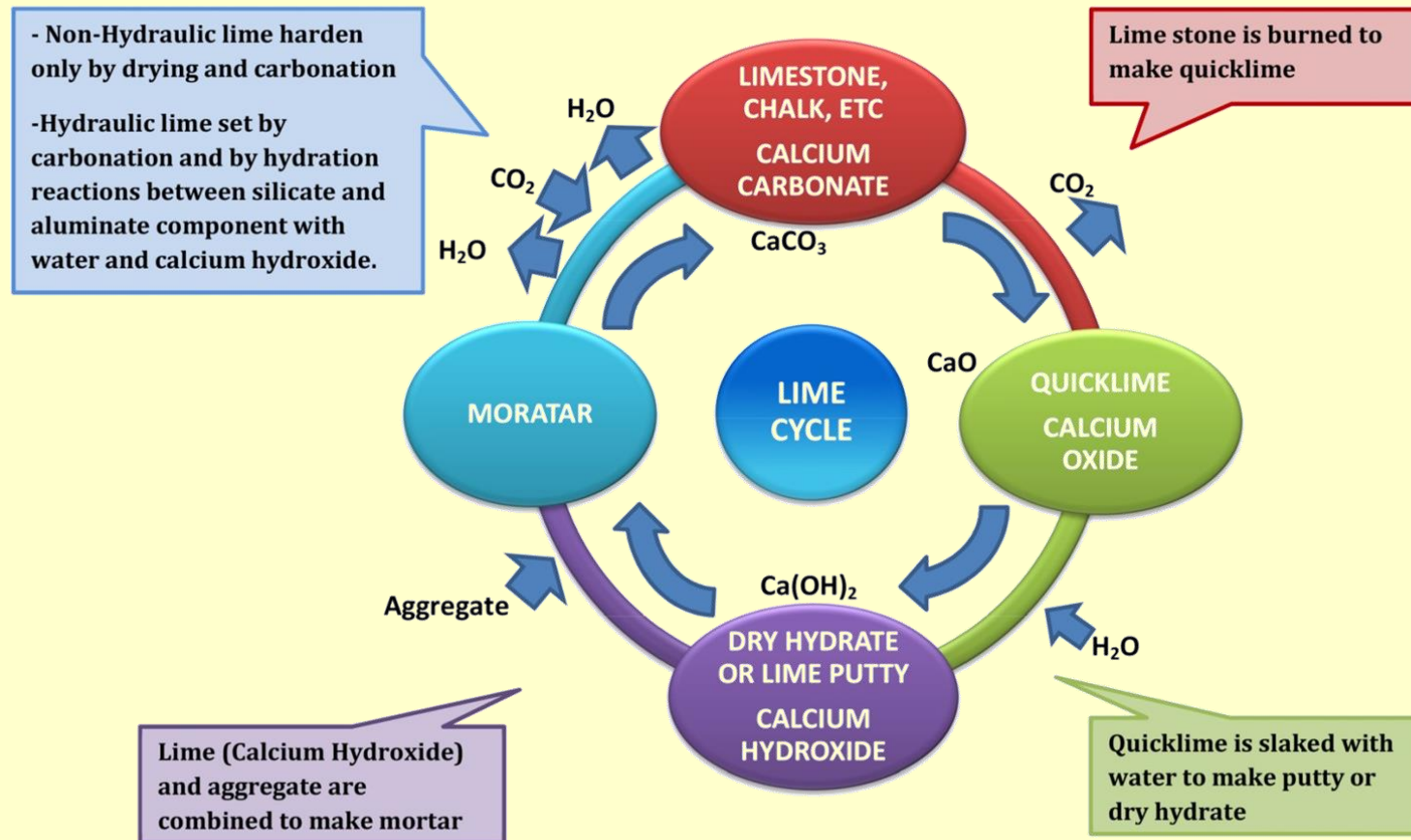
Carbonation : a chemical reaction in which Calcium hydroxide in the mortar reacts with carbon dioxide (in the presence of moisture) in the atmosphere to form calcium carbonate (Snow and Torney, 2014)

Lime Circle

It refers to the process in which lime is transformed from the very solid status (limestone) to quicklime to lime. In a chemical series of reactions “material essentially returns to its original forms, as the set lime is compositionally similar to its original limestone” (Ellis, 2002)

Illustration of Lime Cycle is in the following page

Lime Cycle Illustration



Natural Hydraulic Lime NHL (water lime): Limestone containing clay and/ or silica is burnt in a kiln at below clinkering temperature ($< 1,200$ degree C) and the resultant product is hydrated with only sufficient water to convert the calcium oxide to calcium hydrate, but not to hydrate the C2S, which in any case is slow to hydrate. The setting process is a combination of the hydration of C2S and carbonation of the lime. In most hydraulic limes, a proportion of uncombined reactive minerals: silica and alumina is also present, and these will react with lime in the mortar to also produce calcium silicate hydrates and calcium aluminate hydrates (Ellis, 2002).

“This ‘chemical’ setting mechanism enables the use of hydraulic limes in wet conditions, where air limes would fail to set. Natural hydraulic limes are typically stronger and less vapor and moisture permeable than air limes or what as sometimes called” nonhydraulic lime” (Snow and Torney, 2014)

“Natural hydraulic lime binders are typically sold in bags as a dry hydrate and are produced by mixing quicklime with just enough water to convert the calcium oxide to calcium hydroxide, but not enough to initiate the chemical set of the silicate components. Natural hydraulic lime is suitable for use on copings, chimneys and exposed elements as well as for bedding and pointing mortars, and for rendering and harling. Despite their perceived high strength relative to air lime, most natural hydraulic limes have good water vapor permeability and the ability to accommodate movement. However, both vapor

permeability and flexibility do typically decrease as compressive strength increases. Natural hydraulic lime should not be confused with hydrated builders' lime, which is in fact an air lime" (Snow and Torney, 2014)

NHL 2, NHL 3.5 and NHL 5.

"The indications 2, 3.5 and 5 represent the N/mm² compressive strength at 28 days. The NHL 2, 3, 5 is made Natural Hydraulic Lime (NHL) comes from a siliceous limestone strata at 8 % for NHL 2; 10% for NHL 3.5 and 12% for NHL 5 for some of them, but for others, they are using the same siliceous limestone, only the cooking and the cooling are making the difference" (Labesse, nf)

Non-Hydraulic lime "Limes (>95% Calcium Hydroxide) made by hydrating or 'slaking' the quicklime of relatively pure limestone which set by 'carbonation', a reaction with atmospheric carbon dioxide to form calcium carbonate. Two forms are available:

- a. Lime Putty: Ordinary (no-hydraulic) lime produced by slaking quicklime in an excess of water to form putty. Lime putty is matured for several months in pits or under a thin film of water to prevent carbonation, and during this process the portlandite (lime) crystals change shape, becoming smaller and flatter, thus aiding workability. It is used for the production of lime plasters, mortars and limewash. Also known as 'air' limes, 'fat' limes and 'high calcium' limes.

- b. Dry hydrated lime: Ordinary (non-hydraulic) lime produced as a convert calcium oxide to calcium hydroxide. Also known as 'bagged' lime" (Ellis, 2002)

Aggregate grading

The term 'grading' refers to the size distribution of aggregate grains and is determined by passing samples of aggregate through sieves of a specified size. Aggregate in which the majority of grains are of similar size is termed 'poorly graded' and aggregate with a wide spread of grain sizes is 'well graded'. Well graded sand typically has grain sizes between 4mm and 0.125mm, with the largest proportion of grains at the mid-point sieve fractions (Snow and Torney, 2014).

The grading, and specific grain size, required for a mortar is largely dependent on the intended mortar function. Well graded, sharp sand is often the best choice for mortars used in building and pointing. The largest grain sizes should typically be no more than one third of the width of the masonry joint. Ordinary 'building sand' is poorly graded,

Poorly Graded Aggregate



Well Graded Aggregate



consisting of more rounded grains of uniform size and is not suitable for most lime work. For a very ashlar pointing (small masonry walls) fine sand or stone dust is more suitable (Snow and Torney, 2014).

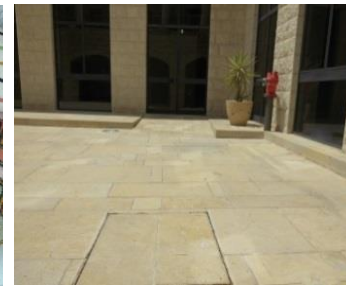


Metal Sieves for aggregate grading



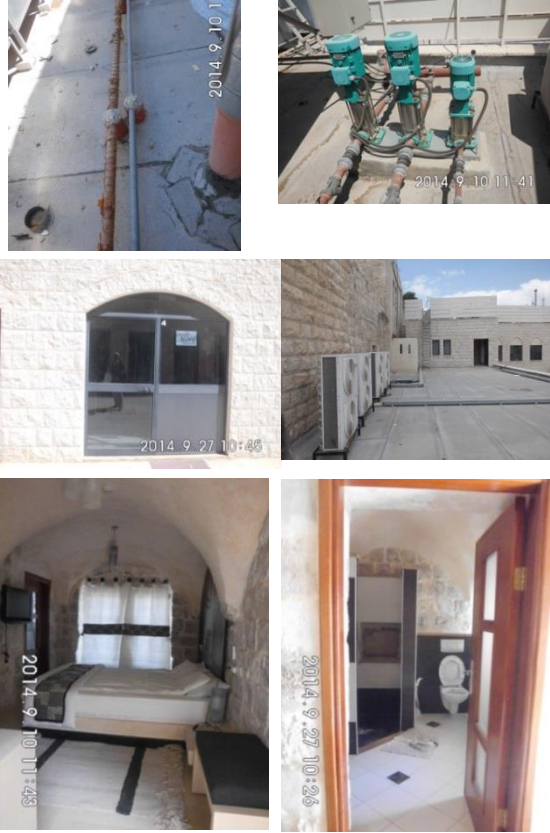
CHAPTER 2: ROUTINE MAINTENANCE

Cleaning and Operational Maintenance



Khan Al Wakaleh is a building that serves public in general and is envisioned to be an economic hub and an active center of interaction between different level of stakeholders, costumers and public. Different considerations for cleaning and operation of the site are highlighted in this section.

ROUTINE_ MAINTENANCE	ELEMENT		MAINTENANCE PLAN	
	CLEANING/ GENERAL		<u>As Specified below</u>	
	IMAGES		PROCEDURE	
			Site Cleaning: Site management responsible for coordinating site cleaning through appointed cleaning staff and following clear schedule and procure. Site management is responsible on checking and assuring quality of service. A. The public area of the site needs to be cleaned regularly (every week) to provide clean access to the different functions of the site (hostel, information center, hotel rooms). B. Public areas include multipurpose room and information center as well as corridors and yard.	

ELEMENT	MAINTENANCE PLAN
CLEANING/ GENERAL	<u>As Specified below</u>
IMAGES	PROCEDURE
	c. Cleaning should ensure, doors, upper windows, doors, accessories such as frames, banners and signs, windows, floors, yard benches and fountain, stair rails, cameras, TVs, Projectors and their screens, firefighting fixtures and boxes, electric boards and any other public area fixtures and accessories are all wiped and clean from dust. d. Cleaning of the general areas includes removing dust from equipment and fixtures located on the roof to maintain their function (fans, tanks, service stairs, etc) e. Hotel Rooms need to be cleaned <u>daily</u> (when occupied), and <u>weekly</u> (when not occupied). A checklist for hotel room inspection needs to be used after guest leaves to ensure room is ready to be used by a new guest (<u>See INDEX II: Checklist Form for Hotel Rooms</u>). f. Avoid excessive humidity generated through excessive water applied on structure surfaces when cleaning in order to maintain rooms' humidity to the minimum. (<u>Note</u> Building

ELEMENT	MAINTENANCE PLAN
CLEANING/ GENERAL	<u>As Specified below</u>
IMAGES	PROCEDURE
  	has a problem of high humidity and measures should be taken to avoid increase of this problem). - Ensure daily ventilation for a <u>moderate time</u> in all the site spaces <u>just enough</u> to refresh the space and to dry any humidity resulted by use of the space. <u>* Excessive dryness is not recommended because it can increase speed of (Efflorescence) salt generation</u> - The site has ongoing salt damp (efflorescence) that cause (mortar and plaster) material to fall on the ground and gathered around the site. The issue is a persisting problem and regular cleaning for walls and grounds using vacuum. Existence of dust around the site impacts the visual character of the site and could lead to health problems for users. - Cafeteria and restaurant daily cleaning. This includes all furniture, appliances, surfaces and applying antibacterial material around actively used surfaces.

ELEMENT	MAINTENANCE PLAN
CLEANING (FURNITURE)	<u>As Specified below</u>
IMAGES	PROCEDURE
  	Site management should coordinate cleaning of furniture to protect it from stain, and insects' invasion which could lead to damage in fabric and or wood furniture. - Regular cleaning (seasonal in-depth cleaning of carpets, curtains- three or four times a year and when needed) - Regular cleaning of bed sheets, bellows and cleaning all surfaces of the room (every week and for each new visitor) - Regular pest control to check if insects' invasion such as (moth, dust mite, fleas, bed bugs, etc.) occurs and apply appropriate treatment if needed by special (pest control). - Mothballs (<u>contains Naphthalene</u>) is an effective and available pesticide that can kill and limit most types of interior and exterior insects. - Wooden furniture with heavy use will require regular cleaning. It is important to dry wood furniture very well when applying water and is preferably avoid using water (unless necessary).

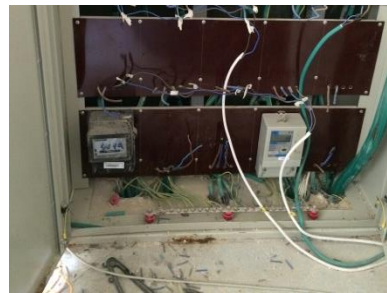
ELEMENT	MAINTENANCE PLAN
OPERATION/ GENERAL	<u>As Specified below</u>
IMAGES	PROCEDURE
    	Operational Maintenance: Site management responsible for coordinating maintenance through operational guidelines and follow up on issues related to operational quality of the site. Site management is responsible for a daily coordination of operations going in the site and ensuring users commitment to maintain spaces service and design quality. - Restaurant and cafeteria ongoing service should take all measures to protect existing appliances, furniture and structural elements. - Avoid impact on floors or walls while moving heavy elements such as cooking gas cylinders that requires special trolley to move outside and inside the cafeteria. - Ensure that portable signs needed for daily work is available such as (temporary hazard sign, slippery surface sign).

ELEMENT	MAINTENANCE PLAN
OPERATION/ GENERAL	<u>As Specified below</u>
IMAGES	PROCEDURE
	d. Service areas are well cleaned and sanitized. e. Appliances should be tested regularly and timely replace any damaged appliances f. Restaurant proposed checklist for maintenance and operational efficiency assurance is provided at index section. (See Index III) g. Ensure that access to main circulation points is clear from barriers or safety hazard. This includes (main doors, connecting doors to other parts of the building, indoor and outdoor stair cases, elevators, main service desk area) h. Kitchen waste material should be stored in metal containers with firm lid and should be removed by trolley outside to dumpster.

ELEMENT	MAINTENANCE PLAN
OPERATION/ GENERAL	<u>As Specified below</u>
IMAGES	PROCEDURE
	i. Ensure that people with disability access is facilitated through maintaining (signs, access to ramps, access to passenger lift, existing hand rails) as well as providing day by day coordination of access to the site by people with disabilities and or special needs users (elderly, families with babies, etc) j. Ensure filling and follow up on comments, notes from users about issues related to access problems to the site facilities, functions problems, etc k. Ensure coordination of cleaning schedule with site functions and provision of cleaning schedule l. Ensure appropriate pest control service to hotel rooms, hostels and restaurant to ensure sanitized and clean spaces.



CHAPTER 3: ELECTRICAL SYSTEMS MAINTENANCE



Site Management is responsible of maintaining warranty information for all electrical appliances, and a categorized professional service providers (electricians, computer maintenance, HVAC specialized service providers)

ELECTRICAL_SYSTEM_MAINTENANCE	ELEMENT	MAINTENANCE_PLAN
	Lighting Fixtures (General : In All the Site)	<u>Every Month</u> and when problem observed
	IMAGES	PROCEDURE
		<u>Responsibility</u> Site management responsible for conducting a monthly assessment for all site lighting functions and conditions of lighting fixtures: - Damaged lights need to be replaced timely to avoid disruption of the different spaces functions and its efficiency. - Any problem in the wiring, electricity supply to the lighting points should be fixed. (Note: it is recommended to invite expert electrician to solve persisting problems or serious electric damage when needed). - Any broken lighting fixture need to be removed and replaced immediately (to avoid safety hazards that could be caused from fixture falling)

ELEMENT	MAINTENANCE PLAN
Lighting Fixtures (General : In All the Site)	<u>Every Month</u> and when problem observed
IMAGES	PROCEDURE



- d. Replacement fixtures should match the existing fixtures or the broken one; that to maintain the same design character of the building.
- e. While conducting maintenance safety measures should be taken into consideration.

ELEMENT	MAINTENANCE_PLAN
Wiring/ Distribution Boards (General: In all the site)	<u>Every 3 Months</u> and when problem observed
IMAGES	PROCEDURE
	<u>Responsibility</u> Site management responsible for conducting assessment of the electricity supply issues, distribution boards (main and secondary boards) in the site. - Check to see if any damaged wires around the site (simple observation) - Check efficiency of the electric supply around the site to identify any damage in the electricity provision around the different functions of the site. - Check distribution board wires/ breakers, doors and ensure all elements are in place, no missing parts, are in good shape and all are functioning properly. - No sign of decay in the distribution box material and or its components. - Check for any improperly placed electrical wiring (misplaced wires, could be a result of users activities or during events such as (misplaced indicator lights).

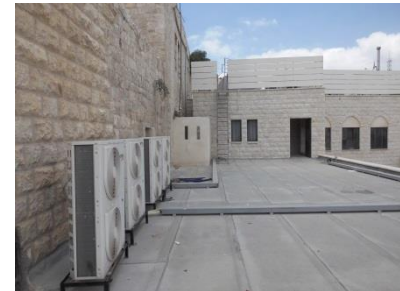
ELEMENT	MAINTENANCE_PLAN
Wiring/ Distribution Boards (General: In all the site)	<u>Every 3 Months</u> and when problem observed
IMAGES	PROCEDURE
	F. Make sure no electrical wirings are exposed to weather conditions and or impacting site ongoing activities and or space character and visual chracteristics.

ELEMENT	MAINTENANCE PLAN
PROJECTORS/ CAMERAS/ TVs/ RECIEVERS/ ROUTERS)	<u>Every 1 Months</u> and when problem observed
IMAGES	PROCEDURE
	G. Ensure that all cameras are working properly, provides clear vision and high quality video input). H. Clean cameras from dust and any stains Warranty should be used to fix cameras; if it is out of warranty it should be fixed timely by local professional service. I. Ensure that projector, computers and TVs, receivers, internet routers are functioning properly in all the spaces. If any damage occur to these items warranty should be used to fix it. If item is out of warranty then seek specialized local service provider. If damage that could not be fixed occurred to any of these items it should be removed and replaced (similar type – model-or equivalent to the existing). J. Check internet connection (wireless router/ internet speed/ wireless signals around site) and ensure fixing if any issue timely).

ELEMENT	MAINTENANCE_ PLAN
OUTPUT SOCKETS? SWITHCES	<u>Every 1 Months</u> and when problem occurred
IMAGES	PROCEDURE
	1. Outlet Sockets- Light switches Maintenance (Site Management responsibility) a. Ensure that all outlet sockets, network data output and electric switches are functioning. b. Conduct a monthly site screening for any broken sockets and switches. c. If any damage is found or missing parts <u>site management</u> is responsible to ensure timely fixing for the damage by inviting professional electrician to conduct the work. d. If socket is loose (as a result of bad finishing around it) site management should ensure proper fixing. e. Ensure that all covered switches and sockets (exterior) are well maintained and protected from weather conditions. f. Take all measures to ensure safety of users and technicians when conducting any maintenance work for electric systems. g. Provision of (emergency) electric supply if maintenance requires prolonged period of disconnected electric supply.



CHAPTER 4: MECHANICAL SYSTEMS MAINTENANCE



ELEMENT	MAINTENANCE PLAN
MECHANICAL FIXTURES (BATHROOMS/ KITCHEN/ CAFETERIA)	<u>Full Check Every 1 Months</u> / and maintenance when problem occurred
IMAGES	PROCEDURE
 The images show various bathroom fixtures in different settings. The top-left photo shows a toilet in a room with stone walls and a shower area. The top-right photo shows a shower area with a stone wall and a date stamp '2014.9'. The bottom-left photo shows a toilet in a room with stone walls and a date stamp '2014.9.27 10:28'. The bottom-right photo shows a toilet in a room with stone walls and a shower area.	1. Plumbing: <u>site management</u> is responsible to check Plumbing system and to coordinate solutions for any problem found. a. All Plumbing pipes should be well connected and do not have any leak. b. In case of any leak site management should arrange for approved plumber to handle the problem and fix it immediately. c. Check and make sure that hot and cold water lines are working properly and provide steady hot and cold water supply. d. Clear any blockage in plumbing systems if occurs. e. Ensure all pipes are in good condition in the collector cabinets, no humidity, no leak, well enclosed 2. Fixed Fixtures a. Ensure that all bathroom fixtures (basin, bathtub, WC) are in good shape (have no cracks, no breaks, no stain, screws in

ELEMENT	MAINTENANCE PLAN
MECHANICAL FIXTURES (BATHROOMS/ KITCHEN/ CAFETERIA)	<u>Full Check Every 1 Months</u> / and maintenance when problem occurred
IMAGES	PROCEDURE
 	place, valves are good, flushing system is in working condition, and system draining properly). b. Any problem found in function of the bathrooms or kitchen fixtures requires immediate professional support. c. Stain should be cleaned (by site cleaning staff). d. Broken fixtures should be replaced or fixed immediately to with <u>similar type and color to existing ones</u>. Damage in drainage system is serious problem because it can lead to increase of humidity in walls and floors which one major problem of the site. e. Kitchen fixtures should be safe to use and checked regularly for any problems (unfixed elements, broken parts, etc) f. Kitchen equipment and fixtures should be regularly cleaned to maintain them and protect them from damage due to dust and cooking components (such as oil)

ELEMENT	MAINTENANCE PLAN
MECHANICAL FIXTURES (HEATING/ COOLING SYSTEMS)	<u>Every 1 Months general/ Twice a year in-depth</u> and maintenance when problem occurs
IMAGES	PROCEDURE
	1. Wall Mounted Air conditioning units installed around the site and Central AC in the public area (restaurant, Cafeteria, multipurpose room) a. Site management is responsible to act upon any issue arise regarding the function of <u>AC units</u> and <u>the central AC system in the ground floor</u>. b. Make sure that all units are functioning and have no dust gather on the fans or distribution points. c. Ensure safety precautions when conducting maintenance (by turning off power to the system) d. Twice a year (before heat and cold seasons) there should be in-depth maintenance to the air condition system to ensure safety and efficiency of the system. The maintenance should be done by professional air conditioning provider. e. The in depth maintenance will require replacement of filters at the beginning of the seasons (winter and summer) and sometimes more frequent if required.

ELEMENT	MAINTENANCE_PLAN
MECHANICAL FIXTURES (HEATING/ COOLING SYSTEMS)	<u>Every 1 Months general/ Twice a year in-depth</u> and when problem occurred
IMAGES	PROCEDURE
	f. The Evaporator and Condenser Coils need to be cleaned twice a year and if any damage occurs to them to be replaced by air condition technician. g. Ensure that no blockage in the draining ports of the units. h. Ensure no leak in the drainage pipes. i. Safeguard and protect surrounding structure, finishing and furniture when conducting maintenance.



CHAPTER 5: SECURITY AND SAFETY SYSTEM MAINTENANCE



ELEMENT	MAINTENANCE PLAN
SECURITY SYSTEMS	<u>Every 2 Weeks</u> and when needed
IMAGES	PROCEDURE
	1. Cameras around the site: - Site management is responsible for ensuring proper connection of all cameras to the DVR system of the building and to maintain data collected from camera. - Data collected from cameras should be stored in a special folder in a central computer and should be packed up every two weeks to be accessed any time when needed by the owner. - All cameras should be connected to the Wall Mounted Air conditioning units installed around the site and Central AC in the public area (restaurant, Cafeteria, multipurpose room) - Cameras should provide clear images and this require regular cleaning of cameras.

ELEMENT	MAINTENANCE PLAN
SECURITY SYSTEMS	<u>Every 2 Weeks</u> and when needed
IMAGES	PROCEDURE
	e. Problems of cameras function should be solved immediately through warranty or (if out of warranty) through specialized service providers. f. If camera is no longer functioning it should be replaced with camera that matches existing ones. g. Data collected from cameras should not be made available for or accessed by other entity than the owner of the site.

ELEMENT	MAINTENANCE PLAN
SAFETY SYSTEMS/ FIREFIGHTING	<u>Every 1 month for all equipment</u> and when needed
IMAGES	PROCEDURE
    	2. Firefighting system: - Site management is responsible to coordinate updating and maintenance of all firefighting facilities around the site and to keep record of maintenance and update of the system. - Site management staff should control source of ignition by coordinating activities in the site (cooking, heating systems, electric work maintenance, etc) - If any of the system units is failing to function or have clear damage it should be replaced promptly. - Fire pumps in the site are connected to water source and are inspected every month. Cover is easy to operate - Ensure no barriers exist around firefighting equipment. - Smoke detectors are working and inspected timely as recommended by the manufacturer.

SECURITY AND SAFETY SYSTEM	ELEMENT	MAINTENANCE PLAN
	SAFETY SYSTEMS (FIREFIGHTING)	<u>Every 1 month for all equipment</u> and when needed
	IMAGES	PROCEDURE
	 	g. Central alarm system located at the main management and control room is connected to power and functioning. Ensure that all fire alarm units are connected to the main fire alarm unit. h. Any damage to the system in the restaurant or the kitchen requires ceasing the space function until firefighting system is in working condition and its equipment is in place.



CHAPTER 6: STRUCTURAL ELEMENTS MAINTENANCE



A. MAINTENANCE OF STONE WALLS

The most challenging problem in Khan Al Wakaleh is the problem of humidity that is causing a serious case of (**Efflorescence**). It is a result of natural evaporation of water rising up from ground and moving from ceiling, this issue ranges from minimal; in shape of white fluffy dust; to sever excessive salt damp in different areas around the site with building material (plaster) falling on the floor. This diagnostic was confirmed by both experts who were invited to the site (**Mr. Nicolas Durnan**) and (**Dr. Alessandro Massari**). However, each one of them has provided different suggestions to deal with this problem (**see Index I for suggestions by each of the two experts**). This condition with humidity and formation of excessive salt damp could by time lead to production of mold and green algae.

SALT FORMATION PROCESS (EFFLORESCENCE)

According to the in-depth analysis and tests as well as review of the site history, salt existed in the site since long time ago; it was proved that the salt form is (Nitrate NO_3) and it is a result of the original use of the site and the existence of organic remain. The site was used by merchants where they could relax, eat, sleep in the hotel (Khan) and leave their horses in the ground floor. Another main source of Nitrate is waste water system leak in the ground which is very common in the Old City due to aging and decay



in the drainage systems. These conditions made the ground rich of organic material that stays in salt for long times and generates Nitrate Salt. Salt will naturally move with water from ground up through walls where it goes to the exterior surface of the walls (the Capillarity action). Due to humidity in the space salt will absorb water and turns to liquid again; naturally it will dry and increase in size. The Nitrate cycle of changing from liquid state to solid state (crystal) and vice a versa is a very quick process making it one of the most dangerous salts if found in buildings. As salt changes from liquid to crystal it increases in size and creates small cracks in the surrounding material leading new crystals to flow through these cracks. As this reoccurs rapidly material starts to decay and falls in shape of dust or small bits.



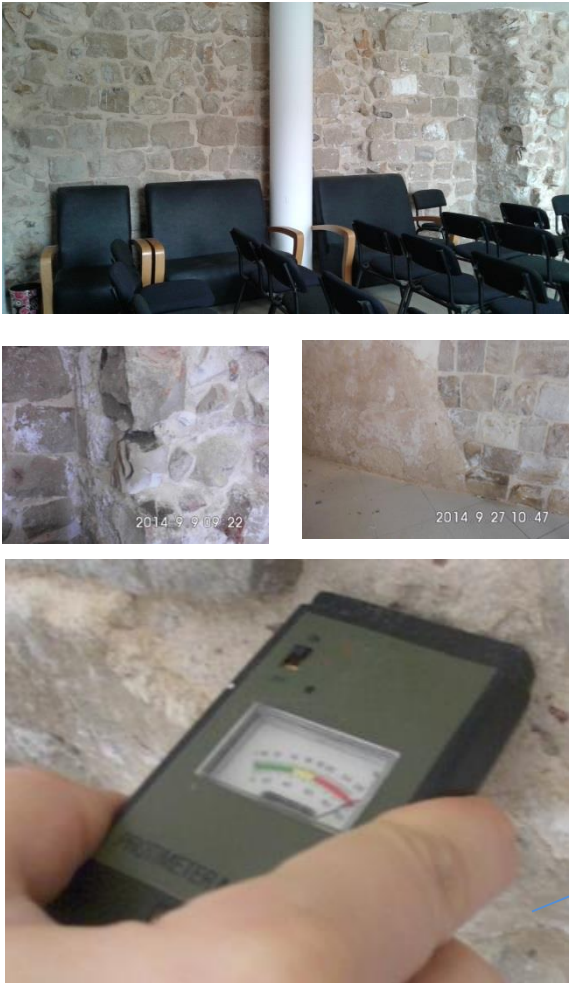
The problem was confirmed by Expert Alessandro Massari (Expert in Building Humidity) through testing walls affected by salt damp using Nitrat test strips. Results show very high level of Nitrat.

Similar test was done to check for existence of Sulfate salt; result was very low. Tests were repeated at different locations of the old walls of Khan Al Wakaleh.

Note: it is not recommended to use cement or modern material in plastering or structure modification at historic sites because these modern materials trap moisture and stop natural evaporation out of the building. Rather it is recommended to use lime mortar because: it allows building to breath, it accommodate a general movement and has better elasticity and is more durable.

The resulted salt formation is also causing dust all around the site and is disturbing the building visual appearance. It worth noting that existence of dust excessively around the site could cause health problems especially in areas that are frequently occupied (hostels, hotel rooms, and street shops).

After analysis, research and advice (recommendation) from experts in the area of historic site humidity (Alessandro Massari) and lime mortar (Nicolas Durnan) it was concluded that the most appropriate solution for salt problem is as explained in the following procedure:

ELEMENT	MAINTENANCE_PLAN
STONEWALLS (EFFLORESCENCE) SALT - PROBLEM	<u>As Specified in the procedure below</u>
IMAGES	PROCEDURE
	1- Take all measures to improve (or stop existing condition from worsening) - Regularly check and fix (where needed) any water leak. - Check for any infiltration sources that could be a result of mechanical connections problems or damage, windows or doors frames bent, exterior walls problems (stone joints leaking water or so). - Calibrate windows and doors as needed to stop infiltration (require special service provider) - Using plastic brush and vacuum machine to clean all surfaces from salt. It is recommended to conduct this stage prior to winter season to avoid water be absorbed again to the structure. <u>Test for Humidity</u> a moisture meter was used; it shows high levels of humidity in the site walls in general and extremely high level of humidity in the Eastern interior wall of the multipurpose room.

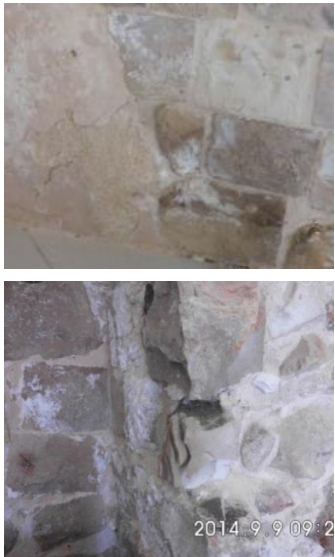
STONE WALLS_ISSUES	ELEMENT	MAINTENANCE_PLAN
	STONEWALLS (EFFLORESCENCE) SALT - PROBLEM	<u>As Specified in the procedure below</u>
	IMAGES	PROCEDURE
		e. If any drainage system damage around the site is identified refer to owner of the affected adjacent property to resolve the matter through formal agreement to avoid damage to the site structure. 2. Improve and reduce the current problem as much The proposed approach relies on protecting the existing structure by introducing temporary plaster (backing plaster) that will hold the damage in place of the original wall. The temporary plaster will allow the salt to rise on its surface and will slowly cause decay in the temporary plaster. Plaster is done as in the following procedure :

ELEMENT	MAINTENANCE_PLAN
STONEWALLS (EFFLORESCENCE) SALT - PROBLEM	<u>As Specified in the procedure below</u>
IMAGES	PROCEDURE
	- Prepare plaster mix in ratio (2 sand: 4 soil: 1 lime putty: 4kg sawdust (wood flour) for each Ton of the mix) - Soak the walls with water by spraying water in low pressure, for 4 hours prior to applying the plaster. - Fix sackcloth or other porous fabric on the wall before applying the plaster (in order to ease the process of removing the temporary plaster) - Apply plaster on the walls and let it dry. - After wall dries humidity will be transferred from walls and ground carrying salt to the external surface of the plaster and will form crystals on the surface of the temporary plaster. By time and as salt crystals increases and cover larger areas of the plaster (it takes 5-7 days or more in winter season) - Remove the plaster outside of the site to a dumping site - Repeat the process two or three times to reduce the salt as much as possible.
Applying Plaster on stone wall (Riwaq, 2004)  Backing Plaster (Durnan, 2014)	

ELEMENT	MAINTENANCE_PLAN
LIMEWASH FOR OLD WALLS AND CEILING	<u>As Specified in the procedure below</u>
IMAGES	PROCEDURE
 	i. Finally Lime wash for the interior walls and on ceiling where problem exists. Lime wash is suitable for traditional walls and vaults because it blends easily to the existing lime plaster and allows humidity to go out of the structure (breathable) improving the general atmosphere of the space. The lime wash (or lime paint) can improve sound behavior of the space by absorbing echo because of its porosity. The lime wash is also suitable for walls that excessively generating salt as the lime wash can be easily removed and replaced if salt generated starts causing decay in its material. Mix is made using hydrated lime; lime should be soaked in water three days before using. Mix ratio is 1 hydrated lime: 1 water (in summer) and 1: hydrated lime: $\frac{3}{4}$ water (in winter), for each 20 Liter of the mix it is recommended to add 50ML of (Lineseed Oil) and 50ML of (high Protein) milk. Mix should be stirred quickly and frequently to ensure oil is melting in the lime does not sink down.

ELEMENT	MAINTENANCE_PLAN
LIMEWASH FOR OLD WALLS AND CEILING	<u>As Specified in the procedure below</u>
IMAGES	PROCEDURE
LIMEWASH_PROCESS	A premix of suitable ratios should be tested (three samples 1*1 m2) should be done and provided to the engineer; approval should be obtained before starting the work. Surfaces should be brushed to clean and dampened with water (normally with a hand-pumped spray) and lime wash is applied thinly and worked in well, using a large, rough-textured brush.
	Note: <u>Lime is Caustic</u> Safety measures should be taken (wear gloves, long sleeves, dust mask and safety glasses)

ELEMENT	MAINTENANCE_PLAN
LIMEWASH FOR OLD WALLS AND CEILING	<u>As Specified in the procedure below</u>
IMAGES	PROCEDURE
	Brush should be large with long bristles (brushes form nylon and polyester combination is better) Limewash is applied in three layers, each layer should be left three days at least to dry before applying the next layer. The first layer could be applied on the plaster before it's fully dried, this will allow filling any small cracks or spaces in the plaster and will help plaster to well absorb the lime wash color. Surface of each layer should be dampened with water using hand-pumped spray before the next layer goes on. Lime wash requires renewing every two years in walls where salt is persisting and every five years in other walls

ELEMENT	MAINTENANCE_PLAN
REPOINTING OF STONEWALLS (JOINTS)	<u>As Specified in the procedure below</u>
IMAGES	PROCEDURE
	Repointing of stone joints is needed in the following situations: 1- To fix a cracks in stones 2- To repoint stone joints were decay is apparent and mortar is falling. 3- To point stone walls that suspected to be a source of water infiltration to the interior space.
	Repointing of stones should be done as in the following procedure: a. Cleaning joints or cracks by removing any dust and broken mortar to the depth equal to the joint width using Rockpick

ELEMENT	MAINTENANCE_PLAN
REPOINTING OF STONEWALLS (JOINTS)	<u>As Specified in the procedure below</u>
IMAGES	PROCEDURE
  	b. If mortar is difficult to move one can use a hammer and a chisel and avoid to damage surrounding stones. c. (For exterior walls) Mix should be done in the following ratio (2.5 non-hydraulic lime (lime putty): 9 sand: $\frac{1}{4}$ clay aggregate and $\frac{1}{4}$ Pumice). Note The clay aggregate and pumice are added to help the mix to dry faster because the non-hydraulic lime dries slowly in general. d. Mortar is mixed manually or by using simple mechanical- hand held- (like whisk mixer). It is not recommended to use the (spiral blade drum mixer). It is recommended to leave the mix to the next work day makes it more responsive and easier to stick on the surfaces e.

ELEMENT	MAINTENANCE PLAN
REPOINTING OF STONEWALLS (JOINTS)	<u>As Specified in the procedure below</u>
IMAGES	PROCEDURE
  	f. Mix is blotted using metal sand sieve (no 10) to remove undissolved lime, then testing the mix by inserting the pointing trowel in the mix and moving it out. The water level in the mix is good if the mix stays on the trowel on the horizontal and vertical positions. If the mix fall this means that it has excess level of water. g. Stone surface should be cleaned by plastic brush and dampened with water (by hand-held spray or a sponge) before pointing h. Mix is added on the hawk and spread over it using the trowel to form a 20mm thick board, then carefully use pointing trowel cut the mix to the depth of the joint and insert the mix into stone joints without spreading mortar

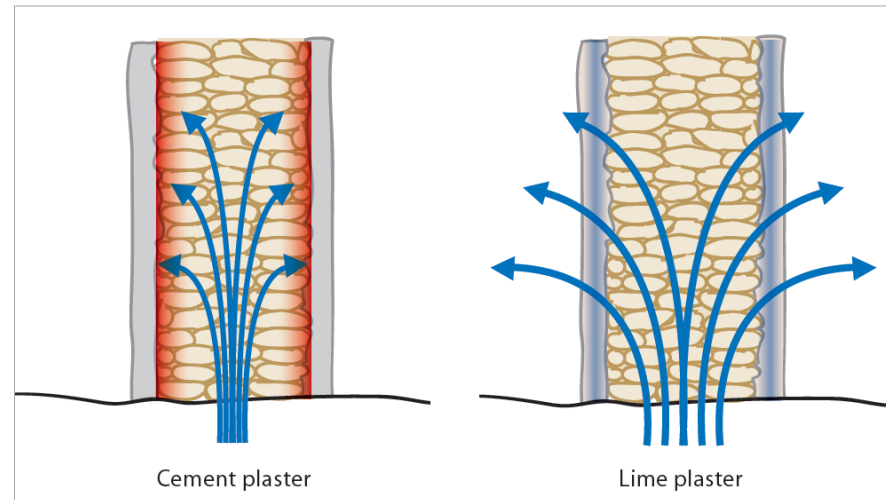
ELEMENT	MAINTENANCE PLAN
REPOINTING OF STONEWALLS (JOINTS)	<u>As Specified in the procedure below</u>
IMAGES	PROCEDURE
	allowing the plaster to overlay any of the surrounding stones.
	i. Mortar is firmed inside the joints using pointing trowel.
	j. Any extra mortar on the edges should be removed using wood brush and then and mortar should be softened using a wet sponge or soft brush while avoiding water spread on the surrounding edges.

REPAIR OF TRADITIONAL PLASTER ON STONE WALLS

Lime mortar is used because it is similar in characteristics to the lime stone which allows this material to stick firmly to the surface of stone.

As a general rule plaster mix applied on stone walls should be weaker than the stone itself. If the limestone is highly porous the mortar mix should be even more porous, this could be achieved by making the mortar mix using (putty lime with larger size well-graded aggregates and porous light type of aggregates such as (Pumice stone). If the stone is very solid and has low porosity then a mortar mix that includes putty lime and well graded sand

aggregate is good. A test for stone strength can be done by taking one or more small cube samples and then test them by applying pressure on them. Then similar samples from lime mortar mix should be done and one month later be tested. According to findings of these tests a sample should be selected to



Cement Plaster behavior with evaporation of moisture versus Lime plaster (Labesse,-)

match the nature of the surfaces to be plastered. This applies to the plaster layers as well; last layer of plaster should be weaker than the second layer and the second layer is weaker than the first layer. This will allow easy removal of the plaster in the future and replacing it with new plaster when needed. Further, (in case salt problem exists in the walls) it will be easy to scarify the plaster in order to protect stones because salt will form on surface of the plaster causing decay in the plaster material rather than damaging the stone itself (RIWAQ, 2004) .

REPLACING_LIME_PLASTER	ELEMENT	MAINTENANCE PLAN
	REPLACING_LIME_PLASTER	<u>As Specified in the procedure below</u>
REPLACING_LIME_PLASTER	IMAGES	PROCEDURE
		In <u>old structure where traditional (lime plastered walls) exists</u> when decay requires replacement of existing plaster. Site management is responsible for coordinating repair in plaster where needed; this need to be done by approved expert in lime plaster. The following mix ratios and important operational measures should be considered while replacing the Lime plaster: - Remove mortar from stone joints to the depth of 20mm minimum. - Stone walls should be brushed and cleaned from dust using a wood or a plastic brush and water. - Fill stone joints with mortar in the ratio (2 putty lime: 6 well graded sand aggregate: $\frac{1}{4}$ clay aggregate and $\frac{1}{4}$ Pumice). Additives from natural products are sometimes advised to be used like (animal hair, cotton, flax, hemp twine) in the ratio (4 kg for each one Ton of the mix).

* This mix is Just
in exterior wall
plastering (non-
hydraulic lime)

ELEMENT	MAINTENANCE PLAN
REPLACING LIME_PLASTER	<u>As Specified in the procedure below</u>
IMAGES	PROCEDURE
Note: Sand here is desert sand (rain washed sand) well graded fine sand and not conventional fine sand. If desert sand was not available coast sand can be used. However, it should be cleaned few days before using it. Cleaning is done by putting the sand in a mixing container, adding water to soak it, stir it with water until a white foam is formed on the surface, pour down the water away and leave the sand. After doing this process twice, sand should be left to dry (RIWAQ, 2004)	e. Apply a (8-20) mm thick (first layer) of plaster in the ratio (2 putty lime: 6 well graded sand aggregate: $\frac{1}{2}$ clay aggregate: $\frac{1}{4}$ pumice) f. Apply a (8-20) mm thick (second layer) of lime plaster in the ratio (2.5 putty lime: 9 well graded sand aggregate: $\frac{1}{4}$ clay aggregate: 4kg animal hair for each 1 Ton of the mix). Animal hair should be goat or horse hair (well cleaned from any organic remains), in varied lengths (2- 7) cm. The animal hair is added to this layer to protect the mix during the primary dryness period. After few months, animal hair decomposes and dissolves leaving internal apertures in the mortar. g. Accordingly; this will improve plaster breathability and improve space sound behavior by increasing its echo absorbing characteristics.

REPLACING LIME PLASTER	ELEMENT	MAINTENANCE PLAN
	REPLACING LIME_PLASTER	<u>As Specified in the procedure below</u>
	PROCEDURE	
	h. Final layer (third) Apply a (3- 5)mm thick layer in the ratio (2 putty lime: 4 well graded sand aggregate: ¼ fine clay aggregate)	
	* This mix is Just for interior walls that suffer from excessive humidity (Natural hydraulic lime) Plaster for Interior walls requires the use of Hydraulic lime (NHL 3.5) instead of non-hydraulic lime. This is recommended especially in Khan Al Wakaleh because the site structure has high level of humidity. Hydraulic lime can dry faster in humid conditions and is more durable and is stronger than non-hydraulic lime.	
	Note: each plaster layer should not exceed 20 mm in thickness. If the wall surface includes recessed or deep areas that require larger plaster thickness one should apply one or two additional plaster layers to even the surface instead of increasing the plaster layer thickness.	

It is recommended to prepare samples of plaster before preparing final mix. Three or more samples of 1*1 m on the target wall could be done and tested and the sample that shows best performance (dryness, cracks, color, etc.) is considered as the best mix to be used.

This is because traditional plaster mixes needs to respond to the strength of the stone used in the building itself in order to ensure its proper consolidation with the stone wall and stones are not necessary similar in characteristic especially in renovated sites which sometimes includes areas built from of new stones.

Following is a table of different hydraulic mortar mixes proposed by (RIWAQ, 2004). Site characteristic, stone type, weather conditions are all determinant on the best mortar mix to be used.

The next section will describe in details the plastering process.

Various Hydraulic Lime Mortar Mix (RIWAQ, 2004)

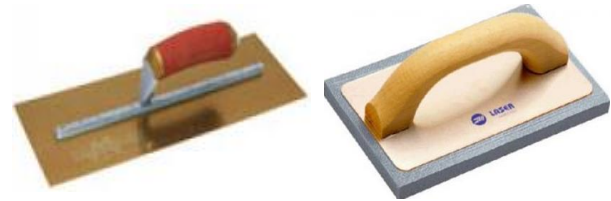
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جدول

19
خلطات مونة جيرية تعتمد في تركيبها على الجير المائي

Hydraulic Lime Mortars

مونة 10	مونة 9	مونة 8	مونة 7	مونة 6	مونة 5	مونة 4	مونة 3	مونة 2	مونة 1	للادة	Material
½							1	1	1	جير عالي اللاتية	Eminently Hydraulic Lime
				1	1	1				جير متوسط اللاتية	Moderetly Hydraulic Lime
	1	1	1							جير قليل اللاتية	Feebly Hydraulic Lime
½										جير هوائي	Non Hydraulic Lime
½			½			½			½	كسر القرميد أو الفخار الناعم	Brick Powder (reactive) ²⁰
1	2	2	½	2	2	1 ½	2	2	1 ½	رمل متدرج	Well Graded Sharp Sand
½	½			½			½			رمل ناعم	Soft Sand
1	1 ½	1	½	1 ½	1	½	1 ½	1	½	كسر حجر جيرى أو كسر فخار	Porous Limestone or Brick Aggregate
1-3	1-4	1-3	1-2½	1-4	1-3	1-2½	1-4	1-3	1-2½	الخلط (بالحجم)	Mix (by Volume)

ELEMENT	MAINTENANCE PLAN
REPLACING LIME_PLASTER APPLICATION OF THE PLASTER ON WALLS	<u>As Specified in the procedure below</u>
IMAGES	PROCEDURE
 	- The mix should be bolted using metal sand sieve (no 5)- 25 holes per one inch to remove any large aggregate or undissolved lime aggregate. After bolting the mix, animal hair can be added and well mixed manually or using hand-held mechanical mixer. Filling stone joints: Stone joints are splattered into the stone joints and using wide plastering trowel. Then using the triangular shaped trowel mortar is compressed into joints to ensure filling the halls or on the stone surface. This step ensures filling all opening and deep halls. First layer of plaster the first layer of plaster is made using the trowel and plastering trowel. Mortar is through on the surface and compacted until an average of no more than 20 mm thick layer evenly distributed is formed. Plaster is then sharpened using a simple saw.

ELEMENT	MAINTENANCE PLAN
REPLACING LIME_PLASTER APPLICATION OF THE PLASTER ON WALLS	<u>As Specified in the procedure below</u>
IMAGES	PROCEDURE
	d. Second layer of plaster using the plastering trowel a plaster layer of no more than 20mm total thickness is created. The surface of the layer should be then sharpened using simple saw or metal brush e. Third layer of plaster the last layer of plaster is done in the ratio (1 fine well graded sand: 1 putty lime). The mix should be bolted using metal sand sieve. Then mix should be spread over the surface using float trowel and evened using a sponge trowel, plaster; layer thickness should be not exceed 5 mm.
Note: each layer of plaster should dry before applying the next layer (in summer around 3 days), (in winter around 6 days or more)	

In the new built up areas (some new structure with modern material that exists in: Cafeteria/ Restaurant and the multi purposes room) plaster is new material and not a traditional plaster. To repair plaster in these areas following procedure should be followed.

REPAIR _ NEW_STRUCTURE _ PLASTER	ELEMENT	MAINTENANCE PLAN
	REPAIR PLASTER IN NEW STRUCTURES	<u>As Specified in the procedure below</u>
	IMAGES	PROCEDURE
		Plaster should be inspected <u>every year</u> to ensure that no damage to the plaster occur and that (coating, sealed joints, flashing system are in good shape and has no water leak at all) - In case of leak, identify source of leak and repair as appropriate. - Patch minor cracks where needed by first widening the crack enough to allow patching material to fill it, clean from dust, mist surrounding dry plaster with water to prevent it from absorbing water from the mix, finally use trowel to fill the crack with patching plaster. After drying mist the patched area and smooth it again with a trowel. Sand it to ensure it's leveled to the rest of surface and then paint it. - Paint every three years to maintain the visual appearance of the site.

ELEMENT	MAINTENANCE PLAN
CLEANING OF STONEWALLS SURFACES (REMOVE PLASTER/ MORTAR/ CONSTRUCTION MATERIAL REMAINS)	<u>As Specified in the procedure below</u>
PROCEDURE	
	In some occasions, especially after conducting site maintenance) building material such as mortar, plaster, paint etc. could stick to stone surfaces. To remove mortar or cement from stone surface one should avoid using chemicals and or sharp tools in order to protect texture of the stone from damage, discoloration or chemical reactions. Rather, one should carefully use manual methods (chisel and hammer) to remove mortar layers form top of stone surfaces. <u>To clean paint from top of stone surface:</u> a. For cleaning paint from stone walls acid material should be avoided; it is better use organic material because cleaning material that contains acids such as Hydrochloric acid can affect the stone color and react with the stone or its lime mortar which results on weakening it.

ELEMENT	MAINTENANCE PLAN
CLEANING OF STONEWALLS SURFACES (REMOVE PLASTER/ MORTAR/ CONSTRUCTION MATERIAL REMAINS)	<u>As Specified in the procedure below</u>
IMAGES	PROCEDURE
(Note: material such as Sodium Hydroxide, and Ammonium Biflorid should be avoided because they are considered “Caustic” and can cause chemical burning to the stone surface).	- For paint material such as oil based, latex, and acrylic paint it is recommended to use cleaners from Potassium Hydroxide or Ammonium Hydroxide or Trisodium Phosphate - To remove organic paint from stone surfaces one can use any of the following solutions (Acetone, Methylene Chloride, Methanol) <u>after cleaning stones</u> with any of these solutions wall should be washed with (distilled water) to avoid stone discoloration. - In cleaning stone surface from paint one should avoid spelling the cleaning material on surrounding clean stones. For that purpose it is recommended to apply the cleaning material on the surface using <u>small brush</u> or spray it directly on the target areas. Measures should be taken to protect eyes and hands and respiratory system while working by using gloves and protective masks.



ELEMENT	MAINTENANCE PLAN
CLEANING STONES SURFACES (FROM BLACK RUST; DARK ENCRUSTATION)	<u>As Specified in the procedure below</u>
IMAGES	PROCEDURE
(Note: There is no dark encrustation problem in Khan Al Wakaleh building. However, this solution was provided in case the problems arise in the future). 	<u>Black Rust or (dark encrustation)</u> on stone wall (If occurred in the future). Site management should coordinate to provide approved expert in stone cleaning to conduct the cleaning (if problem was found in the site) Following steps are taken to clean stone encrustation: a) To remove large areas of incrustation one should start by using chisel and hammer to remove prominent large areas. b) Clean the layer that is directly covering the stone surface using fine sand. c) Cleaning Packs of Ammonium Bicarbonate: Mix is made by diluting ammonium Bicarbonate in distilled water in the ratio 1:5, mix it well to form a well saturated mix then apply it on the areas needed to be cleaned of the stone surface. d) Surfaces should be pre-wetted before applying the clay on its surface. Each stone is different in terms of the time needed to completely clean it. Therefore, one should find out the time

CLEANING_ STONE WALLS	ELEMENT	MAINTENANCE PLAN
	CLEANING STONES SURFACES (FROM BLACK RUST; DARK ENCRUSTATION)	<u>As Specified in the procedure below</u>
	PROCEDURE	
	needed for the stone to be cleaned by applying the mix on a pre-wetted small area for 5 minutes and then clean the area with distilled water. Repeat the process until the stone is completely cleaned. The sum of all intervals needed to completely clean the surface is the time needed for the stone to be cleaned. e) After moving the mix, walls should be cleaned with distilled water. If the wall has different types of stones are used in the same wall a sample for cleaning each type of stone should be done to determine the time needed for applying the mix.	

ELEMENT	MAINTENANCE PLAN
CLEANING STONES SURFACES (FROM BLACK RUST; DARK ENCRUSTATION)	<u>As Specified in the procedure below</u>
IMAGES	PROCEDURE



- f) **Micro-abrasive Blasting** If cleaning was not achieved using chemical methods one can use sand cleaning with simple fine sand blasting machine (Micro Sand Blasting) such as sand powder, stone powder, glass powder, Ammonium Dioxide, plastic grains. It is a dry treatment (does not need water) and is applied under very low pressure (7kg/ cm²) or (100 Pound/ square inch).

Doing this work requires experienced labor and need attention to the thickness and size of the encrustation problem to avoid damaging the stone surface beyond the affected area

ELEMENT	MAINTENANCE PLAN
CLEANING WALLS FROM (PLANTS GROWTH)	<u>As Specified in the procedure below</u>
IMAGES	PROCEDURE
CLEANING_ STONE WALLS	If plant growth problem occur in the building walls site management should ensure proper removing, cleaning and stopping its growth. Carefully examine the vegetation growth to see if the roots have caused any damage to the stone. If there is serious damage to the stone then other procedure to preserve stones will be taken. If the stone has not deteriorated then following procedures should be followed: - examine the plant carefully and identify its type - The type of the vegetation found in Khan Al wakaleh site is <i>Rhuscoriara</i> tree which does require permanent solution as it regenerate even after cutting it. - Use trimming shears to cut the trunk of the plant - Inject the cut trunk with special herbicide. - Allow the plant to die naturally then remove the dried tendrils and roots. Be careful not to move any structure material (especially in old historic structure).

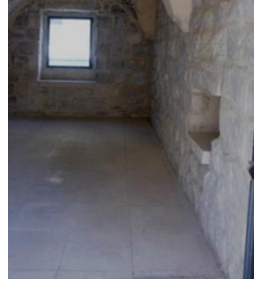
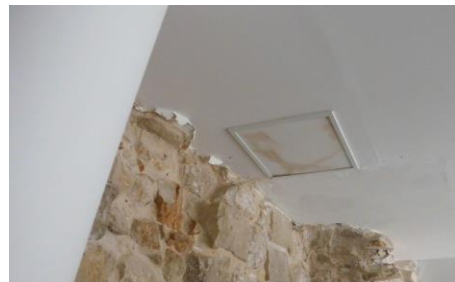
ELEMENT	MAINTENANCE PLAN
CLEANING WALLS FROM (PLANTS GROWTH)	<u>As Specified in the procedure below</u>
IMAGES	PROCEDURE
	- Use wooden scrapers to ease the plant material off the wall apply water when needed to help loosening the plant material. If the plant stems are spread on wide area it might be necessary to cut the stems into smaller sections. - Do not leave any wood inside wall joints, wood can cause decay in surrounding material and can cause even more serious problems. - After moving all material, gently scrub the surface with a soft non-metallic bristle brush and clean, spray water in low pressure. - Use lime mortar to fill any potential plant growth locations such as small halls in exterior walls or damaged joints. - Regularly check for similar issue and possible plant growth in the site.

CLEANING_ STONE WALLS	ELEMENT	MAINTENANCE PLAN
	CLEANING WALLS FROM (PLANTS GROWTH)	<u>As Specified in the procedure below</u>
	PROCEDURE	
	In case of other type of plants growth it could be enough to cut the plant trunk and it will dry and die. One should continue to watch and monitor the plant to see if it grows again and then decide if further action is needed. If a persistent problem of plant growth occurs it is recommended to seek professional advice.	
	(Note: it is a common practice to use herbicide to kill the existing plants at the walls but it is important to note that herbicide generally include salts that could adversely affect stones. Therefore, using such material on stone or masonry is strongly discouraged Ammonium Biflorid should be avoided because they are considered “Caustic” and can cause chemical burning to the stone surface).	

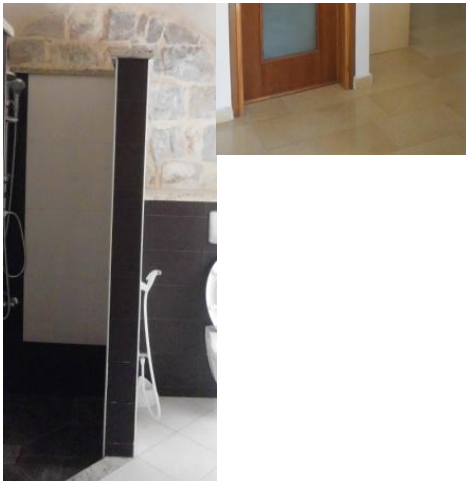
ELEMENT	MAINTENANCE PLAN
ROOF MAINTENANCE	<u>As Specified in the procedure below</u>
IMAGES	PROCEDURE
ROOF_ MAINTENANCE	Site management is required to maintain roof quality (cleaning all mechanical and electrical fixtures) and level of humidity of the roof through the following: - Regularly clean all fixtures from dust to maintain their high performance (Minimum every 3 months or more frequent). - Ensure that all drainage pipes are clear from blockage (no solid elements such as plants, stone or construction material trapped there) - Ensure that drainage gutters are in a clean from blockage and at a good distance from walls of the building (to avoid allowing water access to walls and causing water infiltration)

ELEMENT	MAINTENANCE PLAN
ROOF MAINTENANCE	<u>As Specified in the procedure below</u>
IMAGES	PROCEDURE
	a. Roof slope toward drainage pipes is maintained, no water trapped on roof. b. If waterproofing membrane sheet damage occur immediate repair should be done. Site maintenance should refer to appropriate approved service provider to conduct the work.
	c. If damage occurs to the protective waterproof coating (<u>Brushbond</u>) at top of collective bathroom areas and the hotel rooms roof, immediate repair should be done. Site maintenance should refer to appropriate approved service provider to conduct the work.

CHAPTER 7: TILES/ OPENNINGS/ FINISHING MAINTENANCE



ELEMENT	MAINTENANCE PLAN
CERAMIC TILES/ OLD STONE FLOORS/ CERAMIC TILES)	<u>As Specified in the procedure below</u>
IMAGES	PROCEDURE
  	In Khan Al Wakaleh there are three types of tiles a. Stone (old and new) b. ceramic tiles, c. cement traditional tiles. Regular checkup need to be conducted (every month checkup). If damage occurs action should be taken immediately to avoid movement barrier and to avoid further damage to the surrounding tiles. The regular check should look for: <u>Cracks:</u> (tiles with major cracks need to be replaced with similar type and color to the existing tiles). <u>Grouting loss or decay:</u> decay in grouting constitutes a potential dust and bacteria gathering spots. Further becomes an inviting access points to ants and cockroaches. Grouting should be repaired immediately.

ELEMENT	MAINTENANCE PLAN
CERAMIC TILES/ OLD STONE FLOORS/ CERAMIC TILES/ WALL TILES)	<u>As Specified in the procedure below</u>
IMAGES	PROCEDURE
 	c. Humidity: If humidity is found on the tiles at any location of the site source of humidity should be identified and problem causing the humidity should be handled accordingly. d. Decay in sills or coping as a result of salt and humidity <u>Tiles Cleaning</u> when cleaning tiles it is important to avoid using chemicals that can interact with the tiles material and discolor it such as cleaners containing chloride (bleach) or acid. a. <u>For walls tiles</u>: All-purpose cleaner applied with a non-metallic pad is good for tiles cleaning, rinse and wipe dry. b. <u>For glazed floor tiles</u>, apply a strong solution of all-purpose or non-oil-based cleaner. Let stand for five minutes, brush and scrub. Then rinse with clean water and wipe dry (online, 2014)

ELEMENT	MAINTENANCE PLAN
CEMENT TRADITIONAL TILES/ SUSPENDED AND FALS-CEILING)	<u>As Specified in the procedure below</u>
IMAGES	PROCEDURE
  	c. <u>Traditional Cement tiles:</u> Clean with neutral soap (special tile soap). Do not use acid or aggressive cleaners, to clean stain use a scouring pad or solvent. Cement tiles need to be resealed every four to five years to maintain their shininess and protect their surface. d. <u>Suspended Ceiling (False Ceiling Tiles/ Gypsum Boards)</u> Use vacuum with soft bristle attachment to clean false ceiling tiles <u>every 4 months</u>. Clean in one direction to avoid rubbing dust into the surface of the ceiling. Cover furniture before start cleaning. Wear dust masks and glasses for protection from dust. If water stain occurs (as a result of water infiltration, mechanical fixtures damage or AC pipes problems) solve the reason of stain and then remove damaged tiles (type and color similar to existing)

ELEMENT	MAINTENANCE PLAN
Windows and Doors	<u>As Specified in the procedure below</u>
IMAGES	PROCEDURE
 	Site Management should continuously ensure proper function of windows and doors. Doors and windows in Khan Al Wakaleh was emphasized in the primary maintenance of the building because any problem in them could lead to air and water infiltration causing to reduce efficiency of air conditioning systems and accordingly excessive loss of energy as well as increase of (already existing problem) humidity and its consequences. <u>Wooden doors maintenance</u> wooden doors in the building need to be checked for any problem. If any problem is found such as (no proper sealing, problem in lock, handle, etc.) it should be fixed immediately to avoid interruption of space functions. <u>Aluminum doors and windows</u> all windows and aluminum should be checked regularly (bent frames, broken handles, crack glass, etc.). Needed calibration, repair or change of accessories should be done immediately by an approved professional.

ELEMENT	MAINTENANCE PLAN
Steel protection	<u>As Specified in the procedure below</u>
IMAGES	PROCEDURE
	Site Management should continuously ensure that all steel protection (windows, stair balustrade) are firm and in good conditions. Any problem observed should be repaired immediately. Access should be prohibited to areas where potential risk of falling can occur. <u>Windows Steel Protection</u> should be checked for loosen parts and be fixed immediately by aluminum approved maintenance service. <u>Handrails</u> all stairs handrails (old and new) as well as safety grab bars (for people with disability bathrooms) as well as ramps and walls handrails should be checked in regular basis. Any problem observed should be fixed immediately to avoid access difficulty and safety hazards.

