Q. What is Efflorescence?

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1) **Background**
Efflorescence is a powdery deposit of salts which forms on the surface of bricks and mortar. It is usually white but efflorescence may be yellow, green or brown.

2) **Causes**
Salts enter the wall from various sources. New bricks seldom contain soluble salts but mortar and concrete have relatively high soluble salt contents. Ground waters that are naturally salt-bearing can be drawn into base brickwork. A faulty damp proof course or a damp course bridged by mortar will allow the salts to migrate up the wall. Render which has been applied over a damp proof course can also allow salt to
migrate up the face of the brickwork. The amount of efflorescence that occurs is directly related to the amount of water in the bricks, and their drying time. The more water in the bricks, and the longer it is there, the more chance salts will have to dissolve in it and be brought to the surface as the bricks dry out. Water allowed to enter uncovered cavity walls during construction is likely to cause efflorescence so brickwork must be protected from water entry during construction. Persistent efflorescence should be taken as a warning that water is entering the wall through faulty copings, flashings, or pipe leakage. If allowed to continue unchecked the salts carried to the face of the wall may eventually attack and cause deterioration of some bricks.

3) **Remedies**
Efflorescence can be minimized by laying dry bricks and by speeding up the drying process after the bricks have been laid by providing good ventilation. The salts that cause efflorescence are soluble in water. Hosing with water will cause the salts to dissolve and be re-absorbed into the brickwork, and then reappear when the brick wall dries out again. Acid or alkaline treatments are not recommended as they increase the salt content of the wall. The best method is simply brush off the deposit with a stiff dry bristle brush after the wall has dried out. Then sponge the surface with a damp synthetic chamois or high suction sponge. Use very little water and rinse sponge frequently in fresh water.

Q. How does an Induced Draught Zigzag Kiln (IDZK) operate?

Induced Draught Zigzag Kiln (IDZK) technology has been in use for many decades. Several variations of this technology have been used at different times and in different countries. Currently, the IDZK technology is popular in some parts of India, and in Nepal and Bangladesh. In an IDZK, air is made to flow in a zigzag path and the draught required for the air flow is induced with the help of a fan. How does an IDZK operate? In an IDZK, the bricks are stacked and fired/burnt in the space (called 'trench' or 'dug') between the rectangular central part of the kiln (called miyana) and the rectangular outer wall of the kiln. IDZK is a continuous moving-fire kiln in which the fire burns continuously and moves in a closed rectangular circuit through the bricks stacked in the trench. The flow of air into the kiln, which is required for combustion of the fuel and for the movement of fire in the forward direction, is caused by the draught created by a fan. As the fire moves forward, the fired bricks behind the fire are taken out of the kiln after they cool down, while fresh green bricks are stacked ahead of the fire. For a kiln of

production capacity 25,000–60,000 bricks per day, the central perimeter of the kiln circuit is about 400–500 feet (125–150 m). It usually takes about 25 days for the fire to complete one round of the kiln. The bricks are stacked in such a manner that distinct chambers of brick setting are formed in the kiln. Just like in the case of FCBTK, in Zigzag Kilns also, the bricks are stacked in vertical columns in a row across the width of the trench. However, unlike in FCBTK, all the brick columns are not of the same width. The rows of brick columns are arranged one ahead of the other in the forward direction of fire travel. In an IDZK, one chamber of brick setting consists of eight such rows. The air flow through the brick setting takes place through the gaps provided in between the brick rows. The openings for air flow in every eighth row (i.e., at the end of each chamber) are provided in such a way that they cause zigzag flow of air in the kiln. Usually single zigzag brick setting is practised in IDZKs. The bricks stacked in the kiln are covered with a layer of ash and brick dust. This layer acts as a temporary roof of the kiln, which helps in preventing heat loss as well as air leakages into the kiln. What are the three distinct zones in an operational IDZK? In an operational IDZK, the bricks can be segregated into three distinct zones. Brick firing zone where the fuel is being fed and combustion is taking place. Brick preheating zone (ahead of the firing zone in the direction of air flow) where green bricks are stacked and are preheated by the hot flue gases coming from the firing zone. Brick cooling zone (behind the firing zone) where the burnt bricks are cooled by the cold air flowing into the kiln. What fuels are used in an IDZK and how is the fuel fed? Usually, solid fuels such as coal, firewood, and agriculture residues are used in an IDZK. The fuel is fed in the kiln through the fuel-feed holes provided at the top of the kiln by the firemen standing on the top of the kiln. In each chamber, there are three rows of fuel-feed holes. Ideally, in an IDZK, the fuel should be fed continuously. However, in usual practice, the fuel is fed intermittently. Usually two firemen feed fuel together for about 10 minutes and there is a time gap of about 20 minutes before the next round of fuel feeding takes place. How does the air flow and fire movement take place in an IDZK? In an IDZK, the fire moves along the forward direction of air flow. The air flow in the kiln is caused by the draught created by a fan. The air flows in a zigzag path through the brick setting inside the kiln. The back end of the brick cooling zone, where unloading of fired bricks from the kiln happens, is kept open to allow entry of air from the surroundings into the kiln. The front end of the brick preheating zone is sealed with the help of polythene sheets or tarpaulin to guide the flue gases to the chimney through the flue gas duct system. The flue gas duct system consists of a central duct and several side ducts. The central duct extends along the length of the miyana in both directions till the end. The side ducts are L-shaped ducts, which are provided at regular spacings along the perimeter of the miyana. One end of each side duct opens in the kiln while the other end opens at the top surface of the miyana. Adjacent to the top openings of the side ducts, the central duct also has openings at the top surface of the miyana. The side ducts are connected to the central duct with the help of a shunt. The shunt is an inverted U-shaped metallic duct that is used to connect the top opening of a side duct to the adjacent opening of the central duct located at the top surface of the miyana. At a time, only one or two side ducts are in use to connect the kiln to the central duct for the passage of flue gases. The top openings of the side ducts and the central duct that are not in use are closed with the help of concrete slabs. The central duct is connected with the chimney through a fan, which sucks flue gases from the central duct and discharges them through the chimney. In an IDZK, the chimney can be located either at the centre of the kiln or on any side of the kiln. Air from the surroundings enters the kiln at the brick unloading end and flows through the brick cooling zone into the brick firing zone where it is used for burning the fuel. The hot flue gases flow into the brick preheating zone, and then through the open side ducts and central duct before coming out through the chimney. In the process, the cold air gets heated by the burnt bricks and transfers heat from the cooling zone to the firing zone, and the hot flue gases get cooled by the green bricks and transfer heat from the firing zone to the preheating zone. As burning of bricks get completed in a chamber, fuel feeding is stopped and fuel-feed holes in a new chamber in front of the firing zone are opened for fuel feeding. Usually in every 24 hours, a new side flue duct in the

direction of fire travel is opened to sustain the fire movement. The fire travels a distance of 12– 15 feet (4–5 m, 1.5–2 chambers) in 24 hours in the direction of air flow and fires 25,000 to 60,000 bricks daily. How does loading and unloading of bricks take place in the kiln? Fired bricks, after having cooled down, are taken out of the kiln daily from the back end of the brick cooling zone. An equivalent batch of green bricks is loaded ahead of the brick preheating zone. Wicket gates are provided at regular spacings in the outer wall of the kiln to allow the movement of bricks and workers in and out of the kiln.