Shoreham Cement Works - Area Action Plan - Evidence Base

Preliminary Building Condition, Safety and Demolition Assessment

Draft Report

September 2018

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South Downs National Park Authority

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Revision History

Revision Ref/Date	Amendments	Issued to
September 2018	Draft Report	Kelly Porter

Contract

This report describes work commissioned Hayley Stevenson, on behalf of South Downs National Park Authority, by a letter dated 11 April 2018. Noel Hourican of JBA Consulting carried out this work.

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Purpose

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Contents

1 Introduction

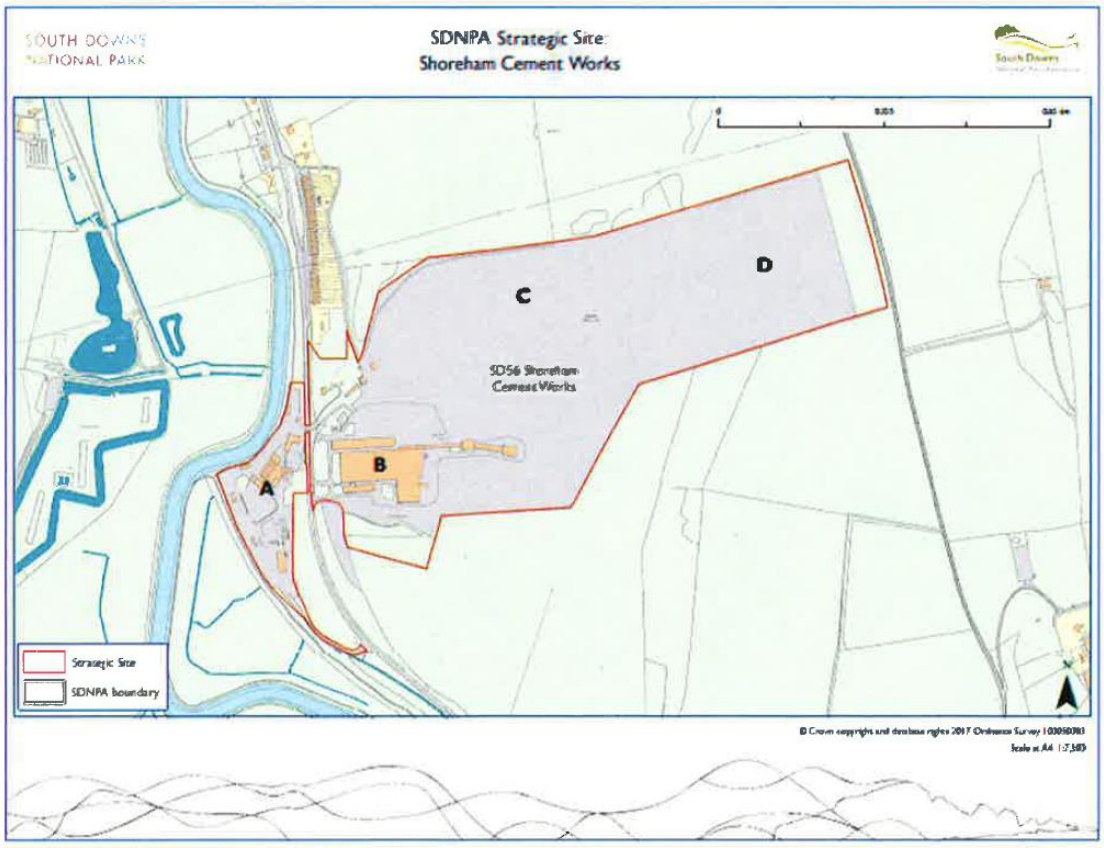
1.1 General

JBA Consulting were commissioned by South Downs National Park Authority (SDNPA) to undertake a number of baseline studies to feed in to the Area Action Plan (AAP) for Shoreham Cement Works site. This report constitutes the preliminary building condition, safety and demolition assessment and describes work carried out during a structural inspection of buildings defined by the Client at Shoreham Cement Works. The scope of the study was set out in Lot 5 of the SDNPA tender document issued in January 2018. JBA is also preparing evidence base studies for Lot 3 (Flood risk and Sustainable urban Drainage systems [SuDS]), Lot 4 (Ground Water Contamination and Water Quality) and Lot 6 (Geotechnical issues).

The work comprised a high-level assessment of the structural integrity and safety of the main buildings (former cement works buildings within Area B and C of the site - although for the purpose of the current study it is assumed that this refers to the area defined as Area B, as Area C does not contain any substantive buildings) and of any abnormal problems expected to be encountered with demolition or remodelling (e.g. asbestos) to help establish it suitability for re-use / redevelopment.

A full building survey was not required, rather the report is intended to give high level guidance on whether or not it is possible to easily re-use these main buildings and the implications with respect to demolition.

Figure 1-1 Site Location



1.2 Location

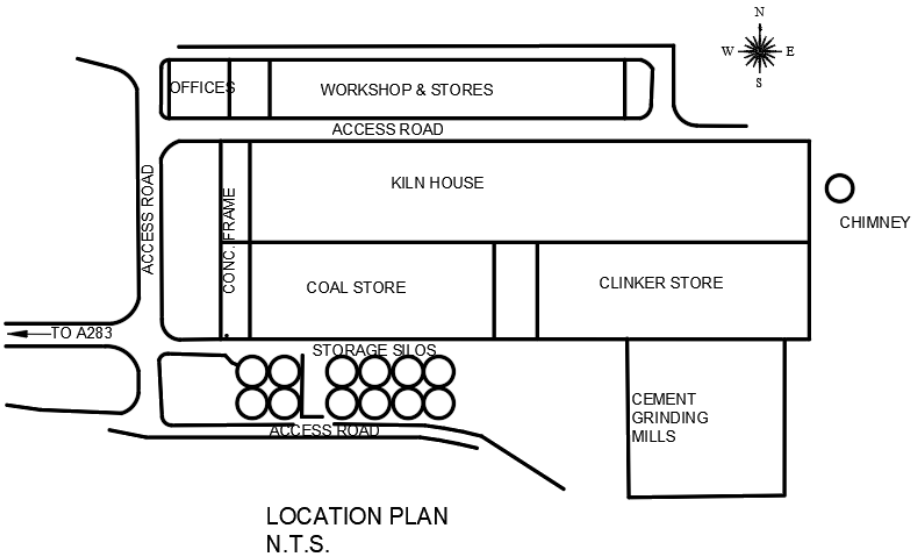
Shoreham Cement Works are located off the A283 road at the east side of the River Adur. Although the works extend to both sides of the road this inspection was confined to buildings

located on the east side and comprising a cluster of buildings referred to as the Kiln House, the Coal Store, the Clinker Store and the Workshop and Stores. The Kiln House and Coal and Clinker Stores are in effect a single building with the Workshop and Stores being a stand-alone building located immediately to the north. There is a two-storey flat roofed building adjoining the west end of the Workshop and Stores. Its first floor houses an open plan office.

Access to all parts of the site is via concrete roads, which are suitable for heavy goods vehicles.

The prevailing wind is from the southwest.

Figure 1-2 Site Plan



2 Fieldwork

2.1 Inspections

A walkover inspection was carried out on 12 July 2018 when the structures were examined from ground level. The weather at the time of the inspection was dry.

Several areas of the buildings were not accessible for inspection. the Workshop and Stores building was locked, as was the Coal Store. Some areas were deemed unsafe to inspect at close quarters.

Photographs of the structures were taken during the inspection;

No drawings or calculations relating to the structures' design were available.

No intrusive inspections have been carried out.

No structural analysis or calculations have been carried out.

No trial pits or boreholes have been excavated. Neither foundations nor other buried structures have been inspected.

3 Observations

3.1 General Description and Condition

3.1.1 Introduction

Industrial structures have existed on the site since at least the mid nineteenth century. The most recent substantial development was in 1946 when the buildings that are the subject of this report were built in the chalk pit at the east side of the A283. This development comprised a chalk crushing plant, wash mills, mixing plant, rotary kilns, coal, gypsum and clinker store, crushing mills and cement storage silos with a large workshop and store building. Production at the site ended in 1991 and since then it has been used for storage and for the repair of motor vehicles. More detail on the historic use and activities at the site can be found in the Preliminary Geotechnical and Ge-Environmental Assessment report prepared by JBA in 2018.

3.1.2 Kiln House and Coal/Clinker Store

The Kiln House and Coal/Clinker Store complex was constructed using steelwork and reinforced concrete. This building is 152 metres long by 20.4metres wide and 20 metres tall; its long axis is aligned east to west. The majority of the structure is formed by an array of steel pitched roof trusses in pairs, supported by stanchions located at the perimeter and under a central valley. The space is divided into halves at the central valley. The northern half houses the Kiln House; the stores are to the south.

The stanchions are formed by laced pairs of steel universal beams. The roof trusses are supported on the stanchions and have knee braces at their eaves to provide in-plane stability of the two bay main frames. Out-of-plane stability is provided by diagonal steel bracing in the roof and wall planes located every four to five bays. The frame foundations are not known.

The steelwork is clad in single skin sheeting. Purlins and cladding rails spanning between the main frames support the roof sheeting and cladding respectively. The cladding extends down to access door height below which there is a concrete blockwork wall.

At its western end the Kiln House and Coal/Clinker Store structure is formed by a single bay reinforced concrete frame extending over the width of the building. Its flat roof is set higher than the ridges of the Kiln House and Coal/Clinker Store roofs behind. The frame is formed by pairs of columns in front of the Kiln House and Coal/Clinker Store. Parapet walls rise above their ridges. Stability is provided by deep reinforced concrete spandrel panels between the columns. Concrete blockwork infill walls housing windows complete the façade. The columns on the external walls project in front of the walls in pilastered form and are, therefore, partially exposed to the elements.

A 91.4-metre-tall chimney built of reinforced concrete and lined with brickwork is located adjacent to the Kiln House east wall.

Two large kilns are housed in the northern part of the structure. Each is 107 metres long by 3 metres in diameter. They are constructed mostly of 25 mm thick steel plate and lined with high alumina bricks. The kilns are supported on six very large reinforced concrete piers.

The Kiln House has extensive steel walkways, platforms, guard rails and stairs.

There are electric overhead travelling (EOT) cranes on steel gantry beams, supported by the main columns in each of the Coal and Clinker Stores.

The ground floors throughout are reinforced concrete slabs. Numerous pits ducts and plinths were located around the buildings.

3.1.3 Office Building

The two-storey flat roofed building adjoining the west end of the Workshop and Stores is a reinforced concrete framed structure. The first floor is largely an open plan office with deep concrete roof beams supporting the roof slab. The roof covering was not inspected. The external envelope is cavity masonry. There is a small kitchen adjacent to the office.

3.1.4 Workshop and Store

Access to inspect this single storey pitched roof building internally was not available. Viewing through windows confirmed that it is of similar construction to the Kiln House, i.e. a steel framed structure, clad with single skin sheeting.

3.2 Defects

3.2.1 Kiln House and Coal/Clinker Store

The roof sheeting, cladding and glazing to the Kiln House and Coal/Clinker Store complex have extensively failed. Large areas of standing water were observed at several locations, most notably in the Clinker Store. A continuous stream of running water was flowing from the higher levels of the Kiln House concrete structure during the duration of the inspection. It was not possible to investigate its source due to access restrictions. It is possible that large high level tanks have filled with water during wet weather and are leaking.

The concrete blockwork perimeter wall below cladding is in generally poor condition.

The areas of the main steel frames that were accessible for close inspection from low level had lost their corrosion protection paint but in the main appeared to have sustained only superficial corrosion.

There did not appear to be any significant out of plane distortions to the main steelwork frames.

The roof trusses were not accessible for close inspection; however, they did not show any signs of undue deflection.

Diagonal wall bracing had been cut at low level in one of the Kiln House north wall bays (Photograph 11).

Corroded reinforcement is exposed where concrete has spalled from the external faces of the Kiln House external concrete columns.

Horizontal cracking, rust staining and exposed reinforcement is visible on several of the reinforced concrete spandrel panels on the external walls (Photograph 2). This spalling is quite extensive at high level on the panels in front of the Kiln House.

The ground floor concrete slabs have been heavily used and are extensively cracked and eroded.

There did not appear to be any evidence of significant ground movement beneath foundations or the ground slab.

The electric overhead travelling (EOT) cranes on steel gantry beams were at high level and not accessible for close inspection. Having been out of commission for so long, it must be assumed that they are no longer operational.

The Kiln House steel walkways, platforms, guard rails and stairs have sustained mainly superficial corrosion and some impact damage (Photograph 20).

3.2.2 Office Building

The main structure of the two-storey building adjoining the west end of the Workshop and Stores is concealed behind finishes. There did not, however, appear to be any out of plane distortions to the walls or evidence of significant ground movement.

Damp staining was visible internally on the south facing first floor wall and around the roof light and roof access hatch.

Mould growth was visible at the top of some walls.

Some hairline cracking was visible in the bed and perpend joints around the windows in the south facing first floor wall.

Erosion of the external blockwork wall faces was visible.

3.2.3 Workshop and Store

Erosion of the external blockwork wall faces was visible on the workshop and store building. In addition, some fine cracking was observed in the external blockwork walls around windows. As per 3.1.4, it was not possible to inspect the internal parts of the building.

4 Conclusions

4.1 General

Although the structures appeared to be carrying their present loads with no obvious signs of distress, this observation is based on very limited information regarding their structural properties. No drawings or calculations relating to their design were available and no close inspection of parts of the structures that are fundamental to their stability, e.g. high-level connections, was possible. Local areas of the Kiln House complex may be hazardous and there is a risk of falling cladding or structural elements such as purlins where fixings may have failed.

It is possible to re-use (with restrictions) some or all of the main buildings; however, significant investment will be required to bring them to an acceptable standard. The various areas where expenditure will be required and some of the main limitations are discussed below.

The concept of design life was not much considered at the time the buildings were constructed. No mention is made of it in the British Standards used at the time; in fact, it was not for quite some time later that the concept gained currency. Nevertheless, for context it is worth noting that current structural design codes work to 50 years for indicative design working life for buildings. Those at Shoreham are already 72 years old and have not been well maintained for the last 27 years.

A given design life does not mean that every part of the building will last that long. Cladding, for example, will have to be replaced at much shorter intervals. Well maintained main structural elements could remain serviceable for significantly longer than the specified life. The foregoing should be given due consideration when deciding whether to retain/refurbish buildings. In purely economic terms, it may be more cost effective to demolish and rebuild structures that may be technically salvageable than to carry out costly repairs to extend the life of the building to less than that of new construction.

The structures subject to this appraisal were built in 1948 and, therefore, presumably designed in 1945-46 to the design standards applicable at that time.

In order to confirm the buildings' structural adequacy, in particular for any refurbishment scheme, a more comprehensive survey will be required involving an analysis of the structure using the design standards and material properties of its era of construction. Modern mild steel, for example, has a yield stress 20-25% higher than the steel used at Shoreham. This survey in itself would be fairly costly. The structural sizes of the main elements will need to be recorded requiring access to high level areas. Tests on a representative sample of steel sections should be carried out to confirm design strengths. In order to provide and order of magnitude for a budget, some conservative cost allowances could be made. For example, all connection bolts to be replaced during the refurbishment contract; all purlins and cladding rails to be replaced etc.

There may be some regulatory challenges to be overcome. British Standard BS 449 was introduced for steelwork in 1932. In November 1939, in order to economise on scarce materials in wartime, an amendment to BS 449 was published as an emergency measure. This increased permissible stresses by 25%, effective for a period of 12 months after the end of the war, which, in Europe, was in May 1945. It is, consequently, very likely that the steel structures have been designed with lower factors of safety than would be the case using current standards. This is pertinent because even without alteration of the existing loading it may prove difficult to justify compliance with current standards, and therefore,

Building Regulations, should the buildings be subject to a change of use application under planning and other statutory legislation.

Since the cladding and roof sheeting require replacement, a new external envelope, which would itself be subject to compliance with current Building Regulations for thermal insulation amongst other things, could increase the loads on the structure significantly.

There are several matters that might indirectly affect structures in any refurbishment scheme under consideration. Depending on usage, significant alterations might need to be made to thermal insulation and fire protection.

It may be required to divide internal areas of the Kiln House complex into fire protected compartments. There is probably little capacity in the existing frames/trusses to provide support to very tall compartment walls. Stand-alone steel structures could be provided; however, the requirement for complete enclosure would mean that a ceiling would be required thus concealing the existing roof. In any scheme for the Kiln House that sought to express its original structure visually, this would be a constraint.

Should a proposed usage result in internal compartmentalisation not being required and this building isolated from neighbouring buildings (by their demolition), it is possible that the frames would not need to be fire protected. On the other hand, the current layout has buildings close to the Kiln House's perimeter. If a proposed scheme had similarly nearby buildings the so-called boundary conditions would come into force and the stanchions would need to be fire protected. It is possible that this could be done using intumescent paint, but this would need to be confirmed by a detailed fire strategy exercise. If painting the stanchions were found to be inadequate, and fire board solution adopted, this might have implications where an architectural scheme sought to express the structure.

It is very unlikely that the existing steel trusses could support a sprinkler system.

If a scheme proposed the division of the Workshop and Store into separate occupancies, similar fire protection provisions would apply.

Fire protection could become so costly, or so limit the type of activity that could be carried out, that refurbishment might become uneconomic.

4.2 Asbestos

As part of any refurbishment scheme roofing and cladding would require replacement It is not known whether the sheeting is an asbestos containing material (ACM). This would need to be confirmed or otherwise by a formal asbestos survey including sampling and laboratory testing.

Notwithstanding the above, work with asbestos cement sheeting can be carried out by non-licensed workers who are appropriately trained. This work would generally not need to be notified to the relevant authority unless it is likely to cause significant break up and deterioration of the material e.g. 'dropping an asbestos cement roof sheet'. This would normally be prohibited in any demolition specification.

Following a desk study, it was decided that a limited walkover asbestos survey would not provide any more useful information to influence the conclusions given here. The locations where asbestos might be found that would be more onerous to remove than sheeting might include ducts that are not easily accessible without a comprehensive intrusive survey. As such, it is believed it would be more useful for specialists to carry out such a survey at a later date, when its scope might be better tailored to future plans for the buildings.

4.3 Steelwork

The areas of the main steel frames that were accessible for close inspection appeared to be in relatively good condition for their age. Even where cladding has completely failed, and the steel is exposed to the elements, the level of corrosion was generally low and did not appear to have significantly impaired the effectiveness of the stanchions. Since the building is relatively sheltered from the prevailing wind driven rain by the large cement silos on its southern side, corrosion to much of the steelwork appears to be superficial.

The roof trusses were not accessible for close inspection; however, they did not show any signs of undue deflection. It would be prudent to assume, nevertheless, that some of the

steelwork – the top truss members and most certainly the purlins have undergone more severe corrosion that steel at lower levels.

The reinforced concrete chimney located adjacent to the Kiln House east wall appeared to be plumb and in reasonable condition.

4.4 Concrete

The precise cause of the corroded reinforcement where concrete has spalled from the outer faces of the Kiln House external concrete columns cannot be determined by a visual inspection alone. At the low levels where the defects are accessible, concrete cover to the reinforcing steel is as little as 20 mm, which is lower than would be specified nowadays. This could be due to a design fault (inadequate cover was routinely specified at that time) or poor workmanship. Intrusive investigations (dust samples and concrete cores) to facilitate laboratory testing of samples as part of more rigorous analysis of the buildings will be required to determine whether there are more endemic problems such as chemical attack. Feasibility of repair would be considered.

The concrete floors to the working areas of the building are past economic repair and would need to be replaced in any refurbishment scheme.

The reinforced concrete chimney located adjacent to the Kiln House east wall appeared to be plumb and in reasonable condition.

4.5 Office Building

Very little of the structure of this building could be directly observed. That said, there was no apparent evidence of structural problems. There is; however, clearly an issue of water ingress.

The flat roof covering will almost certainly have failed and need replacement.

Erosion of blockwork may be contributing to water ingress though walls.

Seals around rooflights and windows have probably failed.

The water ingress problems should be readily solved by investment in the building.

This building does not meet modern requirements for thermal insulation under the Building Regulations. As part of refurbishment, an insulated external cladding could be specified.

4.6 Demolition

Should it be decided to demolish the structures there are several matters to consider. Much depends on whether a full or partial demolition is contemplated. It is believed that complete demolition would be fairly routine (subject to a detailed asbestos survey) for a contractor used to handling this size of project.

Access for demolition contractors' plant to the buildings is good. If, however, it was decided to retain and refurbish the external shell of the Kiln House and Coal/Clinker Store complex and demolish their internal structures to allow interior remodelling, careful planning would be needed. The rotary kiln concrete piers are massive structures in their own right, as are the steel kilns. Local opening up of temporary access routes into the building for contractors' plant may be required.

Retention of some and demolition of other buildings would also ned to be carefully planned.

4.7 Options

When considering the options for the Kiln House, an early decision will be needed on whether to retain the internal structures. The rotary kilns and their piers, along with the network of access walkways and platforms, take up a large part of the floor space. If a heritage type scheme is envisaged and the kilns are retained, they will need to be checked in detail for any residual hazards. Such a scheme would rule out any other occupancy for this part of the building and would also prevent internal fire compartmentation. A detailed review by fire specialist would be required.

Should it be decided to remove internal structures, the option is available to create a large single occupancy building. The useable floor space could be enhanced by addition of a mezzanine floor constructed using light-weight cold rolled steelwork built off a new reinforced concrete ground floor slab. Alternatively, it would be possible to divide the floor space into separate occupancies for say, storage, light industrial, possibly retail areas. There are several entrances to the Kiln House to gain access to potentially separate units. A consideration is that the access road between the Kiln House complex and the Workshop to the north is relatively narrow. Traffic management would need to be given due consideration.

The Coal and Clinker Stores are relatively open plan, but the number of entrances is currently limited. If the Storage Silos and Cement Grinding Mills were demolished, the opportunity would arise to create additional access and sub-division of these units. Similar occupancies to those described for the Kiln House would then be possible.

Similar considerations to those described above apply to the Workshop. It could continue as a single occupancy light industrial or storage use or be subdivided. There is insufficient headroom for a mezzanine floor.

The office adjacent to the Workshop is probably most suited to its current type of use, i.e. an office or administrative area. A significant amount of alteration to access would probably be needed to convert it to say, retail space.

As mentioned above, regardless of their type of occupancy, there will be costs (possibly prohibitive) in upgrading the buildings to comply with current fire protection and thermal insulation standards. Some potential uses in which the buildings are non-habitable, for example storage, might reduce some requirements in this regard: e.g. thermal insulation. On the other hand, the type of storage can increase the fire load. Each proposal will need to be scrutinised on its merits.

Appendices

A Site Photographs

Photograph 1 - Access road entrance from A283

Photograph 2 - Concrete framed structure at front of Kiln House.

Photograph 3 - Workshop left foreground, Offices right foreground, Kiln House background.

Photograph 4 - Concrete framed structure at front of Kiln House, spalling concrete.

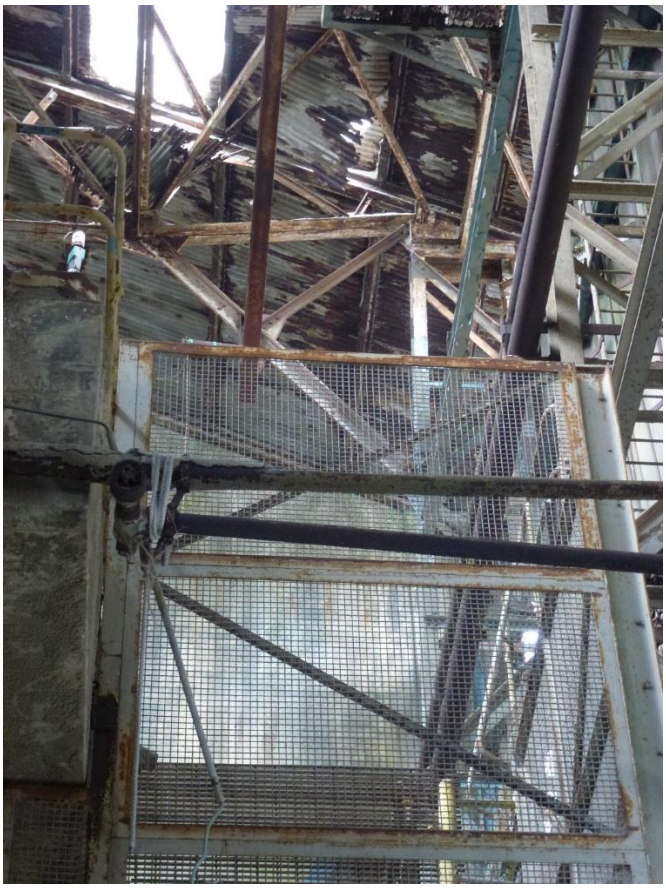
Photograph 5 - Concrete framed structure at front of Kiln House - spalling to spandrels.

Photograph 6 - Superficial corrosion of Kiln House stanchions.

Photograph 7 - Cracking to concrete piers in the Kiln House.

Photograph 8 - Cracking and dampness in Office blockwork.

Photograph 9 - Superficial corrosion of Kiln House steelwork.



Photograph 10 - Superficial corrosion of Kiln House steelwork.

Photograph 11 - Superficial corrosion of Kiln House steelwork.

Photograph 12 - Failed Kiln House roofing.

Photograph 13 - Severed Kiln House bracing.

Photograph 14 - Damaged Kiln House floor ducts.

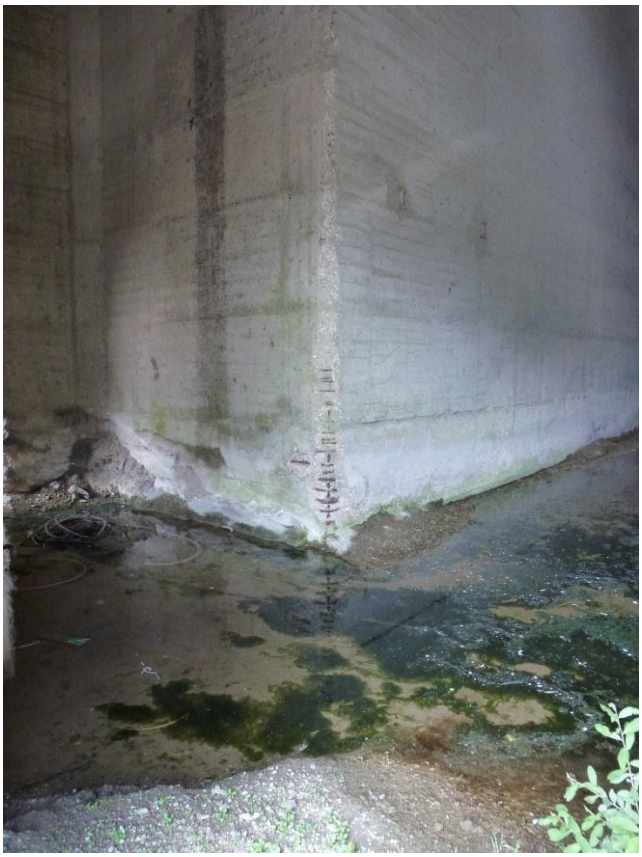
Photograph 15 - Damaged Kiln House roofing - rotary kilns and piers in foreground.

Photograph 16 - Failed Kiln House cladding - eroded blockwork, superficial external steelwork corrosion.

Photograph 17 - Chimney facing east gable of Kiln House

Photograph 18 - Clinker Store

Photograph 19 - - Concrete spalled from Clinker Store wall.



Photograph 20 - - Corroded ancillary steelwork.

Photograph 21 - Kiln House, corroded steelwork, damaged floor slab.

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