



STRUCTURAL ENGINEER'S REPORT

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Site Address: Ratcliffe House Farm, Ratcliffe House Lane, Ratcliffe Culey, Atherstone,
CV9 3LZ

Project No: 231008

Client: Mr and Mrs Garland

Date of Inspection: 7th November 2023

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Weather: It was a sunny day. Temperature: 12°C

1. **BRIEF**

2. This report is a Structural Engineer's Report on the general structural condition of the building and the suitability of the building for the proposed redevelopment into a residential dwelling.

3. **USE OF REPORT**

4. This report is for the use of Mr & Mrs Garland for the purpose of assessing the structural condition of the building for a Part Q Planning Application.
5. This report is to be used for no other purpose than that stated above, without express permission, **in writing**, from BK Consultants Ltd.

6. **EXCLUSIONS**

7. This report does not deal with dry rot, wet rot, rising damp, or infestation of timbers. These items should be dealt with by other specialist companies.

8. **ASBESTOS**

9. This report does not deal with asbestos; specialist asbestos companies carry out such surveys.

10. **CONTAMINATION**

11. We have not been instructed to carry out any investigation into past or present uses of the property or of any neighbouring land to establish whether there is any potential for contamination from these uses or sites to the subject property and therefore have assumed that none exists. However, should it be established subsequently that contamination exists at the property or on any neighbouring land or that the premises have been or are being put to any contaminative use, then this may reduce the value of the property and may effect remedial costs.

12. **INTRODUCTION**

13. The inspection has been limited to the structural fabric of the building only.
14. This document does not contain any valuation nor likely cost of any necessary remedial works.
15. We have not inspected woodwork or other parts of the structure which are covered, unexposed or inaccessible and we are, therefore, unable to report that any such part of the property is free from defect.
16. This document is for the specific use of the aforementioned Client, and shall not be disclosed to other parties without full written consent of the Engineers.
17. This document is issued only to the persons stated above, and on the understanding that this Practice is not held responsible for the actions of others who obtain any unauthorized disclosure of its contents or place reliance on any part of its findings, facts or opinions, be they specifically stated or implied

18. **MOVEMENT**

19. This document cannot categorically state that movement has ceased or that no movement has taken place without monitoring the property for a minimum period of one year.

20. **REFERENCE DOCUMENTS**

21. Appendix A: Hayward Architects:

- Drg No. 23/19. R14 Dated September 2023
- Drg No. 23/19. R15B Dated September 2023
- Drg No. 23/19. R12A Dated July 2023.

22. Appendix B: Corrosion protection: Steel Construction

23. Appendix C: Galvafruid

24. **BRIEF DESCRIPTION OF PROPERTY**
(All heights, sizes and dimensions given are approximate)



Fig 1

25. Fig 1 is a general view of the front and side of the building.
26. The building is a steel framed agricultural building, the building is open on the front and partially open on 1No. side, there are no internal partition walls.
27. **CONSTRUCTION OF BUILDING**
(All dimensions and sizes quoted are approximate)
28. Floor: The internal floor is a concrete floor. The steel building is approximately 13.2 x 30.6m in plan.
29. Steel Frame: The building is supported on 6 No. structural steelwork portal frames. The columns are 254x146 universal beams (UB) the internal columns on the side walls are 203 x 133 universal beams (UB) and the roof beams are 203 x 133 universal beams (UB). The eaves and ridge joints have bolted connections.
30. Walls: The external side and rear walls have precast concrete panels to 3m above the top of concrete (TOC), with hit and miss timber board cladding above. The wall on the side elevation S2 (East Elevation) has sections of blockwork built off the pre cast panels. There are 3No. 100 x 75mm horizontal timber cladding rails.
31. Roof: The roof is clad in corrugated cement fibre board supported on 220 x 75mm timber roof purlins at 1.5m centres.
32. There is a brick built single storey building (stores and stable) on one side of the building (side elevation 2: (East Elevation) is 13.2 x 3m in plan.

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33. BRACING

34. The rear wall is braced.

35. The roof is braced adjacent to side elevation S1 (West Elevation).

36. **DRAINAGE**

37. Plastic gutters and downpipes.

38. **REAR ELEVATION**

39. There is 1No. gutter downpipe at each corner of the barn.

40. **SIDE ELEVATION 1: WEST ELEVATION**

41. There is 1No. gutter downpipe by the front corner.

42. **SIDE ELEVATION 2: EAST ELEVATION**

43. There is 1No. gutter downpipe by the front corner.

44. **BRIEF DESCRIPTION OF FAULTS**
(All heights, sizes and dimensions given are approximate)

45. **FRONT ELEVATION**



Fig FE1



Fig FE2

46. Fig FE1 and Fig FE2 are general views of the front elevation.

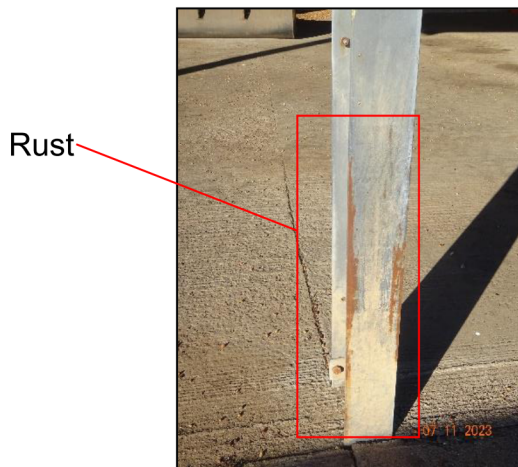


Fig FE3

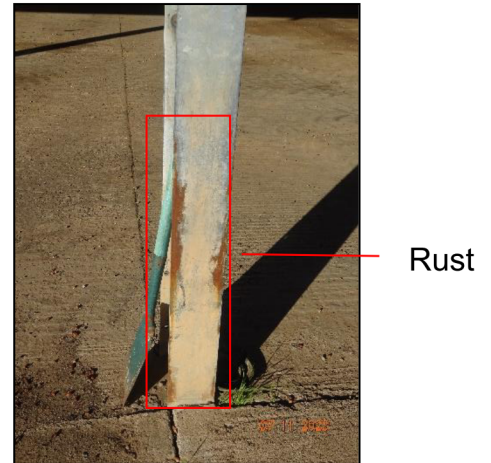


Fig FE4

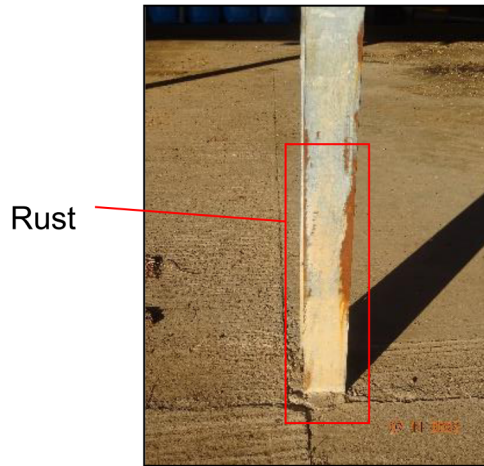


Fig FE5

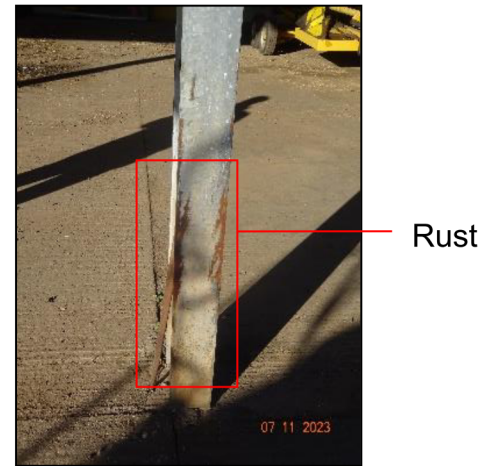


Fig FE6

47. Fig FE3 to Fig FE6 show the rust at the base of the columns.

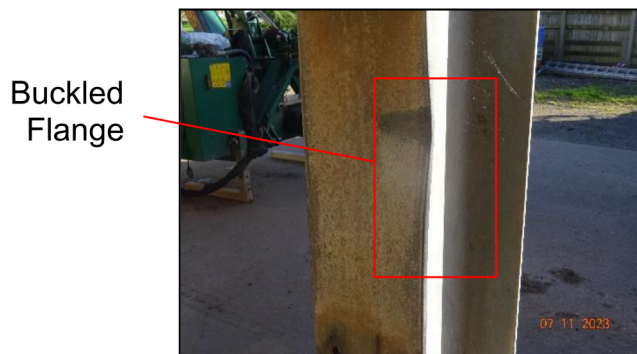


Fig FE7

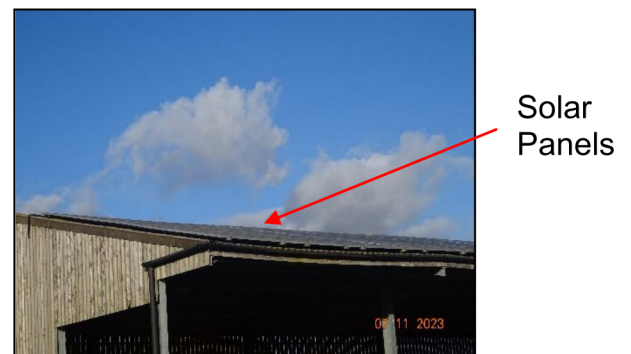


Fig FE8

48. Fig FE7 shows the buckled flange on the column by side elevation S2 (East Elevation).
49. Fig FE8 shows the solar panels on the roof.

50. SIDE ELEVATION 1 (S1): WEST ELEVATION



Fig SE1.1



Fig SE1.2

Precast
Panels
Bolted to
Steel



Fig SE1.3



Fig SE1.4

51. Fig SE1.1 is a general view of side elevation S1 (West).
52. Fig SE1.2 to Fig SE1.4 show the precast concrete 3m high panels on the side elevation. They are bolted to the structural steelwork columns.

53. REAR ELEVATION



Fig RE1

54. Fig RE1 is a general view of the rear elevation.

55. SIDE ELEVATION 2 (S2): EAST ELEVATION



Fig SE2.1



Fig SE2.2



Fig SE2.3



Fig SE2.4

56. Fig SE2.1 is a general view of side elevation 2 (S2).
57. Fig SE2.2 shows the gutter downpipe at the rear corner.
58. Fig SE2.3 and Fig SE2.4 show the boundary wall.

59. **GROUND FLOOR PLAN**



Fig GF1



Fig GF2



Fig GF3

60. Fig GF1 to Fig GF3 are general internal views of the side and rear walls.

61. **JOINT DETAILS**

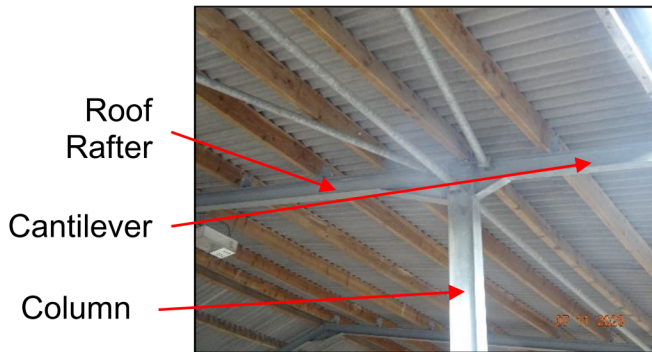


Fig J1



Fig J2

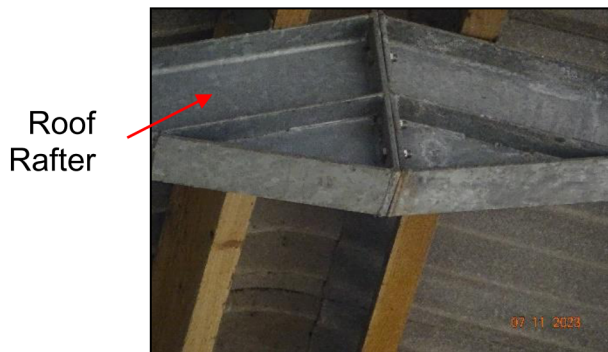


Fig J3

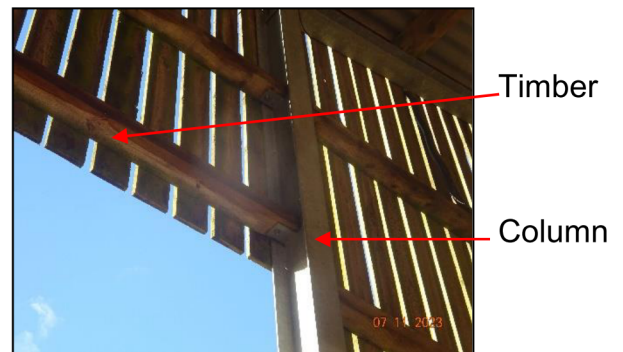


Fig J4

62. Fig J1 shows a typical structural steelwork column beam joint on the front elevation.
63. Fig J2 shows a typical structural steelwork column beam joint on the rear elevation.
64. Fig J3 shows a typical structural steelwork beam to beam ridge joint.
65. Fig J4 shows the timber side cladding rail to column joint.

66. **WALL BRACING**

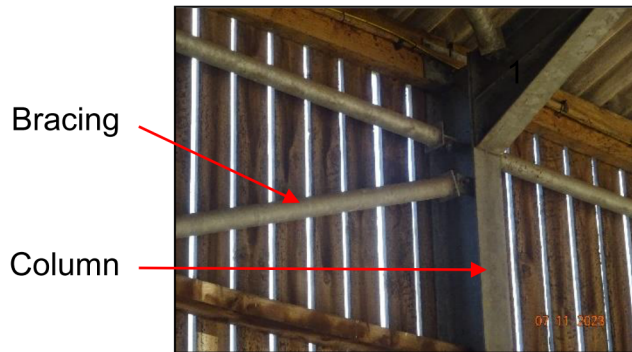


Fig WB1

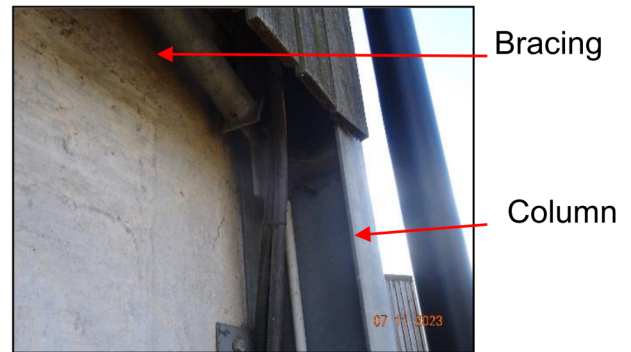


Fig WB2

67. Fig WB1 shows the wall bracing to column joint in the rear wall in the first bay adjacent to the side elevation 1 (S1: West Elevation).
68. Fig WB2 shows the wall bracing to the rear corner column bolted joint.

69. **ROOF BRACING**

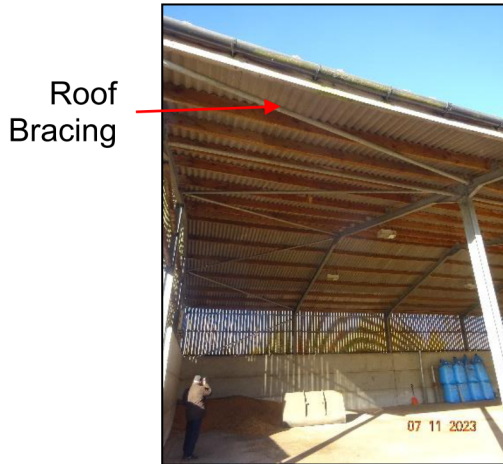


Fig RB1

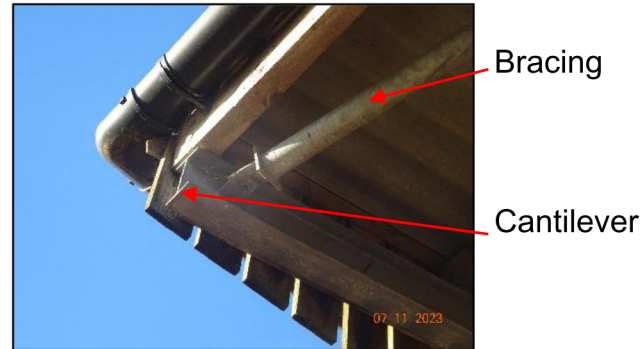


Fig RB2

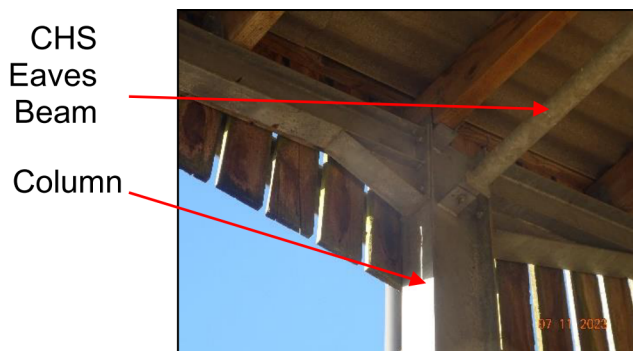


Fig RB3



Fig RB4



Fig RB5

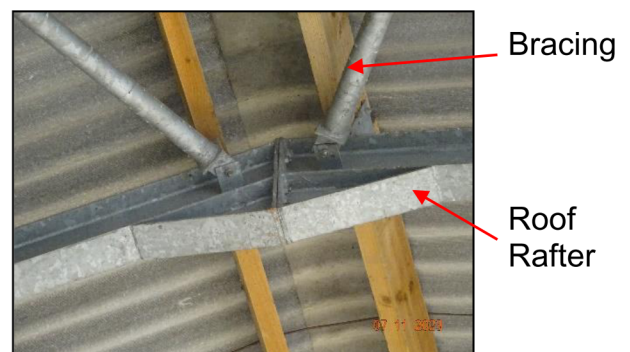


Fig RB6

70. Fig RB1 is a general view of the roof bracing by side elevation S1 (West Elevation)
71. Fig RB2 shows the roof bracing to cantilevered roof rafter joint.
72. Fig RB3 shows the CHS eaves beam to column joint.
73. Fig RB4 to Fig RB6 show the bracing to roof rafter joints.

74. **CANTILEVERED ROOF RAFTER**

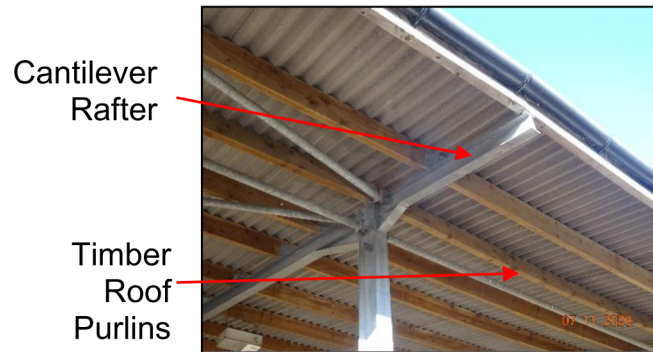


Fig CR1

75. Fig CR1 is a view of the cantilevered roof rafter and the timber roof purlins.

76. **ROOF PURLINS**



Fig RP1

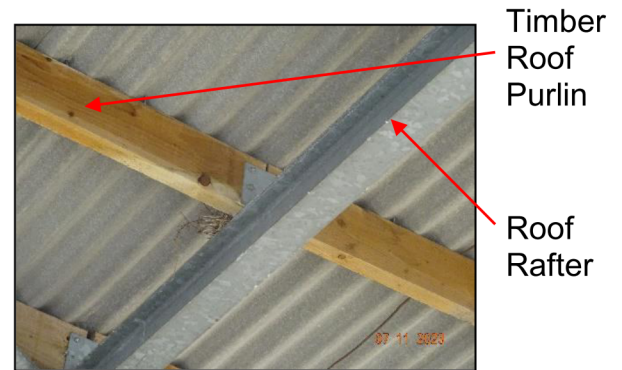


Fig RP1

77. Fig RP1 shows the timber roof purlins supported by the structural steelwork roof rafters.
78. Fig RP2 shows the bolted roof purlin to roof rafter joint.

79. **GENERAL COMMENTS ON CONSTRUCTION**

80. **STRUCTURAL STEELWORK**

81. The structural steelwork portal frames are in a good condition. However, there is rust on the steel, the steel is to be cleaned off and repainted.

82. Additional bracing may have to be installed when the structure is fully clad.

83. **DRAINS**

84. The existing roof structure appears to drain into a below ground drainage system.

85. **CORROSION OF STRUCTURAL STEEL**

86. *"The corrosion of structural steel is an electrochemical process that requires the simultaneous presence of moisture and oxygen. In the absence of either, corrosion does not occur. Essentially, the iron in the steel is oxidised to produce rust, which occupies approximately 6 times the volume of the original material consumed in the process.*

As well as general corrosion, there are various types of localised corrosion that can also occur; bimetallic corrosion, pitting corrosion and crevice corrosion. However, these tend not to be significant for structural steelwork.

The rate at which the corrosion process progresses depends on a number of factors relating to the 'micro-climate' immediately surrounding the structure, principally the time of wetness and the atmospheric pollution level. Because of variations in atmospheric environments, corrosion rate data cannot be generalised. However, environments can be broadly classified, and corresponding measured steel corrosion rates provide a useful indication of likely corrosion rates. More information can be found in BS EN ISO 12944-2[1] and BS EN ISO 9223[2]".

87. The corrodibility category and risk for this site can be categorized as C2 medium.

88. "Atmospheric corrosivity categories and examples of typical environments (BS EN ISO 12944-2[1])

Corrosivity category and risk	Low-carbon steel Thickness loss (μm) ^a	Examples of typical environments in a temperate climate (informative only)	
		Exterior	Interior
C1 very low	≤ 1.3	-	Heated buildings with clean atmospheres, e.g. offices, shops, schools, hotels
C2 low	> 1.3 to 25	Atmospheres with low level of pollution Mostly rural areas	Unheated buildings where condensation may occur, e.g. depots, sports halls
C3 medium	> 25 to 50	Urban and industrial atmospheres, moderate sulphur dioxide pollution Coastal area with low salinity	Production rooms with high humidity and some air pollution e.g. food-processing plants, laundries, breweries, dairies
C4 high	> 50 to 80	Industrial areas and coastal areas with moderate salinity	Chemical plants, swimming pools, coastal, ship and boatyards
C5-I very high (industrial)	> 80 to 200	Industrial areas with high humidity and aggressive atmosphere	Buildings or areas with almost permanent condensation and high pollution
C5-M very high (marine)	> 80 to 200	Coastal and offshore areas with high salinity	Buildings or areas with almost permanent condensation and high pollution
CX extreme	> 80 to 700	Offshore areas with high salinity and industrial areas with extreme humidity and aggressive atmosphere and sub-tropical and tropical atmospheres	Industrial areas with extreme humidity and aggressive atmosphere

Notes:

- $1\mu\text{m}$ (1 micron) = 0.001mm
- The thickness loss values are after the first year of exposure. Losses may reduce over subsequent years.
- The loss values used for the corrosivity categories are identical to those given in BS EN ISO 9223[2].
- In coastal areas in hot, humid zones, the mass or thickness losses can exceed the limits of category C5-M. Special precautions must therefore be taken when selecting protective paint systems for structures in such areas"

89. **RECOMMENDATIONS**

90. The drainage points around the building are to be exposed and checked to trace their drainage runs. It would be prudent to carry out a CCTV of the drainage system.
91. All broken, cracked or leaking drains are to be replaced.

92. **STEELWORK**

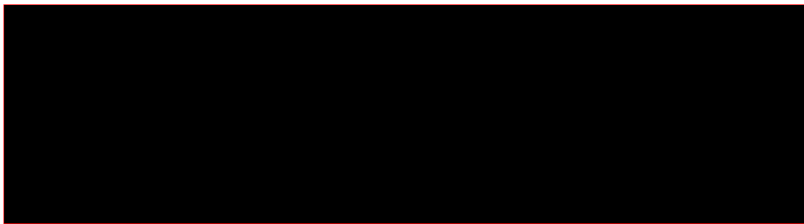
93. To be cleaned of all rusted areas and repainted.
94. All corroded areas to be sandblasted and cleaned off to a Sa 2½ - very thorough blast cleaning (See Appendix B: P.4). All loose material is to be removed and steel is to be sandblasted, primed and painted (See Appendix C: Table 1).

95. **GALVAFROID**

96. Fosroc Technical Department have informed us that 2 coats of galvafroid (grey in colour) applied onto bare metal gives a coating of 30μ (μ micros) of zinc. If an aggressive corrosion of 1.3μ/ per annum (pa) is assumed then a life expectancy of 25 years can be expected for exposed steel. This may be extended by the application of alkyd based overcoat paints and either FOSROC (OSA) specialist paint supplier can advise on this. The steelwork will be inside the building and its life will, therefore, be in excess of 25 years.

97. **CONCLUSION**

98. Further investigations and modifications are to be carried out as outlined in the recommendations of this report.
99. The structure is suitable for renovation and refurbishment into a residential dwelling.



Bogdan Kuncewicz
BEng, CEng, MICE, MIMunE, MIStructE

10th November 2023

LEGEND

AB	:	AIR BRICK
BB	:	BLACK BOLT
CB	:	CHIMNEY BREAST
C/c	:	CENTRE TO CENTRE
CL	:	CENTRE LINE
D/P	:	DOWN PIPE
DPC	:	DAMP PROOF COURSE
DPM	:	DAMP PROOF MEMBRANE
G	:	GULLEY
GD 4.6	:	GRADE 4.6 : GRADE OF BOLT BEING USED
GL	:	GRID LINE
GP	:	GRID POSITION
H/L	:	HAIRLINE CRACKS
IL	:	INVERT LEVEL
M	:	METRES
MH	:	MANHOLE
MM	:	MILLIMETRES
OSA	:	OR SIMILAR APPROVED
SVP	:	SOIL AND VENT PIPE
UON	:	UNLESS OTHERWISE NOTED

DISCLAIMER

This report has been prepared in good faith and intends to provide an overview of structural form, condition, and defects at the property. However, the observations and defects recorded are based on a visual report only i.e. no intrusive investigations have been carried out. It is recommended that any formal quotations to undertake any potential repair work include provisional sum amounts to account for any unseen or unrecorded condition items. The Contractor should satisfy himself that the full scope of works has been understood. Should the Contractor require an accompanied site visit then please contact the report writer.

We have assumed that all necessary permanent planning and other permissions, approvals and consents, have been obtained for the construction and current use of the premises, and that there are no outstanding enforcement or other notices. Non-compliance with any statute or statutory regulations has not been established.

This report does not deal with asbestos; specialist asbestos companies carry out such surveys.

This report is in respect of the buildings construction, repair, and maintenance; we have not considered nor investigated any aspects of the premises which are likely to be affected by mining or tunnelling operations, or by current environmental legislation. We have not instigated or carried out searches with the National Coal Board or prepared an environmental audit of the premises drainage or land.

We have not inspected woodwork or other parts of the structure which are covered, cladded, unexposed or inaccessible, and we are therefore unable to report that any such part is free from rot, beetle or other defects that may exist, or to confirm the adequacy of any structural element or foundation, or soil/ground conditions.

The presence or absence of high alumina cement, calcium chloride, asbestos, or permanent woodwool shuttering, fibre reinforced concrete, alkali silica reaction, sea dredged aggregates, or any other deleterious materials within the premises has not been determined.

We have not carried out detailed examinations or testing of the ventilating, heating, cooling, electrical and electronic, drainage or mechanical services installations.

We have not been able to ascertain whether or not any structural repairs have been carried out, including timber treatment, underpinning and strengthening works, nor have we determined whether or not any guarantees exist.

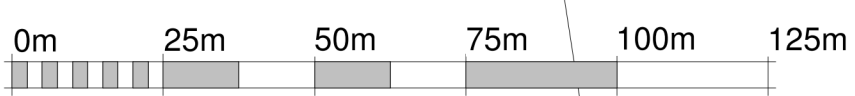
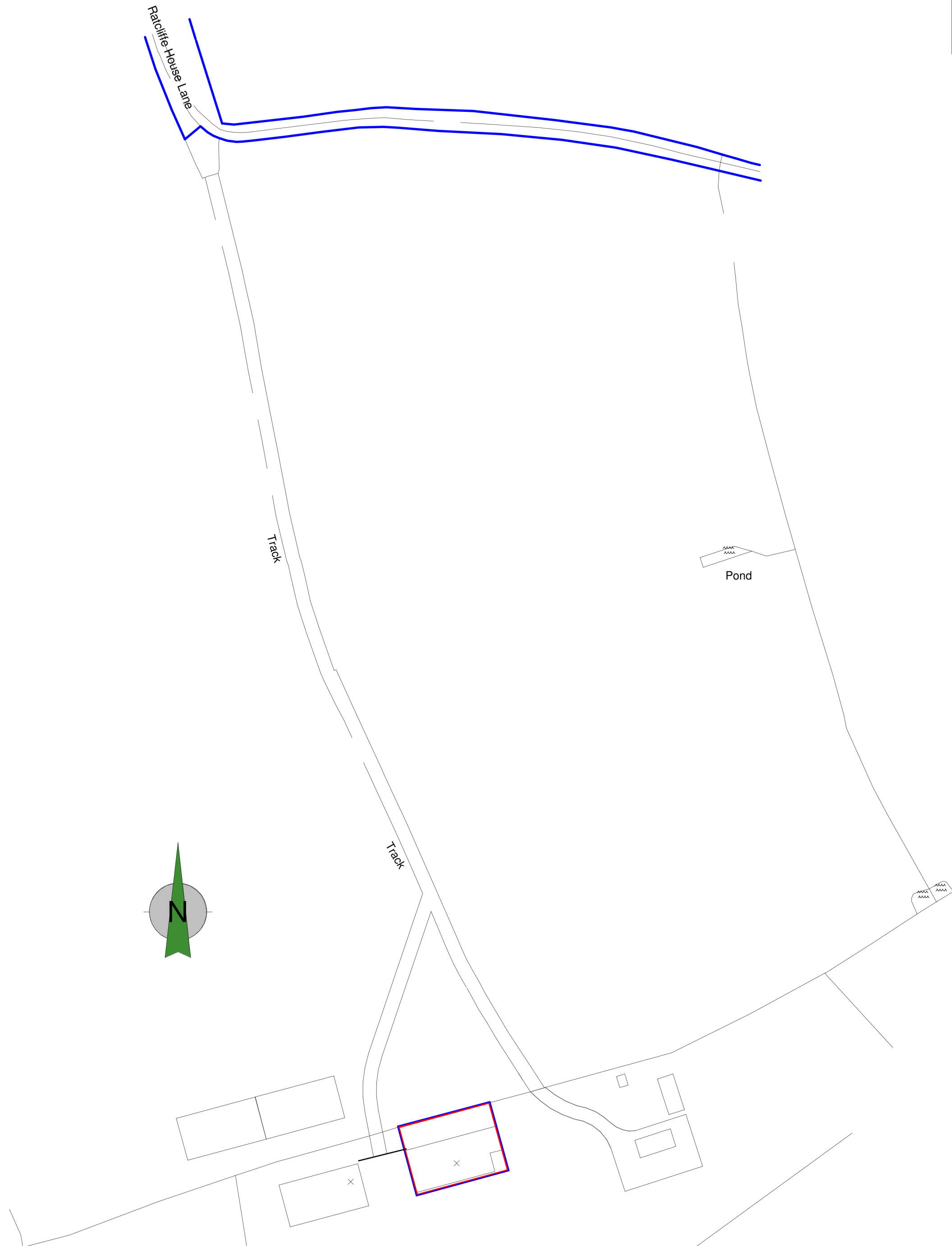
We have not been able to ascertain whether or not the property has ever been flooded or be likely to be affected by flooding in the future.

We have not been able to ascertain the existence of any concealed access hatches or voids.

We have not been able to ascertain any information in respect of any dispute or claim with neighbours or neighbouring properties.

We have made no investigations with any public Local Authority or statutory undertaker to ascertain whether or not there are any current notices or proposals affecting the property.

This report is confidential to the parties to whom it is addressed and whose name appears at the beginning of this report. Neither the whole nor any part shall be disclosed to any other party and no reference thereto may be included in any circular or statement, nor published in any way, without the written approval of BK Consultants Ltd



SCALE 1:1250 @ A3

Client Mr and Ms Garland				hayward ARCHITECTS LTD	
Project Alternations and Extensions Ratcliffe House Farm Ratcliffe Culey		Scale 1:1250	Sheet A3	Job No. 23/19	19 Station Road Hinckley Leicestershire LE10 1AW Tel: 01455 635 665 Fax: 01455 618 971 www.hayward-architects.co.uk
Drawing Site Location Plan		Date July 23	Author LJW	Checked by -	
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Client Garland		
Project Title Barn Conversion Ratcliffe House Farm Ratcliffe Culey		
Drawing Title Site Plan		
Scale 1:200	Date OCT 23	Sheet A2
Author LJW	Checked by -	
Job No. 23/19	Drawing No. 15B	
Status Planning		

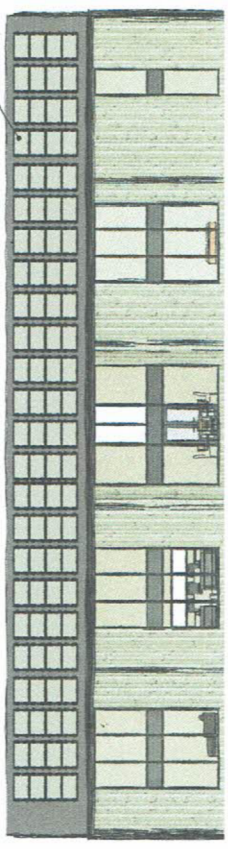
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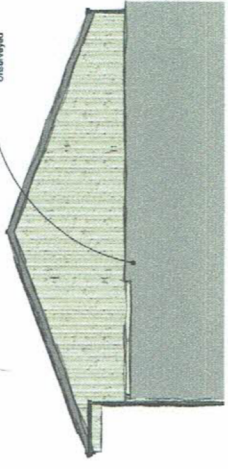
SCALE 1:200 @ A2

Neighbouring Building
Unsurveyed

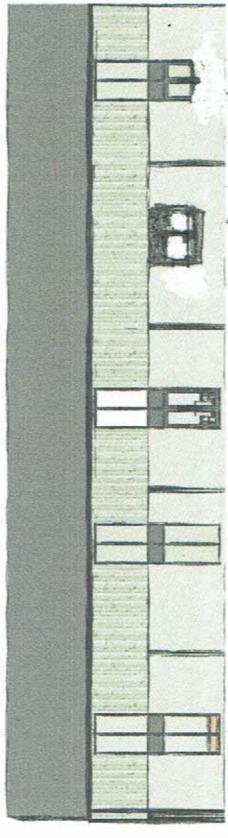
Existing solar panels retained



Front Elevation

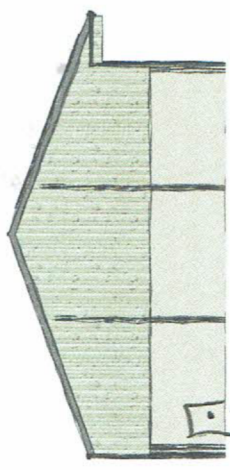


Side Elevation



Rear Elevation

Change Window Design
to above

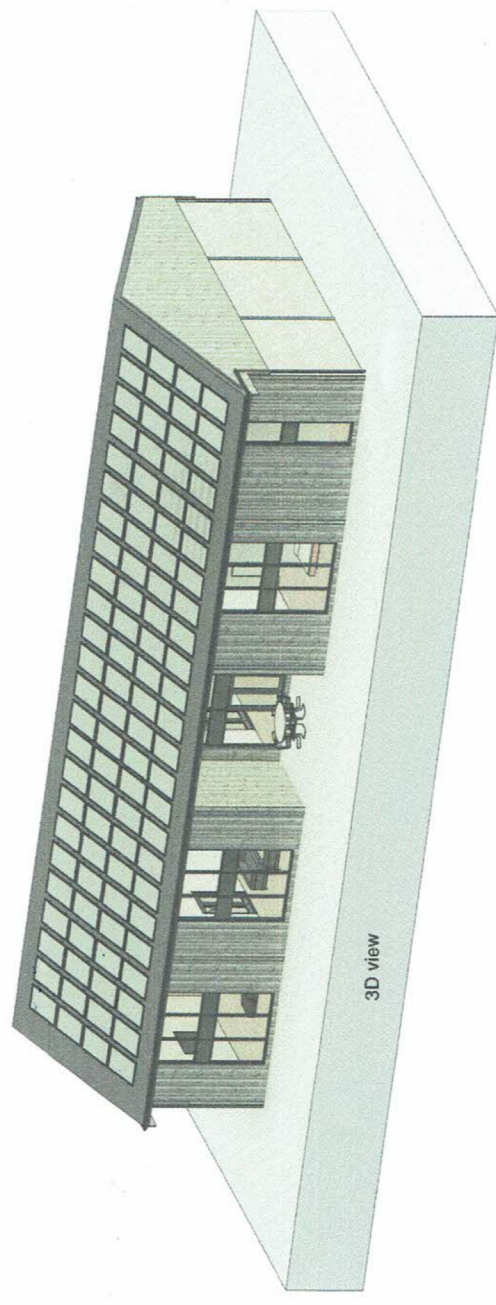


Side Elevation

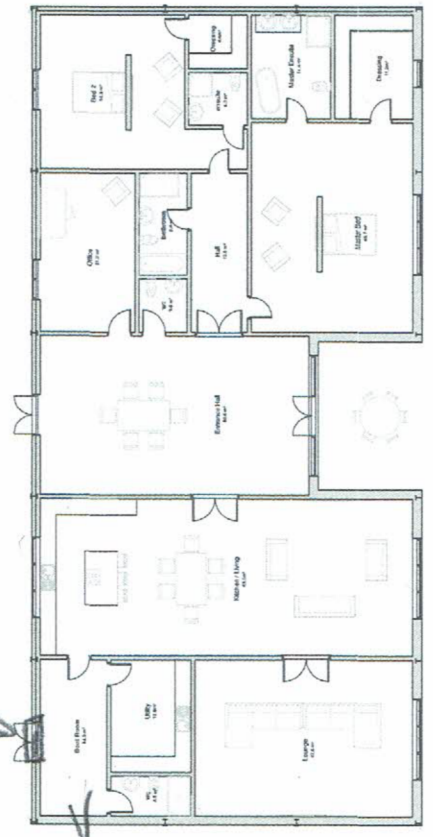
door to Farm

Window

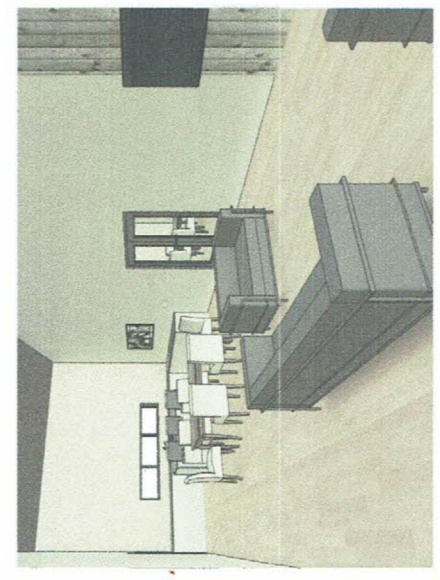
Side door
to Farm



3D view



Ground Floor Plan



Corrosion protection

From Steelconstruction.info

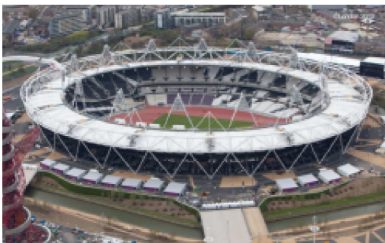
Cost effective corrosion protection of structural steelwork should present little difficulty for common applications and environments if the factors that affect durability are recognised at the outset.

There are many steel structures that have continued in use satisfactorily for many years even in adverse conditions. The first major iron structure, the bridge in Coalbrookdale UK, has survived over 200 years whilst the Forth rail bridge over 100 years old is legendary. Today, modern durable protective coatings are available which, when used appropriately, allow extended maintenance intervals and improved performance.

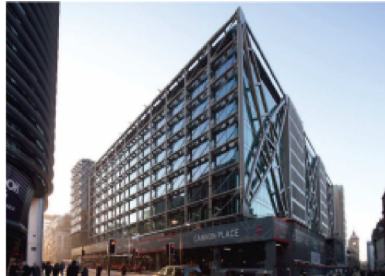
The key to success lies in recognising the corrosivity of the environment to which the structure will be exposed and in defining clear and appropriate coating specifications. Where steel is in a dry heated interior environment the risk of corrosion is insignificant and no protective coating is necessary. Conversely, a steel structure exposed to an aggressive environment needs to be protected with a high performance treatment and may need to be designed with maintenance in mind if extended life is required.

The optimum protection treatment, which combines appropriate surface preparation, suitable coating materials, required durability and minimum cost, is achievable using modern surface treatment technology.

High performance coatings on modern steel structures



Olympic Stadium, London



Cannon Place, London



Peace Bridge, Derry-Londonderry

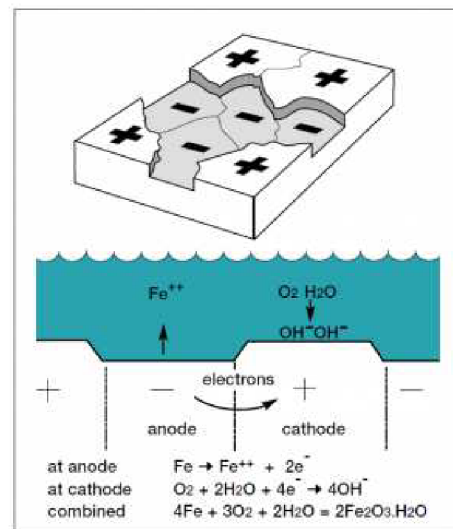
Corrosion of structural steel

Main article: Corrosion of structural steel

The corrosion of structural steel is an electrochemical process that requires the simultaneous presence of moisture and oxygen. In the absence of either, corrosion does not occur. Essentially, the iron in the steel is oxidised to produce rust, which occupies approximately 6 times the volume of the original material consumed in the process. The general corrosion process is illustrated here.

As well as general corrosion, there are various types of localised corrosion that can also occur; bimetallic corrosion, pitting corrosion and crevice corrosion. However, these tend not to be significant for structural steelwork.

The rate at which the corrosion process progresses depends on a number of factors relating to the 'micro-climate' immediately surrounding the structure, principally the time of wetness and the atmospheric pollution level. Because of variations in atmospheric environments, corrosion rate data cannot be generalised. However, environments can be broadly classified, and corresponding measured steel corrosion rates provide a useful indication of likely corrosion rates. More information can be found in BS EN ISO 12944-2^[1] and BS EN ISO 9223^[2].



Schematic representation of the corrosion mechanism for steel

Atmospheric corrosivity categories and examples of typical environments (BS EN ISO 12944-2^[1])

Corrosivity category and risk	Low-carbon steel Thickness loss (μm) ^a	Examples of typical environments in a temperate climate (informative only)	
		Exterior	Interior
C1 very low	≤ 1.3	-	Heated buildings with clean atmospheres, e.g. offices, shops, schools, hotels
C2 low	> 1.3 to 25	Atmospheres with low level of pollution Mostly rural areas	Unheated buildings where condensation may occur, e.g. depots, sports halls
C3 medium	> 25 to 50	Urban and industrial atmospheres, moderate sulphur dioxide pollution Coastal area with low salinity	Production rooms with high humidity and some air pollution e.g. food-processing plants, laundries, breweries, dairies
C4 high	> 50 to 80	Industrial areas and coastal areas with moderate salinity	Chemical plants, swimming pools, coastal, ship and boatyards
C5-I very high (industrial)	> 80 to 200	Industrial areas with high humidity and aggressive atmosphere	Buildings or areas with almost permanent condensation and high pollution
C5-M very high (marine)	> 80 to 200	Coastal and offshore areas with high salinity	Buildings or areas with almost permanent condensation and high pollution

Notes:

- 1 μm (1 micron) = 0.001mm
- ^a The thickness loss values are after the first year of exposure. Losses may reduce over subsequent years.
- The loss values used for the corrosivity categories are identical to those given in BS EN ISO 9223^[2].
- In coastal areas in hot, humid zones, the mass or thickness losses can exceed the limits of category C5-M. Special precautions must therefore be taken when selecting protective paint systems for structures in such areas.

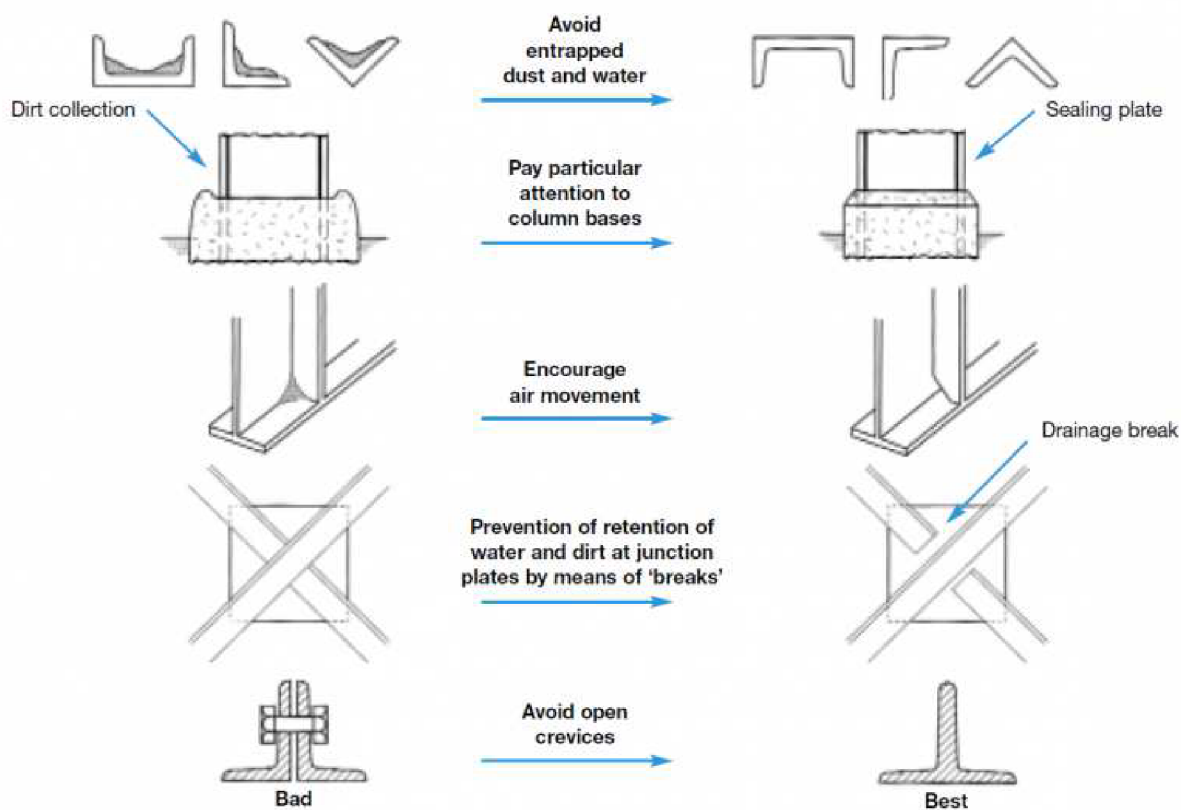
Influence of design on corrosion

Main article: Influence of design on corrosion

The design and detailing of a structure can affect the durability of any protective coating applied to it. Structures designed with many small structural components and fasteners are more difficult to protect than those with large flat surfaces. The key issues to consider include:

- Access for coating application and maintenance
- Avoidance of moisture and debris traps
- Avoidance or sealing of crevices
- Drainage and ventilation to minimise the time of wetness
- Careful management of contact with other materials

General guidance for the prevention of corrosion by good design detailing can be found in BS EN ISO 12944-3^[3], and some typical do's and don'ts for steel framed buildings are shown below.



Examples of detailing for buildings

Surface preparation

Main article: Surface preparation

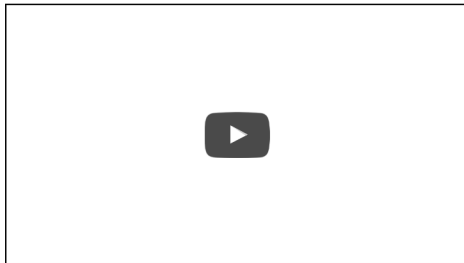
Surface preparation is the essential first stage treatment of a steel substrate before the application of any coating, and is generally accepted as being the most important factor affecting the total success of a **corrosion protection** system.

The performance of a coating is significantly influenced by its ability to adhere properly to the substrate material. The initial surface condition of steel can vary in terms of the amount of residual millscale and degree of initial rusting. However, generally it is an unsatisfactory base upon which to apply modern, high performance protective coatings. A range of methods of preparation and grades of cleanliness exist, but by far the most significant and important method used for the thorough cleaning of mill-scaled and rusted surfaces is abrasive blast cleaning. The standard grades of cleanliness for abrasive blast cleaning in accordance with ISO 8501-1^[4] are:

- Sa 1 – Light blast cleaning
- Sa 2 – Thorough blast cleaning
- Sa 2½ – Very thorough blast cleaning
- Sa 3 – Blast cleaning to visually clean steel



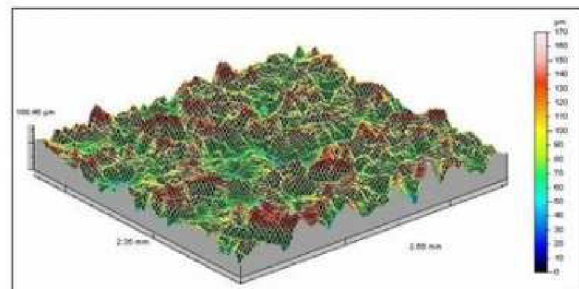
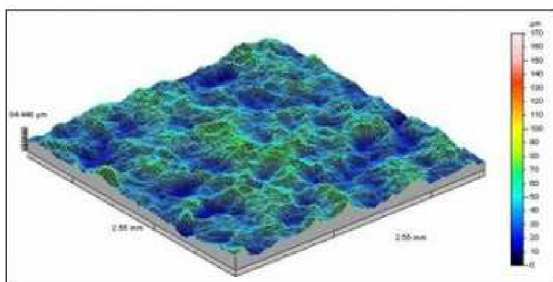
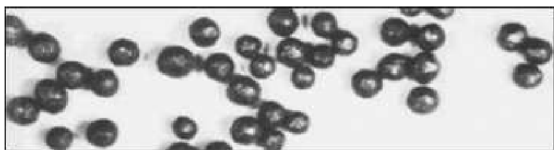
Steel beam emerging from an automatic blast cleaning unit



Manual blast cleaning

(Video courtesy of Corrodere/MPI)

The surface preparation process not only cleans the steel, but also introduces a suitable surface profile and amplitude to receive the protective coating. High build paint coatings and thermally sprayed metal coatings need a coarse angular surface profile to provide a mechanical key. This is achieved by using grit abrasives. Shot abrasives are used for thin film paint coatings such as pre-fabrication primers. The difference between shot and grit abrasives and the corresponding surface profiles produced is illustrated below in the three-dimensional diagrams obtained from non-contact surface characterisation equipment.



Shot abrasive

Grit abrasive

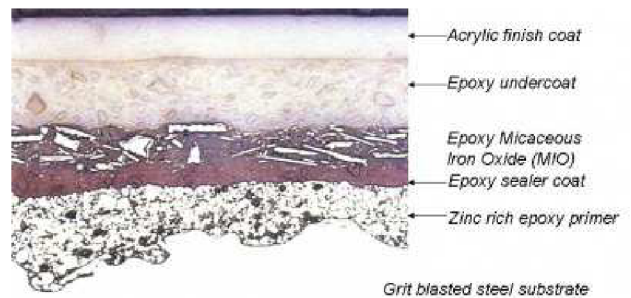
After abrasive blast cleaning, it is possible to examine for surface imperfections and surface alterations caused during fabrication processes, e.g. welding. Certain surface imperfections introduced during the original processing of the steel may not be detrimental to the performance of a coating in service, particularly for structures in relatively low risk environment categories. However, depending upon the specific requirements of the structure, it may be necessary to carry out additional surface treatments to remove surface imperfections on welds and cut edges as well as soluble salts to produce an acceptable surface condition for painting.

Paint coatings

Main article: Paint coatings

Paint coatings for steel structures have developed over the years to comply with industrial environmental legislation and in response to demands from bridge and structure owners for improved durability performance. A paint consists of a pigment, dispersed in a binder, and dissolved in a solvent. The most common methods for the classification of paints is either by their pigmentation or by their binder type.

A modern paint system usually comprises a sequential coating application of paints or alternatively paints applied over metallic coatings to form a 'duplex' coating system. Protective paint systems usually consist of primer, intermediate/build coats and finish coats. Each coating 'layer' in any protective system has a specific function, and the different types are applied in a particular sequence of primer followed by intermediate/build coats in the shop, and finally the finish coat (or top coat) either in the shop or on site.



Cross section through a multi-coat paint system

Prefabrication primers are used on structural steelwork, immediately after blast cleaning, to maintain the reactive blast cleaned surface in a rust free condition through the fabrication process until final painting can be undertaken. These types of primers are not used before the application of thermally spraying coatings.

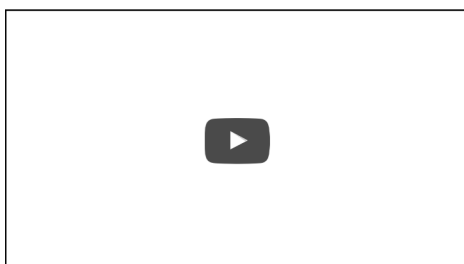
The method of application of paint systems and the conditions of application have a significant effect on the quality and durability of the coating. Standard methods used to apply paints to structural steelwork include application by brush, roller, conventional air spray and airless spray/electrostatic airless spray.

Airless spray has become the most commonly used method of applying paint coatings to structural steelwork under controlled shop conditions. brush and roller application are more commonly used for site application, though spraying methods are also used. 'Stripe' coatings applied to edges and sharp corners are usually applied by brush.

Airless spraying on steel bridge beams



The principal conditions that affect the application of paint coatings are temperature, both steel and ambient and humidity. These can be more easily controlled under shop conditions than on site. With modern high performance coatings, correct application has become increasingly important to achieve the intended performance. Industry has recognised this and established a training and certification scheme for paint applicators (ICATS – Industrial Coating Applicator Training Scheme). ICATS registration has subsequently become a mandatory requirement for work on Highways England bridges and Network Rail structures.



Airless paint spraying
(Video courtesy of Corrodere/MPI)

Metallic coatings

Main article: Metallic coatings

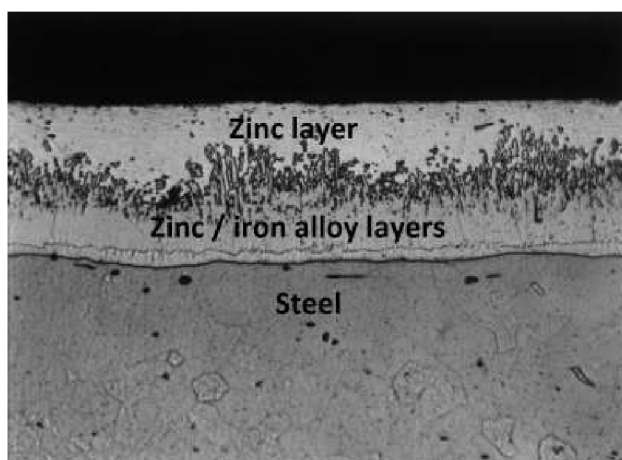
There are four commonly used methods of applying metal coating to steel surfaces. These are hot-dip galvanizing, thermal spraying, electroplating and sherardizing. The latter two processes are not used for structural steelwork but are used for fittings, fasteners and other small items. In general the **corrosion protection** afforded by metallic coatings is largely dependent upon the choice of coating metal and its thickness and is not greatly influenced by the method of application.

Hot-dip galvanizing

Hot-dip galvanizing is a process that involves immersing the steel component to be coated in a bath of molten zinc (at about 450°C) after pickling and fluxing, and then withdrawing it. The immersed surfaces are uniformly coated with zinc alloy and zinc layers that form a metallurgical bond with the substrate. The resulting coating is durable, tough, abrasion resistant, and provides cathodic (sacrificial) protection to any small damaged areas where the steel substrate is exposed. The typical minimum average coating thickness for structural steelwork is 85µm.



Steel elements being withdrawn from a typical hot-dip galvanizing bath

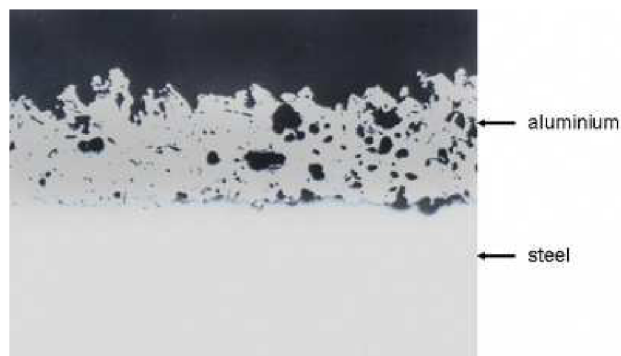


Cross-section through a hot-dip galvanized coating

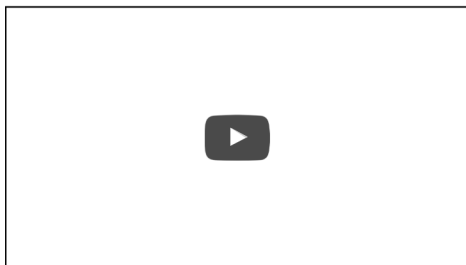
Thermally sprayed metal coatings

Thermally sprayed coatings of zinc, aluminium, and zinc-aluminium alloys can provide long-term corrosion protection to steel structures exposed to aggressive environments. The metal, in powder or wire form, is fed through a special spray gun containing a heat source, which can be either an oxygas flame or an electric arc. Molten globules of the metal are blown by a compressed air jet onto the previously grit blast cleaned steel surface. No alloying occurs and the coating consists of overlapping platelets of metal and is porous. The pores are subsequently sealed by applying a thin organic coating, which penetrates into the surface. It is essential that the sealer completely satisfies the filling of all porosity in the metal coating.

The adhesion of sprayed metal coatings to steel surfaces is considered to be essentially mechanical in nature. It is therefore necessary to apply the coating to a clean roughened surface and blast cleaning with coarse grit abrasive is normally specified.



Cross-section through a thermally sprayed aluminium coating



Arc spraying
(Video courtesy of Metallisation)

Appropriate specifications

Main article: Appropriate specifications

The overall success of a protective coating scheme starts with a well-prepared specification. It is an essential document that is intended to provide clear and precise instructions to the contractor on what is to be done and how it is to be done. The specification should be drafted by someone with appropriate technical expertise, and it should be clear as to what is required, and what is practical and achievable. It should be written in a logical sequence, starting with surface preparation, going through each paint or metal coat to be applied and finally dealing with specific areas, e.g. welds. It should also be as brief as possible, consistent with providing all the necessary information. The most important items of a specification are as follows:

- Metal dressing to remove sharp edges, projections etc. and steel contamination.
- The method of surface preparation and the standard required.
- The maximum interval between surface preparation and subsequent priming or metal coating.
- The types of paint or metallic coatings to be used, supported by relevant standards.
- The method/s of application to be used.
- The number of coats to be applied and the interval between coats.
- The wet and dry film thickness for each coat.
- Where each coat is to be applied (i.e. shops or site) and the application conditions that are required, in terms of temperature, humidity, etc.
- Details for treatment of welds, and bolted connections etc.
- Rectification procedures for damage, etc.

The majority of steel bridges are protected according to the requirements of the Highways England, and Network Rail standard specifications. Alternative coating systems and methods may be specified for other bridges but the same standards and principles of good coating practices should similarly be applied.

Inspection and quality control

Main article: Inspection and Quality Control

Inspection forms an integral part of quality control. Its purpose is to check that the requirements of the specification are being complied with and to provide a report with proper records to the client. One of the greatest assets to the coating inspector is a clear written specification that can be referred to without doubt.

The appointment of an appropriately qualified third party inspector should be seen as an investment in quality and not just an additional cost. Inspection of the processes, procedures and materials required for the protective coating of steel structures is vital, since a major error in even one operation cannot be easily detected after the next operation has been carried out, and if not rectified immediately can significantly reduce the expected life to first maintenance.



Range of testing and inspection instruments

References

1. ^ 1.0 1.1 BS EN ISO 12944-2: 1998, Paints and varnishes – Corrosion protection of steel structures by protective paint systems – Part 2: Classification of environments, BSI
2. ^ 2.0 2.1 BS EN ISO 9223: 2012, Corrosion of metals and alloys – Corrosivity of atmospheres – Classification, determination and estimation BSI
3. ^ BS EN ISO 12944-3: 1998, Paints and varnishes – Corrosion protection of steel structures by protective paint systems – Part 3: Design considerations, BSI
4. ^ BS EN ISO 8501-1: 2007, Preparation of steel substrates before application of paints and related products. Visual assessment of surface cleanliness. Rust grades and preparation grades of uncoated steel substrates and of substrates after overall removal of previous coatings, ISO

Resources

- Hendy, C.R.; Iles, D.C. (2015) Steel Bridge Group: Guidance Notes on best practice in steel bridge construction (6th Issue). (P185). SCI
 - Guidance Note 8.01 Preparing for effective corrosion protection
 - Guidance Note 8.02 Protective treatment of fasteners
 - Guidance Note 8.03 Hot dip galvanizing
 - Guidance Note 8.04 Thermally sprayed metal coatings
 - Guidance Note 8.05 High performance paint coatings
 - Guidance Note 8.06 The inspection of surface preparation and coating treatments
- Steel Buildings, 2003, The British Constructional Steelwork Association Ltd.
 - Chapter 12 – Corrosion Protection

Further reading

- D.Deacon & R.Hudson (2012), Steel Designer's Manual (7th Edition), Chapter 36 - Corrosion and corrosion prevention, The Steel Construction Institute.
- D.A. Bayliss & D.H.Deacon (2002), Steelwork Corrosion Control (2nd edition), Spon Press

See also

- Corrosion of structural steel
- Influence of design on corrosion
- Surface preparation
- Paint coatings
- Standard corrosion protection systems for buildings
- Metallic coatings
- Appropriate specifications
- Inspection and quality control

External links

- British Coatings Federation (<http://www.coatings.org.uk/>)
- Galvanizers Association (<http://www.galvanizing.org.uk/>)
- Paint Research Association (<http://www.pra-world.com/>)
- The Thermal Spraying and Surface Engineering Association (<http://www.tssea.co.uk/>)
- ICATS (<http://www.icats-training.org/>)
- Corrodore (<http://corrodere.com/>)

CPD

- Corrosion protection

Retrieved from "http://www.steelconstruction.info/Corrosion_protection"

Category: Corrosion protection

Zinc rich cold galvanising coating

Uses

To provide a galvanic protection on iron and steel. It can be used as a self-finish or as a durable rust inhibiting primer beneath selected top coats. It is recommended for the protection of structural steelwork, agricultural and construction plant and machinery, gates, railings, iron pipework and guttering, and the rust prevention of in-situ welding work.

Advantages

- Protects ferrous metals against rust
- Suitable as a primer or self-finish
- Easily applied by brush or roller

Description

Galvafruid zinc rich coating is formulated as an easily applied, cold galvanising protection against corrosion on all ferrous metals. Galvafruid has a mid-grey, matt finish.

Properties

Volume solids:	40%
Solids by weight:	80%
Zinc content by volume on dry film:	61%
Zinc content by weight on dry film:	90%
Drying times at 20°C —	
touch dry:	2 hours
hard dry:	24 hours
recoating time:	24 hours minimum

Specification clause

The anti-corrosive primer shall be Galvafruid, a zinc rich material specifically designed to provide a rust inhibiting protection to ferrous metalwork.

 0370	
Fosroc Ltd Drayton Manor Business Park, Coleshill Road, Tamworth, B78 3TL, UK 09 DOP: UK9-174 0370-CPR-0845	
Galavfruid	
EN 1504-7 Surface Protection Systems (C)	
Corrosion protection	Pass
Dangerous substances	None above acceptable levels (REACH Annex XVII / ECHA Candidate List)

Application instructions

Preparation

All ferrous surfaces must be clean and free from oil, grease, mill scale, rust and existing coatings. This is best achieved by grit blasting, although thorough wire brushing can be sufficient. Some rust removers based on phosphoric acid tend to leave an electrically insulating film on ferrous metals and must not be used.

Mixing

Galvafruid must be thoroughly stirred to give a uniform product prior to application. It is recommended that the contents are stirred periodically during application to avoid settlement.

Galvafruid is supplied at the correct consistency for direct application from the tin but, should it be found necessary to thin, only Fosroc Thinner/Cleaner should be added, at a rate not exceeding 1 litre of thinners to 8 litres of Galvafruid.

Application

In order to obtain the protective properties of Galvafruid, it is important that the correct rate of application is achieved. The minimum application temperature is 5°C.

All prepared surfaces should be treated with one or more coats of Galvafruid. The material should be liberally applied without any attempt to brush or roll out. The required thickness of coating may be built up by successive applications of Galvafruid when the previous coat is completely dry.

Fosroc® Galvafruid

Overcoating

Where required, Galvafruid may be painted to improve durability or to enhance appearance. The Galvafruid coating should not be rubbed down to obtain a smooth surface for finishing paints.

For general purposes, a good oil bound or alkyd paint should be used. Dekguard W can be used to provide a decorative finish to Galvafruid; a 2-coat application is recommended. Where the work is subject to corrosive and marine conditions, however, a non-saponifiable finishing paint should be used, i.e. Chlorinated rubber paint. It is advisable to allow the Galvafruid coating to weather for at least 3 days before applying the finishing coat. Cellulose and bituminous paints are not generally suitable for over-painting Galvafruid.

Cleaning

Galvafruid should be removed from tools and equipment with Fosroc Thinner/Cleaner immediately after use. Dried material can only be removed mechanically.

Estimating

Supply

Galvafruid:	Pack of 6 x 400 ml tins Pack of 4 x 800 ml tins 1.9 litre tin
Fosroc Thinner/Cleaner:	0.5 litre tins

Coverage

Galvafruid:	
When used as a primer	16 m ² /litre
When used as a self-finish	8 m ² /litre

Limitations

Galvafruid is formulated for application to clean ferrous substrates and should not be used on rusty, corroded surfaces.

Galvafruid should not be applied over existing coatings.

Galvafruid should not be used on surfaces in contact with drinking water.

Galvafruid should not be used on surfaces exposed to soft water at temperatures above 60°C.

Galvafruid should not be used on surfaces treated with phosphoric acid based rust removers.

Galvafruid should not be overcoated with materials containing strong solvents such as chlorinated and aromatic hydrocarbons, esters and ethers.

Storage

Galvafruid and Dekguard W have a shelf life of 12 months if kept in a dry store between 5°C and 20°C in the original, unopened container.

Precautions

Health and safety

For further information refer to appropriate Product Safety Data Sheet.

Fire

Galvafruid and Fosroc Thinner/Cleaner are flammable. Keep away from sources of ignition. No smoking. In the event of fire, extinguish with CO₂ or foam. Do not use a water jet.

Flash points

Galvafruid:	41°C
Fosroc Thinner/Cleaner:	41°C

Fosroc, Dekguard and Galvafruid are trademarks of Fosroc International Limited



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