Conservation Management Plan for the Blast Furnace Remains at Derryoober, Co. Galway

History, survey and structural assessment

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1. Introduction

During the seventeenth and most of the eighteenth century the vast majority of iron used in Ireland was produced locally in blast furnaces. These monumental structures and their associated works would have dominated the landscape in the areas where they were active; economically, socially and visually. For a variety of reasons, Irish blast furnaces are preserved better than elsewhere and the surviving furnaces in the Sliabh Aughty area, on the Counties Clare and Galway shores of Lough Derg, present one of the finest collection of blast furnaces of that age anywhere worldwide.

The Sliabh Aughty Furnace Project was created in 2014 with the aim to study, conserve and educate about the iron industry in the Sliabh Aughty area.[1] In the Spring of 2015, a grant was obtained from the Heritage Council (Ref. CBH04830) to compose Conservation Management Plans for the four upstanding blast furnace remains in the Sliabh Aughty Mountains area. These Plans, consisting of the known historical information of the ironworks, detailed surveys of the structures and structural assessments of the same, the latter carried out by Architectural Conservation Professionals,[2] are seen as a first study of these furnaces and especially as documents which form the initial steps towards their future conservation.

This Plan concerns the blast furnace remains in the townland of Derryoober, Co. Galway.[3] This blast furnace is probably unique for Ireland as it is the only one likely to be an unfinished one. This fact has undoubtedly contributed to its good state of preservation, with only the furnace in Bealkelly being in better condition. These two furnaces are then the only two in the Sliabh Aughty area which have both their blowing and tapping arches preserved, with interesting differences between both.

1 www.furnaceproject.org and https://www.facebook.com/pages/Sliabh-Aughty-Furnace-Festival/434485340026466
2 Grageen House, Cappanuke, Cappamore, Co. Limerick www.acpgroup.ie
3 Coordinates (ITM): 575023, 696109

2. Historical background

2.1 Iron smelting in Ireland in the 17th and 18th century

Until the late sixteenth century, iron ore in Ireland was exclusively smelted in so-called bloomery furnaces. These installations were generally clay-walled chimneys, about one to one and a half metres high with an internal diameter ranging between 30 and 60cm. In bloomery furnaces the heat was used to remove the oxygen from the iron oxides in the ore and to smelt the non-iron parts of the same, but the iron itself never became liquid. The products of these furnaces are known as blooms and weighed from 20 to 40kg.[4]

Around the thirteenth century, in an area stretching from Sweden over Germany to Switzerland, an altogether different type of furnace appeared. Now the bellows are no longer blown by hand but driven by water-power, the furnaces themselves are substantially larger stone-built square structures (side lengths and heights between 4 to 5m) and the product is now liquid iron. This liquid iron is characterised by a higher carbon content than bloomery iron.[5] The furnaces themselves are invariable equipped with two large arches, set in adjoining walls: one for the bellows ('blowing arch') and one for the removal of the iron and waste ('tapping arch'). The liquid state of the iron is not only due to a higher temperature as a result of the use of water-power, but also because of the use of more charcoal per fuel unit.

The liquid iron leaving the furnace could be poured into a mould resulting in cast iron objects. Because of their high carbon content, cast iron objects cannot be forged; they shatter upon being struck with a hammer. Alternatively, the iron could be cast into large bars of iron known as sows.[6] These sows are then brought to an installation known as a finery where the iron is re-melted in an oxidizing environment to remove the excess carbon. After further operations at the chafery (renewed reheating) and the hammer forge (shaping), so-called wrought iron is obtained which could then be further forged into a variety of shapes by the blacksmith. The finery, chafery and hammer forge all utilised water-power and were frequently part of the same plant.

As a blast furnace was expensive to build, required highly specialised labour and had a high

4 Rondelez 2014: 245-246. Water-powered bloomeries could produce substantially larger blooms.
5 Iron produced in the bloomery can have a low carbon content or a medium one. In that latter case it can be considered as steel. In the blast furnace the iron has to be converted to wrought iron (low carbon content) after which carbon needs to be added to obtain steel.
6 From the late 18th century these are known as pigs of iron

strategic value, it spread only very slowly outside of its original heart-land. Only at the very end of the fifteenth century are the first installations of this kind built in England, in the south-eastern Weald counties of Kent and Sussex. Only when the woods in that area could no longer provide sufficient fuel for the furnaces, around the middle of the sixteenth century, did blast furnaces spread further afield, into northern and central England and Wales. This is the period when the Plantation of Ireland got under way and already in the 1560s we hear of proposals of establishing a blast furnace in the area around Carrigaline, Co. Cork as part of the Kerrycurrihy Plantation.[7]

It is unclear if this furnace was ever built and for the rest of the sixteenth century the sources mention only further proposals and unspecified ironworks working in Ireland, all in Counties Cork and Waterford. The earliest definite evidence of a blast furnace in Ireland is the one built by Sir Thomas Norris in Mallow, Co. Cork which operated from 1583 to 1589.[8] In beginning of the seventeenth century, during several decennia of relative calm, multiple blast furnaces were built in Ireland. Among the most proliferous were the ventures of Sir Richard Boyle, First Earl of Cork, in Co. Waterford and by Sir Charles Coote's ironworks in County Laois and the ones built by both in Leitrim.[9]

Many of these furnaces were destroyed during the Civil Wars of the 1640s but already in the 1650s new ones were built and surviving ones brought into production again. This is the period when the long-lasting works at Enniscorthy, Co. Wexford are constructed.[10] In the 1660s and 70s, William Petty established a substantial iron-producing industry in County Kerry,[11] but it was especially in the 1680s that new plants were started up, many in areas with no previous recorded blast furnaces, such as Counties Cavan, Mayo and Galway. In the eighteenth century we have many references to blast furnaces active all over Ireland, but the limited source material together with little research on the subject means that we cannot yet present a clear picture of the industry at that time. Many ironworks closed down around the middle of that century, with a handful continuing production up till about 1780. These then close down due to lack of fuel and competition from abroad.

In the Sliabh Aughty area, ironworks were active over a period of well over a hundred years (Fig. 1). The earliest furnace, at Ballyvannan, Co. Clare, possibly dates to before 1610.[12] The first furnace

7 BL, Cotton Titus B/XII f.10, Rondelez 2014: 99
8 Rondelez 2014: 108
9 Rondelez In Press
10 Barnard 1985
11 Barnard 1982
12 See the Conservation Management Plan for Ballyvannan furnace, Co. Clare (Rondelez et al. 2015a)

for which we have solid evidence is the one built in 1630 at Scarriff, Co. Clare by English merchants. After legal problems and the onset of the civil wars of the 1640s, the same merchants crossed the Atlantic and were involved in the first functioning blast furnace in the Americas at Saugus, Massachusetts. Back in Ireland, the iron industry along Lough Derg was only started up again in the 1680s, in Scarriff and in Woodford, Co. Galway. About a decade later, a furnace was built near Feakle. We are badly informed about the eighteenth century, but it would seem likely that the remaining furnaces were built during the earlier part of that century. We know that Whitegate furnace was in use in 1760.[13] If Lewis is correct, the industry in the Sliabh Aughty area ended in the late 1770s with the closure of the Woodford ironworks.[14]

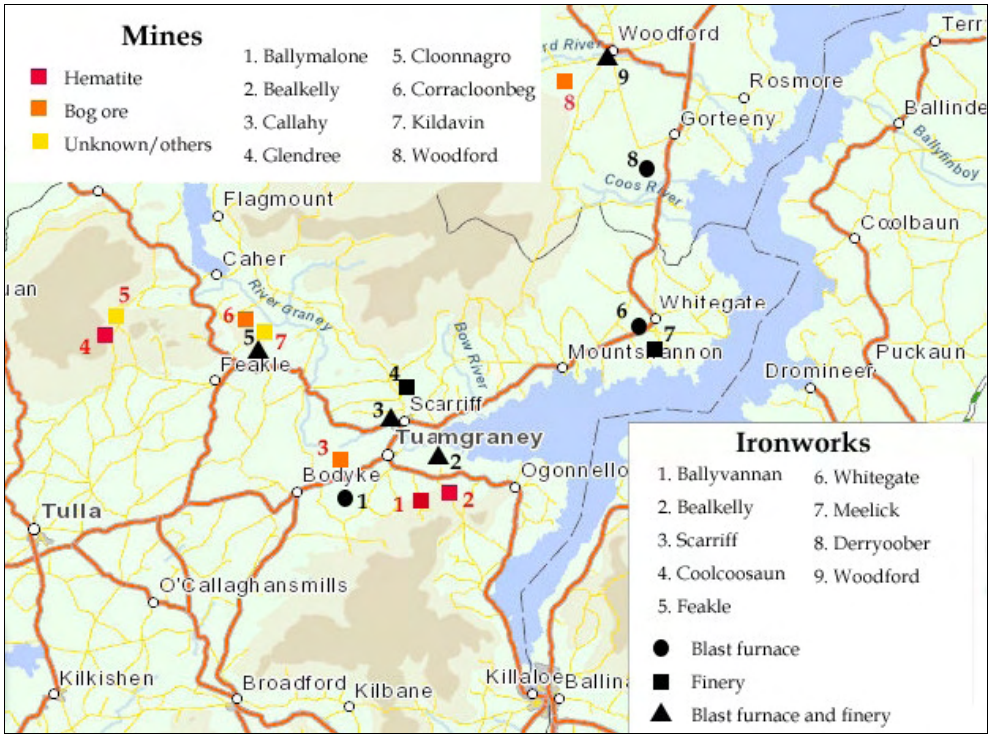

Fig. 1. The Sliabh Aughty ironworks and associated iron mines

13 See the Conservation Management Plan for Furnace, Whitegate, Co. Clare (Rondelez et al. 2015c)
14 Lewis 1837 Vol. II: 724

2.2 Historical background of Derryoober furnace

The furnace at Derryoober is relatively well preserved but no archival material has been found to date that mentions it. The first record of Derryoober furnace is the 1830s Ordnance Survey map on which it is depicted (Fig. 2) together with several structures surrounding it. Next, Geologist G. H. Kinahan refers to this furnace and states that it was only partially built and never used.[15] This might well be the case as it is less high than the other furnaces and to date no slag has been observed around the furnace. There is also little trace of a potential water-supply system. The furnace remains are depicted on the 1910s Ordnance Survey map, this time without any structures nearby (Fig. 3).

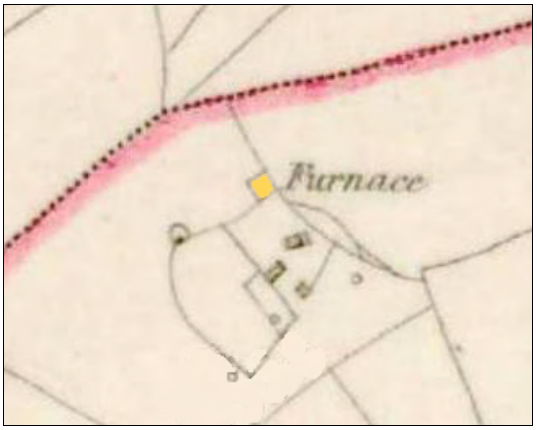

Fig. 2. Derryoober furnace (in yellow) on the 1830s OS map.

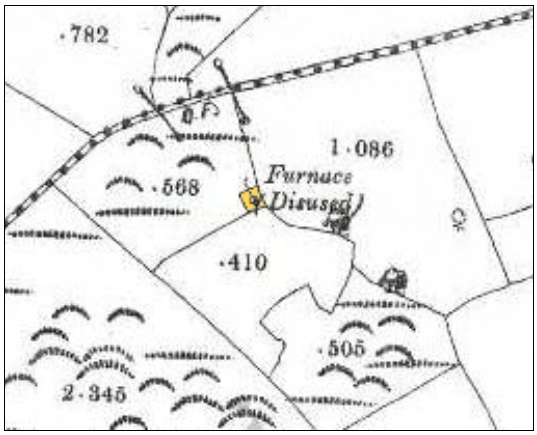

Fig. 3. Derryoober furnace (in yellow) on the 1910s OS map.

15 Kinahan 1863: 47

3. Survey of Derryoober furnace

The furnace is square in plan with side lengths of just over 6.8m and has a maximum preserved height of 3.6m (Fig. 4). On all four sides, the furnace is stepped at a height of about 2m above ground level. The south wall is buried op to this step by material built up between the slope and the wall. The tapping arch is located in the north wall, while the blowing arch is in its east wall. The hearth area is of irregular rectangular shape with a long axis of 2.3m and a short axis varying between 1.9m on its southern end to 2.1m on it northern side. The hearth area has a ledge of about 5cm deep at a height of 1.2m. At its north east corner there is a large pile of stones, most likely debris from the furnace.

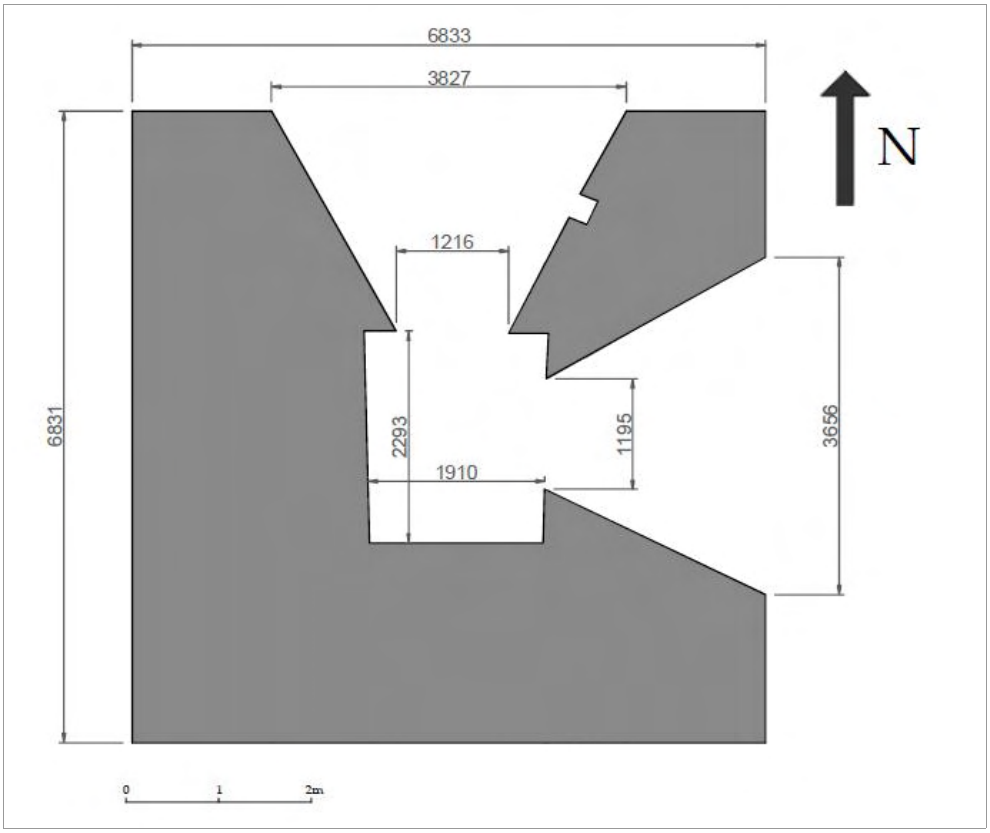

Fig. 4. Plan of Derryoober furnace

3.1 North wall

Most of the north wall is taken up by the tapping arch were both the liquid iron and the waste material (slag) would have been removed from the hearth (Figs. 5 and 6). This arch is 3.8m wide and about 2m high at its front and end as a square opening of about 1.2m where it meets the heath area. About midway the east wall of the tapping arch, there is a rectangular recess with side lengths 0.3m and 0.2m and depth 0.2m, the function of which is function is unclear (Fig. 7).[16] The top of the western tapping arch wall has imprints of timber or wattle, part of the construction frame for the arch (Fig. 8).

The full north west corner is missing its stones and it is possible that the was a wall built into the furnace at this point. The stones above about 1.5m are also missing on the north east corner and this might also represent a robbed out wall, but then with a doorway.

Fig. 5. North wall of Derryoober furnace

16 This recess has an identical parallel in Bealkelly furnace, see (Rondelez et al. 2015b)

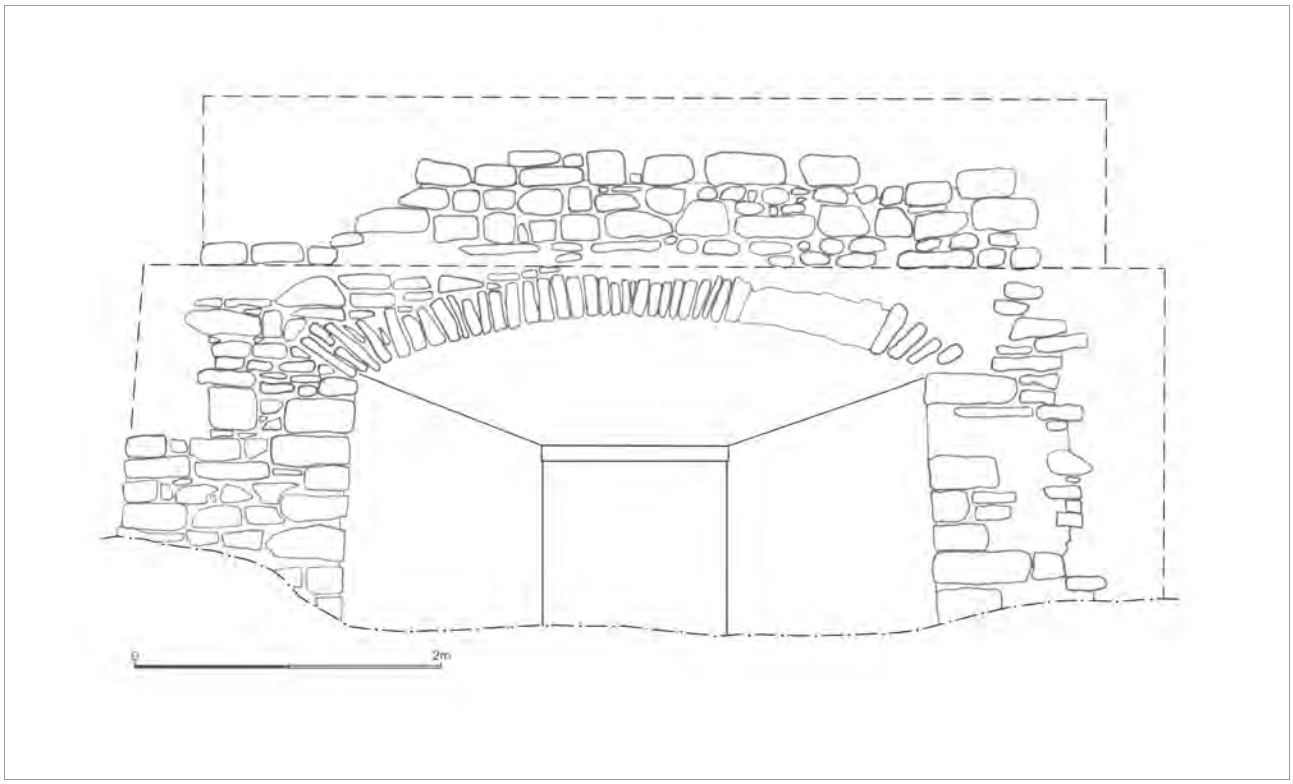

Fig. 6. Elevation drawing of the north wall

Fig. 7. Recess in the western tapping arch wall

Fig. 8. Imprints of timber/wattle in the western tapping arch wall

3.2 East wall

The east wall is the setting for the blowing arch where the water-powered bellows would have been situated (Figs. 9 and 10). Across the the top of the arch are the recesses of three horizontal beams which would have supported the bellows. The outer recess is the largest, measuring 4.8m by 0.7m by 0.5m. The middle beam would have measured about 4.0m by 0.35m by 0.35m and the innermost one around 3.45m by 0.25 by 0.25m. The arch in this wall is nearly 3.7m wide and about 2m high at its front and also ends a square opening of 1.2m side length.

Fig. 9. East wall of Derryoober furnace

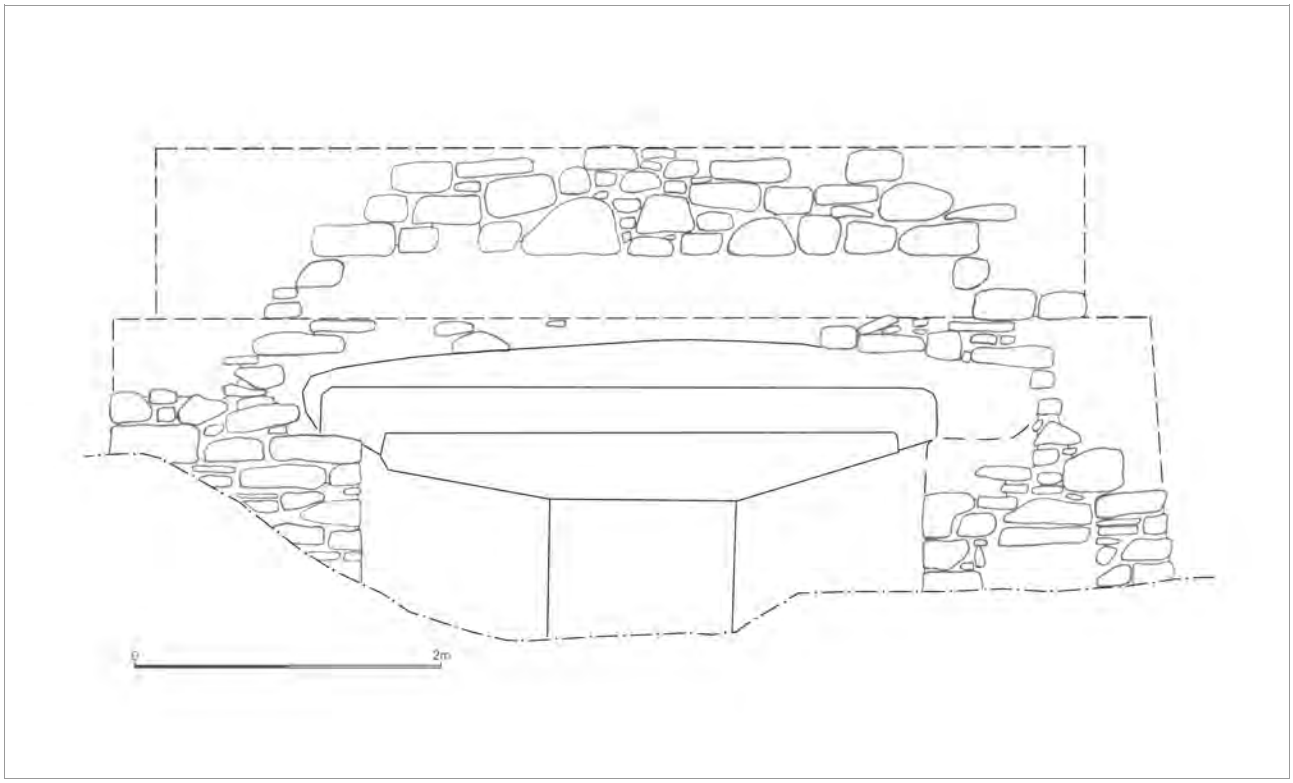

Fig. 10. Elevation drawing of the east wall

3.3 West and South walls

The west wall is a plain wall without distinctive features while most of the south wall is buried by material built up between it and the slope of the hill (Figs. 11 and 12).

Fig. 11. West wall of Derryoober furnace

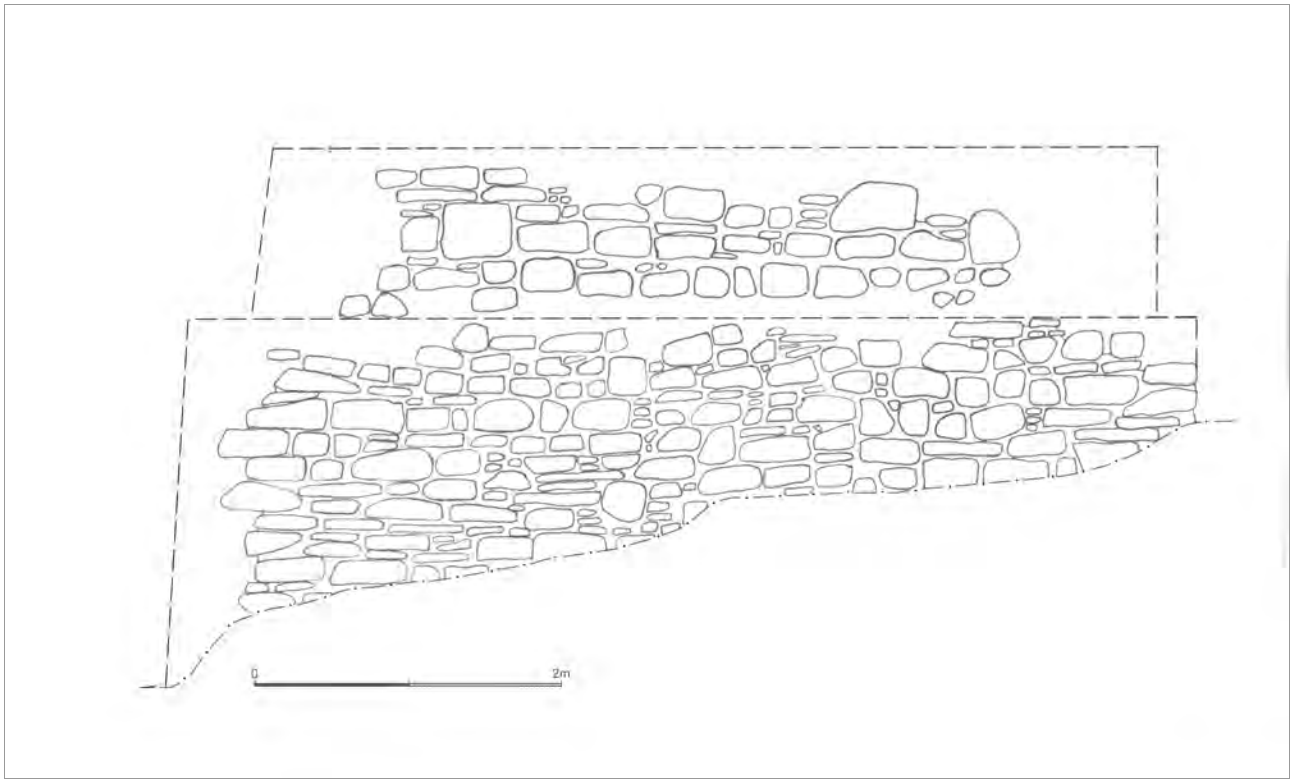

Fig. 12. Elevation drawing of the west wall

4. Structural Assessment of Derryoober furnace[17]

The survey involved the visual inspection of each of the furnace structure and fabric elements within the site.[18] The purpose of the inspection is to identify works required to make the structure safe and to prevent further deterioration of the fabric. A more detailed assessment would be required to identify further works.

The data sheet assesses the condition of each building into five categories as follows:

> **Dangerous** – Serious health and safety issue. Immediate work required to be carried out for the safety of the fabric and users/public.
> **Poor** - Health and safety issue. Urgent work required to prevent active deterioration of fabric, and safety of users/public
> **Fair** – Necessary work needed. Work could be carried out at a later stage.
> **Good** – There is no necessary work needed. Desirable work maybe carried out for aesthetic reasons or adaptive use.
> **Excellent** – There is no work needed but item should be kept under observation

4.1 North elevation

Dangerous	
Poor	✓
Fair	
Good	
Excellent	

The North elevation appears to be structurally sound however there is a small amount of damage to the arch and some loose masonry on the wall top (Figs. 13 and 14). Vegetation is causing the displacement of stones on the upper section of the wall. The original lime render is still apparent underneath the arch and on the side walls.

17 The information for this chapter was compiled from the relevant report composed by Architectural Conservation Professionals (Humphreys and Collins 2015)

18 The structure was surveyed on the 8th August 2015. The following schedules set out the survey notes of the individual buildings/elements. It must be noted that no opening up was carried out on walls etc., and that this report is based on a visual inspection. We can only comment on those items which were both visible and accessible at the time of our inspection. (ACP)

Easy access is gained into the furnace interior where much of the original flue lining is present. There is no evidence of burned materials inside the flue. The interior of the furnace is in a relatively good condition with some localised areas in need of re-pointing particularly around the chimney opening on top.

Works Required: Urgent

It is recommended that the arch on the North elevation is repaired to match existing with suitable stone and lime mortar. This will prevent further deterioration of the arch and prevent a future structural failure. The masonry on the upper section of the North elevation is in need of re-pointing and loose stones on the wall top should be re-bedded in lime mortar after the removal and treatment of vegetation growth on the furnace top.

Fig. 13. North wall showing damage to the arch

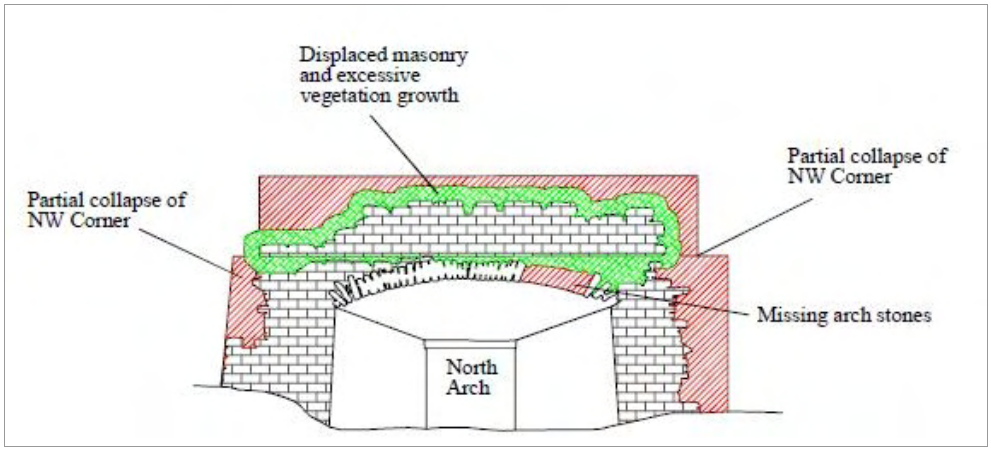

Fig. 14. Problem areas on the north wall

4.2 East wall

Dangerous	
Poor	✓
Fair	
Good	
Excellent	

On inspection the East elevation appears structurally sound however there has been considerable damage caused to the arch (Figs. 15 and 16). The structural timber heads appear to have been removed leaving the stone exposed and overhanging above. There is loose masonry just above the arch and towards the top section of the wall being caused by vegetation growth. A small section of the NE corner has collapsed but does not pose any structural risks at this time. The stones above the arch are in danger of collapse due to their supporting timbers having been removed.

Works Required: Urgent

The removal and treatment of vegetation growth is necessary to prevent the further displacement of masonry on the upper section of the furnace. Consolidation works are required to the damaged arch to prevent further collapse of the overhanging stones. The upper section of the wall is in need of re-pointing to prevent further deterioration of the joints and mortar.

Fig. 15. East wall showing extent of damage to the arch

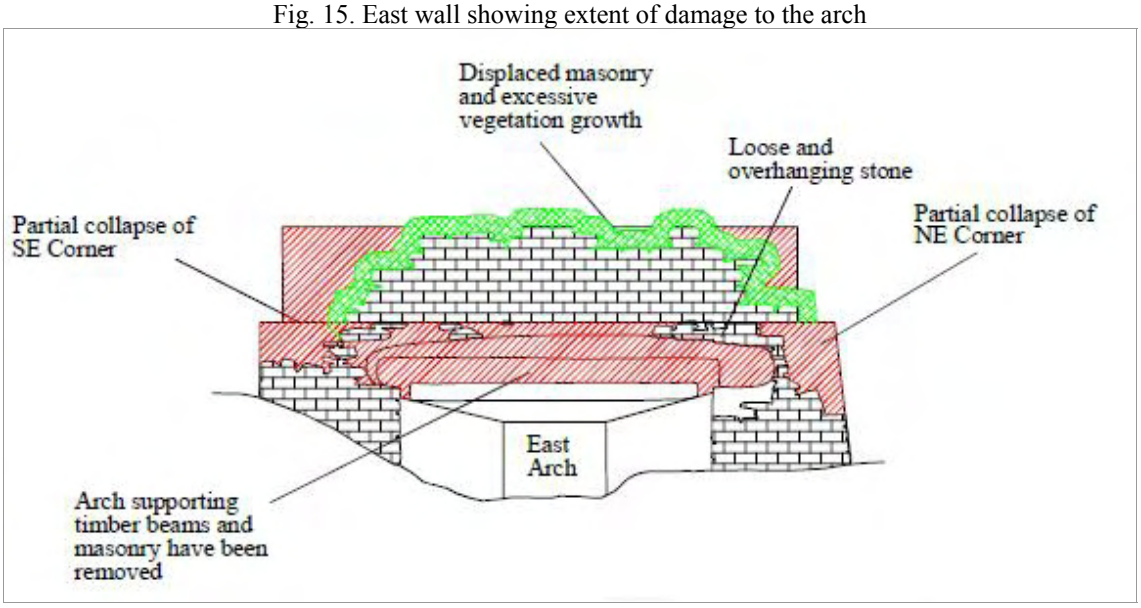

Fig. 16. Problem areas on the east wall

4.3 West & South elevation

Dangerous	
Poor	✓
Fair	
Good	
Excellent	

The South and West elevations are in a reasonably good condition structurally however there are still sections of loose masonry along the wall tops which may fall if not dealt with (Figs. 17 and 18). The west elevation is in need of re-pointing to prevent further deterioration and washing out of the joints. There is a small tree growing out from the SE corner which does not seem to be causing any major issues currently.

Works Required: Urgent

Urgent works required on these sections of the furnace include the removal and treatment of vegetation growing on the top and mid sections to prevent the further displacement of masonry.

Fig. 17. Tree growing on the south east corner

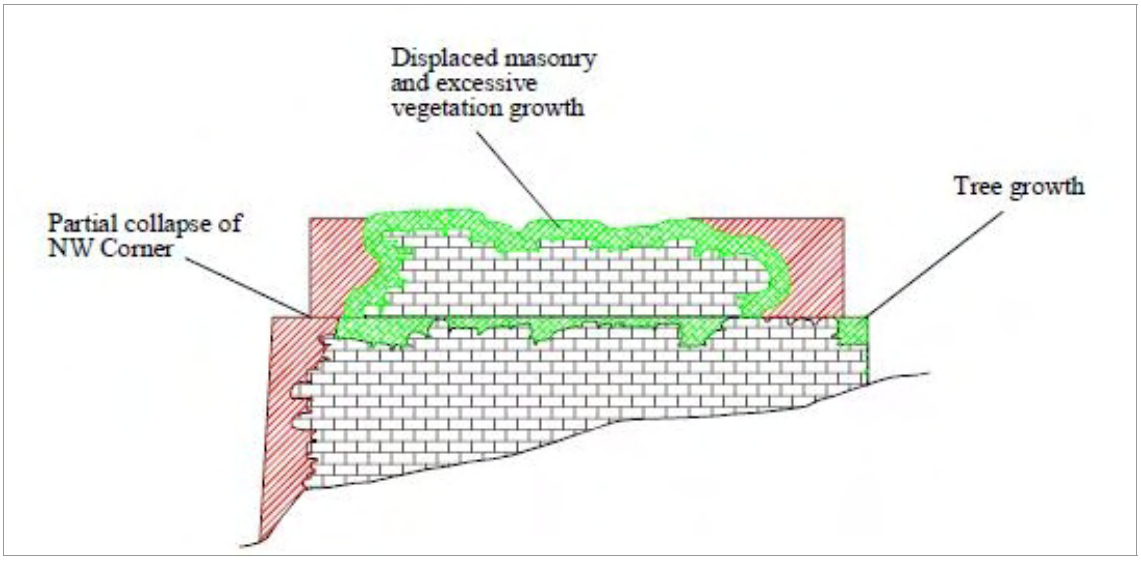

Fig. 18. Problem areas on the west wall

4.4 Recommended and Urgent Repair Works

The following works are required to prevent any further deterioration of the structures fabric and prevent also any further structural failures.

Urgent

- Securing of all loose and dislodged stones from the wall tops and inner chimney areas. The removal of some stones may be necessary to remove excessive vegetation. The trimmed back vegetation should be treated prior to the stones being re-bedded in lime mortar.
- Repair and re-point North arch to match existing with suitable stone and lime mortar.
- Repair and re-point West arch. Replacement timber lintels should be installed to match original.
- Removal and treatment of the tree growing on the SE corner. Further investigations are necessary prior to removal of the tree to be certain it is not providing any structural support to the stone structure.

Necessary

- Re-pointing in lime mortar where necessary to prevent further deterioration of the joints and mortar.

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