Thirlwall Castle: The Use of Soft Capping in Conserving Ruined Ancient Monuments

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The use of ‘soft’ or turf cappings on wall heads has gained in popularity in recent years as a conservation technique for ruined monuments. It is still, however, regarded as experimental by many conservationists and is a developing field with few notable published examples and a number of questions which still need answering. Soft cappings were pioneered at Thirlwall Castle in Northumberland, UK, twelve years ago. Recent repairs to the high wall heads have enabled an assessment of their performance which has helped to answer some of the questions and given increased confidence in the use of soft cappings in the conservation of ruined monuments.

Introduction

Britain’s rich heritage of ruined monuments is an important part of our cultural heritage. However, their wall tops lack the protection from the elements originally provided by roofs, etc. The effects of rain, frost and uncontrolled woody vegetation, which are likely to be exacerbated by climate change, can cause shattering and erosion of the mortar and stones, and cracking, jacking and destabilizing of the vulnerable wall heads. This leads to incremental collapse of the walls and loss of heritage.

For over a century, the conservation of ruined wall heads involved rebuilding them to include an impermeable water shedding surface or ‘hard capping’ using concrete, bitumen, lead sheet or stone paving slabs. ‘Rough racking’ or ‘coring’ was a development of this, using cement mortars and rubble to replicate the appearance of exposed wall core to form a cambered (sloping) profile covering the top of the wall. Though well meant, such interventions tended to be costly, disruptive and irreversible. They also reduced ecological potential and altered the authentic appearance of ruins. It is now recognized that they may actually have increased the erosion of wall faces due to water running down them and sealed water in wall heads resulting in frost damage (Figures 1 and 2).

Over the past fifteen years there has been increasing interest in the use of ‘soft cappings’, which use natural or introduced turf with grass or other growing vegetation on it to cover the wall heads. Analogous to the kind of thatch coverings used by medieval masons to protect unfinished wall tops over the winter months, soft cappings are more economic and, more reversible. They present a more natural appearance and allow water to dry out of the wall head by transpiration and evaporation, while the overhanging vegetation can provide a ‘drip’ detail that helps to direct water away from sensitive wall faces.

Scientific research by English Heritage since 2001 has tended to support these views and, significantly, confirmed that soft cappings can help to protect ruined wall heads from frost.
Figure 1. Stone slabbed wall capping (Spynie Palace, Moray) (R. Kent).

Figure 2. Disfiguring bitumen streaks betray the previous use of bitumen with cement hard capping (Kildrummy Castle, Strathdon) (R. Kent).
attack by providing a ‘thermal blanket’ effect.\textsuperscript{11,12} Parallel research by Historic Scotland has stressed the advantage of soft capping as a sustainable technique.\textsuperscript{13} However, there are still a number of questions that need answering and English Heritage research is continuing.\textsuperscript{14} For example, do turf and grass roots promote the dissolution of mortar and the breakup of ruined wall heads by organic acid leachate from the soil and roots of the turf? Does a turf growing medium encourage trees and other woody plants to take hold and threaten the integrity of the wall head, requiring more maintenance? Consequently, is soft capping appropriate for high walls that are usually less accessible and might only be revisited for maintenance every 50–100 years? How can turfs be prevented from drying out and blowing off?

Given the comparatively recent introduction of the technique, there are as yet few ‘tried and tested’ case studies, but some recent work at Thirlwall Castle, Northumberland, may help to answer some of these questions. In addition, it will hopefully give northern European practitioners more confidence in the use of soft cappings in the conservation of ruined monuments in future. It is acknowledged that other factors may preclude the use of the technique in less temperate climate zones.\textsuperscript{15}

**Thirlwall Castle**

A border tower dating from the mid-fourteenth century, Thirlwall Castle occupies a prominent position in the outstanding landscape of the Northumberland National Park (OS grid reference 6594 6615) and is the largest castle and one of the best architectural monuments in the park (Figure 3).\textsuperscript{16} It is a Scheduled Ancient Monument, a Grade 1 listed building and within the Hadrian’s Wall UNESCO World Heritage Site management area. It is significant for being constructed from stones ‘robbed’ from Hadrian’s Wall, linking the two most important historical periods for the north of England: the Roman occupation and the Border wars between England and Scotland.\textsuperscript{17}

Abandoned and ruinous for some 300 years, progressive decay due to erosion of the soft lime mortar, ground movements and uncontrolled woody (i.e. shrub and tree) vegetation growth had

Figure 3. Thirlwall Castle –a general view, 2005 (R. Kent).
left it in a dangerously unstable condition. A large collapse in the mid-1980s and the growth of mature trees on the walls underlined its precarious condition. In 1997 the Northumberland National Park Authority (NNPA) resolved to stabilize and consolidate it, and to improve tourism and maintenance access. The project lasted from 2000 to 2001. Quinquennial inspections were carried out in 2005 and 2010, and repairs to the wall heads in 2012.

**The decision to use soft capping**

As noted in the Conservation Plan, a key feature of the conservation strategy at Thirlwall was the integration of ecological and cultural values. Designated a geological Site of Special Scientific Interest (SSSI) due to the adjacent Tipault Burn and gorge, pre-consolidation ecological surveys had identified it as a habitat for two species of bats and a colony of swifts as well as other birds, which used the deeply eroded joints between the Roman facing stones for nesting and roosting.

The natural heritage value of the site and the 2 m (6 ft) thick walls suggested the use of soft capping might be appropriate, although adjacent trees and the height of the walls – up to 12 m (40 ft) high in places – and adjacent trees made careful planning for maintenance important. The use of soft capping would also ensure the familiar appearance of the castle was preserved as a well-known landscape feature. NNPA agreed that this approach would be more consistent with the aims of the project than the then more usual ‘hard’ wall capping.

**Investigative work**

The design of the soft capping was informed by visits to view other early examples of the technique such as at Fountains Abbey and Jervaulx Abbey in north Yorkshire, as well as Wigmore Castle, Herefordshire, acknowledged as the seminal example. However there were precious few examples beyond these and NNPA showed itself to be an enlightened client by acknowledging that the use of soft capping at Thirlwall was to some extent experimental.

As soon as the monument had been scaffolded an investigation of the wall heads was carried out. This demonstrated that beneath a thick sward of grass and wild flowers, the walls had been concrete capped some 30 years previously in an undocumented campaign of conservation work, probably by one of English Heritage’s predecessors. The brittle cementitious capping had cracked due to movements of the more pliable lime built walls, allowing tree roots to penetrate and water to be channelled into the wall core. The poor condition of the ‘hard’ capping and its obvious effects on the monument tended to confirm the need for a change of approach (Figures 4–6).

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Figure 4. Trees on wall heads, after scaffolding, 2000 (R. Kent).
Figure 5. Detail of original wall head condition, 2000 (R. Kent).

Figure 6. Removal of roots, 2000 (R. Kent).
The design

The design proposed soft capping on the more level ruined wall-tops and scarcements. The objective was to reproduce the appearance of the natural vegetation by using either the existing turf, but with woody shrubs and sapling trees weeded out, or by introducing Fescue grass or other durable local turf from the surrounding fields.

Given the exceptionally exposed position of the castle, which experiences very high winds, it was proposed to hold the turfs in place until they had rooted with Geocoir or similar biodegradable netting or jute string secured to split beech hooks or pegs driven into the mortar joints.

The turf was placed on a minimal layer of screened topsoil to fill hollows and ensure sufficient growing medium. This was applied to the existing consolidated wall head, built up where necessary to provide a slight slope to allow for drainage. Jagged stones and shallow hollows were specified for this to provide a key for the turf, although the intervention was minimal and in many places amounted to little more than rebedding and repointing the wall top stones. The possibility of using a clay layer to seal the wall head in one area, where there were the remains of vaulting, was included in the project planning but not carried out as it appeared unnecessary in the light of the successful consolidation elsewhere. More thorough ‘traditional’ rough racking was specified for vertical and steeply sloping parts of the wall core which would not support turf.

The mortar specified for consolidating the wall heads beneath the soft capping was informed by analysis of the existing lime mortars by the Scottish Lime Centre and tests. The mix finally adopted in consultation with English Heritage used St Astier NHL5 hydraulic lime in a 2:5 mix, the aggregate comprising three parts of Styford sand, one part of brown building sand and two parts of red Cumbrian sand. This relatively hard lime mortar mix was merited by the exposed situation and the unknowns of the soft capping. On other monuments at that time it was still normal to use Portland cement (OPC) mortar for consolidating wall heads, though the use of hydraulic lime has since become more commonly accepted for forming rough racking.

Work on site

It proved possible to lift off much of the ‘natural’ soft capping almost intact. The turfs were stored on plastic sheets on the scaffolding, where they were watered and treated with hydroponic crystals to maintain growth. The broken concrete capping was removed (a hoist had to be brought in to assist with this). In a few places where removal would have involved excessive destruction, the cement was left in situ, but generally it came away easily. The masonry beneath had been disturbed in connection with forming the concrete capping. It was therefore possible to consolidate the wall heads without disturbing archaeologically important layers. The only exception was where large roots had to be traced and dug out where they penetrated down into the wall core.

Once the mortar had reached an initial set (generally within a week but longer in cold weather), the turf was replaced after weeding out all woody vegetation. The use of natural turf ensured that the wild flower mix was preserved. Some turfs had to be introduced and these were taken from surrounding pasture.

The specification required the contractor to water the soft capping and replace any losses within the first year. It proved unnecessary to replace any turf as the grass quickly took hold, the fine roots bonding to the surface of the mortar so soon that netting also proved unnecessary (Figure 7). The only concern was that the mortar might not cure properly (e.g. by carbonation) beneath the turf or that it might be adversely affected by organic acid run-off from the soil. Despite a small amount of lime leaching after heavy rain towards the end of the summer
before the scaffolding was dropped, inspection of the monument a year later found that the mortar did not appear to be adversely affected. Indeed the protection afforded by the turf may actually have prevented accelerated drying out and aided curing of the mortar.
The quinquennial inspections

The Conservation Plan stressed the importance of quinquennial (i.e. five-yearly) maintenance inspections as recommended in BS 7913. The castle is an important visitor attraction and on two major cross-country walking routes, making safety paramount. In addition, NNPA wanted to monitor the condition of the experimental soft capping.

The first maintenance inspection of the castle was carried out towards the end of the summer, in August 2005, in the presence of NNPA staff and researchers from English Heritage. After considering a range of options for access, including abseiling and safety wires, a rough terrain access hoist was used to gain access to most of the high wall heads. These were visually inspected and photographed, with ‘hands on’ inspection also possible in several areas. The castle appeared very natural and picturesque, with a lush covering of vegetation on the wall tops.

Close inspection showed that the soft capping had survived well. Despite some seasonal drying out and loss of plants from isolated upper ledges where earth was exposed at the edges in places, more shaded lower level turfs and plants with deeper roots such as dandelions remained healthy. A hawthorn sapling was found on one wall head and several thistles, but the soft cappings were generally free of trees and other woody vegetation. This may have been partly due to the main forestry being downwind of the monument. However, a small ash seedling was found on a lower ledge and, as this was accessible from ground level, it was left in place to monitor growth.

The second quinquennial inspection was carried out in August 2010, although the high level inspection was delayed until August 2011. The soft capping was found to be lush, comprising mainly grass and annual wild flowers which would not damage the wall heads (Figure 8). As previously, earth was exposed at the edges of the turf in places. However, this did not seem to be leading to excessive erosion or adversely affecting the masonry, and the turfs generally appeared firmly held in place. Dandelions and ragwort were much in evidence but the wall heads were free

Figure 8. At second quinquennial, showing die back on top and ‘drip’ effect of soft capping at scarcements (ledges) (2011) (R. Kent).
of shrubs and tree saplings, suggesting that the grass covering may have prevented seedlings from becoming established.31

It was a different story for the more ‘traditional’ rough racking (both from the earlier and ten-year previous work) where it was not protected by turf, several loose high level stones being found in two areas, probably due to frost attack. One of these was a lump of cement that had been left in situ at the edge of the soft capping. It was decided to carry out repairs to enable these to be rebedded and to check others. At the same time, it was decided to make a thorough assessment of the condition of the soft capping.

The repairs

Observations

The two areas of the castle identified in the second quinquennial inspection were scaffolded by Heritage Consolidation Ltd in October 2012 (Figure 9). The soft capping was removed for the first time in twelve years to reveal the consolidated wall head beneath, which was inspected by the architect with representatives of English Heritage and NNPA (Figure 10).

Though adherent, the turf was capable of being peeled back and found to be homogenous. The root mass had bonded almost all the soil into a dense mat, which maintained its shape even after removal. The root mass was also shaped into the crevices and around the projecting jagged stones to the extent that it could be fitted back snugly on to the wall head like a jigsaw (Figures 11 and 12). There was no evidence of water pooling or watercourses under the soft capping, and no run-off or algal streaking at the edges. In addition, sedum growth at the edges of the soft capping confirmed that they are relatively dry. All this suggested that the turf was capable of dealing with most of the rainwater. This included the area where a clay substrate had been proposed but omitted.
The lime mortar consolidated wall head beneath the turf was hard and did not show any signs of disaggregation, cracking or damage by the roots that had anchored the turf in place. There were no signs of discolouration or mould growth and the colour and brushed texture of the surface

Figure 10. Sample area of soft capping before removal, showing lush grass covering (R. Kent).

Figure 11. Soft capping peeled back to expose wall head stones, 2012 (R. Kent).
Figure 12. Detail of underside of turf, showing shapes of wall head stones imprinted in the turf, 2012 (R. Kent).

Figure 13. Detail of mortar exposed beneath soft capping, showing ‘fresh’ brush marks made eleven years previously, 2012 (R. Kent).
appeared as fresh as it had been twelve years before when the turf had been applied, to the point that it was difficult to distinguish it from new mortar (Figures 13 and 14). One visitor to the site even thought the work had been carried out the week before! Exposed pointing that had not been covered by the soft capping, for example in areas of rough racking, was by contrast heavily discoloured by algal growth and appeared to be weathered. It was in these areas that minor repairs were needed. Finally, it was noted that overhanging grass clearly provided a coved ‘drip’ effect which directed water away from the wall faces below.

As an aside, the low level ash sapling noted in the first quinquennial was removed (i.e. after more than six years’ growth) and the tap root found to be some 300 mm long. However, it had grown sideways along the soft capping, adopting the path of least resistance and following the water and soil, rather than downwards into the relatively dry masonry, and so had not threatened the integrity of the monument.

Conclusions

The soft capping at Thirlwall provides a very effective protection for the fragile ruined masonry wall heads on an important roofless monument, confirming the experimental observations that turf cappings can protect lime-mortared wall heads from temperature extremes.

There is no evidence that roots or soil in soft capping adversely affect lime mortar used in consolidation, although this will obviously depend on the mortar specification and merits further research.

Clay or other means of sealing the wall heads was confirmed as unnecessary. It was also unnecessary to tie the turfs in place as they did not lose adhesion to the point where they could be blown off, even when they dried out in the summer.

Regular maintenance inspections and weeding out of damaging vegetation are essential for soft capped walls but need be no more onerous than for rough racked or hard capped walls.
The potential for trees and other woody growths to become established on soft capped walls appears to be no greater than on hard cappings and might even be less.

While it is acknowledged that each monument and site presents a unique set of circumstances and must be individually considered, experience at Thirlwall supports the English Heritage research findings to date and should enable practitioners to use soft capping in future with more confidence.32

Acknowledgements
I am very grateful to John Fidler for his helpful observations and contributions.

Biography
Robin Kent, MA, DipArch(Oxf), RIAS, RIBA, AABC, IHBC, RMaPS
Robin is a Director of Robin Kent Architecture & Conservation, an architectural practice specializing in heritage conservation. He has 22 years’ experience as a conservation architect, much of it in the conservation of ruined ancient monuments in England and Scotland.

Notes
1. The UK has ruined historic buildings and monuments spanning from the Roman occupation, through the dissolution of the monasteries and the civil wars of the sixteenth and seventeenth century, to more recent relics of two World Wars and industrial decline. Since the seventeenth century many of these have been viewed as picturesque and preserved for their historic and scenic value.
3. A term believed to have been coined by Sir Frank Baines (1877–1933), chief architect of the Ministry of Works (Fidler, J., personal communication, 12 November 2010).
4. Medieval walls were usually formed of two wythes of masonry with dressed outer faces, with the gap between them filled up with lime and small rubble stones to form a lime concrete core.
5. The ‘hard capping’ treatment of ruined walls was consistent with presenting ruined monuments in a way that could be easily understood by historians. See Thompson, M., Ruins, Their Preservation and Display, British Museum, London, 1981, pp. 24–32.
10. Although adding turf may appear to be an additional expense, in fact less rebuilding is required and the additional protection provided by the turf could make soft capping more durable and long lasting than ‘traditional’ rough racking.

15. For example in less developed tropical countries, where rampant vegetation and lack of maintenance could prove problematic, or in climates that are too dry to sustain turf wall cappings.

16. The name of Thirlwall is first recorded in 1239, and a castle first mentioned in 1369, around the time that John de Thirlwall was listed among the English border gentry. As lieutenant of the Earl of Northumberland, warden of Carlisle Castle and sheriff of Cumberland, he may have been the builder of the present castle. The border wars between England and Scotland lasted for much of the fourteenth century and the castle continued to be garrisoned through the English Civil War of the sixteenth century, but was abandoned by the mid-eighteenth century, when its picturesque qualities as a ruin began to be recognized. Source: *Thirlwall Castle Northumberland Documentary Survey*, unpublished report by The Archaeological Practice for the Northumberland National Park Authority, 2001.

17. The Roman wall constructed under the Emperor Hadrian between 122–128 AD during the Roman occupation of Britain to form the northernmost boundary of the Roman Empire. It runs for 80 miles across the north of England and is a UNESCO World Heritage Site.


20. The SSSI is a site with geological features of national significance which is protected under the Wildlife and Countryside Act 1981 and related legislation.


22. All three visited properties are maintained within the guardianship of English Heritage.


25. No specific maximum slope was specified as suitable for soft capping. The decision was largely an on-site judgement as to whether turf was likely to stay in place naturally or not.

26. Scottish Lime Centre Trust, Charlestown Workshops, 2 Rocks Road, Charlestown, Fife KY11 3EN, UK.

27. For example The Chantry, Walkergate, Alnwick, where the exposed wall head was consolidated and rough raked at the same time using a 1:1:6 cement mortar mix.

28. No scientific monitoring was carried out at Thirlwall. The issue of acidity from soft capping is one of the aspects that are being looked at in current research by English Heritage.


31. Ragwort was removed. Although not physically damaging to the monument, it is one of the five ‘noxious weeds’ covered by the 1959 Weeds Act (Catherides, A., personal communication, 5 December 2012).