

A new beginning for English Heritage's archaeological and architectural stored collections

AMBER XAVIER-ROWE*

English Heritage
London, UK
amber.xavier-rowe@english-heritage.org.uk

CHARLIE NEWMAN

English Heritage
London, UK

BETHAN STANLEY

English Heritage
London, UK

DAVE THICKETT

English Heritage
London, UK

LUCÍA PEREIRA PARDO

Universidade de Santiago de Compostela
Santiago de Compostela, Spain
Lucia.pereira@usc.es

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ABSTRACT

Moving over 153,000 largely robust archaeological and architectural objects from leased stores into a refurbished building on the English Heritage estate has transformed both storage conditions and community access. Conservators and a conservation scientist provided the evidence and leadership skills to successfully deliver the £1.5 million project.

INTRODUCTION

A new sustainable future for over 160,000 stored archaeological and architectural artefacts has been achieved at English Heritage. The change was driven by a combination of factors including economic downturn, conservation leadership, interdisciplinary working and community outreach. Conservation expertise was at the heart of the undertaking informing decisions and actions, which have ultimately facilitated wider research and community access.

BACKGROUND

English Heritage (EH) is responsible for over 400 historic sites across England, the majority of which are ruins and monuments. Archaeological investigations at these sites over the last century have resulted in a considerable collection estimated at 380,000 artefacts plus the archaeological archive of all associated documentary records. EH is also responsible for a collection of architectural artefacts from EH properties as well as those rescued from London buildings prior to demolition during the 20th century, which are known as the Architectural Studies Collection (ASC).

A review of EH stores in 2004 included a recommendation to reduce the number of leased buildings by storing more collections on its own estate. By 2010, this strategy had stalled as finding a solution for large collections in storage at five leased warehouses remained elusive.

Meanwhile, a national survey was completed in 2010 of the condition and risks facing moveable collections located at 115 sites. Results revealed that collections in store were at greatest risk and were actively being damaged from poor storage conditions (Xavier-Rowe 2011).

An economic downturn, combined with a change of government in the UK in 2010, resulted in an unexpected 30% cut to the EH government grant. Revisiting the stores strategy, led by the head of collections conservation, revealed the potential option of closing five leased warehouse stores and moving over 153,000 artefacts into a refurbished 1950s building in the grounds of Wrest Park near Bedford. The annual savings on lease and maintenance costs were £200,000. These financial savings, combined with the evidence that storage conditions were a major risk, produced a

persuasive argument to the EH executive board for a £1.5 million investment in the Wrest building refurbishment and collection relocation.

CONSERVATION LEADERSHIP

The project to move over 153,000 artefacts across the country in two years was an inherently risky undertaking. There was also some uncertainty as to exactly how much space would be required once the collection had been repacked. However, these risks were significantly mitigated through conservation leadership. Two conservators led the project, as project director and stores relocation manager, which proved to be crucial to the successful outcome as objective judgments could be made relating to the risk to the collections. They were supported by a strong interdisciplinary team consisting of documentation assistants, curators, museum technician, conservation scientist, mechanical and electrical (M&E) engineer, accountant, quantity surveyor and architect.

THE PLAN

The plan involved moving collections stored in four warehouses in Atcham (Shropshire) and one building in Beeston (Norfolk) to Wrest Park in Bedfordshire. This would require a 1950s building in the Wrest Park Estate to be converted into a store for archaeological and architectural artefacts and archives. It would need to house a range of materials from stone, bone, ceramic, wood and excavation records, mainly modern papers and photographs. The archaeological material consists of bulk finds, large stone pieces and small finds from sites across the west and east of England, including London. The ASC ranges from ceiling cornices and staircases to doors and fire surrounds.

The Wrest Park building was constructed of a double brick skin with half-height, single-glazed windows to three aspects and an ageing metal roof with a clerestory of glass. The building had previously been used as a vehicle workshop and offices, and had a concrete floor slab. It had significant water ingress and of even more concern was a large pressurised hot water pipe inside that ran at high level along the rear and side walls. This pipe supplied hot water to heat the mansion house. Two large oil-fired boilers located to the rear of the building powered the heating system. Whilst this would suggest that this building was not suitable for the storage of artefacts, the conservators argued that with careful planning most of the risks could be satisfactorily mitigated to allow suitable storage for specific collections of archaeological and architectural artefacts, which are comparatively robust.

ENVIRONMENTAL CONDITIONS

The refurbishment design for the Wrest warehouse involved taking a simple, pragmatic approach involving a new insulated roof, the infilling of all windows, repair and resurfacing of the cement floor, new doors and a new M&E fit out. Further details of the building specification are listed in Table 1.

PREVENTIVE CONSERVATION

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STORED COLLECTIONS

Table 1
Building specification for new store at Wrest

Speciation	Method/manufacture/supplier
Dehumidify Architectural Studies Collection to keep relative humidity below 80%; room volume 2523m ³	2 Munters MCS300 Desiccant dehumidifiers; ducting fitted to encourage circulation; wet air vented to outside Munters Limited, Pathfinder Place, 10 Ramsay Court Hinchingsbrooke, Business Park, Huntingdon, Cambs PE29 6FY
Dehumidify archive store containing archaeological small finds, paper and photographic record to 50% relative humidity and below; room volume 262m ³	1 Munters MCS300 Desiccant dehumidifier, wet air vented to outside, unit located outside the room, ducted inlet and outlet
Infill one large roller door opening	Clay facing brickwork and concrete facing blockwork to inner leaf, full fill cavity insulation with rock wool batts
Infill low level windows and doors	Clay facing and inner lead brickwork to match original, full fill cavity insulation with rock wool batts
Build partition wall between east and central bay to provide space that can be dehumidified	Timber stud partition (vacuum pressure impregnated with Vacsol Aqua preservative), steel intermediate horizontal support beams (primer high build zinc phosphate epoxy two coats) Arch Timber protection
Infill high level windows	Euroclad Linear 1 Pressure equalised Hug Rainscreen panel system; material ALPOLIC/fr composed of non-combustable mineral core (Aluminium Trihydroxide) sandwiched between 2 skins of 0.5mm thick aluminium sheet. Thickness: 40mm. Air gap: 25mm. Euroclad Facades Ltd, Wentloog Corporate Park, Wentloog Rd, Cardiff. www.euroclad-facades.co.uk
Timber stud infill behind the rainscreen cladding	Structural softwood. Preservative treatment as above.
Secondary support/framing system behind the rainscreen cladding	Cement board lining to internal face. 15mm Bitroc sheathing board to outerface. 6mm mastic joint around perimeter of outer face Bitroc panel at junction with brick reveals and lintel overhead. 6mm mastic joint to internal cement board panel and surrounding masonry and concrete lintel. Dpc at perimeter panel. Vapour barrier stapled to timber stud framing. Thermal insulation, Kooltherm K12 framing board manufactured by Kingspan 140mm total thickness (2 x 70mm boards). Vapour control barrier, polyethylene with reinforced HPDE grid manufactured by Monarflex, Lyon Way, St Albans, UK
Build inner room to be humidified to a volume of 262m ³	Timber stud walls lined with Gyproc Duraline board each side and screwed in place. Mineral wool insulation. Sealed with 2 coats of british gypsum drywall sealer. Plywood deck with single layer of reinforced bitumen membrane cold deck roof covering.
Install new roof	Support structure existing 3 by 6 inch RSJ's. Kingspan 1000LP Ecosafe Lo-Pitch roof panel. External facing material: S220GD+ZA hot dip zinc/aluminium protected Galvanised metal to BS EN 10326:20041. Finish: XL Forte Plastisol coated. Internal facing material, hot dip zinc coated steel, polyestered coated, white. Core insulation EcoSafe LPCB certificated PIR formulation. Panel thickness 100mm insulated core thickness, 135mm overall thickness. Sealant: factory applied sealant tape (Premseal BR) at junction with panels.
Infill clerestory windows	Kingspan Limited vertical laid wall cladding system, KS/1000 FL EcoSafe. Flat Insulated Wall Panel. External facings, material: S220GD+ZA hot-dip zinc /aluminium Galfan protected steel thickness 0.63mm. Internal facings: material: hot-dip zinc coated steel, thickness 0.4mm. Panel thickness 100mm
Repair and seal floor to meet 3 tonne point loading and forklift use. Original slab 225mm thick and at least 40mm of thickness is screed.	Cement repairs to floors. Shot blast floor. Applied tacky primer MT100. While tacky applied EP10:1 screed mix to fill deep irregularities from 1mm to 30mm thickness. Remmers UK Letd, Unit B1, Fleming Way Business Park, Crawley
Replace gutters and downpipes	Gutter shoots to mitigate in 100y storm to prevent overflow internally
Install new high level lighting	Tubular fluorescent lamps, colour 835.

Unusually, the works did not include installation of a heating system, which surprised the M&E engineers who raised the risk of frost and condensation events. However, armed with evidence from environmental monitoring of the previous winter (where the building remained above 5°C even in its poor condition) and the experience of stores with a similar design, the advice from the engineers was rejected and the specification proceeded with no heating.

Conservation science was used to guide decisions relating to building design and packing methods. Environments were compared between the existing and proposed stores. The collections being moved included large quantities of stone, rigid organic materials (mainly wood) and metals. Assessments were made using the new European standard for rigid hygroscopic material,¹ and published damage functions for stone, bronze and steel. The temperatures and relative humidity (RH) levels were measured in the present stores and also in the proposed new store building.

The 30-day RH average was predicted to be somewhat higher in the new store. This change was thought to present a greater risk of damage due to wood isotherms being steeper at RH levels above 65%. Hence the store was separated into two volumes, the smaller housing the ASC, which has a high proportion of wooden components. A dehumidification system was installed in this area with a set point of 75% – a compromise between risk to the collections and the energy and running costs for the equipment. The dehumidifiers have been operating since April 2013 (when the major moves in that part of the store were complete).

A year's temperature and RH is now available from the new store. For the majority of this period the collections were being moved into the store. This necessitated doors being open more than during normal operations and hence this data forms a worse case for RH fluctuations. Initial measurements were made from August 2013, when the store move was mainly complete. This data set does not cover a full year, but the first measurements allow an initial assessment of the conditions.

Figure 1 shows the calculated data from two of the old Atcham store buildings compared with the conditions in the Wrest building before refitting as a store. This was corrected to remove the impact of the large windows. Figure 2 shows the previous data from Atcham with the measured data in the dehumidified volume (2523 m³). As can be seen, the fluctuations are well within those set by the European standard, but the seasonal pattern is different. The new store does not show the seasonal variation in RH observed in the two Atcham store buildings. The uncontrolled, larger volume appears to be averaging between 50 and 88% RH (for 95% of the time).

To support damage function calculations, pollution concentrations were either measured with Palmes diffusion tubes (Palmes 1976) for the existing stores or derived from local government automated measurement site data using the IMPACT model to estimate the indoor concentrations (Blades 2002). The IMPACT model only covers nitrogen dioxide, sulfur dioxide, ozone and PM10 (particles less than 10 microns in diameter) required for the steel damage functions. Measurements were taken in the existing store buildings and externally, and simple indoor/outdoor ratios were calculated.

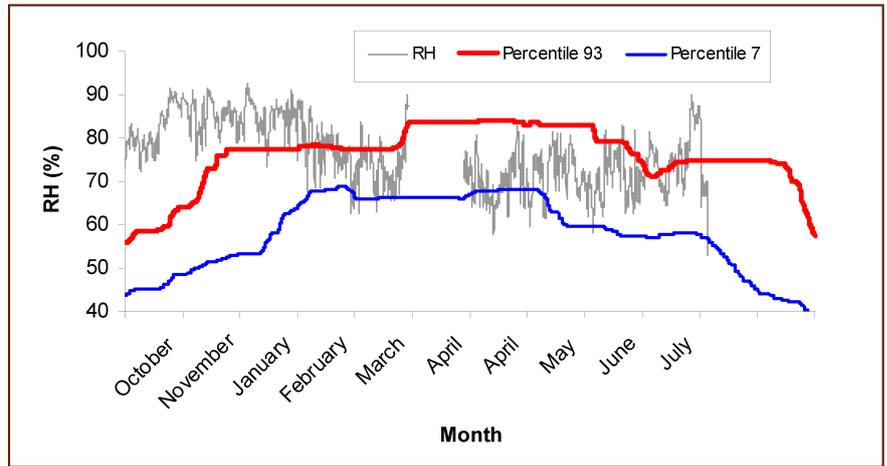


Figure 1

Limits calculated from EN 15799 for old (Atcham) store data with predicted new store environment overlaid

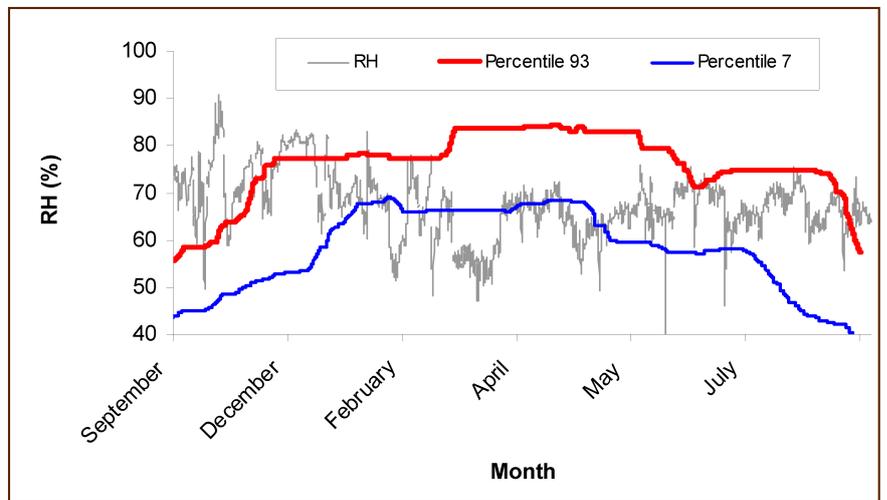


Figure 2

Limits calculated from EN 15799 for old (Atcham) store data with measured new store environment overlaid

Data from a nearby government monitoring site were used to estimate the outdoor PM10 concentration. The indoor to outdoor ratio was then used to estimate the concentration inside the new store. Little published data exists for unoccupied store-type buildings, unlike publically occupied buildings (Burton 2000). Unfortunately, people are a significant source of re-suspended PM10 and such buildings generally have mechanical ventilation systems, hence the ratios are not comparable.

Figures 3, 4 and 5 show the damage functions for stone, bronze and steel in the existing Atcham stores and the new store. As can be seen, the new store was predicted to have a similar environment to the existing storage for these materials. The initial measurement seems to agree with these predictions, but further data (at least a full year) will be required to confirm this.

Polychrome limestone from the Thetford tombs is amongst the most environmentally sensitive of the materials for the new store (Figure 6). This 15th-century material has very little binder left in the polychromy. Over 40 pieces were analysed to determine soluble salts present. A small

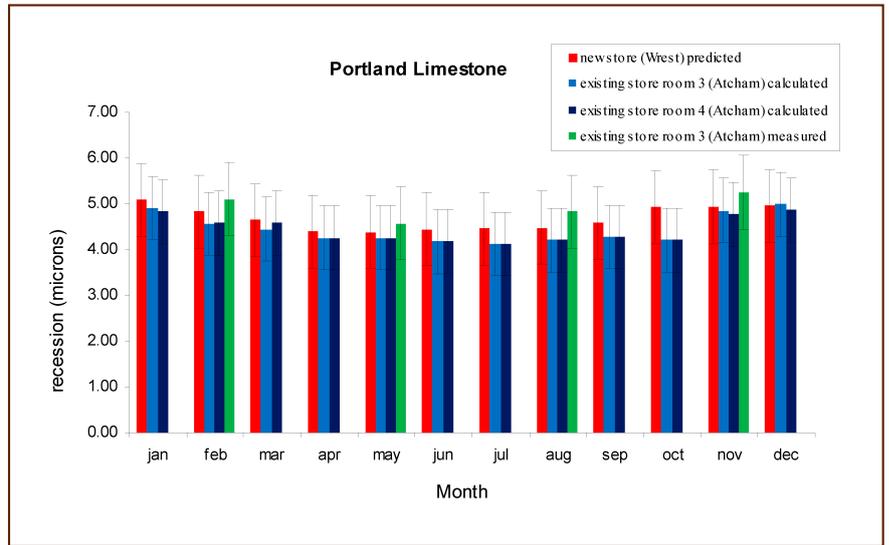


Figure 3
Damage functions for limestone in the existing Atcham stores and the new store

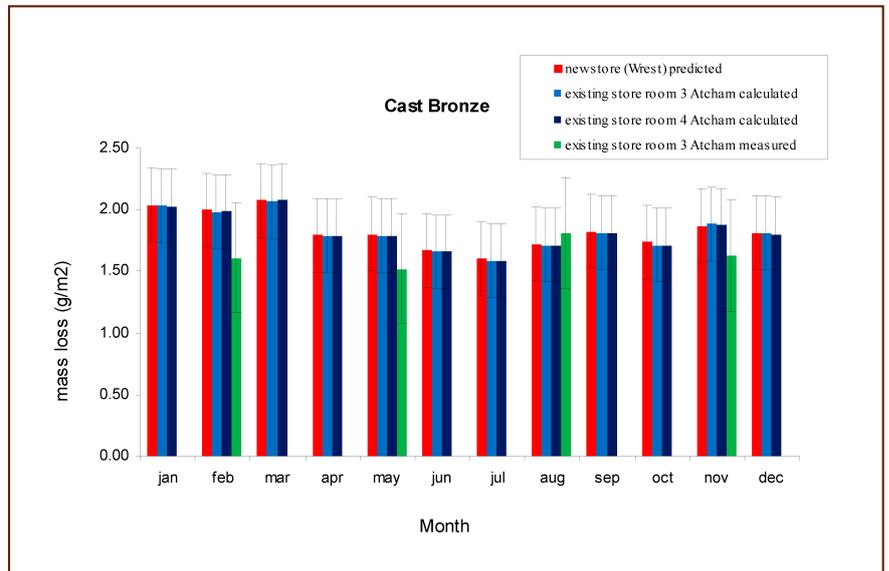


Figure 4
Damage functions for bronze in the existing Atcham stores and the new store

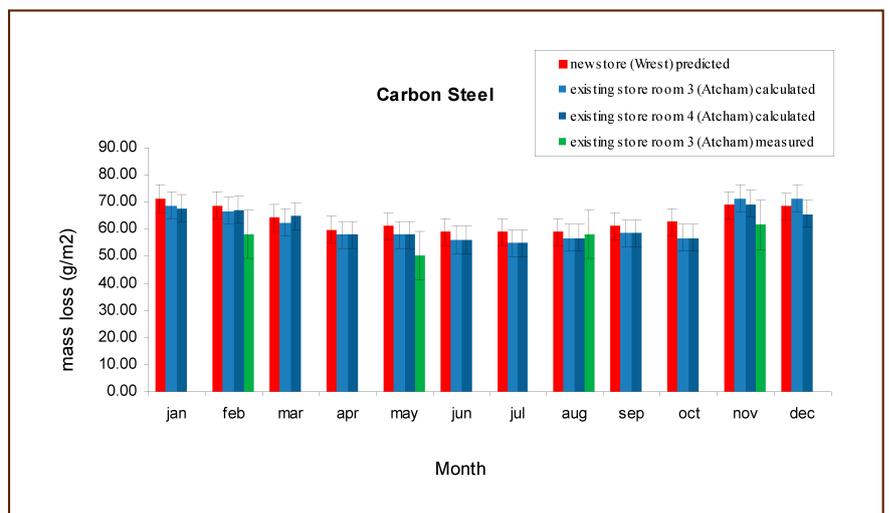


Figure 5
Damage functions for steel in the existing Atcham stores and the new store



Figure 6

Hand of St Peter holding the key to heaven from a large statue probably associated with an altar, late medieval polychrome limestone from Thetford Priory, in store at Wrest Park

Table 2

Key project costs

Dilapidations Atcham	£42,400
Dilapidations Beeston	£16,005
Retaining Atcham	£22,615
Pickfords transport	£84,391
Museum technicians	£92,550
Contract staff - packing	£43,529
Contract staff - documentation	£19,550
Pallets	£7,005
Crates	£23,152
Plastazote	£4,320
Jiffy foam	£6,269
Strapping	£1,955
Small finds and archive packaging	£7,257
Silica gel	£2,380
Stationary/hardware	£6,545
Misc	£8,986
Trolleys	£3,726
N Grange packing	£11,300
Beeston crates	£994
Fort B building works	£67,000
Fort B racking	£39,000
Fort B stacker	£15,408
Wrest Store build	£877,898
Wrest office & IT	£52,991
Wrest large racking	£56,221
Wrest roller racking	£25,645
Wrest Forklift Truck	£27,150
Environmental monitoring	£2,200
Misc other	£3,750
TOTAL	£1,572,192

sample was taken with a 2-mm drill from an undecorated break surface of the stone. The sample was weighed, dried at 110°C and reweighed, and then extracted with 18.2MΩ cm⁻¹ water. The extract was analysed with ion chromatography (Dionex 600 ion chromatograph with AS14A column with 0.02M sodium bicarbonate and 0.018M sodium hydrogen carbonate eluent at a flow rate of 0.5 ml/minute, and CS12 column with 0.018M methane sulfonic acid eluent at a flow rate of 1 ml/minute) and the concentrations of chloride, nitrate, sulfate, sodium, potassium, ammonium and calcium in the solutions were determined. The mass percentage of each salt ion in the pieces was then calculated. Almost all of the analysed pieces had sodium sulfate present (with these two ions accounting for over 95% and, in some instances, 99% of all the soluble ions determined). Most of the pieces had high salt concentration, over 0.5% by dry mass, and several showed very high levels of sodium sulfate (up to 3.5% by weight) in the stone. Surface efflorescence was observed to be removing the polychrome in the existing stores environment.

With only very small remnant flakes of pigment on many of the objects, further loss could in some instances lead to the complete loss of evidence of a particular polychromy on an object. The expansion by hydration of the sodium sulfate (which is temperature and RH dependant) was approximated using a simple spreadsheet calculation (Bionda 2006). The number of cycles when the RH passes over the sodium sulfate to sodium sulfate decahydrate line in the existing and proposed environment was calculated. The old store (Beeston) had 83 cycles per year while the new Wrest store has 34, giving a significant reduction. To reduce cycles further Art Sorb was added to the crates.

The new store had a significant quantity of archaeological metals (in polypropylene boxes with silica gel) and paper records from the excavations of the 1980s. An inner room was built to house this more fragile material and successfully dehumidified to below 50% RH. Archaeological iron and copper alloy stored in polypropylene boxes has been found to be surprisingly affected by the room RH (Thickett 2010) and can dramatically shorten the lifetime of the dry silica gel. Assessment of isoperms for paper (Thickett 2007) indicates dehumidification is a much better strategy than conservation heating, as well as being less energy-intensive in the inner room.

THE MOVE

Preparing and moving the collections took just over two years to complete, commencing in June 2011 and ending in November 2013. Table 2 outlines the key project costs. It was not possible to produce an absolute assessment of the space required, due to a number of factors including patchy or inadequate documentation, poor packing methods, as well as difficulty in accessing certain large items. Much of the material had not been examined for some time. There was also an aspiration to re-examine the collections and to potentially dispose of duplicate items, sample certain sections of the ASC and possibly dispose of items not relevant to the collections. This made it impossible to accurately estimate the number of pallets and storage volume required. The conservator's natural inclination towards organisation and influencing skills shone in this context. The project director, also a

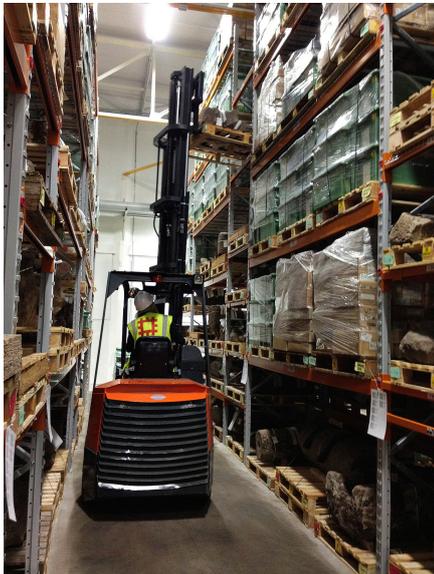


Figure 7
Locating a pallet of stone in the largest area in the store where racking is six metres high

Figure 8
Example of packing methods including stone strapped onto pallets and objects packed into green crates

conservator, was willing to take a risk on capacity predictions, confident that the right leadership and team were in place to develop pragmatic solutions.

Racking

The pallet racking design in the new store would be pivotal in maximising capacity. The purchase of an AisleMaster 20SE narrow aisle articulated forklift truck meant that narrow aisles (2100 mm) and racking heights up to six metres could be installed (Figure 7). The decision to use 1200 mm × 1000 mm four-way European pallets meant they could be located lengthways onto the shelves, allowing shorter shelves which resulted in more bays and hence capacity. Roller racking was installed in the archive room to maximise capacity.

Packing

The packing approach aimed to pack *everything* to a good, basic standard as some bulk finds had not been repacked since their original excavation. Larger objects were padded and strapped onto heat-treated wooden pallets (Figure 8). The objects remained largely visible, which aided security tracking during transport and visibility on the racking, enhancing access for both research and public tours. Each pallet was weighed and the weight recorded onto the pallet on a colour-coded label for rapid visual assessment. Smaller objects were packed in plastic crates in such a way that they could be easily seen when the lid was removed. These 'green' crates were then stacked three high and strapped onto pallets. Skeletal material was packed into brown cardboard 'long-bone' boxes and stacked onto pallets and held with strapping and plastic shrink wrapping. Small archaeological finds were held in individual press-seal polythene bags padded with polyethylene foam inserts and stacked flat in polypropylene boxes with dry silica gel bags. These boxes were stacked six high on pallets and strapped for the move, and then transferred to shelves on the roller racking. Custom-made crates were also made for large heavy objects or particularly fragile or vulnerable items.

Documentation

This project provided the opportunity to ensure that all objects have a digital record where previously only 50% did so. The new enhanced documentation system and procedures developed to track object movements between old and new stores has transformed object accessibility in the new store. EH uses Mimsy XG Version: 1.5(rv 2) as a heritage object management system (HOMS).

Each box and pallet is allocated a unique barcode, which is logged on HOMS with its associated objects. On arrival at Wrest, or if a pallet is moved within the store, each pallet's barcode is scanned to its location QR barcode² and this location is recorded on HOMS. The result of this process is that HOMS is now used to track any object to the building, aisle, bay, shelf number, pallet and box. For the first time at EH, Wifi has been installed in the store, which allows staff to immediately document object movements and ensure HOMS is always up to date.

Transport

As the majority of the material was robust, a transport company was contracted which used articulated lorries with 27-tonne soft-curtain trailers. The pallets were strapped on with an average of 25 pallets per load. Hard-sided lorries were also used to transport wall panelling. All loads complied with the EH safety advisor's stipulations, as well as all government indemnity requirements.

COMMUNITY INVOLVEMENT

Public access to the archaeological and architectural archive has been transformed. Audience research was undertaken during the summer of 2013. One hundred and twelve visitors participated in curator-led tours of the collections store and were asked to complete a feedback form.

The results were extremely positive. The overriding majority (96 to 98%) expressed an interest in the history of the collections store, felt they had learned more about the work of EH and would recommend the tour to family and friends. Although most people rated the tour as excellent, there were some suggestions to improve the experience which EH hopes to incorporate. Visitors expressed a wish to know more about the context of the objects and the history of the sites they came from, as well as the contemporary use of objects. Several people suggested that specialist talks for adults be offered, as well as tours specifically aimed at children. Although this feedback came from different groups, a pattern emerged with similar and comparable views that reflected the overall result. Most encouraging was that 98% of people would recommend a tour to their friends.

The positive comments and wish to promote EH's activities mean that next year pre-bookable 30-minute visits for general visitors and groups will be offered throughout the year. Focusing on English Heritage's work with collections and object handling, these will be volunteer-led with the support of the curatorial team. Specialist tours focusing on specific aspects of the collection (for example wallpaper and sculpture) with the collections curator will also be available, as will specific activities for family audiences to coincide with the school holidays. To sustain this level of public engagement, a dedicated volunteer team has been developed to deliver these introductory tours and assist with research of the objects and the tour content. Developing a robust and sustainable volunteering program is a key part of increasing public accessibility to the collection while maintaining standards of collections care. The volunteer team is made up of relatively local people of all ages with an archaeological interest. The volunteers' main tasks include assisting with the repacking, basic recording of the archaeological collections and conservation cleaning of the collections store and ASC objects under supervision.

A direct result of improved documentation and physical access has been the creation of a research framework for the ASC which would have been impossible to achieve in the old store. Numerous university partnerships are also being developed to increase understanding and exposure of the collection.

CONCLUSION

An underused archaeological and architectural stored collection now has a brighter future resulting from conservation leadership, judgment and practice, which has fundamentally encouraged creative community engagement and access.

NOTES

- ¹ BSI. 2012. EN 15757. Conservation of Cultural Property – Specifications for temperature and relative humidity to limit climate-induced mechanical damage in organic hygroscopic materials. London: British Standards Institute.
- ² QR Code barcodes are specific matrix barcode two-dimensional codes, readable by dedicated QR barcode readers and camera phones.

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