This brief report has been prepared for the Holkham Estate following award of a Covid Recovery Fund repair grant and following further survey work and review of proposals for repair of the Sunken Pit-houses in the East Quadrant of the Walled Garden at Holkham Hall.
This report refers to the Planning and Listed Building Consents, PF/17/0745 & LA/17/0746, obtained in May 2017 for a project addressing repairs to a series of buildings within the Walled Garden and construction of a new Education Building. Repairs to some historic garden structures have been implemented, the new proposals which formed part of the application have not been progressed.

Repair of the Bell Tower Shed and Thomas Messenger Glasshouse was completed in two phases the Bell Tower Shed in March 2020 and the glasshouse in May 2021. Repair of the Samuel Wyatt Vinery is ongoing since the start on site in August 2020 and is due to be completed in the next few weeks.

Attention has now turned to the Sunken Pit-houses in the northern portion of the east quadrant of the Walled Garden. The proposal in 2016/2017 was to repair the masonry of the glasshouses and renew the glazed timber superstructure to match the pattern of the extant existing timbers. Following further survey and analysis it is apparent that the original or earlier pattern of glazing was differently configured and sliding sashes, similar to the nearby cold frames and Samuel Wyatt Vinery to the south, existed to both glasshouses. The proposal for the South West Pit-house is now to reinstate the sliding sashes and pattern of their glazing bars to match the evidence of the historic pattern.
South East Pit-house

North wall, South West Pit-house

East pier and Bay 1, South West Pit-house

West pier, South West Pit-house
The Sunken Pit-houses form a pair of single span, lean-to glasshouses in the northern portion of the east quadrant. Additional sunken pit-houses were constructed in the north slip in the late C19 hence the glass houses in east quadrant are described as the South East and South West Sunken Pit-houses.

The enclosing walls of the Pit-houses are formed in Holkham buff facing bricks, in Flemish bond. Internally bricks are mixed in colour and are limewashed. East and west half gable walls are broad with Portland stone copings and substantial kneelers profiled on the inner face to match the roll top of the principal rafters.

At either end of the rear, north, walls are brick piers, spanning the width of the end bays, through which fine semi-circular red brick arched openings and boarded doors give access to the glass house interior via a short flight of steps. The piers have recessed brick panels facing south and tiers of moulded red bricks below a stone capping. There are chimney pots set over the capping to the west pier of the west glasshouse and east pier of the east glasshouse, continuing the symmetrical appearance.

The AHP/Dr Twigs Way, February 2016, Conservation Plan identifies the chimney pots as ‘false’, however, it is suspected that they originally vented flues from a coal fired heating system for each glasshouse, superseded by the piped district heating from the northern, gas fired, boiler at some point in the late C19. It may be that the substantial gable walls conceal the flues and that the cisterns at the west end of the west glasshouse and east end of the east glasshouse were formerly coal vaults and stoking chambers. A similar vault was found at the west end of the Bell Tower Shed during the recent repair works. The cellar below the portico of the Samuel Wyatt Vinery retains two stoking chambers flanked by coal storage for the original open flue heating arrangement.

The February 2016 CP Gazetteer extract for the SE and SW Sunken Pit-houses is attached at Appendix A. The Pit-houses cannot be conclusively dated. They are shown on the 1839 tithe map and Hot Houses and Forcing Frames are referred to in an 1817 guide. The methods of construction, quality of materials, angles of glass etc. suggest that these Pit-houses are contemporary with the Samuel Wyatt Vinery and are some of the earliest buildings constructed within the Walled Garden, 1780-1807, originally producing pineapples and/or melons.

Both glasshouses are in an advanced state of decay. Paint is retained to lower surfaces of timber rafters but none is in evidence to surfaces exposed to weathering. The SE Pit-house retains approximately 75% of its glass.
South West Pit-house Bay 4
Bay 4 interior north wall slot
South East Pit-house, Bay 20 SP1 and P1 fixings
Bay 4 Sash purlin SP1 and sash cord boss
Bay 4 north wall slot and counterweight
South West Pit-house Bay 4
The original form and operation of the glasshouse appears to have been fixed glazing to the two end bays at east and west and a series of counterweighted sliding sashes between. The half brick slots for the counterweights have been retained in bays 4, 10 and 17 of the SE Pit-house and have been infilled otherwise, the straight joints are visible to both the SE and SW Pit-house rear internal walls and the soft red bricks used for infill in many cases have spalled or lost their limewash. Bay 4 of the SE Pit-house contains a rectangular counterweight, assumed to be original, and pulley. When the sash is drawn up into the closed position the counterweight sits across the face and closes the cast iron vent, through the north wall, at low level.

The east glasshouse is considered to be closest to the original form and retains much of the metalwork and timber for the sliding sashes. The single span rafters are chamfered on the lower face. Rebates for the sashes have a drip groove and the upper edge of the rebate has a slim copper strip as a running edge for the truckles set into the sash stiles. The top of each rafter is formed as a roll profile, mimicked by the roll edge to the stone coping at each end of the glasshouse. Rafters are braced by two oval section iron purlins, P1 and P2, twice face fixed through a ‘tear drop’ end plate at approximately third points.

The eaves and ridge plates to the SE Pit-house are 290x120mm. At the ridge there are additional capping pieces to cover and weather the head of the sashs. Rafters are morticed into the eaves plate and possibly the ridge also, not accessed at present.

The 16 No. sliding sashes to the SE Pit-house are formed of 50x50mm rebated timber stiles, with 50x44mm glazing bars, 155x 50mm rebated top rail and 205x32mm bottom rail. The glazing bars are spaced and strengthened by flat bar purlins, SP1 and SP2, fixed to the stiles through a plate rebated into the underside. The upper purlin, SP1, has a central teardrop shaped boss and loop for connection to the counterweight cord. The existing sashes to the SE Pit-house each have two glazing bars, however the top rail of all sashes show mortices for four glazing bars and the iron sash purlins are similarly drilled and countersunk for fixings to four bars. Four glazing bars is assumed to be the original form, the section size may have been smaller in this case. It is to be noted that the sashes to the Samuel Wyatt Vinery each have 4No. glazing bars at 50x26mm rebated section, the SWV sashes are 1320W x 2830L and those to the Pit-houses approximately 1100W x 3350L. As with the Samuel Wyatt Vinery the sliding sashes to the SE Pit-house have truckles at least on the underside of the stiles. Without dismantling it is not possible to see whether there are truckles fitted to the jamb also.

The SW Pit-house is much altered, the bay arrangement is similar, there is an extra bay to the SW Pit-house 21 No. in total compared to 20No. to the SE. Some rafters may be original and have been adapted to accommodate fixed glazing to the lower 75% of the span by planting a batten into the sash rebate.

The spacing of the two central glazing bars is maintained giving an odd arrangement of narrow centre pane – the original size - and wide side panes. Sashes are stopped short at the head with a transom and a hinged top light introduced below the ridge. The ridge plate has been removed and a cast in-situ concrete capping installed to the north wall in-lieu. Iron rafter straps are cast into the capping and bolted through either side of the rafter ends. Each glazing bar has been rebated into the eaves plate at the foot of the pitch. The fixed sash at the east end has been replaced as evidenced by the lack of mortices for glazing bars and the roll top to the replacement east stile of the fixed light - duplicating the carefully profiled coping edge.

At the west end of the SW Pit-house there are brick arched openings in the south and west walls. The south opening is largely obscured and obstructed by the C19 large bore heating pipes and the shallow vault appears to be filled to floor level with rubble. The opening in the west wall has been partially bricked up and dwarf brick walls form a sump over the floor inside the glasshouse. The west vault extends approximately 1500mm west of the west gable and the invert from external ground level has been measured as approximately 800mm below the glasshouse floor level. Access is restricted to the reduced opening and from this viewpoint it appears the lower walls have been lined with patent cement to form a cistern.

A variegated ivy and other woody growths have taken root in the south-west corner, in the cistern, and have grown through the brickwork of the west gable and west pier, disrupting the masonry at all levels.
The 2016/2017 proposal was to renew the timber superstructure and glazing to the pattern as found to each Sunken Pit-house.

The aspiration for the South-West Sunken Pit-house is now to replace the glazed timber superstructure to the historic pattern and form in line with the recent detailed survey and analysis. It is proposed that the timber superstructure is formed with two fixed lights each with 5 glazing bars, six panes, at east [Bay 1] and west [Bay 21] gables. Between Bays 1 and 21 it is proposed to form 19 equal bays, each with 4 glazing bars, five panes, of these Bay 2 and Bay 20 are also fixed lights and Bays 3 to 19 are sliding sashes complete with replacement ironmongery and fittings. Stainless steel sprigs and spacers will be utilised for the glazing to overcome issues with rusting in the case of the sprigs and to raise the bottom pane clear of the bottom rail of the sashes to reduce the risk of algae growth and discolouration.

The counterweight pockets to the north wall will be re-opened and the south wall itself re-built above external ground level and timber louvres installed to mirror those to the south wall of the SE Pit-house. Bricks will be salvaged and re-used wherever possible and matching facing bricks sourced from the store at Holkham where necessary.

The cistern at the west end of the glasshouse will be drained, cleaned out/de-sludged and the vault inspected and repaired. Existing drains and gulleys will be cleared and the routes traced. It is envisaged that the cistern will be re-used as a soft water store.

The proposed repair and renewal of the timber superstructure is necessary due to the advanced decay of the existing framing. The present format of the SW Pit-house is of more recent adaptation, date unknown, it has evidently decayed more rapidly than the historic pattern to be seen at the SE Pit-house.

The evidence of materials, techniques of operation, metalwork and ironmongery indicate that both Sunken Pit-houses are of an early date, late C18 or contemporary with the Samuel Wyatt Vinery. There is sufficient evidence from the two glasshouses combined to restore the SW Pit-house to its historic form.

The following pages juxtapose the drawings submitted for the 2017 consents with the current proposals for comparison.
Appendix A

Extract from Holkham Walled Gardens CP,
Gazetteer
| 1G SW sunken pit-house | The SW sunken pit-house is one of a matching pair. It is a lean-to greenhouse with brick walls of Flemish bond. The former glass frames were at about 20 degree angle. At either end there is a tall pier with recessed brick panels and moulded bricks; that to the W has a (false) square chimney pot. The piers contain the arched entrance doors down into the greenhouse, framed by brick arches. The E and W walls have stone copings. Below the ground just to the W of the greenhouse is an access hatch into the water reservoir for the building. The rear wall has small ventilation grilles the size of a brick header, as well as two larger iron rotary ventilators. The former louvered openings in the S wall have been blocked. Just in front of the S wall is a clay gulley. |
| These pits were most probably originally for the production of pineapples and/or melons. Holkham was producing pineapples from glazed ‘frames’ before the building of the ‘New Garden’ and it seems unlikely that no pine pits or frames were constructed at the time of the new gardens’ construction in c1780-86. However pine pits are first referred to at Holkham in the period of the New Kitchen Garden in 1844, when new heating apparatus were purchased for the pits (C. Hiskey) and early in the following year (1845) a £15 bill for painting and glazing the ‘new Pine Pits’ was paid, suggesting that these were either being replaced or supplemented. This was obviously successful, as in the At their height of popularity in the early-to-late-C18, pineapples were most usually grown in a system of pits and stoves, which by the 1720s included making hot beds within the pits of tan bark and sinking the potted pines into these, with further heat and moisture via moist bottom heat and warm air flues. By 1754 pineapple stoves 50 ft long and containing upwards of 120 pines were not unusual, with beds typically eight feet wide. Introduction of new cultivars in the 1820s and the ‘Cayenne’ pine in 1830 resulted in year-round fruiting. This in turn meant that the pine plants occupied space all year round and in turn resulted in specific glasshouses or pits being devoted to them, often |}

A survey of the underground spaces in the garden will establish the extent of the water tanks associated with the pit-houses. These have archaeological significance.

See policies 3, 4, 5, 8, 9, 10, 13, 15, 16

This is in very poor condition. The 2014 condition survey recommended works to all parts of the building, notably the replacement of the rotten timber frames, the replacement of their glass, and the removal of damaging plant growth.

See policies 3, 4, 5, 10, 15, 16

AHP: Holkham Walled Gardens CP; Gazetteer, February 2016
Three steps (brick at the W, stone at the E) lead from the doors down into greenhouse, while a brick basin at the W provides access to the water reservoir and originally would have maintained the correct moisture in the greenhouse. The floor is of concrete. There are cast-iron bench standards (but no tops) below which pipes run along the N and S walls. The inside of the N wall is rendered and the slots for the sash weights have been filled in.

Early 1850s pines were plentiful enough to be being sent from Holkham to London for sale in the markets (along with other fruits). On 7 March 1853 an estimate of ‘works’ to the New Pinery was accepted from Messrs Watson, and hot water apparatus was also repaired and relayed to the Pine Pits.

Methods of construction, angle of glass, etc. have led to suggestions that this is one of the older glasshouses within the walled garden, contemporary with the Wyatt Vinery, and the original lean-to glasshouses backing onto the bell tower shed and the potting shed. This places the construction at 1780-1807. ‘Hot Houses and Forcing Frames’ ‘worthy of notice’ were noted by Dawson in his 1817 Guide. Buildings in the position of the pits are shown on the 1839 tithe map and again in 1843, and by 1886 are shown as hatched glasshousing.

Later adaptations to the pits appear to have taken place, and on the 1913 plan of the proposed Carnation House and Muscat House, the sharing with other exotic fruits or even vines (John Claudius Loudon included a Vinery/Pinery in his 1806 Treatise of Forming, Improving and Managing Country Residences). A sunken house/pit is shown in Shaw’s (1794) description of forcing houses and is used for exotics - in particular the pineapple, being too shallow to force any fruit trees. The shallow angled glass was to get a maximum of sun for small plants in the hot bed in the rear against the wall during the warm season.

As the pines required little ‘head room’ (typically no more than four feet), from the 1820s onwards many estate gardens created specific long low runs of ‘pits’ rather than ‘houses’ for the fruits. These were often span-roofed or ‘lean-to’, on a low brick support wall, in runs of so many ‘lights’ (individually moved hinged frames of glass). Typically the pits contained hot water pipes with staging above, and tan bark or oak leaves in plunge beds, providing constant heat and some moisture. The young plants occupied the perimeter beds along the
sunken house to the W is named ‘The Old Carnation House’.

sides of the pit where the eaves met the outer walls, while the fruiting pines (being taller) occupied a central bed beneath the ridge. Where pits were single slope (lean-to or ‘frame’ style) the taller plants would be placed at the back. This system continued on many estates until WW1, although improvements in transport and the relocation of the pineapple growing industry to the Azores meant that pineapples were increasingly imported.

The date of this building has not been established. It was in existence by 1839 and may even date from the late C18. Due to its potential early date and the high quality architectural detailing, it has considerable significance.

The 2014 condition survey recommended works to all parts of the building, notably the replacement of the rotten timber frames, the replacement of their glass, and the removal of damaging plant growth. A survey of the underground spaces in the garden will establish the extent of the

| 1H SE sunken pit-house | One of a matching pair with the SW sunken greenhouse, although here all the glazed frames are still intact. A lean-to greenhouse with brick walls of Flemish bond. At either end there is a tall pier with recessed brick panels and moulded bricks; that to the E has a (false) square chimney pot. The piers contain the arched entrance doors down into the greenhouse, framed by brick arches. The E and S sides of the pit where the eaves met the outer walls, while the fruiting pines (being taller) occupied a central bed beneath the ridge. Where pits were single slope (lean-to or ‘frame’ style) the taller plants would be placed at the back. This system continued on many estates until WW1, although improvements in transport and the relocation of the pineapple growing industry to the Azores meant that pineapples were increasingly imported. The date of this building has not been established. It was in existence by 1839 and may even date from the late C18. Due to its potential early date and the high quality architectural detailing, it has considerable significance. | See entry for the SW sunken pit-house, above. On the 1913 drawing for the Muscat House by Mackenzie & Moncur the SE sunken pit-house is labelled ‘existing carnation house’. | See general discussion under SW Sunken pit-house (above). The date of the building has not been established. It was in existence by 1839 and may even date from the late C18. Due to its potential early date and the high quality architectural detailing, it has considerable significance. | The 2014 condition survey recommended works to all parts of the building, notably the replacement of the rotten timber frames, the replacement of their glass, and the removal of damaging plant growth. A survey of the underground spaces in the garden will establish the extent of the |
| E end | Interior, looking E | W walls have stone copings. Below the ground just to the E of the greenhouse is an access hatch into the water reservoir for this building. The N wall has two large rotary ventilators hidden under uPVC louvres. The S wall has timber louvred openings: five large ones to the E and 5 small ones to the W. The frames have fishtail glass. Just in front of the dwarf wall is a clay gulley. There are metal shading rails along the N and S walls.

Four steps (of brick at the W, of stone at the E) lead from the doors into greenhouse, while a brick basin at the W provides access to the water reservoir and maintains the correct moisture in the greenhouse. The floor is of concrete. There are tables on cast-iron bench standards below which pipes run along the N and S walls. The rear wall has small decorative ventilation grilles at the outside floor level; inside, these line up with the sash weight slots on the inside of the N wall. |
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water tanks associated with the pit-houses. These have archaeological significance.

See policies 3, 4, 5, 8, 10, 13, 15, 16