

**BARBICAN THEATRE LIGHTING WINDLASSES**  
**The Barbican Theatre**  
**Barbican Centre, Silk Street**  
**London EC2**

City of London

Standing building report

September 2009

**BARBICAN THEATRE LIGHTING WINDLASSES**  
**The Barbican Theatre**  
**Barbican Centre, Silk Street**  
**London EC2**

City of London

Standing building report

Site Code: BTK09

National Grid Reference: 532440 181810

Project Manager	Sophie Jackson
Reviewed by	Emma Dwyer
Author	Michael Tetreau
AutoCAD	Valeria Boesso
Graphics	Judit Peresztegi
Photography	Maggie Cox

**Museum of London Archaeology**  
**© Museum of London 2009**

Mortimer Wheeler House, 46 Eagle Wharf Road, London N1 7ED  
tel 020 7410 2200 fax 020 7410 2201  
molas@museumoflondon.org.uk  
www.museumoflondonarchaeology.org.uk

## Summary

Museum of London Archaeology was commissioned by the Barbican Theatre to record stage-lighting windlasses prior to their removal. The 10 hand-operated windlasses were in position on the grid at the top of the fly tower and were used as reels for electrical cables supplying power to lighting bars suspended above the stage. They were custom-designed and built specifically for the Barbican Theatre, as part of its original complement of stage machinery, in order to allow for non-motorised handling of considerable lengths of heavy cable. The Barbican complex, including the Barbican Centre within which the theatre is located, is statutorily listed as being of architectural and historic interest, Grade II. The theatre's stage equipment is considered to be covered by the listing, and afforded protection accordingly. Recording of the windlasses took place in May 2009.

Each windlass comprised a set of reels solidly fixed to a single horizontal axle. As the axle turned, lines would either be reeled in or out depending on which way they had been wound onto the reels. Wound in one direction on any windlass's largest reel was a set of electrical cables and a wire rope leading to a box of lighting power points. The wire rope supported the box as it hung below the grid, with the cables supplying the power for the lights. Wound in the opposite direction on the second largest reel was a wire rope to lift a counterweight. As the lighting cable was paid out, the counterweight hauling line was reeled in, and *vice versa*. The counterweight was a heavy chain suspended such that as the windlass's counterweight hauling line was reeled in, it took up an increasing proportion of the chain's weight, in order to balance the increasing weight of lighting cable being lowered at the same time.

Power for the lights was supplied through solid connections from fixed sources on the grid to the moving cables by means of a third, drum-like reel on the windlass axle. Electrical cables from the fixed source were spooled around the drum and passed through the drum cylinder into its interior, from which they ran to the inside of the large lighting-cable reel. They were run into the lighting-cable reel from inside to outside as well, enabling the cables to remain in a fixed relation to each other as the windlass rotated. When the windlass was turned so that the lighting-cable reel let out its lines, the electrical supply drum let out its cables to hang down into the upper area of the fly loft. When the windlass turned in the opposite direction to reel in the lighting cables, the electrical supply drum also reeled back in its cables. The drum was of a much smaller diameter than the lighting-cable reel, and so even at their lowest, the dangling power cables would not interfere with the equipment lower down in the loft.

## Contents

<b>1</b>	<b>Introduction</b>	<b>1</b>
1.1	Site background	1
1.2	Legislative and policy background	1
1.3	Origin and scope of the report	2
1.4	Specific research aims	2
1.5	Summary of the building and conventions used	3
<b>2</b>	<b>Analytical Description of the Lighting Windlasses</b>	<b>5</b>
<b>3</b>	<b>Conclusions, Publication and Archiving</b>	<b>8</b>
3.1	Realisation of the research aims	8
3.2	Publication and archiving of the results	8
3.3	Copyright	8
<b>4</b>	<b>Acknowledgements</b>	<b>9</b>
<b>5</b>	<b>Bibliography</b>	<b>10</b>
<b>6</b>	<b>Appendix 1 – OASIS form</b>	<b>11</b>
<b>7</b>	<b>Appendix 2 – List of Photographs Taken On site</b>	<b>14</b>
<b>8</b>	<b>Appendix 3 – List of drawings made on site</b>	<b>20</b>



## List of Figures

*Cover: Looking north-west (downstage) from near the back of the grid (just to left of centre stage) showing windlasses 6 (partially, at extreme right), 8 (near right), 7 (centre left) and 9 (far left)*

*Fig 1 Site location*

*Fig 2 Lighting windlass arrangement, May 2009 (edited drawing based on grid floor plan supplied by BITE: Production Office, Barbican Theatre, with additions based on MOLA observations)*

*Fig 3 Lighting windlass elevation drawings*

*Fig 4 Counterweight system: increasing uptake of chain balances increasing weight of cable let out when lowering socket box*

*Fig 5 Electricity supply system: linking fixed electricity supply box (on windlass support frame) to mobile electricity supply box (attached to spokes of lighting-cable reel)*

*Fig 6 Photograph of windlass 5 front elevation (looking N, ie toward stage right)*

*Fig 7 Photograph of windlass 8 back elevation (looking N, ie toward stage right)*

*Fig 8 Photograph of windlass 8 cable-head-side elevation (looking W)*

*Fig 9 Looking SW (ie toward downstage stage left) at windlass 6, showing lighting cables and hauling line running off of lighting-cable reel to cable head pulley (between windlass support rails)*

*Fig 10 Looking SW (ie towards upstage stage left) at windlass 7*

*Fig 11 Looking S (from downstage, stage right, looking toward stage left) at sub-grid level, showing the socket boxes hanging just below the grid – the socket box of windlass 1 is facing the viewer at right*

*Fig 12 Looking down and to S (ie toward stage left) at windlass 6, showing the counterweight hauling line running to the counterweight head block (at the bottom of the support frame)*

*Fig 13 Looking up and to SE (ie upstage and toward the centre from stage right), showing the vertical diversion block below windlass 1 (suspended from the grid directly below the counterweight header block) – this block diverts the counterweight hauling line to run horizontally upstage, towards the back of the fly loft. A horizontal diversion block just visible at the extreme left diverts the line toward the array of loft blocks as shown in Fig 2*

*Fig 14 Looking downstage (to W) from the sub-grid gallery at the back of the fly loft, showing the suspended socket boxes, with the counterweight hauling lines running below the grid (overhead)*

- Fig 15 Looking up and to SW (ie toward downstage stage left), showing the counterweight loft block array suspended below the grid at the rear of the fly loft*
- Fig 16 Looking SE (from downstage, stage right, looking toward the centre back of the loft) at sub-grid level, showing the bars hanging in the fly loft below the grid – the windlass counterweight hauling lines run down from loft blocks at the back of the loft, in front of the stairs at centre left*
- Fig 17 Looking down and to SE (ie upstage and toward the centre from stage right) from sub-grid level, showing the counterweight chains (wrapped in blue plastic) suspended in front of the galleries at the back of the fly loft (at left)*
- Fig 18 View of counterweight head side of windlass 5 (looking W, ie downstage) – showing fixed electricity supply box attached to windlass support frame in front of reels (electricity supply reel [multi-sheaved drum] on left, counterweight reel in centre, lighting-cable reel at right)*
- Fig 19 Detail of axle at front of windlass 5 (looking N, ie toward stage right), with hub of electricity supply reel (showing cable passing into centre of drum, from where it ran to lighting-cable reel)*
- Fig 20 Detail of hub of lighting-cable reel at back of windlass 8 (looking NW, ie toward downstage stage right), showing electrical cables running from hub of electrical supply reel up into bottom of mobile electricity supply box (fixed to spokes of lighting-cable reel), with lighting cables running out from top of box, through inner cable guide, and then through hole in the reel (at right) to spool between the outer cable guides*
- Fig 21 General view of grid looking upstage and towards the centre (ie SE) from downstage-most stage right*
- Fig 22 General view of grid looking inward (southward) from stage right (approximately halfway upstage)*
- Fig 23 General view of grid looking downstage (to W) from near the back of the grid, centre stage, showing windlasses 4 (in the distance, right), 5 (near right), 6 (near, left) and 7 (in the distance, left) – other windlasses are visible to either side*

# 1 Introduction

## 1.1 Site background

The Barbican Theatre is located in Silk Street, within the City of London (EC2Y 8DS). The theatre is one component of the Barbican Centre, within the larger development known simply as the Barbican. The approximate centre of the theatre building is at National Grid reference 532440 181810.

The Barbican Theatre was opened in 1982 as a custom-designed performance space for the Royal Shakespeare Company; however, the company left the theatre in 2002 (English Heritage, n.d., Ludlam 2007, 3, 7). Modifications to the theatre have been proposed in order to better suit varied requirements in the future. Among these modifications is the removal of large lighting-cable windlasses that were custom-built for the theatre.

The Barbican is statutorily listed as being of architectural and historic interest, Grade II, and this listing covers the theatre, including its stage equipment. Thus, the windlasses were afforded the protection of statutory listing.

## 1.2 Legislative and policy background

In 1994, the Department of the Environment published its *Planning Policy Guidance Note 15: planning and the historic environment* (PPG15). This sets out the Secretary of State's policy on historic buildings, spaces and structures – or their visible remains – and provides recommendations, many of which have been integrated into local development plans. The key points in PPG15 can be summarised as follows:

It is fundamental to the Government's policies for environmental stewardship that there should be effective protection for all aspects of the historic environment. The physical survivals of our past are to be valued and protected for their own sake, as a central part of our cultural heritage and our sense of national identity. They are an irreplaceable record which contributes, through formal education and in many other ways, to our understanding of both the present and the past. ...  
(DoE 1994, Paragraph 1.1)

The Secretary of State attaches particular importance to early consultation with the local planning authority on development proposals which would affect historic sites and structures, whether listed buildings, conservation areas, parks and gardens, battlefields or the wider historic landscape. There is likely to be much more scope for refinement and revision of proposals if consultation takes place before intentions become firm and timescales inflexible.  
(DoE 1994, Paragraph 2.11)

Local planning authorities should also consider, in all cases of alteration or demolition, whether it would be appropriate to make it a condition of consent that applicants arrange suitable programmes of recording of features that would be destroyed in the course of the works for which consent is being sought.  
(DoE 1994, Paragraph 3.23)

For the City of London, protection of listed buildings is addressed by the following policies (City of London 2002, 153–154):

- Policy ENV 15 – 'To resist the demolition of listed buildings.'

- Policy ENV 16 – ‘To grant consent for the alteration of the exterior or interior of a listed building only where this would not detract from its special architectural or historic interest.’
- Policy ENV 17 – ‘To encourage new uses for listed buildings, which are not detrimental to the character or special interest of the buildings.’
- Policy ENV 18 – ‘To resist development which would adversely affect the setting of a listed building.’

### 1.3 Origin and scope of the report

The Barbican Theatre has proposed the removal of large lighting windlasses from the grid over the stage, in order to create a more open grid area for increased flexibility of use. A conservation report on the lighting windlasses was produced for the Barbican Theatre by Theatreplan in 2007 (Ludlam 2007). This report discussed the origin and significance of the lighting windlasses and made recommendations regarding their removal. Subsequently, the Barbican Theatre commissioned Museum of London Archaeology to record the lighting windlasses, with the understanding that 9 of the 10 windlasses were to be removed and the 10th to be left *in situ*.

Recording work was completed in May 2009, and the results are presented in this report. The recording work, and this report, are intended to supplement and not duplicate the contents of the conservation report (Ludlum 2007). It is understood that one windlass is to remain in position and to be maintained in demonstrable working order. It is also understood that the counterweight chains are to be left in place.

Within the limitations imposed by dealing with historical materials, the information in this document is, to the best knowledge of the authors and MOL Archaeology, correct at the time of writing. Further archaeological investigation or more information about the nature of the present building may require changes to all or parts of the document.

### 1.4 Specific research aims

As a survey designed to generate an analytical record, the work corresponds to the form of record and reporting at Level 3 in the specifications *Understanding historic buildings: A guide to good recording practice* recommended by English Heritage (EH 2006), albeit with a narrow focus on the windlasses rather than the theatre building at large.

The archaeological investigation has concentrated on recording the general form and dimensions of the windlasses, elucidating the way in which they operate, and describing their layout in relation to the grid and fly system. Measurement and note taking were supplemented by a photographic record of the windlasses and their general arrangement in the fly loft. Measurement, on-site drawing and note-taking were carried out with the aim of creating the following drawings:

- measured elevation drawings of the windlasses from the front (showing all three reels) and from at least one side
- one or more analytical diagrams, as necessary to elucidate the operation of the windlasses; and
- a plan of the grid showing the arrangement of the windlass system, to be based on the grid drawing supplied by the client.

## 1.5 Summary of the building and conventions used

The Barbican Theatre, on the south side of Silk Street, was designed by architects Chamberlin, Powell & Bon with structural engineers Ove Arup & Partners, mechanical and electrical consultants Buckle & Partners, acoustic consultant Hugh Creighton, and lighting, stage equipment and sound consultants Theatre Project Consultants Limited (Russell 1982, 69). Theatre Project Consultants Limited joined the project team to complete the work of original lighting, stage equipment and sound consultants Hall Stage Equipment Ltd, who had ceased trading (Russell 1982, 69).

The Barbican Theatre is a proscenium theatre with three balconies (Circle, Upper Circle and Gallery) in addition to floor seating (Stalls). The stage is to the west of the seating, below the fly loft (the space above the stage where scenery and lighting can be suspended). The fly loft extends upwards within the fly tower for 33m above the stage, to the floor of the grid. The grid – literally a grid of steel beams – is situated near the top of the fly tower and is covered with perforated steel flooring. Scenery and lighting are suspended from the grid, or from equipment sitting on the grid floor or fixed to the ceiling above. The fly loft of the Barbican Theatre was built much taller than is typical, in order to give the Royal Shakespeare Company additional space above the stage to store scenery ready for use (Ludlam 2007, 3; Russell 1982, 68). As a repertory company performing seasons of several plays, it was convenient for them to set up all of a season's plays at the outset. The lower portion of the loft was to be used to fly in and out (lower and raise) scenery for a single performance, with the upper part used to store scenery from other shows in the company's repertoire (Russell 1982, 68).

According to the lighting windlasses conservation report (Ludlam 2007, 3), the lighting arrangement would be designed to be fixed for an entire season, although suspended lights would need to be raised and lowered at scene changes and for maintenance. Thus, the facilities for suspending lights needed to be vertically mobile during a season, but could require horizontal mobility between seasons, to facilitate new lighting designs. The 10 lighting-cable windlasses under investigation were arranged across the grid floor and were designed to supply electrical cable to lights suspended from bars over the stage (cf Parkey 1982), taking the weight of the cables and picking up or reeling out cable as needed when the bars were raised or lowered. The design of the windlasses meant that there was some flexibility with regard to the location from which a windlass dropped cable into the fly loft, as needed between seasons. The windlasses themselves could, at least theoretically, also be moved along tracks running from the downstage side of the grid (toward the audience) to upstage (away from the audience), although this would have required very significant (perhaps almost prohibitive) effort.

Fig 2 shows the lighting windlasses, numbered 1 to 10 for reference in this report, as they were arranged in the grid at the time of investigation.

Where compass directions are given (north, south, etc.), it is for simplicity assumed that the theatre is aligned perfectly west to east, with the seating facing eastward towards the stage.

The following terms are used in this report:

- **fly tower** – the tower, rising above the stage, in which is located the fly loft and grid
- **fly loft** – the open space within the fly tower, above the stage, in which lighting and scenery is suspended

- **grid** – the grid of steel beams at the top (interior) of the fly tower, above the fly loft, from which scenery and lighting are suspended; also, the area for which the grid serves as a floor
- **grid floor** – the upper surface of the grid beams, together with the perforated steel flooring that fills in the gaps between the beams
- **lighting bars** – the horizontal bars or trussed beams suspended within the fly loft above the stage and to which lights, as opposed to scenery, are affixed
- stage directions
  - **upstage** – within the stage and fly loft area: away from the audience (ie, towards the rear of the theatre, which is westward in the Barbican Theatre)
  - **downstage** – within the stage and fly loft area: towards the audience (ie, towards the front of the theatre, which is eastward in the Barbican Theatre)
  - **stage left** – within the stage and fly loft area: to the left when facing the audience (ie, towards the south in the Barbican Theatre)
  - **stage right** – within the stage and fly loft area: to the right when facing the audience (ie, towards the north in the Barbican Theatre)

## 2 Analytical Description of the Lighting Windlasses

As shown in Figure 2, the 10 lighting windlasses were arranged throughout the centre of the grid such that the lighting socket boxes were relatively dispersed throughout the fly loft, but with something of a concentration downstage. As noted in Section 1.5, above, the windlasses could, at least theoretically, be shifted upstage or downstage on their support rails, and Figure 2 illustrates how the layout of these rails would have allowed the windlasses to be positioned such that a socket box could have been dropped almost anywhere within the fly loft.

Fig 3 presents elevation drawings of the windlasses.

The windlasses were supported on pairs of C-shaped steel rails laid down over the grid with their flanges to top and bottom and the opening of their C-shaped profiles facing outwards (see also Fig 6 to Fig 9). The horizontal windlass axle was supported at either end on truss-like frames composed of C-shaped horizontal members and structural tubing for verticals and diagonals (see Fig 3 and Fig 6 to Fig 8). As with the rails, the openings of the C-shaped profiles of the horizontal frame members faced outwards. The lower horizontal members sat on top of the rails, flange to flange, and were secured to them by bolts. The rails were not covered in any sort of a pattern of bolt holes, so if a windlass was to be moved along its rails, new bolt holes would need to be drilled. Most of the rails did not feature redundant bolt holes, but there were holes seen in a few places on some of the rails, indicating that some of the windlasses may have been in different positions in the past.

With regard to positioning, the grid drawing supplied by the client showed windlass 4 significantly further upstage than the position in which it was found during the investigation (and where it is shown in Fig 2). At the same time, the vertical diversion pulley that would have been on the underside of the grid directly below that windlass's counterweight head pulley was observed even further upstage, in a location that would not have been compatible with that shown on the client's drawing nor with the observed position of the windlass. Perhaps this constitutes evidence that windlass 4 was moved at least once in the past. However, the counterweight hauling line for windlass 4 was broken or severed, so the biography of that windlass may have involved more than a simple change of position.

For each windlass, there were three reels: a lighting-cable reel, a counterweight reel, and an electricity supply reel, all fixed to a straight, freely-rotating axle and thus all turning together (see Fig 3 to Fig 5). The largest reel was for both the lighting cables and the wire-rope hauling line that supported the multi-socket box fed by the cables. This reel, in the form of a spoked wheel, was divided into five sheaves for the various lighting cables and the hauling line. In front of the lighting-cable reel was a smaller, spoked wheel for the counterweight hauling line – another wire rope. In front of this counterweight reel was the electrical supply reel. The latter was drum-like, with its outer surface divided by discs into several sheaves for electrical cables.

Fig 4 shows schematically how the counterweight system functioned. The lighting cables and the socket box hauling line were spooled onto the larger lighting cable reel in the opposite direction from that in which the counterweight hauling line was wound onto the counterweight reel. The lighting cables and the socket box hauling line descended from their reel down to a multi-sheaved, drum-like pulley set between the windlass support rails. From this pulley, the cable head pulley, the lighting cables and socket box hauling line hung freely through the grid, able to descend into the fly loft over the stage. The cable head pulley could be moved along the windlass support rails independent of the rest of the windlass, and could be sited within the

windlass frame as well as outside it, allowing for a flexibility in the positioning of the socket boxes (compare Fig 9 and Fig 10). Fig 11 shows the socket box of windlass 1 hanging just below the grid. The positioning of the windlasses and their cable head pulleys at the time of investigation is shown in Fig 12.

On the other side of the windlass, the counterweight hauling line descended to its own head block, a single-sheave pulley fixed within the windlass frame between the support rails (Fig 12). From this head block, the counterweight hauling line descended to a vertical diversion pulley directly below, on the underside of the grid (Fig 13). This pulley diverted the hauling line to run horizontally along the underside of the grid, through one or more horizontal diversion pulleys to the counterweight loft block array near the back of the fly loft (see Fig 12 and Fig 13). The counterweight loft blocks diverted the windlass' counterweight hauling lines to vertical, so that they ran downward just downstage of the galleries at the back of the fly loft (Fig 14 to Fig 16). Fig 12 shows the arrangement of pulleys below the grid for the counterweight hauling lines as observed during the investigation.

The counterweights themselves were lengths of heavy chain wrapped in blue plastic and suspended from support structure of the galleries and the hauling lines descended directly in front of them (ie on their downstage sides) (Fig 17). The hauling lines were fastened to the bottoms of the chains such that they took up none of the chains' weight when the hauling lines were fully extended. As a hauling line was reeled in, it picked up the bottom of the chain, taking an increasing proportion of the chain's weight (see Fig 4).

As the socket box was lowered such that an increasing weight of lighting cable and hauling line was pulling on the windlass (encouraging rotation of the axle in one direction), so the counterweight hauling line was being simultaneously reeled in, taking up an increasing weight of chain (encouraging rotation of the axle in the opposite direction). Thus, the forces acting on the axle could be kept in balance, enabling the axle to be rotated by hand with steady pressure. In practice, this balance was probably imperfect and the windlass was probably fixed in place when steady. No locking mechanism was observed and it seems likely that the windlasses were simply tied off by rope run through their spokes, as they were at the time of the investigation.

Fig 5 shows the windlass' electrical supply system. A fixed electrical supply connector box (in fact, a back-to-back pair of boxes) was attached to the windlass frame on the side of the counterweight head block, with cables that could be connected to power points on the grid (Fig 18). From this fixed electrical supply box, several cables ran to the electrical supply reel and were spooled around that reel from outward to inward, ultimately passing through a hole into the drum of the reel (Fig 19). From the inside of the reel they passed backwards and out of the drum along the line of the axle, and ran up to an electrical supply connector box fixed to the spokes of the lighting-cable reel (Fig 20, see also Fig 3).

Because they had passed from the inside of the drum to the fixed box on the spokes, with the drum and spokes maintaining a constant relationship as the axle turned, the electrical supply cables between the two reels remained in a fixed relationship as well, neither being pulled or twisted as the windlass rotated. However, the lengths of cable spooled onto the electrical supply drum would be wound or unwound depending on which way the drum was turning (see Fig 5). Thus, they would hang in a longer or shorter parabola between the drum and the fixed electrical supply box as shown in Fig 3 and Fig 5. As observed, the electrical cables were wound onto the drum so that they would be paid out as the lighting cables were lowered. Because of the small diameter of the drum relative to the lighting-cable reel, a much smaller length of electrical supply cable would be unreel in comparison to the length of



lighting cable, so the electrical supply cables hanging between the drum and the fixed electrical supply box would never descend very far down into the fly loft. The grid floor was open beneath the windlass to enable these cables to hang down, and an array of guide bars was fixed inside the windlass frame to prevent the cables from becoming tangled (see Fig 8).

Fig 21 to Fig 23 are general views of the grid that, together with Fig 2, suggest how much of the grid space was taken up by the windlasses and their support rails.

## **3 Conclusions, Publication and Archiving**

### **3.1 Realisation of the research aims**

The custom-designed lighting-cable windlasses of the Barbican Theatre were an integral component of the original complement of stage equipment intended to serve the needs of the Royal Shakespeare Company. As such, they were a component of the original theatre design and their significance with regard to that design is attested by both their key role in facilitating flown lighting and by their imposing physical presence on the grid. Indeed, it is their very imposing presence – including the level changes created by their support rails set above the level of the grid floor – that may set obstacles for the future use of the grid, given that their role with regard to lighting has diminished since the repertory company left the Barbican. The archaeological investigation has been undertaken to create a record of these windlasses in acknowledgement of their significance as components of the listed building.

### **3.2 Publication and archiving of the results**

The conservation report (Ludlam 2007, 7) states that the ‘windlasses are not unique, although they are the only UK set extant, and even some of these have been butchered in the last 25 years.’ The windlasses are therefore of some historical significance with regard to stage equipment in general and it is appropriate that a programme of recording has been undertaken prior to any removals, and that one windlass will be retained in full working order. The academic requirement to publish the results will be met by the placement of a summary in the annual archaeological round-up in the *London Archaeologist*. The final report will be given to the client and to the City of London, the London Metropolitan Archives, and also to other archives, local studies libraries, or repositories as appropriate.

The original site records and subsequent analytical drawings – in pencil and ink as well as digital – will be deposited in due course in the London Archaeological Archive and Research Centre (LAARC), indexed by the site code BTK09.

### **3.3 Copyright**

Copyright in the text and original illustrations of this report is held by the Museum of London; Ordnance Survey plans are reproduced under licence and remain Crown copyright. Museum of London Archaeology grants the Barbican Theatre a licence to use the text and original artwork in connection with redevelopment of the site, provided that the source is acknowledged.

## **4 Acknowledgements**

The archaeological survey and this report were commissioned by the Barbican Theatre, whom the author and the project manager wish to thank. They are grateful especially to Ashley Pickles of the Barbican Theatre for supplying the plan of the grid and for providing information, facilitating access and providing assistance during the investigation.

The archaeological recording project was designed by Emma Dwyer and on-site measurements, observations and drawings were made by Valeria Boesso, Emma Dwyer and Michael Tetreau. The photographic survey was undertaken by Maggie Cox, assisted by Michael Tetreau. AutoCAD drawings were made by Valeria Boesso, based on hand-measurements, pencil sketches and digital photography. Schematic drawings were produced by Judit Peresztégi based on sketches made by Michael Tetreau.

## 5 Bibliography

This bibliography lists works consulted in addition to those cited in the body of the report.

City of London, 2002 *Unitary Development Plan*

Department of the Environment, 1994 Planning Policy Guidance 15: planning and the historic environment

English Heritage, n.d., 'Barbican', 'Listed Buildings Online', *Heritage Gateway*, accessed on 4 March 2009 at <[http://www.heritagegateway.org.uk/gateway/Results\\_Single.aspx?uid=489705&resourceID=5](http://www.heritagegateway.org.uk/gateway/Results_Single.aspx?uid=489705&resourceID=5)>

English Heritage, 1991 *Exploring our Past. Strategies for the Archaeology of England*, English Heritage

English Heritage, 1991 *Management of Archaeological Projects (MAP2)*

English Heritage, 1997 *Sustaining the historic environment: new perspectives on the future*

English Heritage, May 1998 *Capital Archaeology. Strategies for sustaining the historic legacy of a world city*

English Heritage Greater London Archaeology Advisory Service, June 1998 *Archaeological Guidance Papers 1-5*

English Heritage Greater London Archaeology Advisory Service, May 1999 *Archaeological Guidance Papers 6*

English Heritage, 2006 *Understanding Historic Buildings: A guide to good recording practice*

Institute of Field Archaeologists (IFA), 2001 *By-Laws, Standards and Policy Statements of the Institute of Field Archaeologists.): Standard and guidance for archaeological investigation of standing buildings or structures*

Institute of Field Archaeologists (IFA), supplement 2001 *By-Laws, Standards and Policy Statements of the Institute of Field Archaeologists: Standards and guidance – the collection, documentation conservation and research of archaeological materials*

Ludlam, D., 2007 *Barbican Theatre Conservation Report: Lighting Windlasses*, Draft 0.2, unpub report produced for Barbican Theatre by Theatreplan LLP, London

Museum of London, 2002 *A research framework for London archaeology 2002*

Parkey, J., 1982 'Lighting at the Barbican Theatre', *Sightline* vol 16, no 2 (Autumn), 72–77

Russell, A., 1982 'The Barbican Theatre Flying System', *Sightline* vol 16, no 2 (Autumn), 68–71

## 6 Appendix 1 – OASIS form

**OASIS ID: molas1-59819**

### Project details

Project name Barbican Theatre Lighting Windlasses

Short description of the project MOLA recorded lighting-cable windlasses prior to their removal. The 10 windlasses were on the grid at the top of the fly tower and were custom-designed and built specifically for the Barbican Theatre, as part of its original complement of stage machinery, in order to allow for non-motorised handling of considerable lengths of heavy cable. The theatre's stage equipment is considered to be covered by the Grade II listing. Each windlass comprised a set of reels solidly fixed to a single horizontal axle. As the axle turned, lines would either be reeled in or out depending on which way they had been wound onto the reels. Wound in one direction on any windlass's largest reel was a set of electrical cables and a wire rope leading to a box of lighting power points. The wire rope supported the box as it hung below the grid, with the cables supplying the power for the lights. Wound in the opposite direction on the second largest reel was a wire rope to lift a counterweight. As the lighting cable was paid out, the counterweight hauling line was reeled in, and vice versa. The counterweight was a heavy chain suspended such that as the windlass's counterweight hauling line was reeled in, it took up an increasing proportion of the chain's weight, in order to balance the increasing weight of lighting cable being lowered at the same time. This enabled the windlass to be operated by hand.

Project dates Start: 05-05-2009 End: 29-05-2009

Previous/future work Not known / Not known

Type of project Building Recording

Site status Listed Building

Current Land use Other 2 - In use as a building

Monument type THEATRE Modern

Methods & techniques 'Annotated Sketch','Photographic Survey'

Prompt Listed Building Consent

### Project location

Country	England
Site location	GREATER LONDON CITY OF LONDON CITY OF LONDON Barbican Theatre
Postcode	EC2Y 8DS
Study area	1500.00 Square metres
Site coordinates	TQ 32440 81810 51.5191649499 -0.09092835170470 51 31 08 N 000 05 27 W Point

### Project creators

Name of Organisation	MOL Archaeology
Project brief originator	Self (i.e. landowner, developer, etc.)
Project design originator	MOL Archaeology
Project director/manager	Sophie Jackson
Project supervisor	Emma Dwyer
Type of sponsor/funding body	Client
Name of sponsor/funding body	Barbican Theatre

### Project archives

Physical Archive Exists?	No
Digital Archive	LAARC

recipient

Paper Archive recipient LAARC

---

**Project bibliography 1**

Publication type Grey literature (unpublished document/manuscript)

Title Barbican Theatre Lighting Windlasses

Author(s)/Editor(s) Tetreau, M.

Date 2009

Issuer or publisher Museum of London Archaeology

Place of issue or publication London

Description A4 client report

---

Entered by Michael Tetreau (mtetreau@museumoflondon.org.uk)

Entered on 24 August 2009

## 7 Appendix 2 – List of photographs taken on site

Table 1: Photographic survey

Image Number	Description
10209001	General view of grid looking upstage and towards the centre (ie SE) from downstage-most stage right
10209002	View of grid looking upstage and towards the centre (ie SE) from downstage-most stage right – windlass 1 is nearest the viewer, at left in the photograph
10209003	General view of grid looking upstage and towards the centre (ie SE) from downstage-most stage right
10209004	General view of grid looking upstage and towards the centre (ie SE) from downstage-most stage right
10209005	View of windlass 1 from NE (looking SW)
10209006	View of windlass 1 from NE (looking SW)
10209007	General view of grid looking inward (southward) from stage right (approximately halfway upstage)
10209008	General view of grid looking inward (southward) from stage right (approximately halfway upstage)
10209009	View downstage towards windlasses 2 and 3 (looking W from E of the windlasses)
10209010	View downstage towards windlasses 2 and 3 (looking W from E of the windlasses)
10209011	Looking towards stage left (and slightly downstage) from near the centre of the back of the grid, showing windlasses 5 (partial, at right) and 6 (centre), with windlass discernable in the background (at right). At left, foreground, is a power hoist.
10209012	Looking downstage towards windlasses 4, 5, 6 and 7 (looking W from E of the windlasses)
10209013	Looking downstage towards windlasses 4, 5, 6 and 7 (looking W from E of the windlasses)
10209014	Looking downstage towards windlasses 4, 5, 6 and 7 (looking W from E of the windlasses)
10209015	Looking downstage towards windlasses 4, 5, 6 and 7 (looking W from E of the windlasses) – working shot
10209016	Looking NW towards windlass 8 (from SE of the windlass)
10209017	Looking NW towards windlass 8 (from SE of the windlass) – working shot
10209018	Looking NW towards windlass 8 (from SE of the windlass) – working shot
10209019	Looking NW towards windlass 8 (from SE of the windlass) – working shot
10209020	General view of grid looking inward (northward) from stage left (approximately halfway upstage)
10209021	Looking N (towards stage right) towards back of windlass 8 (from S of windlass)
10209022	Detail looking NW towards back of windlass 8 (from S of windlass)
10209023	Detail looking N towards back of windlass 8 (from S of windlass)
10209024	Detail looking NW towards back of windlass 8 (from S of windlass)
10209025	Detail looking NW towards back of windlass 8 (from S of windlass)
10209026	Looking W (downstage) towards cable-head-side of windlass 8
10209027	Looking W (downstage) towards cable-head-side of windlass 8
10209028	Looking SW at windlass 6 (from NE of the windlass), showing lighting cables and hauling line running off of lighting-cable reel to cable head pulley (between windlass support rails)
10209029	Looking N (towards stage right), showing front of windlass 5
10209030	Looking N (towards stage right), showing front of windlass 5



Image Number	Description
10209031	Detail of axle at front of windlass 5 (looking N, ie towards stage right), with hub of electricity supply reel (showing cable passing into centre of drum, from where it ran to lighting-cable reel)
10209032	View of counterweight head side of windlass 5 (looking W, ie downstage) – showing fixed electricity supply box attached to windlass support frame in front of reels (electricity supply reel [multi-sheaved drum] on left, counterweight reel in centre, lighting-cable reel at right)
10209033	View of counterweight head side of windlass 5 (looking W, ie downstage) – showing fixed electricity supply box attached to windlass support frame in front of reels (electricity supply reel [multi-sheaved drum] on left, counterweight reel in centre, lighting-cable reel at right)
10209034	Looking SW at windlass 7 (from NE of the windlass), showing lighting cables and hauling line running off of lighting-cable reel to cable head pulley (between windlass support rails)
10209035	Looking E (upstage) towards windlass 6
10209036	Looking down and to S (ie towards stage left) at windlass 6, showing the counterweight hauling line running to the counterweight head block (at the bottom of the support frame)
10209037	Looking E (upstage) towards windlasses 5 (at left in photo) and 6 (at right in photo), from centre stage
10209038	General view of grid looking upstage and towards the centre (ie SE) from downstage-most stage right – working shot
10209039	General view of grid looking upstage and towards the centre (ie SE) from downstage-most stage right – working shot
10209040	General view of grid looking upstage (eastwards) from downstage-most stage right, showing power hoists along walls (at left in photo) with windlasses over stage (at right in photo)
10209041	Looking SE (from downstage, stage right, looking towards the centre back of the loft) at sub-grid level, showing the bars hanging in the fly loft below the grid. The lower tier of power hoists are against the walls of the tower at this level (the upper tier is above them, on the grid).
10209042	Looking S (towards stage left, from downstage, stage right) at sub-grid level
10209043	Looking S (from downstage, stage right, looking towards stage left) at sub-grid level, showing the socket boxes hanging just below the grid – the socket box of windlass 1 is facing the viewer at right
10209044	Looking S (from downstage, stage right, looking towards stage left) at sub-grid level, showing the socket boxes of windlass 1 hanging just below the grid
10209045	Looking up and to SE (ie upstage and towards the centre from stage right), showing the vertical diversion block below windlass 1 (suspended from the grid directly below the counterweight header block) – this block diverts the counterweight hauling line to run horizontally upstage, towards the back of the fly loft. A horizontal diversion block just visible at the extreme left diverts the line towards the array.
10209046	Looking up and to SE towards the counterweight loft blocks at the rear of the fly loft, attached to the underside of the grid
10209047	Looking up and to SE towards the counterweight loft blocks at the rear of the fly loft, attached to the underside of the grid
10209048	Looking up and to SE towards the counterweight loft blocks at the rear of the fly loft, attached to the underside of the grid
10209049	Looking down and to S (ie towards stage left across the back of the fly loft, from stage right) at sub-grid level, showing the counterweight chains (wrapped in blue plastic) suspended in front of the galleries at the back of the fly loft (at left)
10209050	Looking down and to S (ie towards stage left across the back of the fly loft, from stage right) at sub-grid level, showing the counterweight chains (wrapped in blue plastic) suspended in front of the galleries at the back of the fly loft (at left)
10209051	Looking downstage (to N) from the sub-grid gallery at the back of the fly loft, showing the socket boxes suspended in the loft, with the counterweight hauling lines running through blocks fixed to the underside of the grid above

<b>Image Number</b>	<b>Description</b>
10209052	Looking downstage (to N) from the sub-grid gallery at the back of the fly loft, showing the socket boxes suspended in the loft, with the counterweight hauling lines running through blocks fixed to the underside of the grid above
10209053	Looking up and to SW (ie towards downstage stage left), showing the counterweight loft block array suspended below the grid at the rear of the fly loft
10209054	Looking up and to SW (ie towards downstage stage left), showing the counterweight loft block array suspended below the grid at the rear of the fly loft
10209055	Looking SW (ie, across the back of the fly loft, from slightly to stage right), showing the counterweight loft block array suspended below the grid at the rear of the fly loft, in front of the sub-grid gallery
10209056	Looking S (ie, across the back of the fly loft towards stage left, from slightly stage right), showing the counterweight loft block array suspended below the grid at the rear of the fly loft, in front of the sub-grid gallery
10209057	Looking up and to S (ie, across the back of the fly loft towards stage left, from slightly stage right), showing the counterweight loft block array suspended below the grid at the rear of the fly loft, in front of the sub-grid gallery

Table 2: Other on-site photographs taken during the investigation

Image Number	Description
DSCN2131	At rear of fly loft, at sub-grid level, looking S
DSCN2132	At rear of fly loft, at sub-grid level, looking W
DSCN2133	At rear of fly loft, at sub-grid level, looking W
DSCN2134	Just to N (stage right) of centre of gallery along back of fly loft, at sub-grid level, looking up and to S, showing counterweight loft blocks
DSCN2135	Just to N (stage right) of centre of gallery along back of fly loft, at sub-grid level, looking up and to S, showing counterweight loft blocks
DSCN2136	Just to N (stage right) of centre of gallery along back of fly loft, at sub-grid level, looking up and to SW, showing counterweight loft blocks
DSCN2137	Just to N (stage right) of centre of gallery along back of fly loft, at sub-grid level, looking up and to SW, showing counterweight loft blocks
DSCN2138	At rear of fly loft, at sub-grid level, looking up and to W at counterweight loft blocks below grid
DSCN2139	Just to S (stage left) of centre of gallery along back of fly loft, at sub-grid level, looking up and to NW, showing counterweight loft blocks
DSCN2140	At sub-grid level, approximately halfway upstage along stage left gallery, looking NW at windlass 10 counterweight hauling line with diversion blocks fixed to the underside of the grid
DSCN2141	At sub-grid level, looking downstage (ie, W) to left (stage left) of centre of back of fly loft, showing windlass 9 counterweight hauling line with diversion blocks fixed to underside of the grid
DSCN2142	At sub-grid level, looking towards centre stage (ie, NW) from just left (stage left) of centre of back of fly loft, showing windlass 8 counterweight hauling line with diversion blocks fixed to underside of the grid (lower half of image)
DSCN2143	At sub-grid level, looking downstage (ie, W) from gallery at rear of fly loft, showing counterweight hauling lines with diversion blocks for windlass 6 (upper, near viewer) and 7 (lower, in distance)
DSCN2144	At sub-grid level, looking up and downstage (ie, W) from gallery at rear of fly loft, showing counterweight hauling line with diversion blocks for windlass 7 (in distance and at upper left) and horizontal diversion block for counterweight hauling line of windlass 4 (near centre of view – the now-broken hauling line was not running through the block)
DSCN2145	At sub-grid level, looking up and downstage (ie, W) from gallery at rear of fly loft, showing several counterweight (horizontal) diversion blocks. The 3 in central part of view are: horizontal diversion block for windlass 6 (lower left), horizontal diversion block for windlass 5 (uppermost, with hauling line), and horizontal diversion block for windlass 4 (lower right, without hauling line)
DSCN2146	At sub-grid level, looking up and downstage (ie, W) from gallery at rear of fly loft, showing diversion blocks for windlass 4 (pair lower in view, in distance, without hauling line running through them) and for windlass 5 (pair higher in view, with hauling line)
DSCN2147	At sub-grid level, looking downstage and slightly to stage right (ie, NW) from gallery at rear of fly loft, showing diversion blocks for windlass 3
DSCN2148	At sub-grid level, looking downstage (ie, W) to right (stage right) of centre of back of fly loft, showing windlass 2 counterweight hauling line with diversion blocks fixed to underside of the grid (in distance at centre of view, beyond hanging socket box from same windlass)
DSCN2149	At sub-grid level, looking downstage (ie, W) to right (stage right) of centre of back of fly loft, showing windlass 2 counterweight hauling line with diversion blocks fixed to underside of the grid. Also showing socket box from same windlass hanging below the grid.
DSCN2150	At sub-grid level, approximately halfway upstage along stage right gallery, looking SW at windlass 1 counterweight hauling line with diversion blocks fixed to the underside of the grid

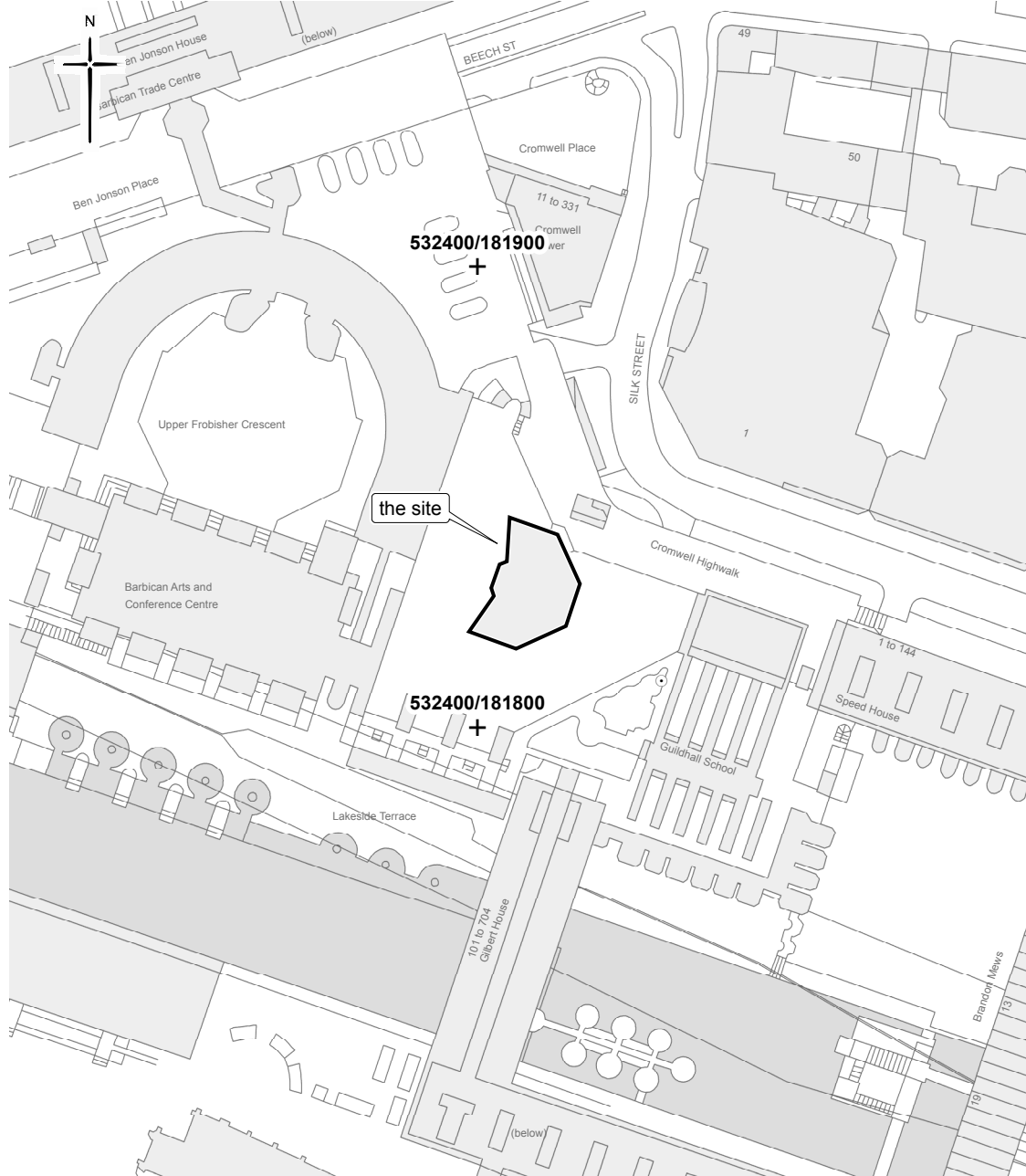
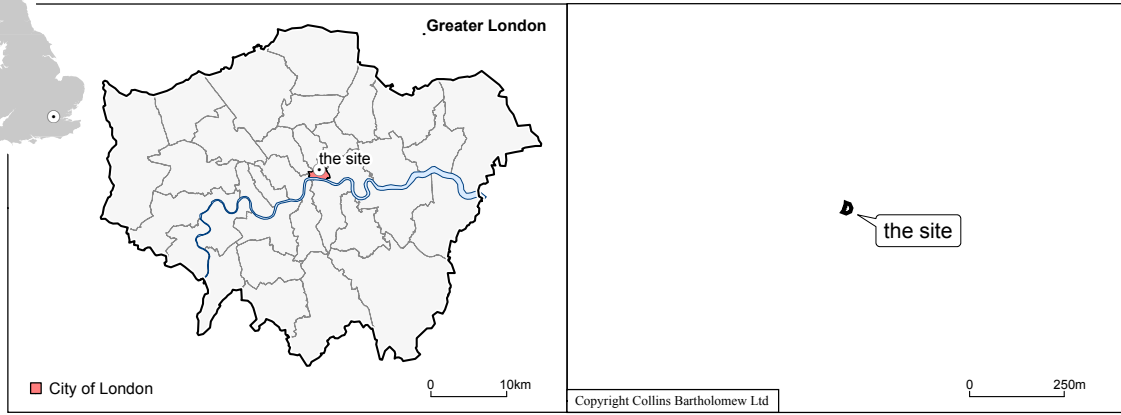
Image Number	Description
DSCN2151	At sub-grid level, approximately halfway upstage along stage right gallery, looking SW at windlass 1 counterweight hauling line with vertical diversion block fixed to the underside of the grid directly below counterweight head block (not visible but within the windlass frame above the grid floor)
DSCN2152	A windlass's socket box hanging below the grid
DSCN2153	A windlass's socket box hanging below the grid
DSCN2155	Looking S (towards stage left) showing front of windlass 9
DSCN2156	Looking S (towards stage left) showing front of windlass 9
DSCN2157	Looking S (towards stage left) showing front of windlass 9
DSCN2158	Looking S (towards stage left) showing front of windlass 9
DSCN2159	Looking S (towards stage left) showing front of windlass 9
DSCN2162	Looking S (towards stage left) showing front of windlass 9 – detail of axle end
DSCN2163	Looking S (towards stage left) showing front of windlass 9 – detail of axle end and front of electrical supply reel (drum-like reel)
DSCN2164	Looking S (towards stage left) from front of windlass 9 – detail view over top of electrical supply reel (multi-sheaved drum) toward spokes of counterweight reel and lighting-cable reel
DSCN2165	Looking S (towards stage left) from front of windlass 9 – detail view showing portion of counterweight reel and lighting-cable reel, with mobile electrical supply box fixed to spokes of lighting-cable reel
DSCN2166	Looking S (towards stage left) from front of windlass 9 – detail view showing portion of lighting-cable reel at base of outer cable guide
DSCN2167	Looking S (towards stage left) from front of windlass 9 – detail view showing portion of lighting-cable reel at base of outer cable guide
DSCN2168	Looking S (towards stage left) from front of windlass 9 – detail view of portion of lighting-cable reel showing outer cable guides
DSCN2169	Looking N (towards stage right) showing back of windlass 8
DSCN2170	Looking N (towards stage right) showing back of windlass 8
DSCN2171	Looking N (towards stage right) showing back of windlass 8
DSCN2172	Looking N (towards stage right) showing back of windlass 8
DSCN2173	Looking N (towards stage right) showing back of windlass 8 – detail of axle end
DSCN2174	Looking N (towards stage right) showing back of windlass 8 – detail of axle end
DSCN2175	Looking N (towards stage right) showing back of windlass 8 – detail of hub area
DSCN2176	Looking N (towards stage right) showing back of windlass 8 – detail of hub area
DSCN2177	Looking N (towards stage right) at back of windlass 8 – detail of hub of lighting-cable reel, with electrical supply box fixed to spokes
DSCN2178	Looking N (towards stage right) from back of windlass 8 – detail view of portion of lighting-cable reel at base of outer cable guides
DSCN2179	Looking N (towards stage right) from back of windlass 8 – detail view of portion of lighting-cable reel showing outer cable guides
DSCN2180	Looking N (towards stage right) from back of windlass 8 – detail view of portion of lighting-cable reel showing inner cable guide fixed to spokes of reel
DSCN2181	Looking W (downstage) towards cable-head side of windlass 9, showing cable guides (in grey, lower portion of image) between strap cables (being wound onto electrical supply reel)
DSCN2182	Looking W (downstage) towards cable-head side of windlass 9 – detail of cable guides (grey) between strap cables (being wound onto electrical supply reel)
DSCN2183	Looking S (toward stage left) at front of windlass 9 – detail view through mesh of windlass frame, showing cable guides below electrical supply reel
DSCN2184	Looking down and to E (upstage) at counterweight-head side of windlass 9 – detail view showing cable guides below electrical supply reel
DSCN2185	Looking down and to E (upstage) at counterweight-head side of windlass 9
DSCN2186	Looking E (upstage) at counterweight-head side of windlass 9
DSCN2187	Looking SE from just E of windlass 9 (windlass 9 is at extreme right of view)

<b>Image Number</b>	<b>Description</b>
DSCN2188	Looking W (downstage) at cable-head side of windlass 3
DSCN2189	Looking W (downstage) at cable-head side of windlass 3
DSCN2190	Looking W (downstage) at cable-head side of windlass 3
DSCN2191	Looking W (downstage) at cable-head side of windlass 3 – working shot with tape measure held in front of windlass at approx. height of camera lens
DSCN2192	Looking down and to W (downstage) at cable-head side of windlass 3
DSCN2193	Looking W (downstage) at cable head pulley of windlass 3, with tape measure in front of pulley
DSCN2194	Looking down and to W (downstage) at cable head pulley of windlass 3, with tape measure in front of pulley
DSCN2195	Looking S (towards stage left) at side of cable head pulley of windlass 3, with tape measure in front of pulley
DSCN2196	Looking up at to SW at windlass 3, from front: detail view showing portion of lighting-cable reel, especially outer cable guides
DSCN2197	Looking SW at windlass 3 showing upper portions of reels
DSCN2198	Looking W (downstage) at windlass 3 from cable-head side, showing electrical supply reel
DSCN2199	Looking W (downstage) at windlass 3 from cable-head side: detail side view of end of axle
DSCN2200	Looking SW into hub of windlass 3, showing axle and spokes behind electrical supply reel
DSCN2201	Looking SW into hub of windlass 3, showing axle and spokes of lighting-cable reel (upside-down V-shaped pairs of spokes to left) and counterweight reel (single spokes on right): note how all spokes are joined and stiffened by horizontal tubing
DSCN2202	Looking down and to S at top of cable head pulley of windlass 3
DSCN2203	Looking down and to SE at windlass 3 – looking over the top of the windlass frame toward the electrical supply boxes attached to the frame and set behind the electrical supply reel
DSCN2204	Looking down and to E at the electrical supply boxes attached to the frame and set behind the electrical supply reel of windlass 3
DSCN2205	Looking S into the hub of the electrical supply reel of windlass 3, showing the electrical supply cables running into the interior of the reel's drum
DSCN2206	Looking SE into the hub of the electrical supply reel of windlass 3, showing the electrical supply cables running into the interior of the reel's drum
DSCN2207	Looking SE into the hub of the lighting-cable reel of windlass 3, showing the inner cable guide fixed to the spokes of the reel
DSCN2208	Looking E into the hub of the lighting-cable reel of windlass 3, showing the mobile electrical supply box attached to the spokes of the wheel
DSCN2209	Looking down and to SE within the frame of windlass 3, showing the counterweight head block with the counterweight hauling line (wire rope) running down to it
DSCN2210	Looking down and to E, showing the counterweight head block of windlass 3

## 8 Appendix 3 – List of drawings made on site

*Table 3: Drawings made on site*

<b>Drawing Number</b>	<b>Description</b>
1	Back of windlass (elevation) – measured observations drawn to scale on grid-lined paper
2	Front of windlass 9 (elevation) – measured observations drawn to scale on grid-lined paper
3	Schematic notes for windlass side elevation – scaled and dimensioned sketch on grid-lined paper
4	Windlass side elevation (counterweight head pulley side) – measured observations drawn to scale on grid-lined paper
5	Profile / elevation (partly sectional) – A4 dimensioned sketch
6	Observations below grid: counterweight loft blocks (A4)
7	Schematic / analytical observations (A4)
8	Grid arrangement observations made on A3 drawing of grid floor plan



Based upon the Ordnance Survey mapping with the permission of the Controller of Her Majesty's Stationery Office © Crown Copyright. Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings. City of London 100023243 2009.

Scale 1:1,500 @ A4

0 50m

Fig 1 Site location

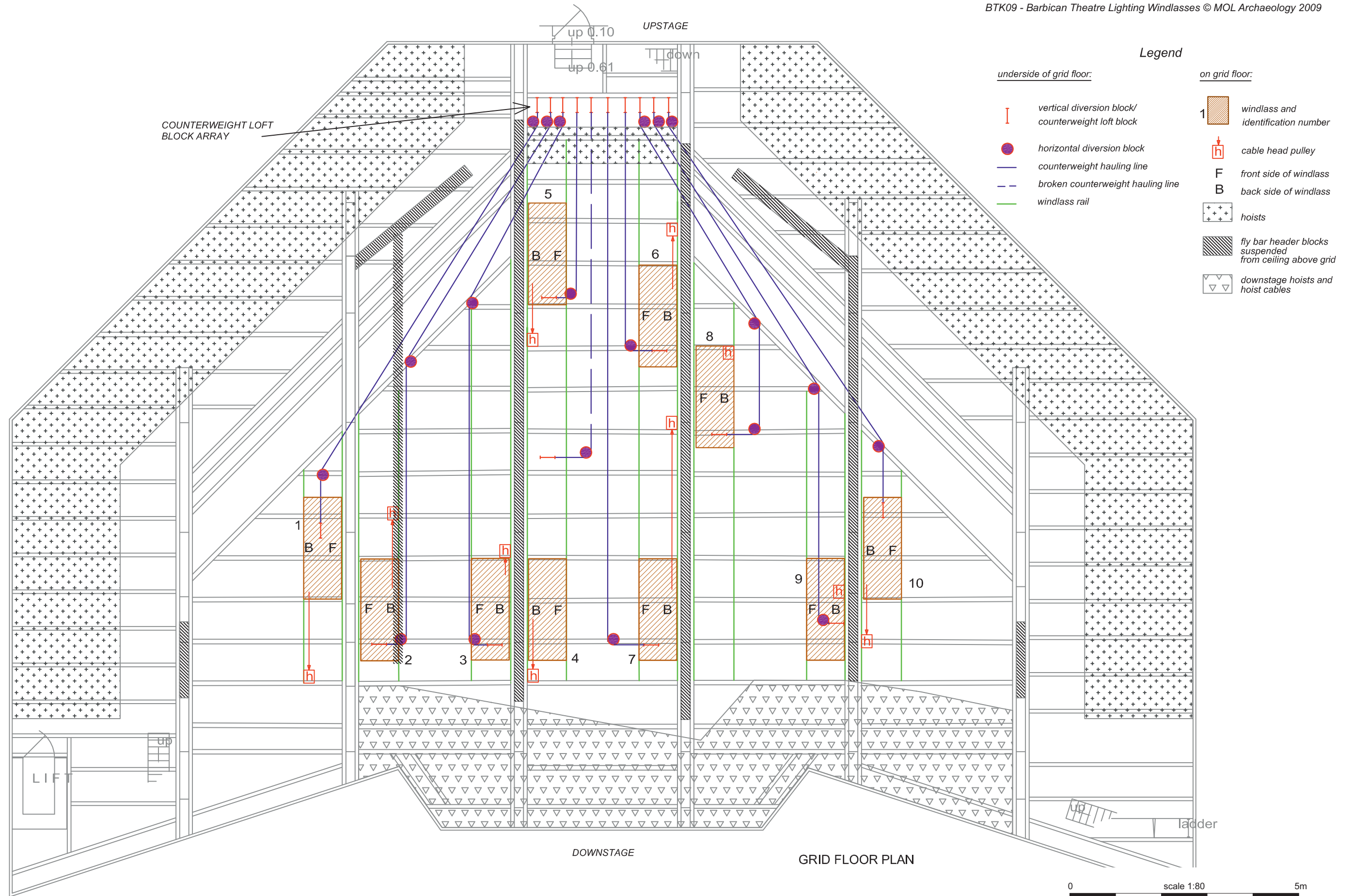
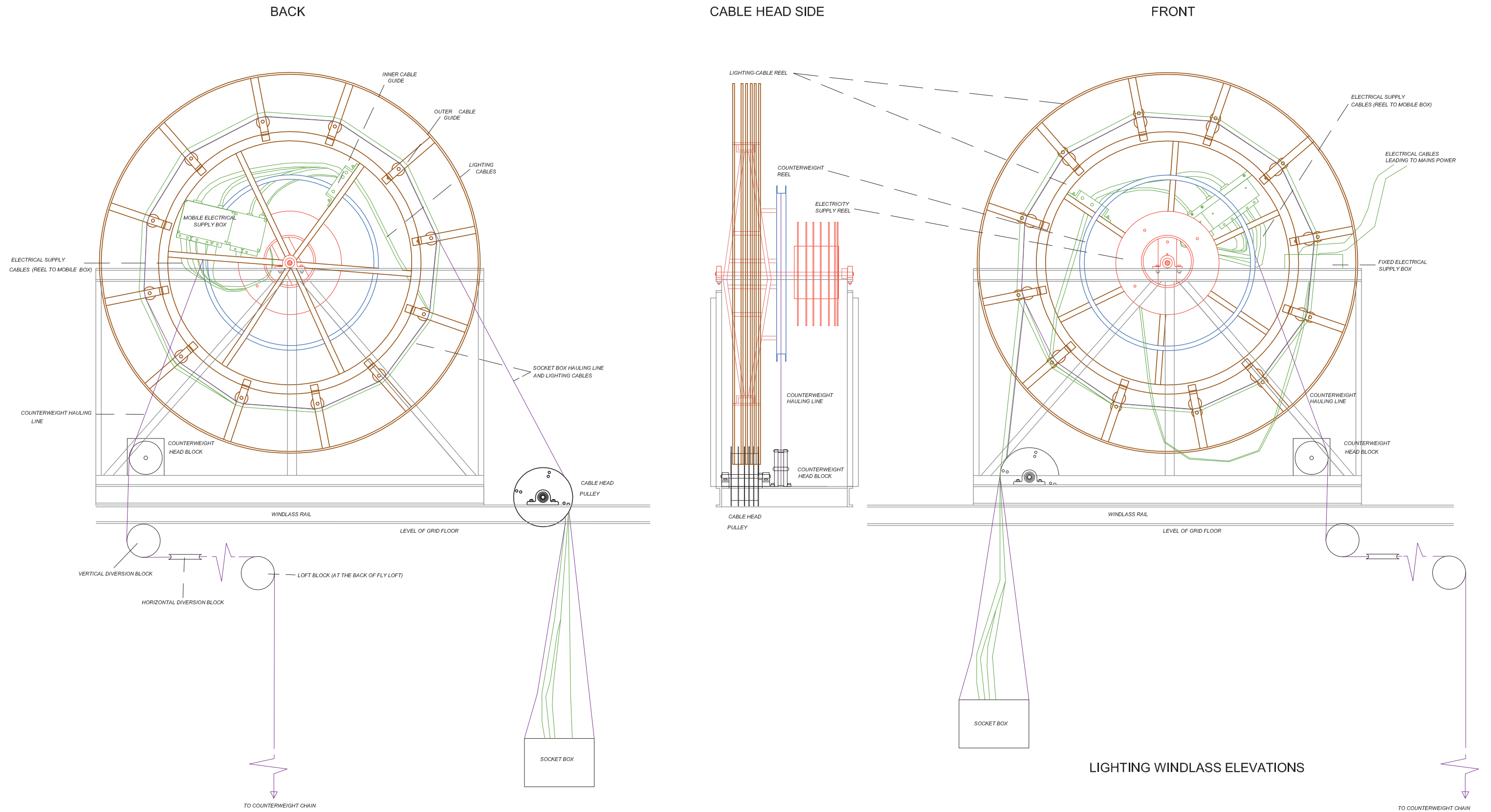


Fig 2 Lighting windlass arrangement, May 2009 (edited drawing based on grid floor plan supplied by BITE: Production Office, Barbican Theatre, with additions based on MOLA observations)





LIGHTING WINDLASS ELEVATIONS

0 scale 1:20 1m

Fig 3 Lighting windlass elevation drawings

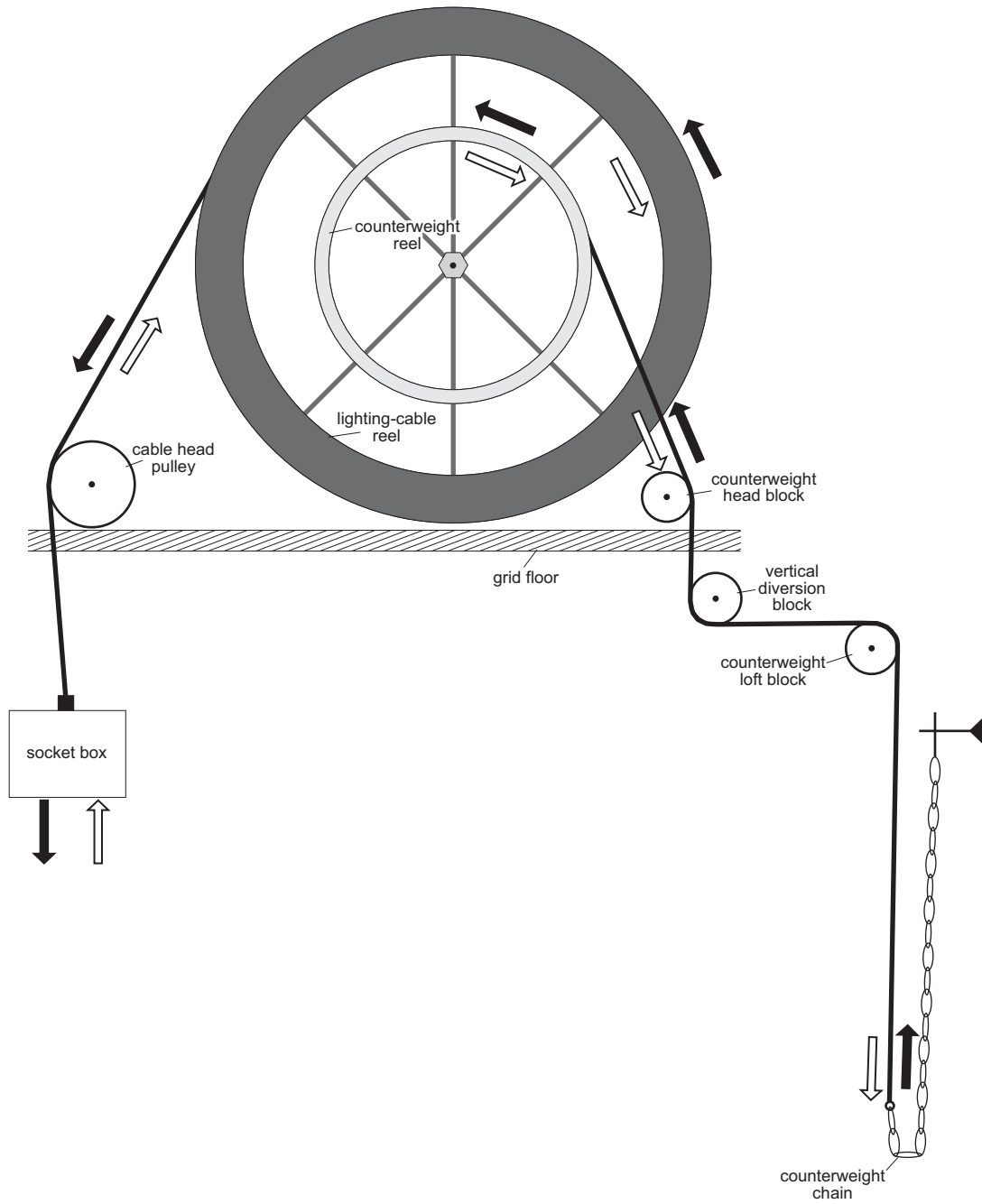


Fig 4 Counterweight system: increasing uptake of chain balances increasing weight of cable let out when lowering socket box

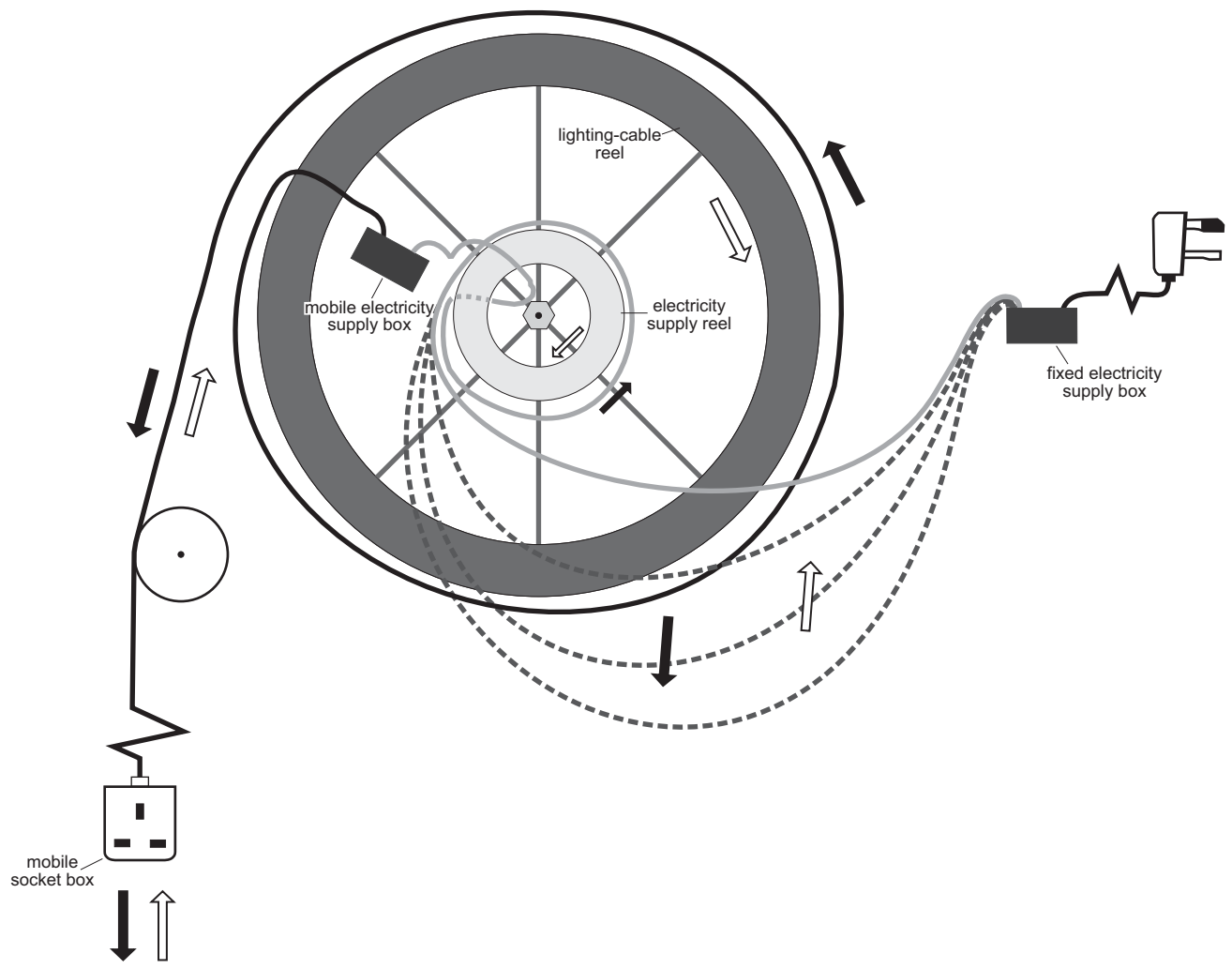


Fig 5 Electricity supply system: linking fixed electricity supply box (on windlass support frame) to mobile electricity supply box (attached to spokes of lighting-cable reel)



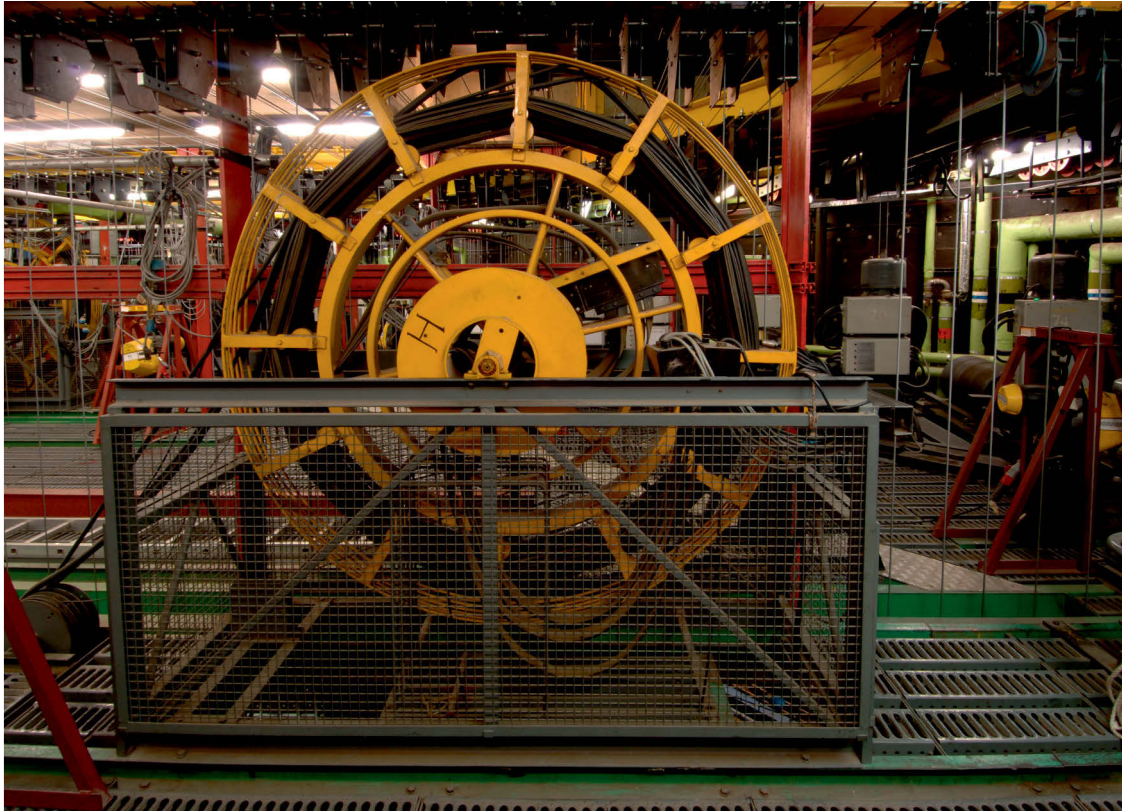


Fig 6 Photograph of windlass 5 front elevation (looking N, ie toward stage right)

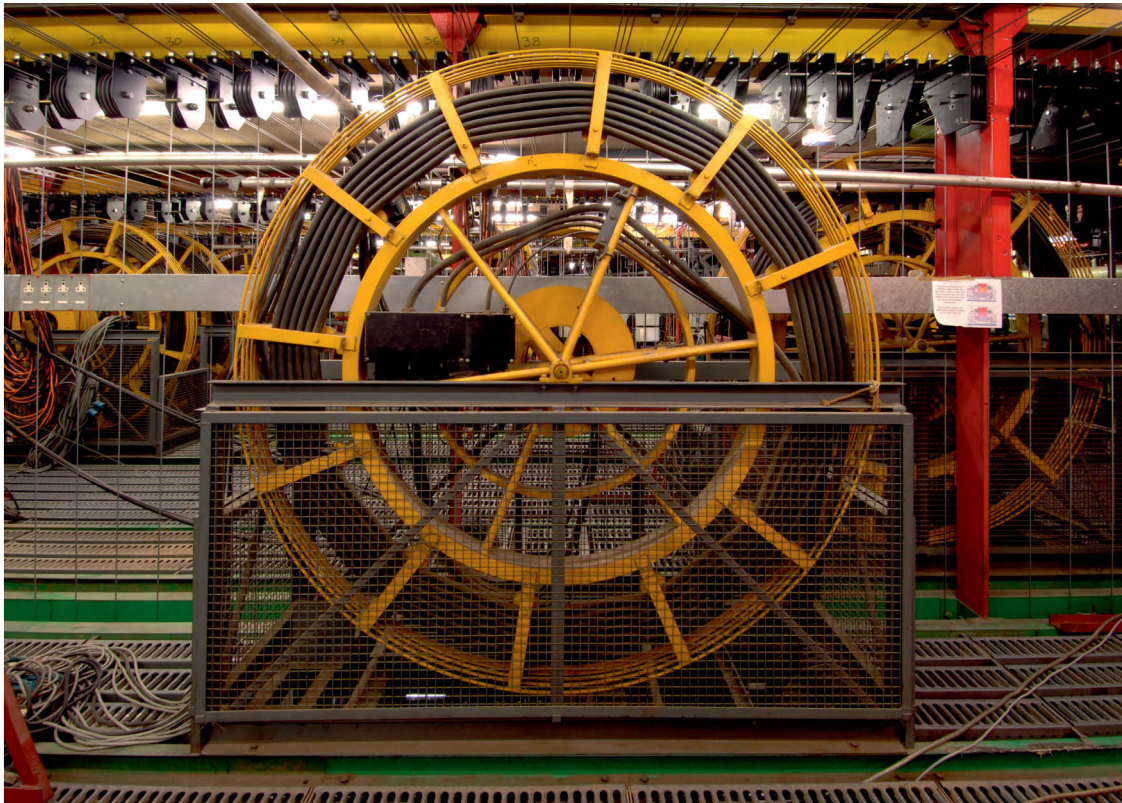


Fig 7 Photograph of windlass 8 back elevation (looking N, ie toward stage right)



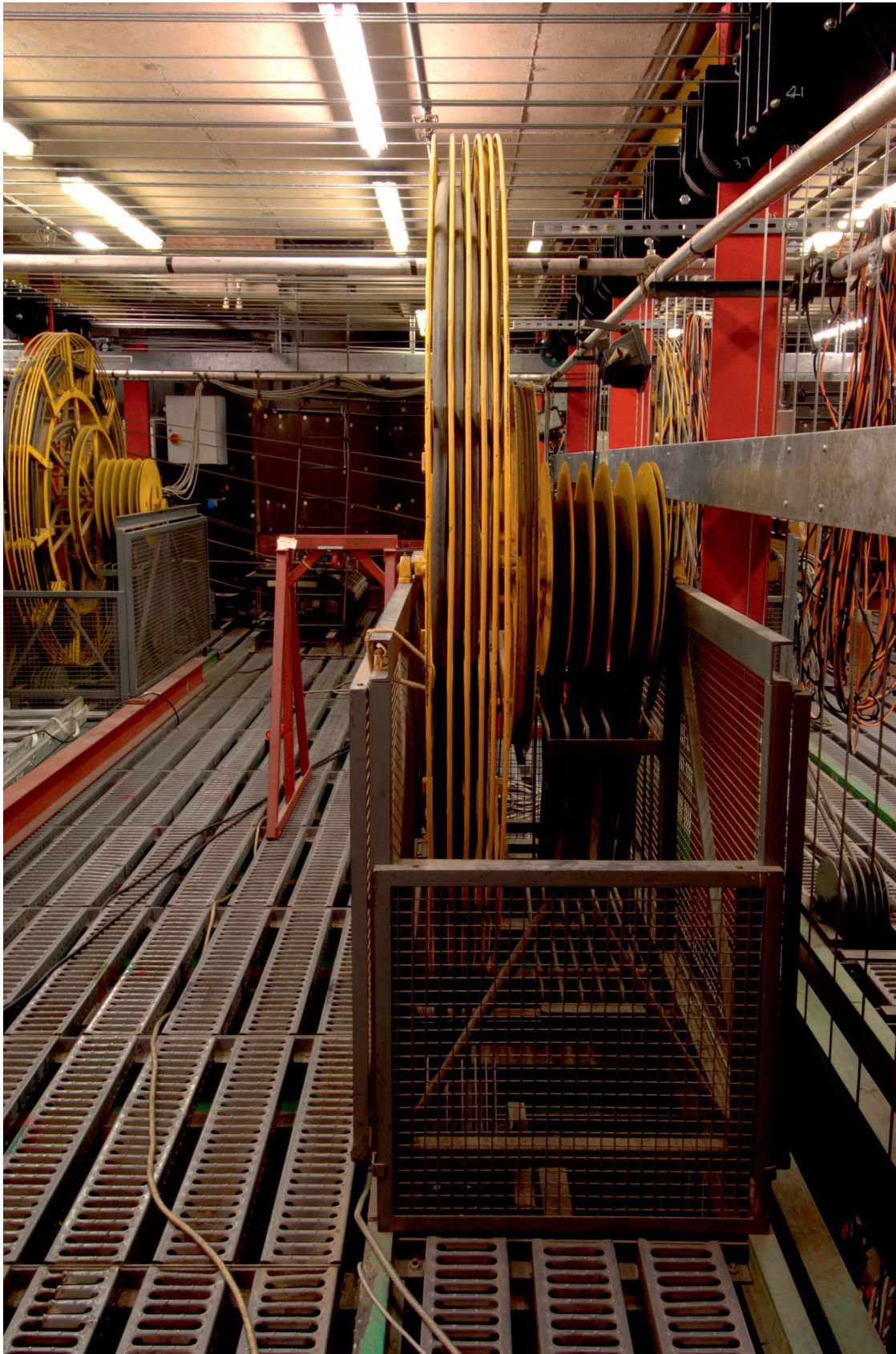


Fig 8 Photograph of windlass 8 cable-head-side elevation (looking W)



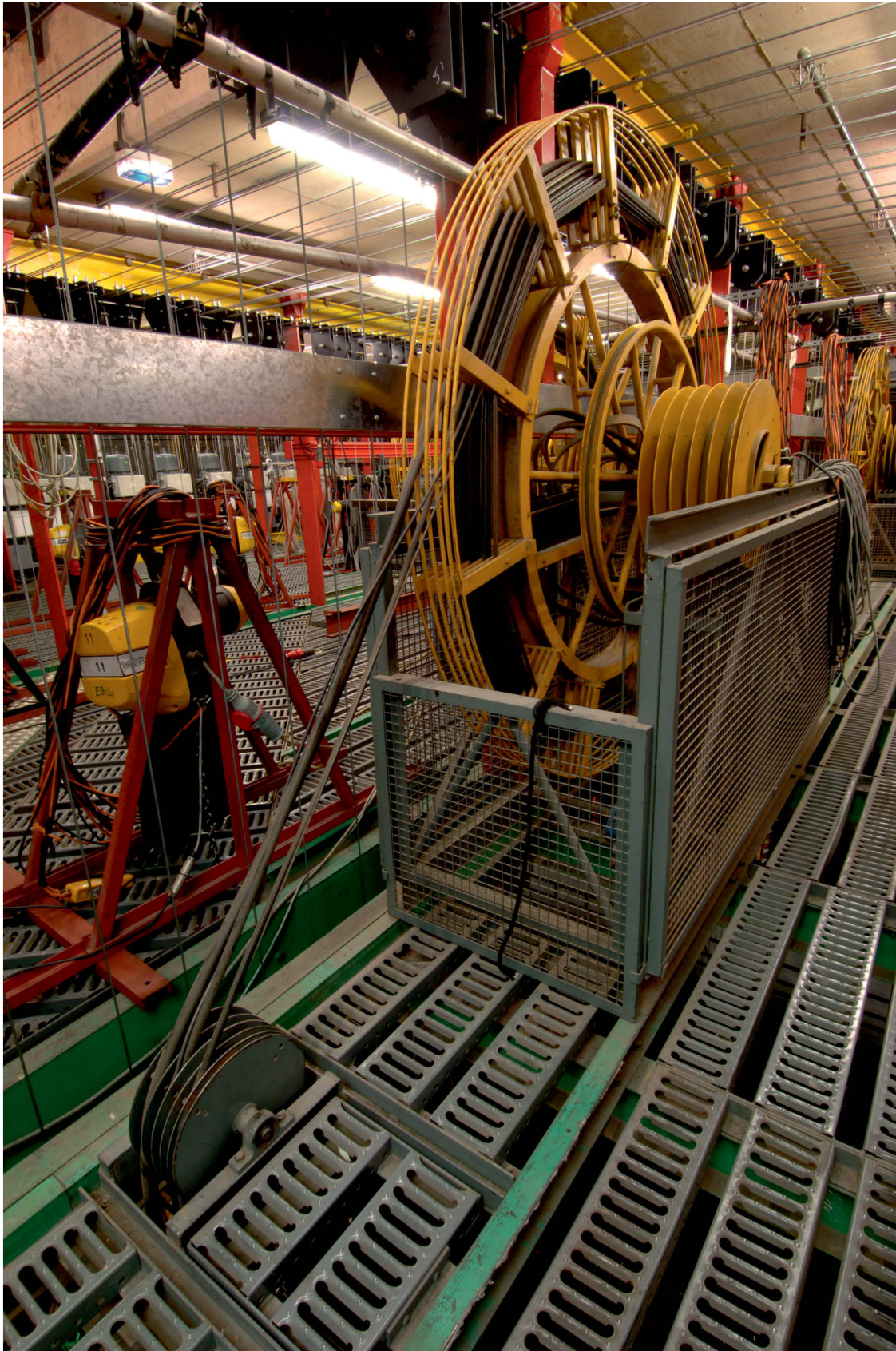


Fig 9 Looking SW (ie toward downstage stage left) at windlass 6, showing lighting cables and hauling line running off of lighting-cable reel to cable head pulley (between windlass support rails)



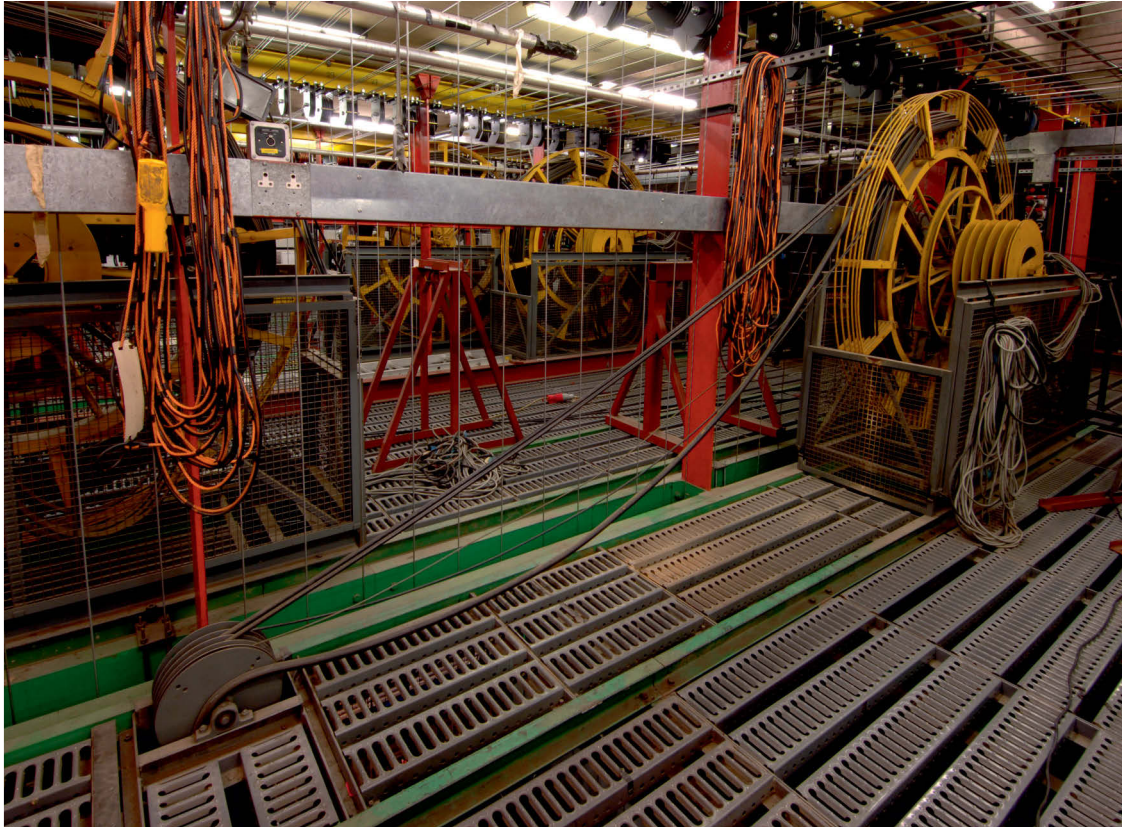


Fig 10 Looking SW (ie towards upstage stage left) at windlass 7

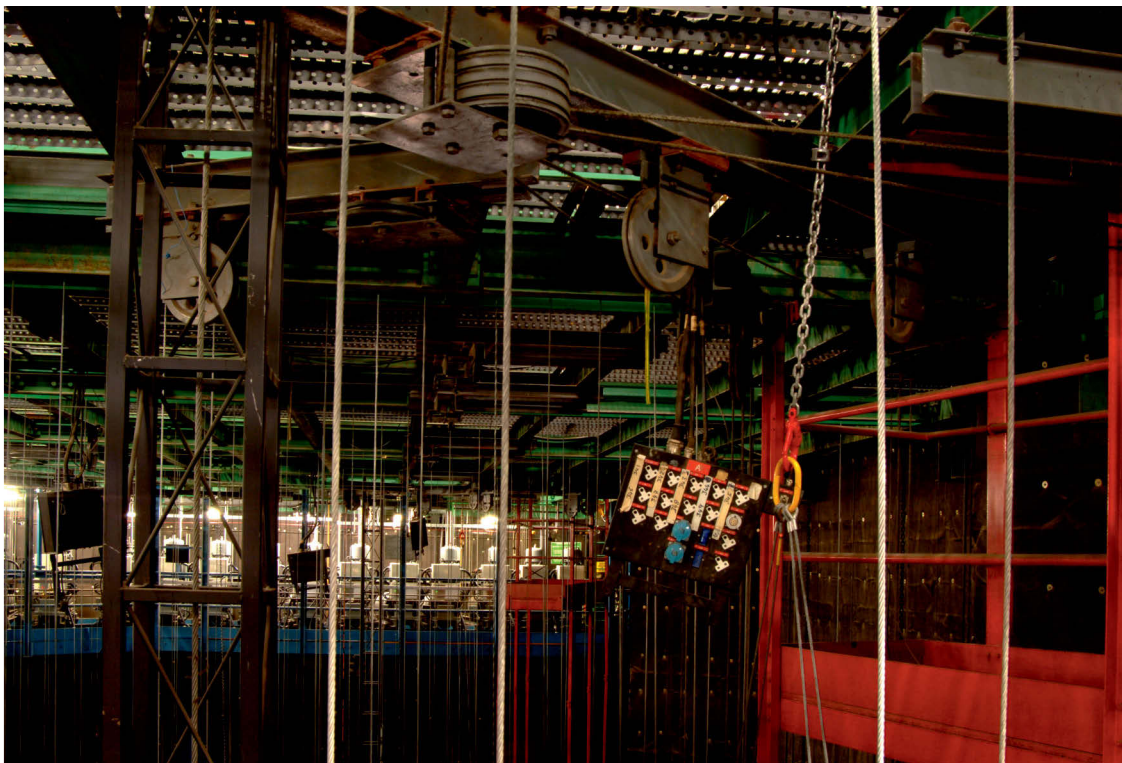


Fig 11 Looking S (from downstage, stage right, looking toward stage left) at sub-grid level, showing the socket boxes hanging just below the grid – the socket box of windlass 1 is facing the viewer at right



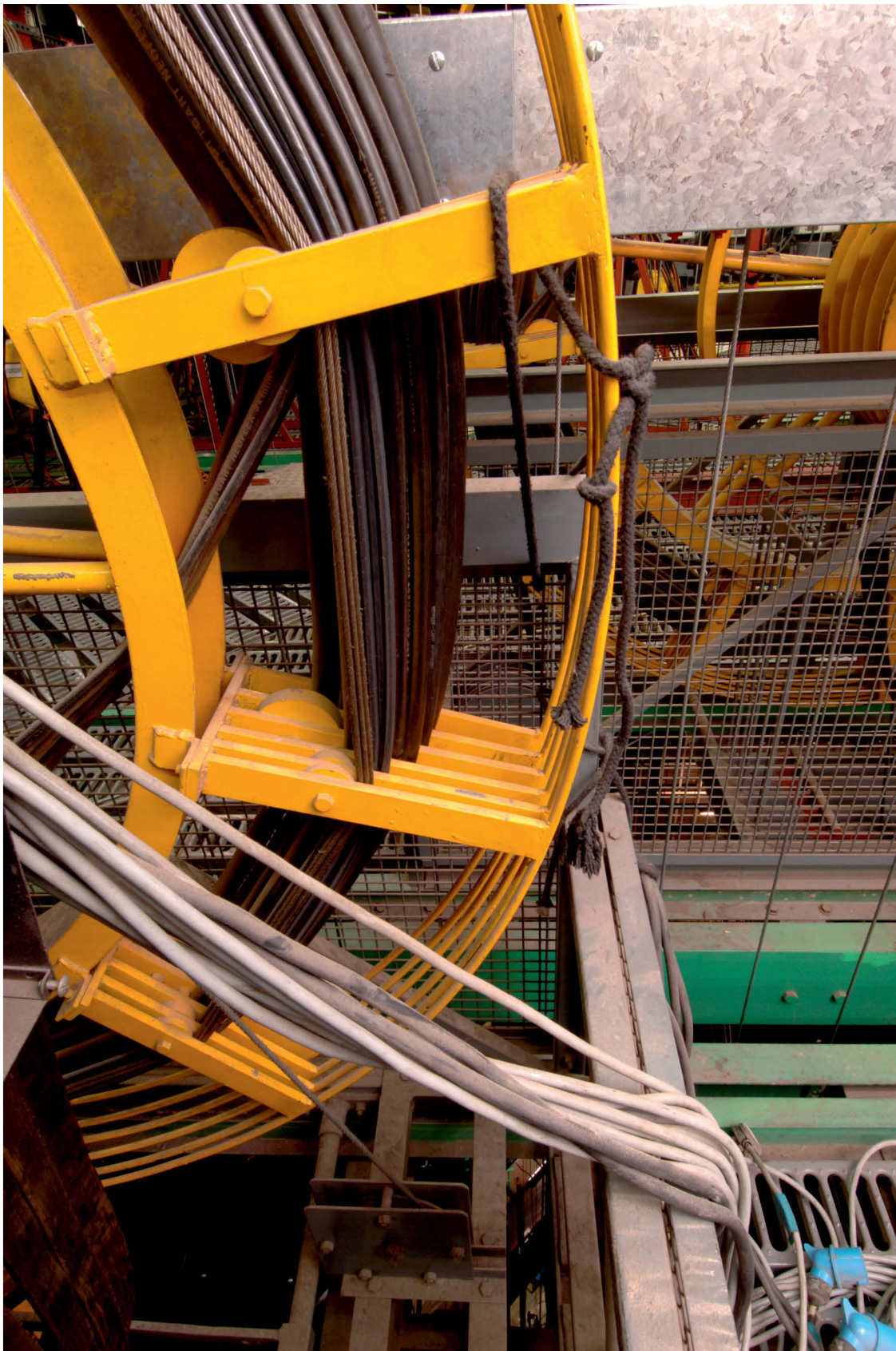


Fig 12 Looking down and to S (ie toward stage left) at windlass 6, showing the counterweight hauling line running to the counterweight head block (at the bottom of the support frame)





Fig 13 Looking up and to SE (ie upstage and toward the centre from stage right), showing the vertical diversion block below windlass 1 (suspended from the grid directly below the counterweight header block) – this block diverts the counterweight hauling line to run horizontally upstage, towards the back of the fly loft. A horizontal diversion block just visible at the extreme left diverts the line toward the array of loft blocks as shown in Fig 2



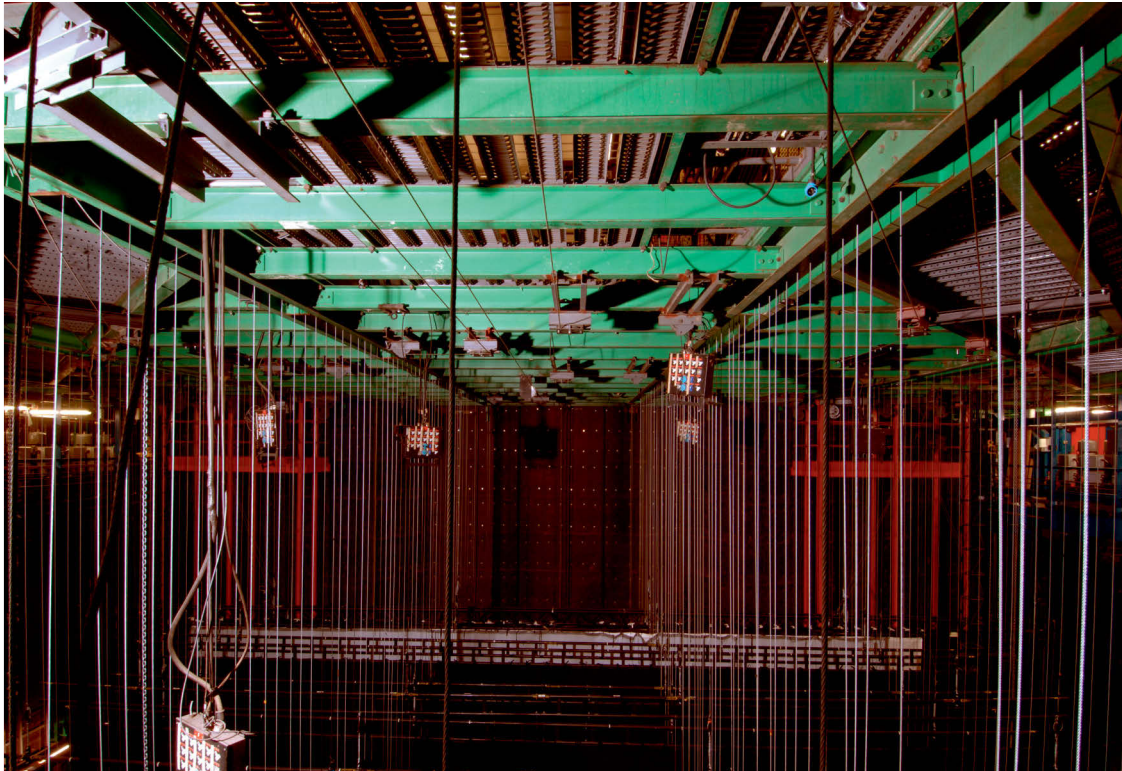


Fig 14 Looking downstage (to W) from the sub-grid gallery at the back of the fly loft, showing the suspended socket boxes, with the counterweight hauling lines running below the grid (overhead)



Fig 15 Looking up and to SW (ie toward downstage stage left), showing the counterweight loft block array suspended below the grid at the rear of the fly loft





CITY1175SBR09#16

Fig 16 Looking SE (from downstage, stage right, looking toward the centre back of the loft) at sub-grid level, showing the bars hanging in the fly loft below the grid – the windlass counterweight hauling lines run down from loft blocks at the back of the loft, in front of the stairs at centre left





Fig 17 Looking down and to SE (ie upstage and toward the centre of stage right) from sub-grid level, showing the counterweight chains (wrapped in blue plastic) suspended in front of the galleries at the back of the fly loft (at left)



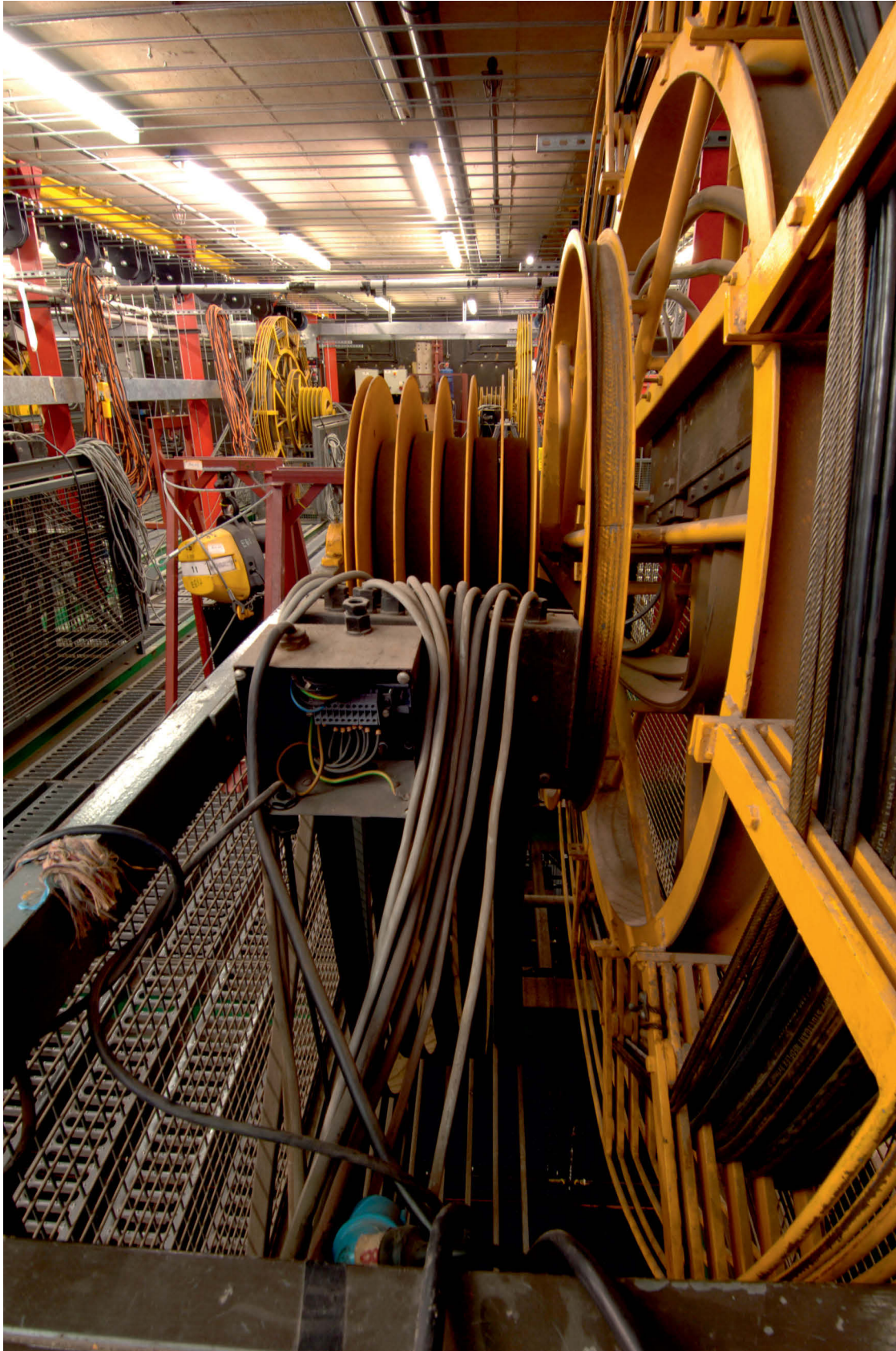


Fig 18 View of counterweight head side of windlass 5 (looking W, ie downstage) – showing fixed electricity supply box attached to windlass support frame in front of reels (electricity supply reel [multi-sheaved drum] on left, counterweight reel in centre, lighting-cable reel at right)





Fig 19 Detail of axle at front of windlass 5 (looking N, ie toward stage right), with hub of electricity supply reel (showing cable passing into centre of drum, from where it ran to lighting-cable reel)

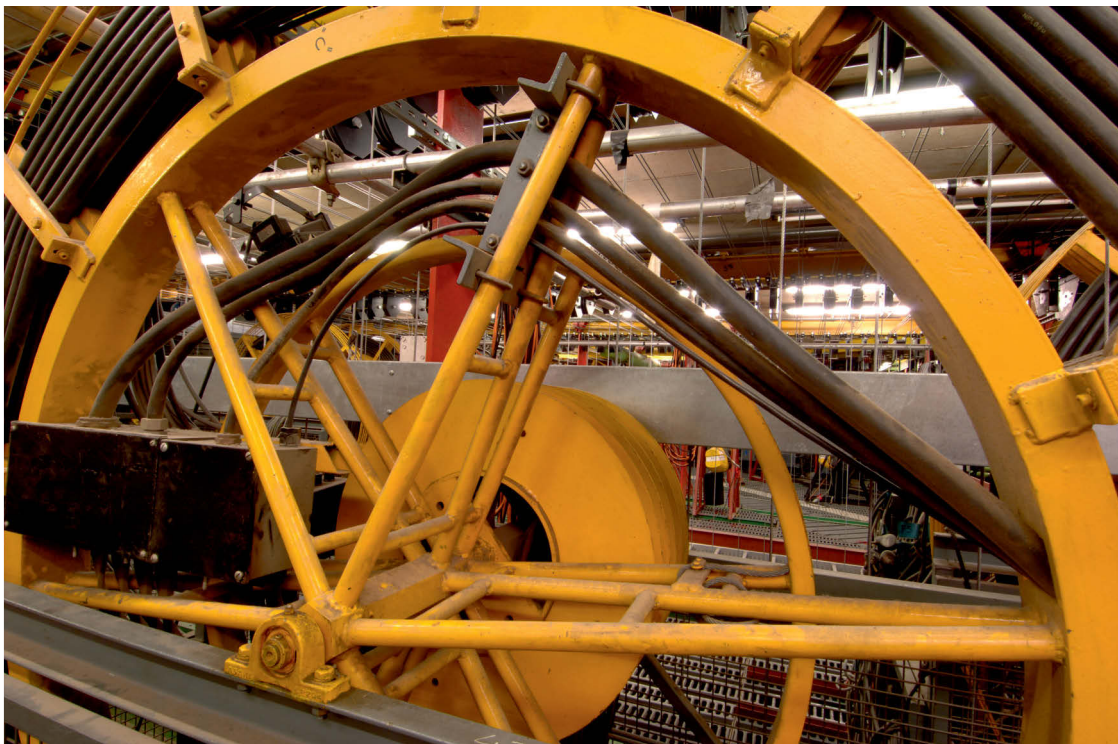


Fig 20 Detail of hub of lighting-cable reel at back of windlass 8 (looking NW, ie toward downstage stage right), showing electrical cables running from hub of electrical supply reel up into bottom of mobile electricity supply box (fixed to spokes of lighting-cable reel), with lighting cables running out from top of box, through inner cable guide, and then through hole in the reel (at right) to spool between the outer cable guides



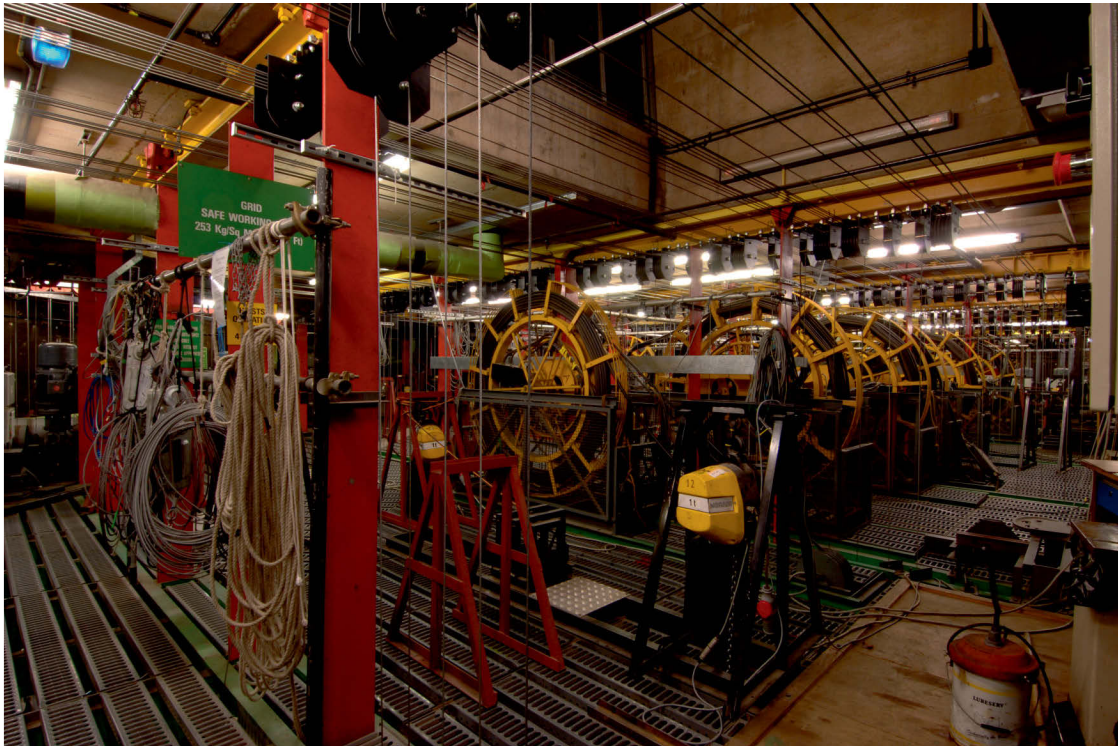


Fig 21 General view of grid looking upstage and towards the centre (ie SE) from downstage-most stage right

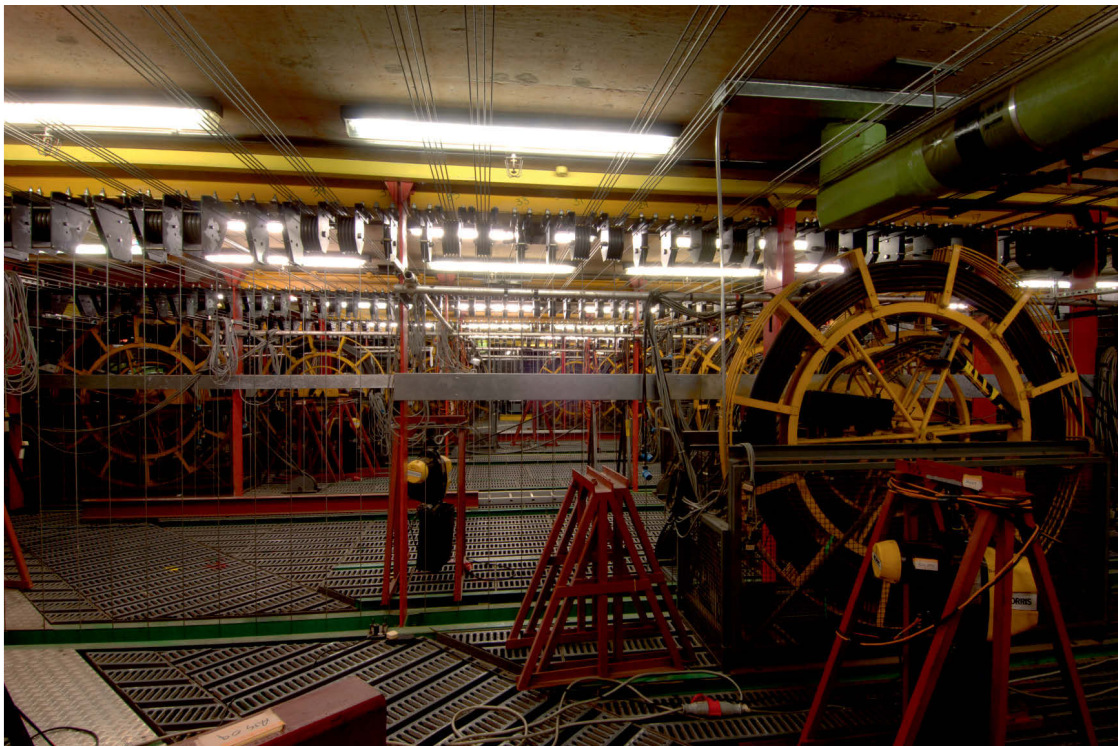


Fig 22 General view of grid looking inward (southward) from stage right (approximately halfway upstage)



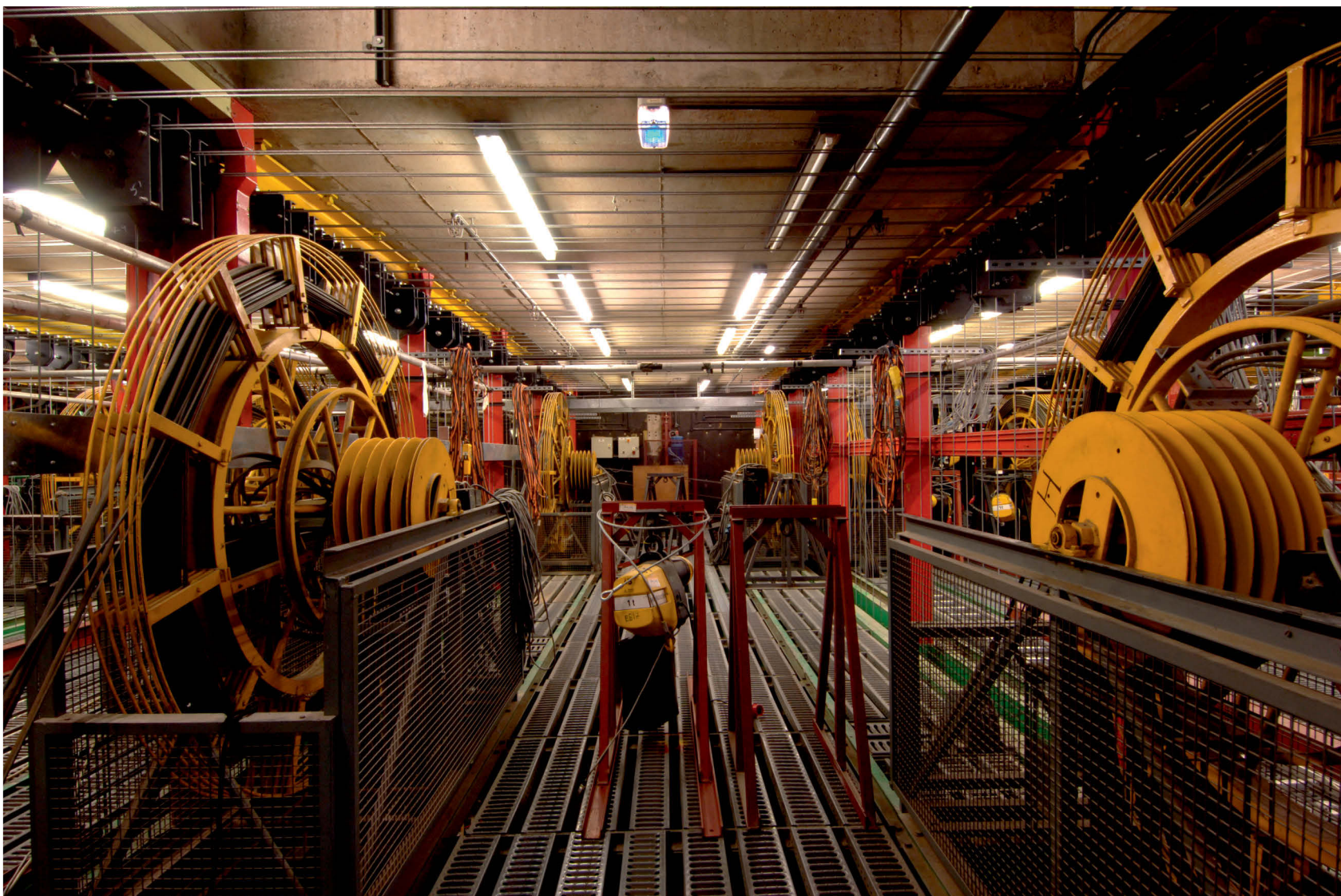


Fig 23 General view of grid looking downstage (to W) from near the back of the grid, centre stage, showing windlasses 4 (in the distance, right), 5 (near right), 6 (near, left) and 7 (in the distance, left) – other windlasses are visible to either side