



Royal Albert Hall

RIGGING CODE OF PRACTICE

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1. Introduction

The Royal Albert Hall (RAH) recognises that rigging activities can have the potential to pose higher risks if not adequately controlled. This document therefore describes the code of practice, including safe working practices, which need to be adhered to in order to ensure the safety of anyone that could be affected by these activities.

This document describes the techniques, methods and precautions that the RAH insists are employed by anyone rigging in the Hall. If you have any questions regarding it please contact your event's Technical Manager.

All work in the Hall is governed by, and must comply with the following regulations:

- The Health and Safety at Work, etc. Act 1974
- The Management of Health & Safety at Work Regulations, 1999
- The Provision and Use of Work Equipment Regulations 1998 (PUWER)
- The Manual Handling Operations Regulations 1992 (2nd edition 1998)
- The Workplace (Health, Safety and Welfare) Regulations 1992
- The Personal Protective Equipment at Work Regulations 1992 (PPE)
- The Lifting Operations and Lifting Equipment Regulations 1998 (LOLER)
- The Work at Height Regulations 2005
- The PLASA National Rigging Certificate Handbook (3rd edition) 2007
- The ABTT Technical Standards for Places of Entertainment 2013

The RAH is licensed by, and takes instruction from, Westminster City Council and must adhere to Rules of Management and the Technical Standards for Places of Entertainment.

Included within this Code of Practice are the following documents:

- [Safe Working Practices for Production Rigging](#)
- [Working at Height - Safe systems of work](#)
- [Working at Height - Rescue of a Casualty.](#)
- [Microphone sling reference guide](#)
- [RAH Rigging Scheme of thorough examination](#)

1.1. Rigging Equipment Inspections

As part of our compliance with LOLER and PUWER, the Royal Albert Hall currently engage Allianz Engineering as the appointed inspection company to carry out thorough examinations on all rigging equipment. A reputable LEEA affiliated contractor is also engaged for some chain hoist examinations.

All relevant certification is held electronically by the Royal Albert Hall and is provided by Allianz Engineering and other relevant contractors involved in the examination process.

We as the Royal Albert Hall are satisfied that all rigging equipment receives a thorough examination by competent persons and conforms to the relevant health and safety regulations.

2. Production Rigging

2.1. General visiting production rigging

It is the responsibility of the promoter or production company to provide a suitably competent rigger (see section 2.1.4) who will work closely with the RAH technical team with the rigging elements of the event. They will also be required to sign off rigging elements specific to that event.

2.1.1. Existing RAH hoists

The Hall has approximately 120 hoists (to BGV-D8 standard) permanently installed. Some of these hoists are dedicated to house lighting trusses and PA systems, the rest are available to use in fixed locations over the stage. RAH spare hoists in non-standard locations may be used but will incur additional charges. Please ask your event Technical Manager or visit the Hall's website for a recent plan detailing the locations of fixed hoists.

2.1.2. Submission of rigging plans

All rigging activities must be in coordination with your event Technical Manager, who require plans of proposed rigs at least 28 days before an event. These plans must include maximum estimated or measured loads likely to be imposed on any suspension point (including RAH suspension points) and will need to be formally approved and signed off before work can commence. Plans should be presented in such a way that makes it clear where individual loads are being imposed, and in the case of complex rigging designs, must be accompanied by a spreadsheet detailing each of these loads and their effect on any RAH hoists or trusses.

Submitted weight loadings are not to be exceeded without permission from the Technical Manager. The Technical Manager has access to load-cells which can monitor the loading on any single fixed house point.

2.1.3. Bringing rigging equipment in to the Hall

All equipment must be suitable for the task, conform to PUWER and LOLER where appropriate and be marked with a safe working load (SWL).

The Hall requires proof of thorough examination of all lifting equipment and accessories brought on to its premises. These must be available to see on request with the exception of proof of examination for lifting machinery which must be available for the Technical Manager to see at the start of the load-in as stipulated in LOLER 1998. To avoid any potential hold-ups at the start of the load in, it is suggested that all certification is submitted along with the relevant Health and Safety documentation in advance.

2.1.4. Competence and practices

All rigging tasks must be undertaken ONLY by a person fully competent in rigging methods and standards - the PLASA National Rigging Certificate or equivalent is a good example of proof of competence.

Care must be taken when routing around installed rigging and cable management. This especially applies to rigging on the Hall's Trusses, many of which have equipment installed on them.

All rigging must be steel. All bare steel wire rope (SWR) must be sufficiently burlapped at baskets and bearing points. Wire-rope round slings and SWR sufficiently protected by a suitable sleeve may also be used.

Where it is preferable to use polyester round slings (Spansets) instead, then they should be backed-up by taut steel.

2.2. Building grids and spreader truss information

Owing to the closed nature and height of the roof, it is often necessary to construct a grid (or grids) using a system of spreader trusses between the house trusses or from trusses hung directly from the roof points.

Any show points required not directly below a roof hole or house truss will usually have to be obtained by building a grid in the auditorium. In the simplest case this will consist of a single truss (spreader) suspended from house hoists with the show point hung from it in the required position.

Spreader trusses picked up from two hoists should be loaded to no more than the SWL of the hoist with the least lifting capacity (for hoists with the same SWL this is 50% of the total lifting capacity). Where a long spreader is required, extra points or secondary suspensions should be considered. Please note that this also applies to the hanging of screens (see 2.8.2)

2.2.1. Grid design

If it is intended that a piece of show equipment is to be flown from and/or safetied back to the grid, all elements must be able to safely withstand any foreseeable shock load caused by the failure of a primary point. The same must also apply to any shock loads that could occur from any sub hung equipment.

Cantilevering spreaders are only allowed in accordance with manufacturer's instructions and if the spreader contacts the grid at two primary members. Cantilevered trusses are likely to create uplift at the distal end which must be considered in the design.

The lifting capability of the house trusses must be carefully considered. The four over-stage house trusses have an SWL of 2000Kgs or 2 tonnes per truss (this figure includes the self-weight of truss and pre-installed equipment already present). It is imperative that the individual hoists that pick-up these trusses are also considered and that any production loads do not overload these hoists. The house trusses are made from steel and so even when stripped of equipment; it is still likely that the individual hoists will see around 300Kgs before any production equipment is added.

Although every best effort should be made to avoid climbing a grid, sometimes it is unavoidable. Therefore access by a climber must be considered. As well as providing adequate fall protection, extra loads on hoists where a climber may be present (thereby overloading the hoist) must be considered. As a rule of thumb, including the self-weight of the chain hoist in load calculations can be sufficient. Please see 3.1 below for more information on access to flown structures.

2.2.2. Rigging practices (specific to grids and spreaders)

It is best practice to pick truss at node points and to rig points onto the grid at lattice nodes/cross brace positions only; this must be done in line with the manufacturer's guidance.

Spreader trusses must be strapped and safetied with a short steel at both ends. Cantilever spreaders should be strapped at the primary member that is not the fulcrum of the cantilever. Allow sufficient overlap in the spreader length such that natural movement does not create a hazard. Steels must be rigged using good slinging practice that will be effective should they be brought into the load path.

Wire rope slings should be rigged such that ferrules and shackles do not bear on the members of a truss.

Grids must always be slung with sleeved or burlapped rigging steels or 'Steel Flex'.

. Any steel wire rope sling in contact with aluminium or steel trusses should be sleeved in PVC tubing, provided with burlap or other effective means of protecting the truss from the cutting action of the wire rope under tension

Bridling between the (spread) grid trusses is forbidden as trusses used are not designed to take the horizontal forces created by bridles.

Grids and spreader trusses must be flown flat not raked to ensure the load is distributed correctly.

2.3. Hoists and winches

All hoists must be rigged using wire rope slings (rigging 'steels').

'Long link chain' complying with the HSE guidance may be used in the Hall

Hoists that are not German BGV C1 or BGV D8+ or equivalent compliant (suitable for holding loads above people) must either be suitably down-rated or employ a taut steel bypass once at rest. Using additional hoists as a means of secondary suspension is also acceptable.

Hoists should not be loaded to maximum capacity and should allow for an unexpected increase in load, for example someone climbing on a truss could potentially inadvertently overload the hoist.

2.3.1. Chain bags

Due to the distance between stage and roof extreme caution must be practiced to prevent chain spilling from chain bags.

A suitably designed and sized chain bag must be used in conjunction with any chain hoist in accordance with the hoist manufacturer's instructions. These should be of the 'ARS' (double clip) type, or bracket type attachment. **Bucket type chain bags are not allowed in any configuration.**

The end of the hoist load chain contained in the chain bag must be connected to the hoist body to reduce the length of chain that could spill. The connector and anchor point used must be strong enough to arrest the forces generated by a chain spill.

As with all other rigging incidents, chain spills are to be reported immediately to a member of the RAH Technical Team for investigation.

In order to help prevent the occurrence of chain spills as much as possible, the following must be adhered to:

- Hoists and chain bags must be regularly serviced and inspected in line with LOLER regulations
- Chain and hook must be in good working order and suitably stored/lubricated/maintained
- Hoists must be rigged correctly so that the chain bag hangs freely and is not obstructed in any way.

2.3.2. Winches

Winches must be considered as hoists and therefore the same rules apply in relation to rigging them as to hoists outlined above.

Automation and winch systems brought into the hall will be individually assessed for suitability and safety at pre-production and in relation to use at the Hall.

Therefore Production Risk Assessments of all such equipment and method statement must be submitted at least 28 days in advance (see notes on live moves and automation in 2.5 below).

2.3.3. Hoists from different manufacturers

Hoists from different manufacturers may run at different speeds which could lead to instability of suspended loads and excessive strain on other components. This should be avoided whenever possible. Extra precautions should be taken if this is the case, such as periodically checking the loads during a long lift.

The same should be considered when moving loads under multiple controls. Consideration should be given to the effective communication between all parties. In the event that one party is RAH control, adequate notice must be given to the RAH operative so that they can give full attention to the tandem lift. One person must be nominated to observe and 'call' the lift using pre-determined terminology or signals.

2.3.4. Using rope and pulleys

The use of rope and pulleys ('block and falls') may be allowed for insubstantial pieces of set/equipment. However this is subject to a separate risk assessment.

2.3.5. Single point hangs

In general, all points should employ a secondary suspension in case of primary failure. Certain exceptions to this may be allowed, for example on lightweight set pieces where automation makes it difficult for a piece to hang from multiple points. In this case,, additional safety measures and a significant factor of safety must be employed. Please 2.5 below for more information on live show moves and automation.

2.4. Slinging show trusses

Trusses must be used in accordance with the manufacturer's instructions.

Show trusses must be slung with steel flex, wire rope slings, brackets, or by soft slings (spansets) with a taut steel backup.

The allowable load/span of the truss in question must always be considered. Trusses must be picked-up with a sufficient number of points, such that in the event of any one point failing, catastrophic failure and collapse of the truss would not occur.

Where this is not possible, the SWL of the hoists in question should be suitably down-rated so that their factor of safety becomes in excess of 10:1 (i.e. a 1t hoist is down rated to have an SWL of 500Kgs)

Where there is insufficient redundancy in hoist suspension of a flown object, additional steel safeties must be employed.

2.5. Live show moves and automation

The sole use of hoists for any moving effect during the show must be the subject of a separate Risk Assessment and Method Statement; this must be provided at least two weeks prior to the show. In such cases proprietary automation or motion control systems/software are preferred. This is also subject to approval by the RAH Rigging Manager.

Live moves that use chain hoists should make use of use of BGV C1 hoists. If a non BGV-C1 hoist is to be used then it must by suitably down-rated to have a 10:1 safety factor and make use of limits and positional encoders. Additional 'spotters' may be required where any part of the move is out of sight of the operator. Live moves must be well rehearsed prior to the show move itself.

2.6. Equipment suspended from show trusses

All equipment suspended from a show truss must have an effective secondary suspension with a safety factor of 5:1 against failure. This includes moving items such as mirror balls.

2.7. Rigging PA

2.7.1. PA Rigging design

It is essential the loads to any part of the PA flying system do not exceed the SWL of any component. Special attention should be paid to the top row cabinet links of any columnar system.

The weight of hoists, rigging equipment, cables, climbing personnel and PA equipment itself must be taken in to account when calculating point loads. Additionally 25% extra capacity should be factored in to the design to account for dynamic forces. Therefore it is highly likely that a PA speakers weighing 850kg will have the potential to weigh over a tonne and therefore should be picked up from 2 tonne hoists.

It is essential that redundancy is employed in any rigging design, but especially where PA is concerned. For example on a PA hang that employs two hoists, each hoist should be able to hold the full load without exceeding its SWL. Where this is not the case, taut secondary suspensions must be used. Please see notes in section 0.

2.7.2. PA Rigging practices

Only PA systems with dedicated flying hardware can be lifted.

In the case of a multiple bumper PA system, each bumper should be considered a separate flown item even if the bumpers are linked with spreader or spacer bars. (Bumpers – the custom made hanging frames for the speaker system).

As PAs are often flown independently of the house grid it is common to employ a travelling or ‘running’ safety system in order to avoid pulling SWR safeties to the roof. If this is the case it is important to consider any swing that could be induced by a point failure and the transference of load to the remaining points.

If the Hall deems that a single point failure would lead to an overload of the remaining points, that system must have a secondary suspension to the grid or to the roof. Any equipment or labour required to do this must be provided by production.

In the event that a house hoist is used alongside a production hoist as a ‘running safety’, extra care must be taken when raising or lowering the hang as this will commonly need to be coordinated between both control parties (see section 2.3.3 for information on tandem lifts). This method is discouraged, however, when used, must by-pass as much of the flying system as possible. Steel stingers must be used when using 2tonne double-fall hooks as travelling safeties to reduce the risk of the chain going slack.

Lightweight Truss mounted PA cabinets are considered a truss fixture (in the same way as moving light would be) and must have a secondary suspension to the truss (see section 0).

Care must be taken when adjusting PA equipment on hoists. ‘Bumping’ of hoists under heavy load can cause a dramatic increase in dynamic load and overload rigging equipment and the supporting structure.

2.8. LED and projection screens

2.8.1. Notes on LED Screens

LED screens should be considered in much the same way as PA systems. In general all PA rigging notes (see section 2.7) also apply to LED screens.

Each header for a column or columns of modules must be treated as a separate lift.

Cross safetying LED header bars should be avoided. Usually a truss grid is put in above a screen with an ample lifting capacity and the headers are safetied back to the grid (see section 2.2.1 for information on grid design).

2.8.2. Fast-fold projection screens

If lightweight screens are to be flown only on two points the suspension equipment must not be loaded above 50% of its rated capacity. For example two 0.25tonne hoists may be used to fly a screen of 250kgs max (see notes on hoist criteria 2.3).

Rigging should ideally be picked up from a suitable attachment point. Where no such point exists, a choke round the frame may be acceptable at the discretion of the Technical Manager. Where manmade fibres are used as a primary rigging source, a steel bypass must also be used too.

2.9. Cable picks

Cable picks must be supported by suspension equipment that is not loaded above 20% of its rated capacity or utilize a secondary suspension. In most cases, multiple cable picks is sufficient.

Cable picks may utilise made-made fibre slings to avoid damaging cables.

2.10. Rigging in the gallery and on the circle rail

2.10.1. Safe working loads

The bars located in each bay of the gallery have a SWL of 180Kg UDL per bar. This figure does not include any pre-installed equipment and therefore this equipment must be considered before rigging extra equipment. These gallery bars are suitable for vertical loads only and must not be subjected to any horizontal forces.

The circle rail has a SWL of 75Kg UDL between brackets.

2.10.2. Cabling

All cabling must be positioned within the cable run troughs along the gallery edge. These can be accessed from below with a suitable ladder or from the working area if harnessed, dependent on the work assessment.

3. Working at height

All work at height must be undertaken in strict accordance with the Working at Height Regulations (2005), as well as the RAH Working at Height SWP (see section 3.2).

All work at height must be covered by a risk assessment, method statement, and appropriate rescue procedure, supplied to the Event Manager or Technical Show Manager at least 28 days prior to commencement of work.

3.1. Access to flown structures

Any structure that requires access must have a safety system built into it for access, egress and movement across it, in addition to any progression equipment. Grids should be accessible by means of a truss ladder backed with a fall arrestor, in case there is a need to adjust a point hung from them. 'Inertial Reel' type fall arrestors should be rigged such that they remain above the user at all times.

3.1.1. Climbing trusses and other show equipment

In the case of a truss, access will usually be a ladder and inertia fall arrestor (or mobile fall arrester and rope). Movement across the truss should make use of a suitable Y-Lanyard, always maintaining a connection to the truss (or other suitable anchor point) and fall-arrest should only be used where work restraint is not possible.

In the case of LED screens or PA systems all movement on the equipment must be protected by fall arrest devices or at the very least fall arrest lanyards clipped into suitable anchor points on the grid it is suspended from. Anchor points for fall arrest should comply with the relevant part of EN 795. The use of fall arrest, work positioning or restraint lanyards should be carefully designed to be compatible with the allowable loads on the flown structure, suspensions and roof. Access to such structures must be supplemented with a method statement and rescue policy. Please note that handles on speaker cabinets are not suitable anchor points as they are inadequate for fall-arrest (unless deemed otherwise by the manufacturer).

3.1.2. Rope access

Rope access should be avoided where possible. However in the event that rope access is the only option, the task should be completed by a person fully competent in rope access, for example IRATA qualified.

3.2. Safe working practices for production rigging

The following must be read in conjunction with the Working at Height Regulations 2005.

Employers must ensure that:

- Working at height is avoided if it is possible to do so.
- All work at height is properly planned and organised.
- The risks from working at height are assessed and appropriate access equipment is selected and used.
- Those working at height are competent.
- The use of appropriate equipment and other measures are employed to prevent falls where WAH cannot be avoided.
- Equipment used in work at height is properly maintained.

3.2.1. When work at height is allowed

Before undertaking any working at height, persons intending to do so must ensure that they have permission from the duty Technical Manager and that they have taken every precaution to ensure the

safety of both themselves and others working in the vicinity. They should not access any structure or begin work until:

- They have made sure that there has been adequate notification to others of their intent to work. This is achieved by signs, beacons and PA announcements enabled by the Technical Manager.
- They are supervised by the duty Technical Manager and (if necessary) a colleague with adequate ability to assist them in an emergency.

3.2.2. Access equipment and PPE

Wherever possible, create an exclusion zone beneath the work in progress.

Whenever activity involving working on or around rigging, lighting or other technical equipment is taking place at height then ALL personnel in the following locations are required to wear a suitable hard hat (EN397):

- Stage
- Choir Stalls
- Arena
- All of the Stalls (Including all entrances and exits)
- In/On the Main Arena Lift including at sub-basement level.

There are a limited number of hard hats available for use provided by the RAH, although it is strongly recommended that you provide your own. Suitable PPE head protection is to be worn by anyone working at height. The Technical Manager has the right to remove from the area any person not complying with these directives and, if necessary, from the building (See RAH Hard Hat - Safe Working Practice for more information).

All persons working at height should be attached to an appropriate safety system via a suitable lanyard and/or safety connectors. All personal fall protection systems (PFPS) must be suitably tested and inspected. Persons working on any structure where a fall may cause injury, and which does not have purpose built guard rails, must use a suitable fall arrest/restraint harness, lanyard and helmet; and remain attached to an a suitable anchor point at all times.

If using progression equipment (i.e. flexible sided ladders) or abseiling to access/egress a structure persons must be constantly attached to a secondary safety system such as an inertia fall arrest device or a flexible anchorage line via a suitable fall arrest device and/or connectors rigged to an anchor point capable of sustaining the forces generated by an arrested fall. Descenders must be of a fail-safe design. Figure of Eight descenders should not be used. These are all requirements of the Work at Height Regulations 2005

Any equipment carried up the structure must be attached to the person using it, sealed in a pouch, or hauled up on a drop line once the worksite has been reached. Pockets or belt clips are not acceptable.

3.2.3. The use of chain hoists as access equipment

In certain situations a chain hoist may be the only available means of access, though this should only ever be used a last resort and the climber must employ a secondary means of fall arrest. Where this takes place using a double fall hook-block, a lanyard must be used so that the climber is kept clear from the moving chain.

The hoist operator must be entirely focused on the move and clear communication is essential between climber and operator. It is suggested that 2-way radio communication with a dedicated channel is used. Spotters may also be required and the move must never take place where the ambient noise would inhibit the operator from hearing someone shouting to 'stop'.

A risk assessment and rescue plan must be in place before this takes place (see 3.4 and 3.5 below), and the risk assessment must be reviewed immediately prior to each commencement.

3.2.4. Climbing without fall arrest

Free climbing or 'solo-ing' of any structure, at any height is forbidden at the RAH.

3.3. Artist flying and stunts

All activities and the rigging for artist flying and stunts will be individually assessed and agreed (subject to specific risk assessment and method statement) during pre-production and in relation to use of such effects at the RAH. These tasks may only be undertaken on the specific instructions or under the supervision of RAH Technical Show Managers. Prior approval must be sought by the Senior Technical Manager and/or the Health and Safety Manager.

3.4. Rescue of a casualty

It is the responsibility of any visiting company to provide a rescue plan if any of their personnel may be working at height. It is not the responsibility of RAH to provide this plan for you. This may also include the nomination of a rescuer (please note that this person may not be a member of the RAH technical team).

Any casualty may need to be attended to and recovered quickly. It is the responsibility of the person's employer to ensure this; not some other organisation or the emergency services.

3.5. Devising a rescue plan

The ideal situation for working at height would make use of work restraint equipment, thus preventing a person falling in the first place. However in some circumstances however this is not always possible. In the majority of fall-arrest situations involving trusses the rescue procedure is to simply lower the truss down..

Where lowering the truss is also not possible, a more complex rescue plan needs to be devised taking in to account the following points:

- Type of situation from which a rescue might be required.
- Type of fall protection equipment being used.
- Safety of those carrying out the rescue.
- Type of equipment appropriate for the rescue.
- Method by which the casualty will be connected to the rescue system.
- The direction the casualty will need to be moved in order to get to a place of safety.
- Anchor points required for the rescue procedure and the likely loads.
- Needs of the casualty following rescue

3.6. Implementation

In case of incident requiring rescue plan to be implemented:

- Assess the situation fully before commencing a rescue operation.
- Stage Door should be notified immediately either in person, by RAH radio channel 1 or internal telephone ext.88. Stage Door will notify the emergency services and co-ordinate their arrival. Do not ring 999 direct.
- In the event of an incident the safety of the rescuer and all others should be considered first, it is recommended that all non-essential personnel are vacated from the area
- Identify possible appropriate methods of rescue suitable to the situation including any anchorage points that may be required.
- Ensure all involved are aware of their role in the process and have suitable training /competence.

- Carry out the rescue in a controlled and considered manner.
- Ensure communication is maintained at all times.
- Monitor the casualty's condition at all times and where possible provide first aid.
- Review situation and identify probable causes for future improvement or change in working practices.

3.7. Equipment specifications for working at height

(Category 3 PPE)

Helmet: EN 397 (Ground).
EN 12492 (Height).

Descender: EN 341 Class A.
EN 12841.

Harness: EN 361 – Fall arrest, full body.
EN 813 – Work positioning – sit harness.
EN 358 – Work positioning.

Or a combination chest/sit harness which together comply to EN361

Lanyard: EN 358 – Work positioning.
EN 355 – Energy Absorber (fall arrest).
EN 354 – Lanyard webbing or rope part (fall arrest).

Connectors: EN 362.

Inertia Reel: EN 360 (Self retracting fall arrest).

Fall Arrester (Rope) EN 353-2

Arrester System EN 363
(Complete):

Rope: EN 1891 Type A (Work positioning).
EN 1891 Type A used with EN 353-2 guided type fall arrest device. N.B. This should have a sewn upper termination.

Anchor Points: EN 795 B AND D

N.B. According to LOLER, work positioning and rope access equipment is classed as lifting equipment for people and requires a safety factor equal to twice that typically used for normal lifting. SWL's may be calculated from Minimum Breaking Loads. Safety factors should be at least doubled

3.7.1. Gallery level working at height

High level works in the Gallery area may be conducted via the use of a Scissor Lift MEWP. This may be requested from the Hall, subject to availability and that anyone using the MEWP presents, in the eyes of the Hall, adequate proof of training and is insured to operate it. Please contact a member of the RAH Technical Team for further details. A hire fee may also apply.

Working in the area over the Gallery Handrail requires suitable fall arrest equipment connected to a suitable point as recommended by a member of the RAH Technical Team. Slow descender systems are situated at points around the Gallery edge and may be used with the consent of a Technical Manager.

4. The roof

The terms 'roof' and 'roof void' in this document refer to the space between the top side of the aluminium ceiling and the underside of the glass roof.

4.1. Roof access

The Hall operates a Roof Access Procedure for access into the roof void. This is controlled via the Stage Door and requires prior arrangement before access can be approved.

4.1.1. Inductions

Part of the access procedure requires those who need access to the roof to have an induction. Please see Roof Access Control document for specific information on this, otherwise please contact a member of the RAH Technical team.

4.1.2. Risk assessment

3.3 No work is to be undertaken unless specific risk assessments and method statements have been submitted and a Roof Access Induction has been signed.

4.2. Working in the roof space

The Hall's roof void is floored with aluminum sheeting which is a fragile surface. You must not walk on this surface. Absolute care must be taken to ensure the safety of persons working in the void and those below. Anyone at height on the roof beams or working away from the walkways (e.g. over the coving to access the ring-beam), must attach themselves using the correct restraint or arrest PPE before commencing work, in compliance with the Hall's policy on working at height. Attachments must be made on the iron frame work only.

Loose equipment and materials must not be left lying around on the floor of the roof as they can easily be kicked through one of the many holes or puncture the roof surface.

Trailing cables should be routed such that they do not cause a hazard around the wooden walkways. This will usually mean routing the cable under or over the walkway.

The central area of the roof is known as the Corona. Additional precautions will be required if working within the Corona area this is to be included in your risk assessment. Any loose personal items must be dispensed in to the 'loose items' bucket before entering the corona.

4.3. Structural information

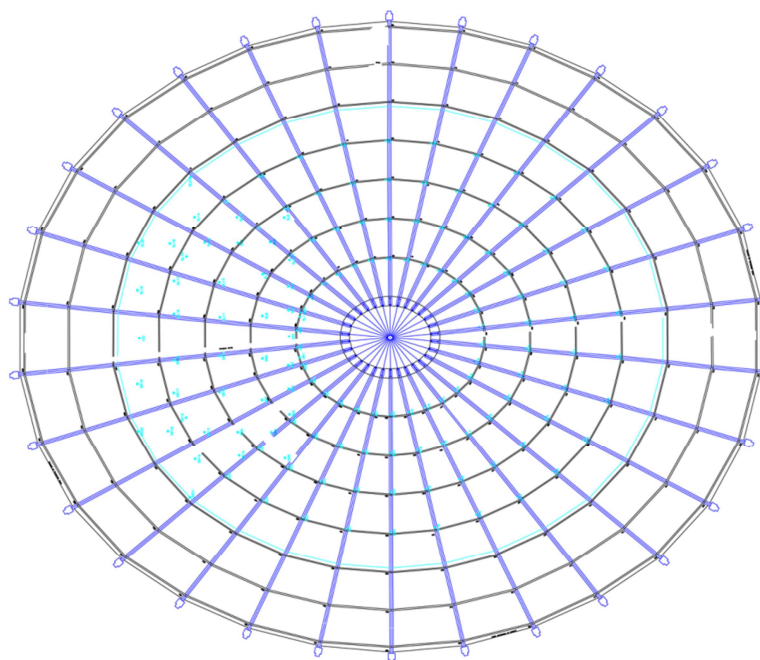


Figure 1 - Roof structure

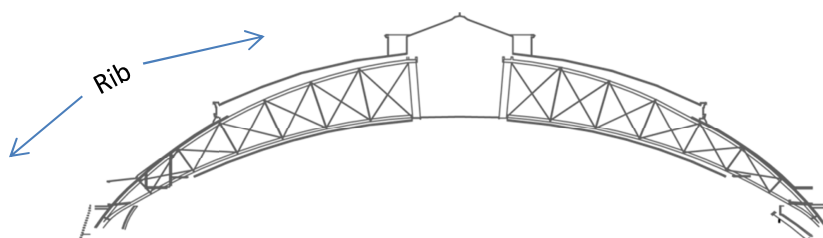


Figure 2 - Roof structure (section view)

4.3.1. Show loading

A recent structural engineer's report concluded that typical show loads were not imposing any undue stress on the roof members. A gross production load of 30 tonnes max can be accommodated in positions agreed by a member of the RAH Technical Team.

If a show is heavier than this or if the loading arrangement is more concentrated than normally occurs, the RAH are likely to require their structural engineers to analyse the effects and advise according. This would be carried out at the promoter's expense.

4.3.2. Ribs

Care should be taken to ensure that the iron Ribs (the beams that run from the corona out to the perimeter of the roof, see Figure 1 - Roof structure and Figure 2 - Roof structure (section view)) do not get over loaded. They have an SWL of 15 tonnes each (with a maximum single point load of 3 tonnes at each node); note that this figure includes any existing installed equipment already in place which must be taken in to account. This figure only accounts for vertical loads; horizontal components should be considered but are unlikely to cause issue. Adjacent Ribs can be similarly loaded but note the constraint of a total production load of 30 tonnes detailed above. It is recommended that points are placed as close to nodes on the Ribs as possible. For more information on roof loadings please contact the RAH Technical Team.

4.4. Manual handling

4.4.1. Hoists

Most RAH hoists are in fixed positions and cannot be moved. In-house spare hoists for 'specials' may be available for use by visiting productions but will attract a cost for the additional work involved in rigging them.

RAH Hoists must not be rigged without permission from the Technical Manager, and all RAH hoists rigged must be internally signed-off.

Productions may bring in additional hoists of their own as necessary but should take into account the complexity and time taken to install these safely. There may be an additional cost for staffing or supervising such work.

Moving of hoists around the roof is subject to a manual handling risk assessment. They must not be carried across the aluminum roof skin as this will overload the skin and chains should wherever possible not be dragged around the roof but should be carried in the chain bags.

4.4.2. Manual handling aids

A track and trolley system is in place around the lower walkway to facilitate moving hoists. The use of this is covered under the Halls risk assessment and must be used in conjunction with a hand-winch to move hoists around the roof void.

There is a service hoist which can be used to transport heavy items of equipment from the auditorium (Orchestra stalls entrance on the ground floor) to the roof void. This is a variable-speed chain hoist with a SWL of 250Kgs. Please note that the hatch dimensions are 3' x 3' so any equipment must be smaller than this to fit through. The service hoist is only to be operated by authorized persons, please ask a Technical Manager if you wish to use this. Equipment brought in to the roof must be stored in appropriate storage areas and not block walkways.

4.5. Rigging points

4.5.1. Rigging hoists in the roof void

Special care needs to be taken when rigging hoists body-up in the roof void. When these hoists are running they are generally out of sight of the control position and spotters, leading to problems noticing chain jams or other entanglements.

Hoists must only be rigged off known, load-bearing anchors and they must be rigged so that the chain 'falls plumb', avoiding the towing of chains or top rigging which may drag on the sides of the aluminum roof.

Cable must be managed sensibly to avoid any risk of entrapment, stretching or tangling and must not run across catwalks.

Chain bags must be rigged clear of the floor or other obstructions and hung straight so dead chain collects correctly. If it is necessary to empty a bag and re-load it by hand then the dead chain must be fed back into the bag in the correct quarter, by single strand, starting at the dead end termination on the block.

4.5.2. Pulling points (for motor-down configurations)

Most hoists will not have a great enough HOL and therefore will need to use compatible stingers. Allow 41m (135') Height of Lift (HOL) Arena floor to Corona. 23m (82') from Arena to the underside of the mushrooms. It is 30m (100') from the back of 'G' riser (back of the stage) to the slot. Therefore the top-rigging must be installed before the chain with stinger is pulled to the roof.

A ratchet sheave must be used when pulling points from the arena below. This must be rigged above the attachment point of the top-rigging (this top-rigging must be in place before starting the pull). The rope must be attached to the hook (or stinger) using a bowline and effective radio communication must be had between both ground and 'top' parties at all times. The chain or stinger should be secured to the rigging point by its shackle **before** the hauling line is released

Grounds men must wear hard hats and keep the working area clear of all other persons. See RAH Hard Hat SWP.

Great care must be taken when rigging around 'House light' mushrooms. See below.

It is recommended that a 1tonne chain is a 2 man pull and a 2tonne chain is a 4. Care must be taken when positioning personnel so that there is no risk of falling on the aluminum skin.

Getting a line in past the mushrooms may require the use of the 'mushroom stick'. Some mushrooms have hoists attached to them so that they may be lowered to avoid the use of the mushroom stick. This procedure must be agreed in advance with your event Technical Manager.

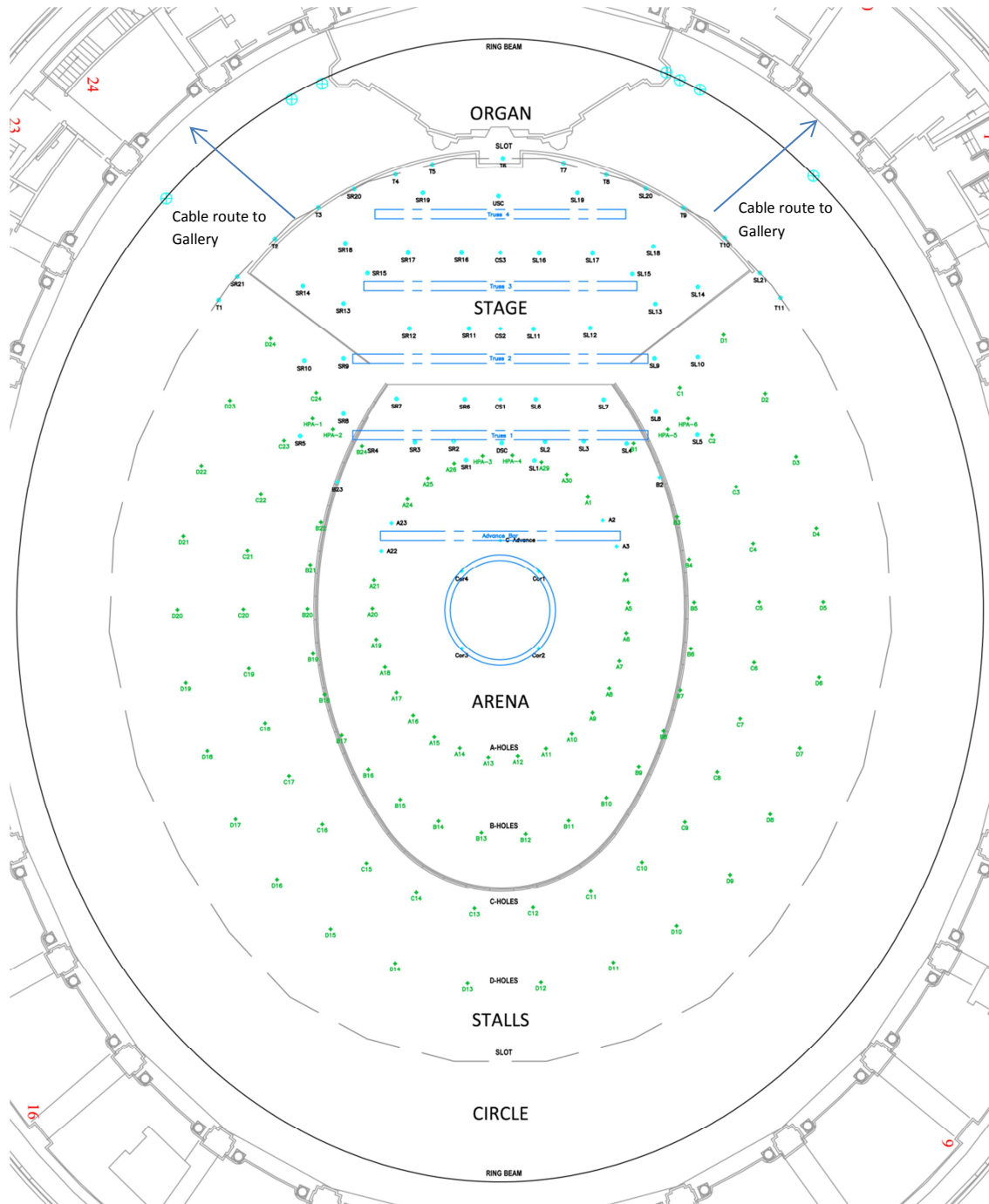


Figure 3 - Overview of roof holes

4.5.3. A holes

Each 'A' hole consists of a 150mm (6") and a 100mm (4") Ø hole either side of the roof trusses' (Ribs) lower chords. The distance from the stage to the underside of these holes is approximately 38m.

All of the A holes have covers which should only be removed when necessary and must be replaced after use.

Points are made from uneven two way bridles, the difference in leg length of 3 inches (2x 5/8" 3 1/4T shackles) allowing for the width of the roof truss chords.

Bridle legs are made off two 2T SWL brackets at the top chords of the roof truss either side of the point in question e.g. a point in A14 is made by bridling A13 to A15.

4.5.4. B, C and D holes

These positions consist of two 50mm (2") holes (except B holes which have one 150mm hole and one 50mm hole), one either side of the roof truss lower chords. Therefore any point being pulled through one of these 50mm roof holes will require a soft eye stinger at the top and a max. 10mm Ø pull rope.

These points are nearly always dead hangs, with the exception of 2 tonne points which require the bridling of the roof beams either side of the point.

A 6m basket and long link chain (see below) chain gives a good usable point for a dead hang. 6m baskets should be used for bridles also. ('Long link chain' complying with the HSE guidance may be used in the Hall)

Hoist-ups are prohibited in these positions, as to pass them through the roof it is necessary to de-hook the hoist chain.

RAH basket assemblies are the best way to rig these points especially off the stage, out in the arena positions.

The approximate distance to the underside of these holes from stage height is as follows:

B holes – 37m

C holes – 36m

D holes - 34m

4.5.5. Slot

Slot Points are to be rigged from beam clamps wherever possible, attached to the slot beams, using clutch chain or RAH dedicated stingers (pre-made steel wire rope). If necessary, 3m (10ft) basket hitches should be employed on the beam, instead of clamps.

It is potentially easy to overload the slot top steel (beam). The Rolled Steel Joists (RSJ's) are rated at 2000kg Uniformly Distributed Load (UDL) or 1250kg point load. Be sure to distribute heavy loads across as much of the roof as possible and do not rig off the low iron beams. If a point load or a combination of point loads will exceed 1250kg it will be necessary to bridle between the top chords of the roof beams.

Be aware of specific obstructions in the slot, especially the conduit under the lip of the offstage edge and the cross joists that support the scalloped roof skin.

Only the slot covers necessary to achieve the point should be opened and these must then be blacked out using Black Wool Serge.

4.5.6. Mushrooms

Sixteen mushrooms have houselights rigged inside them. Great care must be exercised when rigging near or through these mushrooms.

The rest of the Mushrooms are permanent fixtures and cannot be moved.

4.5.7. Corona

There are six standard points in the corona. They consist of 1Tonne SWL latch hook steels located on the points of the compass NE, E, SE, NW, W, and SW. There are no installed North or South points.

There is a house circular truss permanently installed from four points in the corona, these are at NE, NW and approximately SE and SW. Care must be taken when rigging extra hoists near these points.

Other points in the Corona can be made by basketing the top chord terminating at the oculus. This is the preferred method as it does not interfere with the soft masking around the corona.

The Corona houses a tension wired grid. Care must be taken to ensure that rigging does not bear on this grid. Special deflector squares are available if required.

Any work occurring above TWG level (e.g. from the ladders) or when any of the trap doors are open, must be carried out with appropriate restraint equipment and suitable risk assessments. See Roof Access control document.

4.5.8. Ring-beam

The Ring Beam is a steel beam that runs continuously round the perimeter of the roof that has a sub-hung RSJ running around the perimeter of the auditorium.

Access to the lower Ring Beam is by rope only (see notes on rope access 3.1.2) via one of several holes in the plasterwork to the roof. Ropes must be installed at suitable points on the upper-support-beam located in the roof however please note that off-catwalk access is required. Points may then be installed using beam clamps/trolleys to the underside of the Ring Beam.

It is far easier to install a point where there is already a hole as this does not require direct access to the underside of the beam. This can be achieved by pulling up a split-basket to the roof and connecting it across the upper-support-beam (off catwalk access required). Please see Figure 3 - Overview of roof holes for information on existing Ring Beam access holes

Please note that the ring beam has a SWL of 1000Kg p/m UDL or a maximum point load of 1.5tonnes. Any additional loads may need to be reviewed by the Hall's structural engineer.

4.5.9. Anchor Points

There are several anchor points located on the grand and second tiers. These are primarily used as anchor points for guy wires. Depending on their intended use, it is likely these points will need to be load tested and inspected by a structural engineer prior to use.

5. Microphone slings

Microphone (mic) slings usually carry a relatively low load but should be regarded as a piece of lifting equipment. All components used in the sling should have a marked safe working load (SWL), be inspected in accordance with LOLER and certification held.

This section describes the recommended components to make up a mic sling and how to safely attach it to the building. Please note this section cannot cover every eventuality so if in doubt ask a member of the RAH Technical Team for assistance.

5.1. Components

5.1.1. Steel Wire Rope (SWR)

The main component of a mic sling is steel wire rope (SWR); this provides the support for the microphones and cable. A minimum of 4mm diameter SWR is recommended

5.1.2. Terminations

The SWR part of the mic sling has two types of termination, the adjustable termination at each end of the SWR where it attaches to the building and fixed terminations where any sections of SWR are joined together.

For fixed terminations it is recommended to have a ferule secured eye, (see Figure 4). Made in the SWR by the manufacturer when it is purchased.



Figure 4 – SWR Termination

If you are going to do the fixed terminations in the SWR yourself the components must be suitable for use with the diameter of SWR supplied, have a marked SWL and be fitted in accordance with the manufacturers' instructions.

For the adjustable terminations at the end of the SWR it is recommended that a Reutlinger Wire Rope Holder is used, see Figure 5. They don't require any tools to fit or adjust and can be protected from accidental release.



Figure 5 - Reutlinger

Other suitable types of terminations are wedge sockets (Figure 6 – Symmetrical Wedge Socket) and bullets (Figure 7 – Strandvise/Quickterm/Bullet). These require some tools to fit and can be quite hard to adjust once fitted.



Figure 6 – Symmetrical Wedge Socket



Figure 7 – Strandvise/Quickterm/Bullet

5.1.3. Connectors

Quick Links, otherwise known as Maillon Rapides (Figure 8), are the most suitable connector to be used when joining sections of SWR together within a mic sling. Other suitable connectors are shackles or screw gate carbine hooks. All connectors must be stated as suitable for lifting purposes by the manufacturer and have a marked SWL.



Figure 8 – Maillon Rapide

5.1.4. XLR Cable

The XLR cable to each microphone should be attached with cable ties to the SWR at regular intervals.

5.1.5. Microphone Safeties

The microphone to XLR connection needs to have a back-up safety in case that connection fails. The best way to do this is to attach a small steel bypass from the microphone to the cable. One end of the steel is attached by the eye to the microphone using a jubilee clip and at the other end the eye is attached to the cable just above the XLR connector using two cable ties. See Figure 9. For an assembly diagram of the components.



Figure 9 – Microphone safety

5.2. Anchors

To attach the sling to the circle rail it is recommended that a half coupler with an eyebolt is used, (see Figure 10). These are easy to fit, secure and remain in position.



Figure 10 – half-coupler with eyebolt

5.3. Fixing to the RAH Structure

The only part of the RAH structure that mic slings can be attached to is the lighting bar running around the front of the Rausing Circle and Organ Circle. This is a standard size scaffold bar, (48.3mm diameter).

If you want to attach a sling to any other part of the RAH please speak to a member of the RAH Technical Team.

5.4. Exclusion Zones and Hard Hat Areas

Before you start rigging any microphone slings, you must have permission from the duty Technical Manager. You should not begin work until a PA announcement has been made and the warning beacons have been activated. Please see RAH Hard Hat - Safe Working Practice for more information.

6. Banners

Please note that there is a separate document with specific information on the rigging of banners. To download a copy of this document please go to <http://www.royalalberthall.com/about/technical/downloads.aspx> or alternatively contact your Event Manager.

7. RAH Rigging Scheme of thorough examination

The Royal Albert Hall engage Allianz Engineering to carry out thorough examinations on all rigging equipment and a reputable LEEA affiliated contractor for chain hoist examination.

Allianz Engineering are also responsible for the examinations of the all passenger and good lifts throughout the Royal Albert Hall.

We can confirm that all relevant certification is held with our insurers and other relevant contractors involved in the examination process.

We as the Royal Albert Hall are satisfied that all rigging equipment receives a thorough examination by competent persons and conforms to the relevant health and safety regulations.

7.1. Loose tackle items (accessories)

Loose tackle items will undergo examination every 6 months by an appointed inspection company. In order to ensure that only in-date items are used, upon inspection they will be tagged with a coloured cable tie. Any items missing this tag must be quarantined into one of the bins provided (roof and rigging store).

7.2. Fixed top rigging, truss and canopy accessories

The top rigging accessories for fixed chain hoists in the roof (i.e. those with a designation such as SL1, CS1, T1, T1/1 etc.) are fixed and only altered after recommendations by the examiner. As these assemblies are considered cranes, all items will undergo annual examination. Non-captive items in an assembly currently have a green tag connecting them together in such a way that if any item was to be removed, the tag would have to be cut. During the thorough examination, the examiner is instructed to look for these tags between the non-captive items on their records to be sure that no un-authorised changes have been made to the assembly. Once the crane inspection is complete, a single large notice is attached to the crane to indicate that it has been (see appendix 1). These notices will rotate colour annually to ensure that none get missed.

Please note that Green tags are not used for 6 monthly items to avoid confusion. This change in regime has been made to improve the safety of inspectors working at height

7.3. Fixed bottom rigging, truss and canopy accessories

The lower parts of the crane assemblies (fixed trusses and canopies etc.) are also inspected annually. As there are no work at height issues relating to their inspection, every single tackle item will be tagged on a rotating colour scheme upon inspection.

7.4. Chain hoists

Chain hoists will undergo a service strip down, and load test biennially, alternating every other year by a reputable LEEA affiliated contractor.

Chain hoists that are not due for their service will undergo examination during the same period as the rest of the crane assembly. In some cases this will involve running the hoists down until all the chain is out of the bag. As much chain as possible is examined from the ground while the remainder is inspected from the top, while the chain runs back in to the bag. The chain is marked by the examiner on the ground so that the examiner at the top knows when the full length of chain has been completed.

All chain hoists undergo full examination annually.

7.5. Quarantine

Signage is located in relevant stores to identify current in-date tag colours. All items missing their inspection tag, or are believed to be otherwise not suitable for use must be quarantined. There are two quarantine

bins located in the rigging store and the roof. These items may be returned back to service upon successful re-examination and tagging. All other items will be destroyed.

7.6. Document Control Information

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