Rigging and Dismantling

Guidance to the technical author:

- ***Please do not comment on items that are greyed out in this document as the context of this text will be supplied by the Arboricultural Association.***
- *Throughout the guide there will be sections or boxes that will directly relate to the ICoP - please take note of these in your response.*
- *The tone of the document should reflect the intended audience, e.g. the climbing arborist and should also reflect the relationship between this guide and the content of the ICoP.*
- *The document is also intended to provide reference for supervisors / team leaders; this will appear as summary 'check list' information in each section, generally reflecting the main items from the relevant AFAG Safety guide.*
- *Comments in green are provided to identify the expected information to be included within the technical guide.*
- *Please indicate where illustrations or photos should be included - you do not need to supply these but should either provide a rough sketch, or describe the important elements of any image.*
- ***When typing your response for each section, please use the TECH AUTHOR style.***

Front cover

Verso page

Contents

1 Introductory material:

Foreword by the Association and Acknowledgements - This would be a non-exhaustive list of those individuals who have provided significant contribution to the project.

1.1 Introduction:

Why the technical guide came about, development history and intended use.

1.2 Structure:

Clearly defining how the technical guide is framed into parts and how these parts relate to each other.

1.3 Scope and limitations:

Who the technical guide is aimed at and who is excluded from it. Who the technical guide does not apply to, such as, tree climbing for the purposes of sport or recreation.

2.0 Guidance

2.1 General

competence, training, pre-planning, job packs, statement / diagram of pre-planning

(b-f from 2.2.2 ICOP)

2.2 Planning and Management

2.2.1 Risk Control Systems and Emergency Planning

This section will include information to enable the practical arborist to understand the purpose of the risk assessment process and their role within it. We anticipate an illustration is used here depicting a common work scenario relating to the guide title, identifying 15-20 hazards, accompanied by brief guidance on application of generic and site specific risk assessments.

2.2.1.1 Emergency procedures

This should include any standard practice for emergency communication during rigging operations - e.g. blowing a whistle to stop all operations, allowing further communication.

2.2.1.2 Method statements

2.2.1.3 Briefing of all parties

2.2.1.4 Other work site considerations

These should include comments on areas such as wildlife, utilities, TPO's, biosecurity, traffic and pedestrian management etc.

2.2.1.5 Resources

These should be specific to the work operation and guide title, e.g. equipment in good working order and compliant with PUWER and LOLER, suitable for the job, present on site, equipment for rescue, first aid kit etc.

2.3 Roles and Responsibilities

2.3.1 General

Please refer to ICOP 2.3.1 page 10 "proficient operator"; we suggest providing suitable examples of the points raised with the proficient operator box in this section.

2.3.2 Communication

2.3.2.1 Purpose and benefit of communication

This should be specific to the guide title.

2.3.2.2 Knowing who to speak to and raising concerns

2.3.2.3 Types of communication systems

Please list examples, pros and cons of those examples, and any issues surrounding interpretation and confirmation of messages.

2.3.3 Supervision

See ICOP page 10, "competent person" box.

2.3.4 Operator Proficiency

This should be a brief statement which encompasses ensuring the operator has undertaken appropriate training and read manufacturer's instructions' the equipment in use.

2.4 Work Site Assessment

2.4.1 General

This should cover areas such as safe zones, danger zones, escape routes, layout and positioning of equipment relevant to the guide title; you should consider aerial rescue methods, site access and egress (any illustrations are to include a power-line example) and areas such as drop zones.

2.4.3 Tree Work Specification

For template purposes only - include this section if appropriate for the guide title.

3.0 Tree Condition Assessment

This should be based around the information presented in chapter 2 of the Rigging Research document.

3.1 Tree related hazards

This should cover areas such as strength loss in load-bearing parts of the tree due to visible damage, poor structural development, primary failure points, and climatic conditions.

3.2 Key steps of an assessment

Refer to Section 2.4.3 in the Rigging Research document.

3.2.1 Red flag indicators

Using illustrations, show the 'red flag' indicators as per Chapter 2, Rigging Research. This section should be structured in a suitable, logical, order, e.g. according to a typical sequence of inspection (overall state of tree seen from afar, symptoms in the root zone, at stem base, along the stem, at crown base, in the crown and in the prospective working area / at potential anchor points).

3.2.2 Rating structural defects

Provide key information relating to strength loss tables as well as a list of fungus / tree species combinations known to be hazardous to climbing / rigging. Also include a list of tree species reported to be more susceptible to failure than average.

4.0 Understanding the Forces Generated

4.1 General

Use a 'decision tree' showing the process of selecting an appropriate tree access method, (including the decision to not climb where appropriate ref. ICoP p. 24). This should also include information on selecting an access method and planning a route or movement around the tree relating to the task.

4.2 Estimating section mass and potential peak load

This section should include worked examples and an example worksheet, along with relevant reference data.

4.2.1 Estimating log mass

This should include tables and/or graphs that provide an estimate of log mass, e.g. log mass chart for green Oak; briefly describe how the chart should be used. Point out any limitations of such estimations.

4.2.2 Estimating the mass of crown sections

Describe techniques appropriate for crown sections, suitable form factors or reference values based on experience (you must be able to show how you arrived at these experiential figures and clearly state that these values are not scientifically proven). Also include any safety factors used in these estimations.

4.3 Correction factors

Include a short introduction - no more than a sentence or two - about correction factors used. This heading should be seen as little more than a 'holder' for the following headers detailing specific types of correction factors.

4.3.1 Species correction factors

This should include a list of 8-10 examples of the species correction factor to be used when calculating log mass. These examples must show the range of factors from maximum to minimum and include commonly found species.

4.3.2 Safety factors

State the safety factors to be used in estimating log mass. Refer to the worked example on page 353 in the Rigging Research report. Also "Adequate Factors of Safety" on page 258.

4.3.3 Other factors

Include proposals for correction factors to account for taper in log sections, irregular form, decay and moisture content.

4.4 Potential peak loading

Explain why safety considerations should start with determining the worst-case scenario.

Explain when and how peak forces are generated, along with the kinematics of snatching timber. Point the reader to sections in the Rigging Research dealing with how energy is dissipated, specifically 8.4 Dissipation of Energy in A Worst Case Scenario, and 8.4.3 Elastic Energy ("stretch in the rope" -and- "stem deflection")

State the consequences of the log's impact on the stem for the tree and the climber.

4.4.1 Parameters affecting potential peak loads

Briefly cover the following points, providing a description of their meaning (using illustrations wherever possible):

- *Mass of the section (potential energy)*
- *Distance of fall (including log length and the actual flight curve)*
- *Rope length and rope modulus (how elasticity determines the deceleration rate when the log is being stopped by the rope)*
- *Elasticity, height and slenderness of the trunk (how flexibility cushions deceleration of the log, but enhances the amplitudes of sway)*
- *Aerodynamics and dampening (effects of retained branches on section and trunk)*
- *Friction and rope angles at the rigging point (how they affect the anchor force)*
- *Lever arm length*
- *The consequences of high peak loads should also be covered and how peak forces and amplitudes of sway can be minimised.*

4.4.1.1 Pulley above the load

State the correction factor to be used when the attachment point for rigging is above the load, include an example of loading when a pulley is used. This is often quoted as being x2.

4.4.1.2 Pulley beneath the load

State the correction factor to be used when the attachment point for rigging is below the load, include an example of loading when a pulley is used. This is often quoted as being x11 - see Rigging Research pg237 for a worst case scenario.

4.4.1.3 Calculating potential peak loads

Devise a worksheet to show a worked example of the potential loading during rigging when snatching a load. [This example should be realistic and will be used later in the document for ensuring system component compatibility.] Also provide a blank worksheet to be used by readers for their own purpose.

It will be important to clearly state that this can only be a rough estimate of peak loads... no rule-of-thumb can be applied and new information is becoming available through additional research.

4.5 How to minimise peak loads

- *Avoid shock loads*
- *Keep the anchor point above the cut as long as possible*
- *Cut shorter sections*
- *Minimise the distance between cut and block positions*
- *Pre-tension the installed lowering line*
- *Add rope to the system without increasing the bending moment acting upon the stem*
- *Let the log run and decelerate gradually*
- *Retain branches and leaves on the section where possible*
- *Use advanced techniques such as re-directs, fish-pole technique, or lifting where appropriate.*

5.0 Anchor selection and evaluation of load-bearing capacity

5.1 Strength of living trees

Provide brief descriptions, with illustrations wherever possible to highlight specific points, regarding:

- *Failure modes of living trees, branches and stems. Include root failure.*
- *Strength parameters and their influence on bearing capacity in rigging application (this should also include the effect of increased stiffness under dynamic loading).*
- *Natural variation of properties in green wood for various species.*
- *Yield strength, ultimate strength and stiffness.*

5.2 Bearing capacities of natural anchor points

This section should briefly highlight the parameters determining the bearing capacity of a natural anchor point in the tree, and should include statements (and illustrations where appropriate) about:

- *Diameter, shape and structure, of the anchor point and all load bearing parts of the tree.*
- *Structural integrity of wood and branch unions.*
- *Branch attachment angle and stem / branch diameter ratio and branch origin (e.g. water-sprouts, epicormic shoots).*
- *Load angle and length of lever arm.*
- *Moisture content of fibres.*
- *Pre-stress conditions (crown weight and length plus additional loads caused by ice and snow, high winds, branch angle and position of the centre of gravity).*

5.3 How to prevent failure of compromised trees

- *Examine defects thoroughly and evaluate their severity (with caution)*
- *Minimise peak forces (see above), avoiding snatching*
- *Retain branches and co-dominant leaders as long as possible*
- *Keep the fall of the rope in the opposite direction to the direction of fall*
- *Guy the weak structure to the ground or adjacent trees*
- *Strap split / weak stems or junctions*
- *Bolt split / weak junctions and cable unstable crowns*
- *Use diagnostic tools, if required, to detect the extent of defects, and/or consult an expert who has the skills needed to assess the load-bearing capacity of a severely compromised tree.*

6.0 Rigging Equipment

[To include examples of correct installation (illustrations). At the author's discretion, discuss equipment selection, compatibility and configuration for the equipment and techniques highlighted.]
Highlight the need to understand the forces involved in rigging and that the rigging system must be able to withstand the potential loading during operations, and be installed correctly.

6.1 Cordage and webbing components

6.1.1 Proper use and inspection

This should cover areas such as bend ratios and friction, abrasion, kinking and fibre breaks, cycles to failure, ageing, fatigue and dynamic loads.
It should also mention (un)suitable fibres for a given purpose e.g. Dyneema / Vectran are not suitable for dynamic lowering operations.
Include the concept of cycles to failure.

6.1.2 Knots

[This section is ideally suited to the use of illustrations – please provide rough sketches of those images that you feel are appropriate to your text.]
Introduce parameters for knot suitability in rigging operations, e.g. easy to tie / untie, stability under loading, strength loss.

6.1.2.1 Attaching a log

To include clove hitch, running bowline, cow hitch, half-hitch and marlin hitch.

6.1.2.2 Configurations for sling attachment

To include spliced eye with girth hitch, bowline, and timber hitch.

6.1.2.3 Rope attachment

To include anchor hitch, buntline hitch and double fisherman's bend, as well as mid-line attachments using the butterfly (Alpine) hitch and friction hitches.

6.1.2.4 Strength loss in knots

Include tables listing strength loss for commonly used rigging ropes when tied in the following configurations: rope-to-log, sling-to-log, rope-to-hardware.

6.1.3 Karabiners and connectors

Briefly describe the types of karabiners and connectors that should be used in rigging operations, or describe the common features / specifications found in karabiners and connectors used in rigging.

6.1.4 Pulleys and arborist blocks

Briefly describe the types of pulleys that should be used in rigging operations, and their application in rigging, e.g. when used below the load / above the load / as a fairlead.

6.1.5 Friction and lowering devices

Briefly describe the types of friction devices use for lowering and the advantages of different methods of connection to a ground anchor.
Include newer devices such as 'rigging rings' along with any perceived advantages / concerns regarding their use.

6.1.6 Fiddle blocks and lifting devices

Briefly describe the types of lifting devices used in rigging operations.

7.0 Building the System

7.1 Certification and conformity

State any relevant certification of statements of conformity to show that components are suitable for rigging purposes.

7.2 Compatibility

Review and define the meanings of compatibility, incompatibility and good / poor configuration.
Provide generic guidelines for designing rigging systems, using examples of correct sub-assemblies of rigging components.
Provide indications of potential areas of conflict, such as tight bend radii, abrasion due to rope-on-rope / rope-to-webbing / webbing-to-webbing.
Provide worked examples, showing forces and SWL / MBS as appropriate, using the previously calculated potential peak load for the following scenarios, and describe how to minimise the issues raised in the examples:

- *Snatching a load, too many wraps on lowering device (effectively locked off).*
- *Lowering a load, no wraps on lowering device, rope held by grounds-person.*

7.3 Inspection and maintenance

Provide generic points that should be considered when carrying out inspections and maintenance activities, with special consideration given to any conflict points already noted. Highlight the requirement to follow manufacturer's guidelines on equipment lifespan / rejection, corrective actions and maintenance criteria.
Pay particular attention to the lifespan of rigging ropes e.g. shock loading. Provide guidance, or direct the reader to manufacturer's information / research data.

7.4 Dealing with the load

[This should cover a description of each, along with the advantages / disadvantages of the chosen system. Include any sketches you feel are appropriate).

7.4.1 Tip-ties.

7.4.2 Butt ties.

7.4.3 Cradles

7.4.3.1 Spider-legs & rigging plates

7.4.4 Speedlines

Make the reader aware of the forces that may occur and consider advising the reader not to drop sections onto an already tensioned speedline.

7.4.4.1 Use of guy-lines

7.4.5 Drift-lines

7.5 Cutting Techniques

Review commonly used notches and cutting sequences and the effects they create; include sketches where appropriate to demonstrate the points made.
Include cutting techniques to avoid dropping of sections and enable hand control.
Include techniques for when lifting loads instead of dropping.
Include tools that may be used to assist the cutting / dropping of larger sections.

8.0 Index