Bowen and others versus the National Trust, 2011

…a personal commentary, submitted by David Lonsdale in response to interest generated by the posting of the court documents on the QTRA website[1]

Introduction and summary of the case

This case concerned a fatal incident at the National Trust's Felbrigg Hall Estate, Roughton, Norfolk. Ten schoolchildren were following a trail on the estate during the afternoon of 26th June 2007. While they and their teacher were sheltering from rain, a branch fell from a mature beech tree, with tragic consequences. One of the children was killed and three others were seriously injured. The Defendant's records indicated that the tree had been inspected for safety on 2nd January 2007.

In preparation for the court hearing, the solicitors for the Defendant instructed me to identify the cause of failure of the branch and to give my opinion as to whether the Defendant had taken reasonable steps in respect of tree risk management prior to the accident. The solicitors for the Claimants issued similar instructions to Julian Forbes-Laird of Forbes-Laird Arboricultural Consultancy Ltd. He visited the site on 3rd October 2007 and I did so on 26th October. In April 2011, after our reports had been exchanged, Julian and I held a joint meeting of Experts. The case went to trial at the High Court of Justice, Queen's Bench Division (London) in June-July and resulted in a ruling in favour of the Defendant.

With regard to the cause of failure, Julian and I reached the same conclusion; i.e. that the branch had begun to fail by cracking in the crotch several years prior to the accident. The crack acted as a trigger for the final failure in June 2007. We both also concluded that, since the branch attachment had been approximately 9.5 m above-ground, the crack would have been completely hidden from the view of a ground-based inspector. (The branch had been almost 22 m in length, thus extending as far as the main portion of the tree, which is about 30 m high.)

Since the branch was very large (basal diameter approximately 500 mm), Julian I and agreed further that the potential for severe impact would have been obvious to a competent inspector prior to the accident.

Despite our agreement on the above matters, Julian and I disagreed as to whether the Defendant had taken reasonable steps to manage tree-related risk. There were two main areas of disagreement: (1) regarding the ability of a competent inspector to recognise that the branch was likely to fail and (2) regarding the usage of the site as a risk-factor.

I will comment first on site-usage, since this was a key factor in determining whether the Defendant had taken reasonable steps to inspect the tree and to decide whether any remedial action had been warranted.

[1] www.qtra.co.uk

Site usage near the tree and the 'zoning' of the estate

Julian and I disagreed about site-usage in relation to the inspection regime. At the time of the inspection in January 2007, the frequency and rigour of tree inspection were determined according to a zoning system, which equated to "high", "moderate" and "low" site-usage. On this basis, Julian argued (in Section 6 of his report) that the Defendant's staff should have taken account of the fact that "thousands of children" were using the adjacent trail every year. He also argued that, since they were engaged in orienteering, they would be likely to stop at the adjacent confluence of paths to check maps or compasses. For these reasons, he concluded that the locality should have been included in the zone of "high" usage. In practice, it had been included in the "moderate" zone, following an improvement to the footpath system, which was thought to have encouraged access.

In Section 10 of my report, I took account of the available information on the use of the locality by school groups and other visitors. This indicated that the average number of passers-by for an entire year (day and night) was just over 14 per day. This figure agrees with Julian's estimate of "thousands" annually but it is low in relation to the overall national spectrum of usage, which (as I have mentioned above) includes busy locations at the top of the spectrum.

In Section 5 of his report, Julian also criticised the instructions for tree inspection that were in force in January 2007. He compared these unfavourably with newer instructions, which took effect later that year. In particular, he argued that the older instructions were fundamentally flawed because they included an incorrect use of terms such as "risk". I agreed that the wording included errors but I concluded that the intention was clear and had been fulfilled in practice. Julian argued also that the older instructions had been too broad-brush because they had stipulated only three zones. I argued, however, that zoning is only a means of apportioning resources appropriately in respect of different parts of the property concerned. Zoning should determine the frequency and rigour of inspections (if any) but this does not mean that the intensity of usage is assumed to be uniform throughout each of the zones (see Appendix 1 to my report, regarding para. 7g of the Particulars of Claim).

The judge, the Hon. Mr. Justice Mackay, recognised the need to discriminate between trees within a given zone, taking account both of the usage of the land immediately around them, and of their potential to cause harm. At para. 35 of his judgment, he wrote: *"Risk as defined in Instruction 1, and as a matter of common sense, has to take into account both the defects in the tree and the physical location or "the intensity of use of the immediate surroundings" looked at together and not in isolation from each other*. Also (at para. 16 of the judgment), he did not accept Julian's argument that the instruction was fundamentally flawed.

Evidence relating to the probability of failure

In Section 6 of my report, I considered the signs that a competent inspector could reasonably have taken into account (in January 2007) when deciding whether there was cause for concern about the biomechanical integrity of the branch attachment that failed in June of that year. In my Section 7, I also considered the extent to which the inspector could reasonably have taken account of evidence of past branch failures in the same tree. In this context, I took account of the usage of the site (see above), since this was important in determining whether, for example, a more detailed inspection and/or remedial action was warranted.

With regard to the failed branch attachment, I observed in Section 6 of my report that the crotch was somewhat cup-shaped, as is often the case when a bark inclusion is either present or is in the early stages of development. The structure of the 'branch bark ridges' also indicated the possible presence of a slight bark inclusion[2]. Perhaps more obvious was the presence of two shoulder-like (or step-like) bulges; one on either side of the cup-shaped crotch. The interpretation of these bulges (also variously described as "ribs", "flares" or "ears") proved to be a key aspect of the evidence presented on behalf of the Claimants.

Although I concluded that the above signs could have led a competent inspector to suspect that the attachment of the branch was not biomechanically optimal, I observed that the same could be said for many beech branch attachments, most of which do not fail unless they have first become obviously cracked or affected by adjacent decay. (On my advice, the Defendant's side submitted numerous photographs to the Court, showing various bulges and bark inclusions in beech forks and branch attachments at other sites where usage was much higher than at the site in question, and yet where no remedial action had been taken.)

Julian took a different view of the shoulder-like bulges, which he described as adaptive growth flares. He argued that they had grown in response to mechanical stresses that had been developing in the crotch area and that had latterly increased as a result of the hidden cracking in the crotch. He argued that a competent inspector would have concluded that the flares were the same as the 'large ears' (or 'pointy-nosed ears') that Prof. Claus Mattheck has described as typical of a weak kind of compression fork[3].

In considering how an inspector should have interpreted the bulges, I looked at the available guidance. This distinguishes between branch attachments and forks. A fork is generally depicted as the division of a stem or branch into two or more subsidiary stems or branches of similar size, which in many cases diverge from each other at highly acute angles[4]. (Branch attachments can of course also be highly acute but this was not true of the incident branch.)

Claus Mattheck distinguishes between tension forks and compression forks, of which the latter are depicted as being more acutely angled and having extensive bark inclusions[5]. The guidance for branch attachments is different. It generally shows a branch as being smaller in diameter than its parent stem, which is not typically angled away from the branch. In a book that was published after the inspection of January 2007, Claus Mattheck depicts a weak branch attachment as not showing any bulges (aka "ears" or "ribs")[6]. By way of explanation, he states that branch attachments do not show "welding". In a compression fork, this is the development of wood around the bark inclusion, contributing to the formation of "ribs" or "ears".

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[2] Interestingly, the eventual failure did not reveal a bark inclusion (except where rolls of occlusion tissue had formed along the edges of the hidden crack).

[3] Mattheck, C. (1999). *Stupsi explains the tree - a hedgehog teaches the body language of trees*. Verlag Forschungszentrum Karlsruhe, 3rd enlarged edition.

[4] Lonsdale, D. (2000). Hazards from trees: a general guide. *Forestry Commission Practice Guide*, Forestry Commission, Edinburgh. 28 pp.

[5] Mattheck, C. & Breloer, H. (1994). *The Body Language of Trees: A handbook for failure analysis* (Research for Amenity Trees 4), HMSO, London, 240 pp. [Note: the caption to fig. 35 in this book states that the compression fork "*…is a structure that is absolutely bound to fail if a tensile load is applied at right angles to the axis of the stems, pulling them apart.*" I understand this to mean that there is an inherent weakness but that failure will occur only if tensile stress exceeds a critical threshold. The statement is accompanied by guidance to look for additional signs (e.g. the presence of visible cracks), which help to indicate whether failure is likely.]

[6] Mattheck, C. (2007). *Updated field guide for Visual Tree Assessment*. Verlag Forschungszentrum Karlsruhe, p.23.

Taking account of the above characteristics of forks and branch attachments, I concluded that it was reasonable for an inspector to have recognised the structure in question as a branch attachment. On the other hand, the bulges (aka "ribs", "flares" or "ears") resembled those of a fork but they did not have the appearance of the "elephant's ears" that are depicted as being typical of a weak kind of compression fork (e.g. see Mattheck, 1999[3], p. 22). I therefore concluded (in Section 7 of my report) that the available guidance had not indicated any particular cause for concern at the time of the inspection.

Since certain branch attachments (like the one in question) show bulges and other features that – according to available guidance – are characteristic of forks, I see a need to revise certain aspects of the guidance. A revision might, however, depend on future research on the anatomy and biomechanical integrity of these 'intermediate' structures, especially in relation to the possible presence of hidden cracks.

Although it would be helpful to develop a better understanding of the biomechanics of forks and branch attachments, this does not mean that tree inspectors should be expected to know more than they can learn from the existing guidance and from their experience in the field. It was on this basis that I concluded that the inspectors at Felbrigg could not have been aware of any cause for concern, given the relatively low usage of the site. In contrast, Julian argued that, by dint of their training and of other guidance that was available to them[7], the inspectors should have recognised that the incident branch attachment was likely to fail. The judge evidently agreed with me that they had acted competently (see para. 25 of his judgment). He nevertheless took the view that "*their judgment was wrong*" with regard to the condition of the incident branch, but I take this a simple statement of the fact that they were not in a position to diagnose the presence of the hidden crack.

The tree showed other features that Julian regarded as warranting concern. In this context, we both considered whether there was evidence of decay near the attachment of the incident branch. We agreed that an inspector should have been aware that an area of exposed decayed wood was present on the other side of the stem, in a very large wound at about 7 m above-ground. We also agreed, on the other hand, that decay had not played any part in the subsequent failure of the attachment. We differed with regard to the actions that a competent inspector, having observed the old wound, could reasonably have taken. As mentioned in Section 7 of my report, this wound had resulted from the tearing-out of a major branch, reportedly in the Great Gale of 1987. Julian argued that the loss of this branch remained a cause of concern not only because of possible decay but also for two further reasons. His arguments in this regard can be summarised as follows:

1. the substantial loss of mass had probably led to changes in the biomechanical characteristics of the stem, perhaps leading to a concentration of stress (a stress notch);
2. the development of decay in the wood exposed by the wound might have extended upwards and laterally, perhaps as far as the branch attachment which eventually failed in June 2007, and
3. signs of a bark inclusion were visible at the fracture surface, indicating that other branches might contain similar inclusions in their attachment areas and might therefore have a tendency to fail.

[7] In Section 6 of his report, Julian refers to a witness statement from David Dowson. This concerned the availability of training material for tree inspectors, including images of the diagnostic features of weak forks and weak branch attachments. David's witness statement was appended to Julian's report but the Claimants' side later decided not to cite it in the trial.

With regard to the last of the above matters of possible concern, Julian observed that a smaller branch, also with a bark inclusion, had failed about two years before the accident and he argued that the inspectors should have been aware of this. A further branch failure, involving the fracture of another cup-shaped crotch, had occurred after the accident.

I stressed the need for inspectors to be aware of previous branch failures in a particular tree if they need to assess its propensity for future failure. However, I also stressed the need to take account of site-usage when deciding whether the condition of a tree warrants detailed inspection or remedial action (see above). In this instance, site-usage was evidently rather low on the spectrum that ranges from very high (e.g. on busy roads) to very low (e.g. in remote woodland areas with no means of access by people).

Julian seems to have agreed with me to some extent about the relevance of site usage in determining the need, if any, for detailed inspection. Referring to the past major failure of the tree in question, he stated "*In my opinion, large-sized mature trees with this type of defect should be subject to close inspection by a competent person if there is public access nearby*." He did not, however, differentiate between sites according to the frequency of access.

Allowing for site usage in this instance, I took the view that the old wound would not have warranted closer inspection unless it had been associated with distinct signs of loss of biomechanical integrity. Thus, although the presence of a stress notch might have been suspected, I argued that there would not have been cause for concern unless there had been warning signs, which were not present in this instance. Potentially, there might have been bark cracks near the wound, or signs of the associated decay being extensive or poorly 'compartmentalised' (see my report for detailed comments).

The leverage exerted by the incident branch was another matter of disagreement. Julian argued that the branch was almost straight and that a competent inspector would have concluded that, because of its weight and its angle (estimated by him to have been 45º), it had a high propensity for failure, owing to excessive leverage. In my opinion it is rare for branches to exert excessive leverage, since their increasing weight tends to be countered by the adaptive growth of their attachments to their parent stems. (It is a separate question as to whether an attachment is structurally compromised; for example by included bark.) In this instance, my observations of the fallen branch indicated that it had curved upwards to form part of the main crown of the tree prior to failure. On this basis, I did not see a reason to suspect excessive leverage. Following my site visit, the upward curve of the branch and its position in the crown were confirmed by accurate measurements and by examination of an aerial photo that pre-dated the failure.

Retrospective risk assessment

In order to decide whether, in my view, the Defendant had acted reasonably, I used QTRA to carry out a retrospective risk assessment for the incident tree. I stated that I was doing so only for the purpose of my report and that there was no implication that the Defendant ought to have carried out a similar assessment on the basis of the inspection that was made in January 2007.

Julian did not attempt a retrospective risk assessment and, while we were drafting our joint report, he invited me to withdraw my reliance on the risk assessment that I had included in my report. He explained that, if I chose to continue relying on this assessment, he would submit a supplementary report in order to explain various concerns that he had about QTRA and about the use, in principle, of an inevitably subjective retrospective risk calculation (see the Introduction to his supplementary report). I decided to continue relying on my risk assessment and so Julian submitted his supplementary report, whereupon I was instructed also to submit a supplementary report in response. At the start of the court hearing, the judge decided not to admit either of these supplementary reports. They were however, later deemed to be in the public domain and have been posted on the QTRA website[1]. I think that they are both worth reading, especially in the context of the debate about the foreseeability of harmful events.

My retrospective risk assessment (in Section 8 of my report) indicated that the risk of harm according to the QTRA value-ranges would have been 1 in 720,000, using the information that I believe would have been available at the time of the January 2007 inspection. I also refined my calculation by replacing the QTRA value-ranges with my actual estimates for the risk-components. On that basis, I calculated a risk of harm of slightly lower than 1 in 1 million, which would have indicated a 'broadly acceptable risk' and no need for further consideration according to the "Tolerability of Risk" (TOR) Framework, published by the Health and Safety Executive[8].

My report also included an additional calculation, as if the inspectors had known about the concealed crack in the crotch of the incident branch. On that basis, the risk of harm would have been far higher but would not have exceeded the limit of tolerability of the TOR framework (i.e. 1 in 10,000 for the risk posed to members of the public).

It is of course possible to challenge my assumption that a competent inspector could not have known about the hidden crack. Although Julian agreed that it could not have been directly observed from ground-level, he effectively took the view that its presence could have been deduced from the presence and size of the bulges ("adaptive growth flares").

Other evidence considered by the court

Counsel for the Defendants decided to cite the 2010 draft of the National Tree Safety Group, which refers to the very low risk posed by trees to members of the public (according to national statistics that show an annual average of about 6 fatalities in a population of 60 million). I think that these statistics are an essential basis for comparing tree-related risk with other (often far greater) kinds of risk and thus for gaining a proper sense of perspective. Also, I agree with the HSE[9] that the statistics are relevant to the general public, since the vast majority of us are, to some extent, exposed to tree-related risks. In my view, however, national statistics do not absolve landowners and managers from the need to manage their particular trees appropriately. Also, it is necessary to take account of non-fatal accidents, which are far more frequent than fatal ones.

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[8] Anon. (2001). *Framework for the tolerability of risk*. Health and Safety Executive, HSE Books, Sudbury, UK.
[9] Anon. (2007) *Management of the risk from falling trees* **SIM 01/2007/05**. Health and Safety Executive. 6 pp.