Conservation of the Hollow Tree in Vancouver's Stanley Park

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Vancouver's Hollow Tree, a 1,000-year-old western red cedar and major tourist attraction, faced removal but has been saved by a determined citizens' group in an innovative heritage-conservation project.

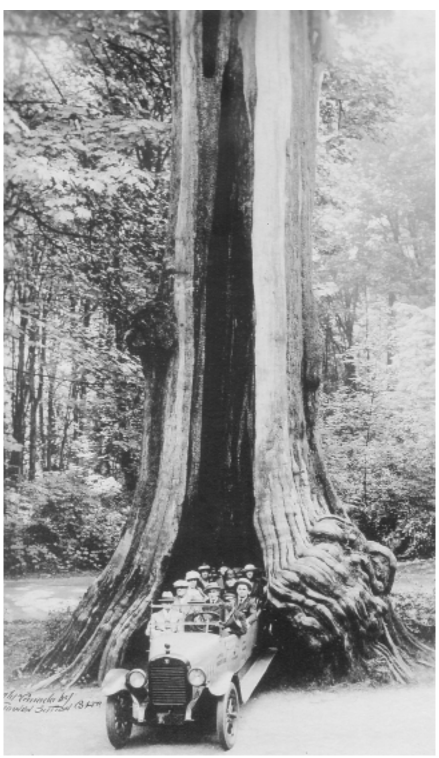

Fig. 1. The Hollow Tree, with a touring car and its passengers, c. 1923. Photograph by Gowen Sutton Co.

The Hollow Tree

Historic landscape features deserve recognition for both their natural and cultural history; those of particular value deserve conservation. The initial failure to conserve a historic tree by the Board of Parks and Recreation of the City of Vancouver, British Columbia, led to a conflict that polarized residents but ultimately resulted in an intriguing and innovative heritage-conservation project with a successful resolution.

The Hollow Tree — formerly called the Big Hollow Tree — is a western red cedar (*Thuja plicata*), perhaps 1,000 years old, whose core is mostly a hollow void. Although no longer living or growing, it is possibly the oldest tree in Stanley Park, a spectacular 1,000-acre (400-hectare) peninsula that was reserved for recreational use by Vancouver's first city council in 1886 (Fig. 1).[1]

The western red cedar is the Provincial tree of British Columbia, the "tree of life" of First Peoples in the Pacific Northwest, and the traditional material of choice for builders and carvers of the Coast Salish First Nations. Lumber cut from western red cedar is easily split and extremely resistant to rot and so is also a favorite of contemporary builders. Of all trees in the region, western red cedar grows the largest in diameter and often becomes hollow in later years. Only the outside of the trunk contains living, growing cells — xylem and phloem — so the tree can continue to grow without its inner core.[2] Many western red cedars also have multiple tops (or spikes); when one top dies in a severe drought, a new one will grow later.

Vancouver's Hollow Tree grew large. Past descriptions, from a time when its girth was larger than it is today (see below), claimed the circumference reached 80 feet (25 m); today, it measures an impressive 50 feet (15 m). Its present truncated height is about 50 feet (15 m). Vancouver's location at the southern edge of the coastal British Columbia rainforest has made it home to some of the world's tallest trees, including two Douglas firs more than 400 feet tall, which were felled around 1900.[3] Western red cedars grow stouter but less tall than Douglas firs. The Hollow Tree, which has lost its upper portion, likely to wind or lightning, may have reached a height of between 150 and 200 feet (45 to 60 m).[4]

The heart of the Hollow Tree began to decay centuries ago. Today the void, entered from the east side of the tree, is large enough to accommodate several dozen people. Recent analysis of the tree rings (which survive only near the circumference) by the Tree-Ring Laboratory at the University of British Columbia indicate that the Hollow Tree was last alive around 1875; after then it ceased to produce new growth rings.[5] The tree survived windstorms in 1934, 1962 (Typhoon Freda), and 2006, which collectively destroyed some 15,000 trees in Stanley Park.[6]

Canada's Dominion Entomologist, inspecting the trees in Stanley Park, reported in 1914 that "the Cedar is very generally 'stag-headed' and hollow-hearted."[7] Foresters recommended at the time that the "stags," or dead heads, be cut so as to reduce the risk of their being blown down in windstorms and to improve the tree's appearance and that the hollow cavities be filled with concrete to extend the time before the remainder of the tree would fall to pieces. However, concrete was never inserted into the Hollow Tree (nor any other tree in Stanley Park).

It is generally believed that the Hollow Tree lost its upper portion at some time before the arrival of Europeans in

Fig. 2. The Hollow Tree sketched as an intact tree with foliage, 1932. Dominion Map and Blue Print Company, Vancouver Public Library, Map 130100.

the second half of the nineteenth century, although this loss may have occurred as recently as 1934. No known early images show the upper portion — with or without branches — and photographs of the truncated top appear only in the second half of the twentieth century. An image on a 1932 map of Stanley Park shows the Hollow Tree with its upper portion and foliage intact and with its hollow core and identifies it as Large Hollow Tree (Fig. 2).[8] The question remains whether this sketch was intended to represent actual conditions or whether the foliage was simply a conventional way to draw a tree. If the top were indeed intact in 1932, it would most likely have been blown over in the vicious windstorm of October 21, 1934, an extreme weather event that toppled an estimated 2,000 trees in the park. The Vancouver Board of Parks and Recreation resolved to remove the debris and restore Stanley Park to an undisturbed appearance, but cleanup was slow. A federal-municipal funding agreement was finally reached in November 1935, and the restoration work followed.[9]

Within a few months the first known references to the Hollow Tree being topless appeared. In January 1936 newspapers reported that "the famous 'Big Tree' or 'Hollow Tree' on the Stanley Park roadway...is going to lose some of what is left of its splintered top" and that "the famous old 'Big Tree' of Stanley Park is to depart for all time...and be shorn of the last ragged ends of its one-time grandeur."[10] The Park Board considered stripping the tree of its signage in response to a letter from banker W. M. Sellens, complaining that the tree was no more than "a 'warty, unsymmetrical butt' [that] should be called 'the hollow stump.'" (Technically the tree is a "snag" and not a stump, and the "wart" is a large burl to the right of the opening.) An editorial in the *Vancouver Sun* at the time suggested that "the Hollow Tree has gone to its fathers, to become one of the legends of time."[11] The no-longer-living tree certainly had reached one of the last stages of its natural progression. As is common with old trees, it was "nursing" two young hemlocks, one growing out of the burl on the eastern side and the other out of the roots on the western side.

In 1965-1966, just after Typhoon Freda wreaked havoc on Stanley Park, the Park Board made a number of interventions to protect the Hollow Tree. It built a curb around the base of the tree to discourage motorists from driving into it and paved the adjacent parking area. About 2 feet of loose fill was placed around the base of the tree, raising the grade to the top of the curb. This action had the unfortunate effect of retaining rainwater in the fill, in contrast to the naturally well-draining hardpan below, and probably significantly accelerated the deterioration of the tree's lower structure. Other interventions at that time included adding metal braces, cables, and plates as reinforcements and removing another 8 feet from the top of the tree for perceived safety reasons (Fig. 3).[12]

An Early Tourism Attraction

Europeans settled in Vancouver in the second half of the nineteenth century, just as the Hollow Tree stopped growing. The tree attracted attention among early Vancouverites for its age, its size, and the large void at its core. The tree was seen as a link to the romantic, distant past in a city with a very young history. One early writer, ignoring millennia of First Nations' presence, speculated that "The Big Tree may have flourished before a human voice disturbed the silence of the Park, or before a human foot left its impress upon the ground near where it stands."[13] The Hollow Tree became one of early Vancouver's premiere tourism attractions and remained such for more than a century. As two old-timers told City Archivist Maj. J. S. Matthews in 1949, it was one of early Vancouver's few points of interest: "nowhere much to go; nothing much to see. So visitors were taken for a drive around Stanley Park, and shown the 'Big Hollow Tree." It was one of the sights no visitor was permitted to miss."[14] Major Matthews himself was quoted as saying: "To come to Vancouver and not see 'The Big Hollow Tree' was like eating an egg without salt."[15]

The Hollow Tree was highly accessible and remains so today, possibly a unique example of one of the world's largest trees being located within a few feet of an urban road. Stanley Park's popular circular roadway, Park Drive, was laid out in 1889 so as to pass alongside the tree. Residents and visitors alike could not resist being photographed inside the tree. A favorite pastime was backing one's car (or carriage) into the tree and recording it on film. Between 1908 and 1941 the Park Board encouraged the practice by retaining an "official" photographer to set up shop beside the tree. Countless images showing people outside, inside, or climbing on

Fig. 3. The Hollow Tree being topped, 1966. Note the two young hemlocks growing out of it. City of Vancouver Archives, 392 1012.

Fig. 4. The Hollow Tree, with a circus elephant inside, lifting a woman off the ground, c. 1925. Photograph by Gowen Sutton Co.

the Hollow Tree, often sitting in their vehicles, have survived in archival collections and on postcards (Fig. 1). The many celebrity visitors to be photographed included the Governor General, the Duke of Devonshire, with his entourage; another was a circus elephant (Fig. 4).

The Hollow Tree began to lose its superstar status in the second half of the twentieth century, as Vancouver developed many other tourism attractions and visitors began to seek experiences that were more active. Nevertheless, the tree's established role as a cultural attraction earned it formal recognition as a significant historic place. It is listed as a landscape-resource "monument" on the Vancouver Heritage Register.[16] The Government of Canada has designated Stanley Park a National Historic Site, and the Hollow Tree is identified as a "tree with cultural significance" in the Commemorative Integrity Statement prepared by Parks Canada.[17] The enduring value attached to the tree was even evident in a promotional animated video for the Vancouver 2010 Winter Olympics, in which two Olympic mascots court each other at the base of the Hollow Tree.[18]

The Hollow Tree has considerable heritage value as a cultural landscape — a landscape that has been modified by, and reveals evidence of, human activity — and as a monument of nature. "Monuments of nature" is a developing category in the ICOMOS lexicon, consisting of prominent natural features that carry important cultural dimensions.[19] The Hollow Tree has cultural-heritage value for having been perhaps the most popular attraction in Vancouver, and it has natural-heritage value in its being representative of the oldest and largest surviving trees in the Pacific Northwest.[20] The tree has added public value for being a uniquely accessible historic place.

The Hollow Tree in Crisis

As the tree aged, its natural structural-support systems weakened. This condition was probably exacerbated by the loose fill placed around the base in 1965. The result was considerable deterioration of the underground structure of the Hollow Tree. It may have been this intervention that caused the tree to tilt eastward and slowly force the open (east) side to descend toward the ground. Comparison of photographs taken around 1920 and 1980 shows that approximately 3 feet (1 meter) of the trunk on the east side has disappeared from the bottom and that the diameter of the tree at the base is less than it was previously (Fig. 5).

In December 2006 a storm lashed Stanley Park with hurricane-force winds, leveling about 100 acres (40 hectares) of forest and toppling an estimated 10,000 mature trees.[21] In the subsequent inspection of damage to the park, it was found that the Hollow Tree was leaning about 12 degrees out of plumb. The Park Board blamed the storm, but in fact, as Figure 5 demonstrates, the tree had been leaning for some time and was remarkable for having survived the winds while so many younger trees had been felled.

Stanley Park's maintenance staff recognized that the Hollow Tree posed a hazard, as it was unstable and could collapse at any time. In November 2007 a safety fence was erected around the tree, and a structural-engineering firm was retained to examine options for its stabilization.

The Park Board staff report of March 2008 presented two options. The first was an expensive stabilization of the Hollow Tree in its tilted state, supporting it on four hefty steel braces secured in concrete pedestals, with the tree strapped in steel bands, its base protected with a concrete curb, and its peak sheltered by a large, hovering, circular transparent cover. The other proposed option was to cut down the tree, split it into two, and position it horizontally on a nearby gravel pad, planting a young western red cedar near its head. While the latter proposal would have cost little while providing some educational value, the report itself had major flaws. The report failed to acknowledge the tree's cultural values or its formal municipal and federal heritage recognition. It also overstated the engineering challenge of stabilizing the tree and claimed that the public favored removing the tree, although no survey of public opinion had been carried out.

Staff presented the report to the elected Park Commissioners on March 31, 2008, with little advance publicity and virtually no public debate.[22] A few citizens identifying themselves as the Friends of the Hollow Tree argued for a more balanced study before irreversible action was taken, but the Commissioners ignored the discussion and unanimously resolved "that the Board approve the taking down of the Hollow Tree as it has become a public safety concern."[23]

The Friends turned to the Vancouver Heritage Commission, the body appointed to advise the city council on heritage matters. The commission requested that the Park Board follow established cultural-resource-management principles, but the Park Board rejected the appeal and upheld its original resolution.

In the weeks ahead, as workers were preparing the Hollow Tree for being cut down, several Park Commissioners began to hear the reasoning in the arguments for the tree's conservation, as well as the growing negative public reaction to their stance. Sensitive to grassroots feelings with an election approaching, two commissioners convinced their colleagues to reverse their stance. Consequently, on July 7, 2008, the Park Board agreed to delay taking down the tree for 150 days to allow the community group to undertake an engineering report confirming that the tree could be "stabilized and made safe in an upright position on its current site" but also asserting "that the Board will not provide any funds for the retention of the Hollow Tree in its present position."[24]

The community group was incorporated as the Stanley Park Hollow Tree Conservation Society. The society immediately set out to raise funds, retain structural engineers (the Cascade Engineering Group of Canmore, Alberta, specialists in wood structures), and use

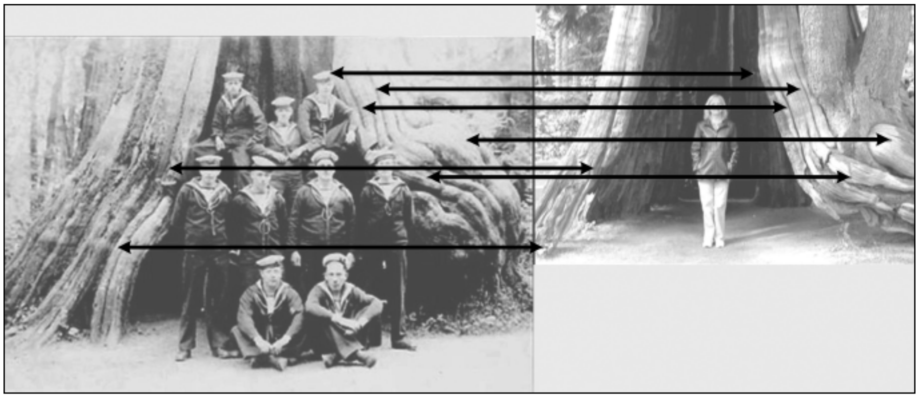

Fig. 5. Photographs of the east side of the Hollow Tree, c. 1920 and c. 1980. The horizontal lines match the same features in the two photos. The lost material at the bottom required shifting the right photograph upward by the equivalent of about 3 feet (1 m). Composite photograph by Lorne Whitehead.

the group's own skills and ingenuity to stabilize the Hollow Tree.[25]

Relations between the Conservation Society and the Park Board improved after November 2008, when the election brought in a new, more empathetic group of Park Commissioners. One (who subsequently became the Board chair) had appealed to the previous Park Board to save the tree. In time the Society would complete the righting and stabilization of the tree and hand the tree back to the Park Board for landscaping and interpretation.

Conserving the Hollow Tree

The project posed a complex conservation challenge. Ideally a conservation project proceeds in four distinct and consecutive stages — research, design, fundraising, and implementation. In this case, this sequence was impossible to follow. Some of the most important research information could not be obtained until implementation was underway, so it was necessary to take an iterative approach that blended the stages in a manner that required careful judgment and entailed taking calculated risks, while ensuring life safety at all times. Such a complex path is never desirable, but in this case, due to the short time frame required by the Park Board, it was unavoidable. The following is a somewhat simplified account that describes the work as if it had progressed in the ideal order of research, design, fundraising and implementation. Although this omits some of the iterative aspects of the project, it has the advantage of presenting more clearly the keys issues and main stages of the project.

Research to Determine the Nature of the Structure

The condition assessment of the Hollow Tree was performed through a variety of methods. One technique used a resistograph, which measures wood density along boreholes that are so small (1/16-inch diameter) that they essentially seal themselves after measurement. The resultant data established that the material of the Hollow Tree was primarily sound and as dense as newly harvested western red cedar. However, the form of the Hollow Tree was found to consist of seven very strong individual vertical segments that had comparatively weak connections to one another. Furthermore, the wood within 20 inches (50 cm) of ground level was largely eroded, and the roots below ground level were essentially nonexistent. Finally, large sections of the wood contained voids, comprising about 20 percent of the volume, although they did not substantially reduce the overall integrity of structure. In essence, the Hollow Tree was somewhat like the leaning tower of Pisa — it was a fairly solid object on a foundation that was slowly and continuously giving way. As the tilting progressed, the resultant torque from the overhang of the center of mass was growing, and hence the process was accelerating. At some point — possibly very soon — the Hollow Tree would collapse.

Careful dimensional measurements were also taken to allow solid modeling of the structure. Small samples of wood were taken to measure its density and strength. The bending strength of the wood was measured at the Faculty of Forestry at the University of British Columbia, using a hydraulic press that applies a gradually increasing displace-

Fig. 6. This 2008 photograph shows the unstabilized position of the Hollow Tree, and the lines and arrows show the movement of the tree that resulted from the test displacement. Image by Lorne Whitehead.

ment to the center of a 16-inch-long sample with a 1-inch-by-1-inch cross-section, with the grain aligned with the long dimension. The bending resistance was observed with a load cell until the point of failure. It was somewhat surprising to find that the strength of the ancient tree was slightly higher than that of typical western red cedar harvested and marketed today. Interestingly, the wood's density, relative to water, was found to be 0.76, dropping to 0.37 after kiln-drying. This result is surprising because the values for green western red cedar are generally considered to be about 0.43, dropping to about 0.32 when kiln-dried. Apparently the water content of the wood in living western red cedar trees stays considerably below complete saturation, thereby maximizing their strength-to-weight ratio. This was an important observation, since it showed the Hollow Tree was highly waterlogged, and therefore its weight could be considerably reduced by placing a rain barrier over the exposed end grain at the top. The resultant drying effect was also expected to slow further decay.

In a final test, a hydraulic jack system applied pressure to a temporary support member, to achieve a displacement of about 6 inches (15 cm) at the midpoint of the structure. Digital photography and computer-analysis techniques accurately determined the movement of various points on the tree. It was found that the tree would preferentially rotate, as a single coherent object, around a horizontal axis near ground level and centered beneath it. Figure 6 shows the original position of the tree, and the superimposed lines and arrows show the movement of the tree that resulted from the test displacement. The only exception to this rotation was at the leftmost point, at the top of the burl, which did not move, showing that although the burl was adjacent to the tree, it was not structurally connected to it. The test also determined that the required force to cause such movement was less than 11.25 tons (100,000 Newtons), which is well within the capacity of available large cranes. This finding meant that returning the Hollow Tree to a vertical orientation was feasible.

Based on this finding, further engineering calculations, and considerable multidisciplinary deliberation, the team devised a practical design for stabilizing the Hollow Tree.

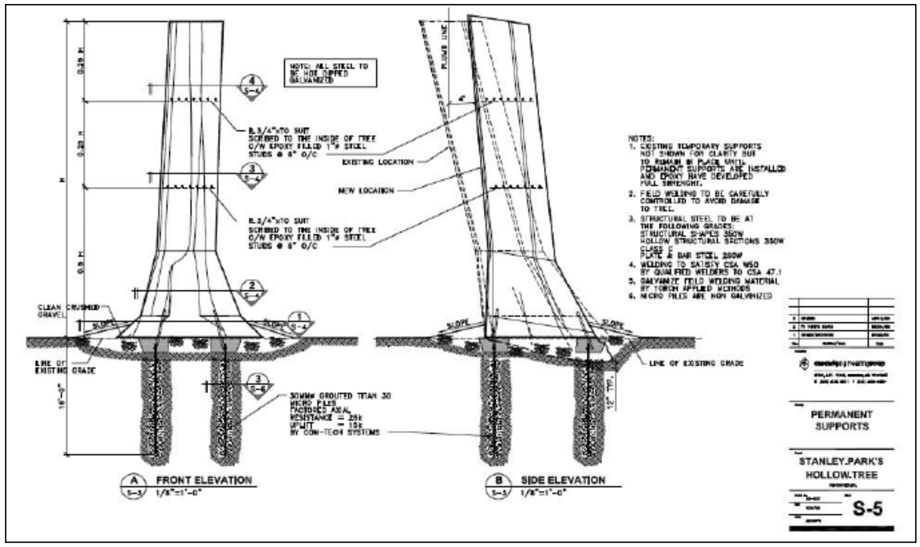

Fig. 7. Sections showing the micropiles, concrete pile cap, and major support frame, 2009. Drawing by Cascade Engineering.

Conservation Approach and Design

The Stanley Park Hollow Tree Conservation Society prepared a conservation plan that set out the principles for the interventions to the Hollow Tree. It declared the overall goal to be "To safely retain the Stanley Park Hollow Tree, in situ, upright and with its appearance substantially unchanged, as a significant lasting heritage landmark in Vancouver." The plan stipulated that all work should follow best practices in both heritage conservation and engineering. It recommended that the conservation approach should be the restoration of the tree to its appearance in the early twentieth century, when it was a major tourist attraction. It also determined that all work should follow the *Standards and Guidelines for the Conservation of Historic Places in Canada*.[26]

Working according to these principles, a set of structural drawings was prepared by the engineers (Fig. 7). The design system comprised four basic elements, none of which was unusual in and of itself but which together comprised a unique solution to a problem that, to our knowledge, had not previously been encountered in this form in either professional engineering or heritage-conservation practice. These elements were a foundation system, a frame system for supporting the tree, an attachment system between the foundation and the frame, and an attachment system between the frame and the wood.

Foundation. The foundation system design called for 14 steel foundation micropiles, each grouted to a depth of 15 feet (4.5 m) in the glacial-till hardpan beneath the Hollow Tree. In other circumstances, a simpler alternative could have been to form a deep and broad reinforced-concrete foundation whose weight alone could provide sufficient stability against wind and earthquakes. However, in this situation it was not possible to remove the Hollow Tree to enable such major excavation. In contrast, because of the Hollow Tree's open interior, it would be possible to employ handheld drills inside the tree in order to create the required holes into which the micropiles could be grouted to form, effectively, artificial roots. Topsoil was to be removed in a circular area around the tree approximately 40 feet (12 m) in diameter, but to a depth of only 1 foot 8 inches (50 cm), and then replaced with a steel-reinforced concrete pile cap that would encapsulate the top portions of the micropiles, each of which was to be topped with nut-locked connection plates. The strength of this foundation design would exceed the anticipated loads from possible weather-related and seismic events by approximately a fac-

Fig. 8. The Hollow Tree supported by temporary braces, July 2008. Photograph by Harold Kalman.

Fig. 9. The Hollow Tree being raised upright, June 11, 2009. Photograph by Amy Cameron.

tor of 10. Although frost heave is not an issue in Vancouver, another advantage of this design is that the micropiles would provide stability against frost heave in essentially any climate.

Frame. For the frame, tubular, black-painted, hollow structural-steel elements were to be placed next to the inside walls of the Hollow Tree, each with an inclination from the vertical matching that of the inside surface of the structure (about 6 degrees). This simple design concept had the benefit of being hardly noticeable to casual observers, yet clearly distinguishable from the tree with a close look, consistent with best practice in conservation. The system was also adaptable to the need of the complex structure at hand through the use of two different tube diameters. Three 6-inch (15-cm)-diameter tubes were planned to provide the main structural support, rising up to a height of 16 feet (5 m) within the structure, and an additional seven 3-inch (7.5-cm)-diameter tubes would rise to a height of 6 feet 6 inches (2 m) adjacent to smaller sections of the Hollow Tree that required additional stabilization near ground level.

Attachment of the frame to the foundation. The design for the attachment of the tubular frame elements to the pile cap of the foundation was very strong and simple but also subtle. The tubes would be put in place and would extend to the bottom of the excavation region before the reinforced concrete of the foundation pile cap was poured; they would be threaded with steel rebar to ensure an extremely solid connection to the foundation system. (Although intrinsically simple, this plan did complicate implementation by constraining the order of operations.)

Attachment of the frame to the Hollow Tree. Two different approaches were devised for attaching the frame to the wood. The first involved threading 1-inch (2.5-cm)-diameter galvanized threaded rods through the wood from outside the Hollow Tree structure and the adjacent steel tube, with matching washers and locked nuts to ensure strong positive attachment and friction. The second involved spanning the tops of the large steel tubes with a welded 6-inch (15-cm)-square, hollow structural-steel bridging element, which would provide added mechanical stability to the frame. Twenty 1-inch (2.5-cm)-diameter galvanized connection bolts, each penetrating the wood of the Hollow Tree, would be placed along this bridging element. These bolts would be embedded in a long-life epoxy glue deposited in oversized bore holes to provide an enlarged bearing area and bond to the wood of the Hollow Tree. These two attachment techniques were known to have different minor advantages and disadvantages and a combination of the two was considered optimal. When attaching steel components to slender, tall trees, one important area of concern is the effect of the natural swaying of the tree in the wind. This is not an issue for the Hollow Tree, since it is, by comparison, wide and short. In any event, the stiffness of the steel and the connections to the tree would prevent any movement at the connection points.

Fundraising

One of the greatest challenges faced by the Conservation Society was that the Park Board was unwilling to pay for the work. The society was therefore required to undertake its own fundraising efforts. Shortly after this condition was agreed to, the recession of 2008 commenced, and fundraising became profoundly more difficult. Fortunately, although cash donations had essentially stalled, suppliers supported the project by assisting with substantial in-kind

Fig. 10. The internal support frame, showing the tubular-steel uprights and the horizontal bridging elements, August 2011. Photograph by Harold Kalman.

Fig. 11. A portion of the concrete pile cap, shortly after pouring, October 2009. Photograph by Lorne Whitehead.

donations of goods and services. In the end, the work was achieved with approximately Can$60,000 in cash donations and Can$120,000 in in-kind donations of goods and services.

Implementation of the Conservation Design

The implementation process took place in six steps:

Temporary support. We now know — but did not know at the onset of work — that the Hollow Tree was very close to falling over. Fortunately, the very first step in the conservation process was to install two 33-foot (10-m)-long, 1-foot (30-cm)-diameter temporary timber braces that spanned the installed foundation blocks to points approximately 16 feet (5m) above ground level, effectively forming a large tripod that would be stable, even if all torsion support from the ground were to fail (Fig. 8).

Excavation. Because of the sensitivity of the project and the confined geometry, a painstaking manual process was necessary to remove the top 1 foot 8 inches (50 cm) of soil to make way for the installation of the micropile and reinforced-pile-cap foundation system. During this process, valuable structural information was also obtained, which informed the design process in the iterative manner mentioned earlier. As careful excavation continued, the reason for the north-south axis of available rotation was identified: the entire weight of the Hollow Tree was supported on two main roots passing into the ground, located on the north and south sides of the tree, on approximately its east-west center line. In order to maintain this support, no excavation was undertaken beneath these support points. However, the entire remaining area within the circle was excavated, both to make room for the foundation pile cap and to clear the way for the rotation of the tree that would be required to straighten it.

Straightening. A large construction crane was used to apply an upward stabilizing force to the east side of the Hollow Tree, which enabled the timber supports to be temporarily removed. The crane then pulled it up further, and, as hoped and expected, the Hollow Tree achieved a vertical orientation (Fig. 9). The timber supports were lengthened so that they could reach their attachment points and were reinstalled to again temporarily stabilize the tree. The crane was then removed.

The two "nursing" hemlocks were removed, in part because their growth was slowly destroying the Hollow Tree, and also because their removal was consistent with the conservation plan, which called for restoration to the appearance in the early twentieth century, before they began to grow. In addition, hemlock has a comparatively short life span, and the two trees would soon have begun to rot, causing damage to the Hollow Tree in the process. A sheet-metal flashing was inserted at the top of the tree to prevent saturation with rainwater.

Installing micropiles. The installation of the micropile foundation was complicated by geometrical constraints within the structure of the Hollow Tree. Additionally, there were difficulties with excess grout, which later had to be removed by jack-hammering in order for the reinforced-concrete pile cap to be installed. A test of a nearby micropile established a very good connection, with both high tensile and compressive strength, into the glacial-till-hardpan substrate.

Installing the support frame. The installation of the tubular-steel frame elements was done simultaneously with their attachment to the interior of the Hollow Tree, using the design methods described earlier. The installation process involved removal of small amounts of wood to allow a snug fit to the interior in a manner that did not attempt to hide the support elements but that made them unobtrusive in this setting (Fig. 10). The support frame is painted black and is visually lost in the shadows; however, it is fully evident upon entering the tree. Ironically, one of the greatest challenges was in drilling the long bolt holes through the wood — the wood was much stronger and harder to drill than anticipated.

Pouring the pile cap. Although critically important, the last step was also the least problematic: reinforcing steel was installed in the excavated region, also threading the tubular-steel support elements, and the concrete was poured, resulting in a smooth surface just below the level of the adjacent ground (Fig. 11). The only difficulty was that the confined geometry of the hollow tree and its surroundings limited access of the concrete truck and required very labor-intensive placement of the concrete.

The outcome of the conservation process is a clean appearance that very much resembles the appearance of the Hollow Tree from decades earlier (Fig. 12).

Interpreting and Landscaping the Hollow Tree

The project includes a program of interpretation to tell the public the principal stories about the tree. The Stanley Park Hollow Tree Conservation Society

Fig. 12. The Hollow Tree after conservation and landscaping, August 2011. Photograph by Harold Kalman.

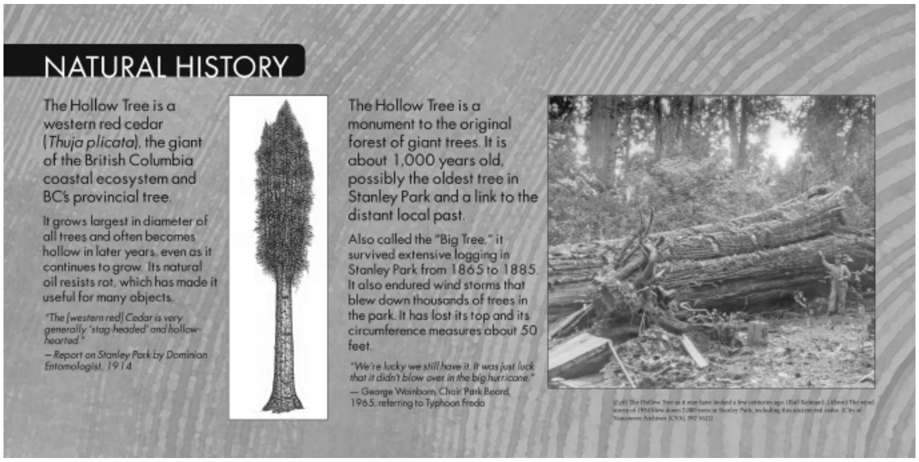

Fig. 13. One of the four interpretive panels, 2011. Design by Christina Lazar-Schuler.

produced an interpretation plan.[27] Two complementary media have been planned. The first consists of interpretive panels in front of the hollow opening; the second is the pavement within and in front of the tree, which will provide the chronology of the Hollow Tree.[28]

The principal stories associated with the Hollow Tree are told in four panels in front of the tree. Three panels provide the narrative: they address natural history, recent history, and deliberations, the last offering both sides of the preservation argument. Each has text, quotations, and illustrations (Fig. 13). The fourth panel provides acknowledgments, listing the many people and businesses who donated money, goods, and services.

A wedge-shaped plaza in front of the opening of the Hollow Tree, as well as the ground within the tree, will record 18 key events that directly affected the tree, from its germination a millennium ago until its conservation, all related by the Hollow Tree in the first person.[29]

The chronology will be treated as a series of concentric, undulating curves reminiscent of tree rings, formed by inscribed basalt blocks set into the concrete pavement. The tree's birth is marked at its center, and the present is at the circumference, with the distance between events roughly representing the time elapsed between them on a logarithmic scale, so that modern events are not squeezed together. Some bands are wider than others for emphasis (such as natural disasters that the tree survived) and visual interest.

The interpretation design is part of a larger landscape plan. The landscape plan, which has been carried out, included enlarging the paved parking area, devising an improved traffic-circulation plan, rebuilding the curbs, placing a split-rail fence along Park Drive, and providing the site with a new drainage system constructed across the roadway. The soft landscaping includes planting the area on which the tree stands with grass and low ground cover using indigenous plant materials. A young western red cedar was planted south of the Hollow Tree. As it grows it will provide a backdrop to the Hollow Tree and ultimately will replace it. As planned from the outset, the landscape work was carried out and paid for by the Park Board.[30]

Conclusion

Clearly the most important outcome of this endeavor has been the conservation of a significant natural and cultural resource in a manner that follows both best conservation and best engineering practices, satisfies the majority of interested parties, and is safe, durable and affordable. The Park Board had dismissed the task as being impossible to achieve, based on one design that had been prepared without any investigation of the physical conditions and without an understanding of conservation objectives. What began as a political challenge became a technical one. Success was by no means assured and was achieved only through extraordinary effort and dedication from a diverse group of skilled participants with a broad range of complementary knowledge. Most had not previously known one another and had come together because of the importance of the cause to them. The group had the courage to reject its own interim designs that did not meet the objectives and to continually search for the best way to achieve the project.

It is only natural to ask whether there are lessons to be learned, beyond the creative engineering design and application of construction and conservation techniques that enabled success. We suggest that there are several.

First, it was troubling to observe that a well-intentioned Park Board could, at first, remain intransigent when presented with evidence that its initial decision was based on incorrect and incomplete information. The only reason appeared to be an all-too-human reluctance to admit to an innocent, unintentional error. From that perspective, it was encouraging later when, in the face of growing public concern, Park Board found the courage to say, "We made a mistake; let's fix it."

Second, despite Park Board's reversal, the Hollow Tree took on a symbolic significance in the eyes of some people with strong nature-centric beliefs, who believed that any structural intervention was inappropriate in Stanley Park. In the end, a subtle but important principle of a democratic society triumphed: a healthy democracy is not one in which the majority of people like every single thing, but rather a place where the majority of people allow the simultaneous expression of a many views, any one of which may appeal only to a minority.

Third, a lesson was found in the success of the fundraising, which was made much more difficult by the economic recession. On the one hand, the wisdom of saving the Hollow Tree was readily apparent. On the scale of funds routinely applied to such stewardship purposes and given the significance of the project, the amount required was quite small. Yet to a world fraught with serious economic problems, a conservation effort could be derided as misguided. How reaffirming it was, in this setting, to have a great many committed citizens, professionals, and corporations step forward and offer their support to make this work.

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Notes

1. Meg Stanley, "Stanley Park's Big Hollow Tree," *The Beaver* 77, no. 4 (Aug.-Sept. 1997): 27–29.

2. Nancy J. Turner, School of Environmental Studies, University of Victoria, communication to Harold Kalman, Aug. 10, 2010. Additional information from Turner, "'Trees for Life': The Cultural Roles of Western Red Cedar and Yellow Cedar for First Peoples of Northwestern North America," presentation at First International Cedar Symposium, Univ. of Victoria, 2010.

3. Bruce Macdonald, "The Tallest Trees in the World Grew in Vancouver?" unpublished essay, 2009. Robert Van Pelt, author of *Forest Giants of the Pacific Coast* (Seattle: Univ. of Washington Press, 2001), 34, 46-47, lists the largest Douglas fir (by volume) as being British Columbia's Red Creek Tree, and British Columbia's Cheewhat Lake Cedar as being the second largest and second tallest red cedar. It is impossible to know what stood before many of the old-growth trees in the Northwest — and virtually all in urban areas — were logged in the late nineteenth century.

4. The presumed height is extrapolated from other western red cedars of similar circumference and age; the tallest recorded by Van Pelt is 195 feet tall.

5. Lori D. Daniels, Tree-Ring Laboratory, Dept. of Geography, Univ. of British Columbia, e-mail to Bruce Macdonald, Aug. 16, 2010.

6. Sean Kheraj, "Restoring Nature: Ecology, Memory, and the Storm History of Vancouver's Stanley Park," *Canadian Historical Review* 88, no. 4 (Dec. 2007): 590–608.

7. Memorandum by Dominion Entomologist, Vancouver, B.C., 1914, City of Vancouver Archives, quoted in Stanley, 29.

8. Map of the City of Vancouver, British Columbia (Vancouver: Dominion Map and Blue Print Company, 1932), Vancouver Public Library, Map 130100.

9. Kheraj, 590, 597, 598.

10. *Vancouver Sun,* Jan. 24, 1936, pp. 3–4; see also *Vancouver News Herald*, Jan. 24, 1936, p. 8.

11. Quoted in Stanley, 29.

12. Stanley, 29. Unidentified clippings, probably from *Vancouver Sun* or *Province*, Mar. 24 and Mar. 30, 1965.

13. Catherine Mae MacLennan, *Rambling Round Stanley Park* (Toronto: Ryerson Press, 1935), 40, cited in Stanley.

14. Memorandum by Maj. J. S. Matthews, 1949, City of Vancouver Archives, Stanley Park, G.N. 104 N. P.11. Major Matthews, an untrained but immensely enthusiastic archivist/collector, did not document material that he collected.

15. Quoted in Stanley, 28.

16. City of Vancouver, *Vancouver Heritage Register*, rev. April 2006, p. 32, http://vancouver.ca/commsvcs/Guidelines/V001.pdf. Registration identifies historic places but does not provide protection.

17. Parks Canada, *Stanley Park National Historic Site of Canada: Commemorative Integrity Statement*, 2002, p. 17, http://www.stanleyparkecology.ca/programs/conservation/research/CommemorativeIntegrityStatement2002.pdf.

18. At the time of writing, the video could be viewed at http://www.youtube.com/watch?v=lnSncdPP8VY. It had been available on the web site of the Vancouver Olympic Organizing Committee (VANOC), which has been removed from the Internet. The image includes an interpretive panel to the left of the tree.

19. The theme of the International Day for Monuments and Sites in April 2007 was Cultural Landscapes and Monuments of Nature; see the introduction by Dinu Bumbaru, Secretary General of ICOMOS, at http://www.international.icomos.org/18thapril/2007/18thapril2007-4.htm. Resolution 28 of ICOMOS's 16th General Assembly in Québec in 2008 directed that the theme of monuments of nature should be explored further; Dinu Bumbaru to Harold Kalman, May 19, 2010.

20. Van Pelt, *Forest Giants of the Pacific Coast,* 30–31.

21. See Vancouver Board of Parks and Recreation, *Stanley Park Restoration*, Dec. 2007, http://vancouver.ca/parks/parks/stanley/restoration/pdf/RestorationProgressReport_2007_WEB.pdf. This progress report makes no mention of the Hollow Tree. See also http://vancouver.ca/parks/parks/stanley/restoration/index.htm for a summary of the storm and the work.

22. Vancouver Board of Parks and Recreation, Staff Report, Mar. 31, 2008; the engineering report appended to it was David Nairne and Associates, "Structural Assessment of the Hollow Tree in Stanley Park," March 2008.

23. Park Board minutes, March 31, 2008.

24. Park Board minutes, July 7, 2008.

25. The board of directors comprised University of British Columbia physicist and engineer Lorne Whitehead, heritage-conservation consultant Harold Kalman, teacher and historian Bruce Macdonald, lawyer Edward Lewin, historian Meg Stanley, and engineer Jon Scott. Construction management was by engineer Doug Campbell and tree expertise by arborist Julian Dunster. Many other skilled professionals volunteered abundant service and labor. Construction services were carried out by Macdonald & Lawrence Timber Framing Ltd. and several other firms.

26. Stanley Park Hollow Tree Conservation Society, *Conservation Plan for Stanley Park's Hollow Tree*, Oct. 2008; http://www.savethehollowtree.com/id2.html.

27. Harold Kalman et al., *Interpretation Plan for the Hollow Tree*, Vancouver, 2010, http://www.savethehollowtree.com/id2.html.

28. The landscape and interpretation design were provided pro bono by Phillips Farevaag Smallenberg, landscape architects and planners. The graphic design was produced pro bono by Christina Lazar-Schuler, graphic artist.

29. Robin Inglis kindly suggested the first-person voice.

30. The installation of the interpretative pavement remained incomplete at the time of writing this article.

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