

MIFACE Investigation Report #09MI163

Subject: Tree Trimmer Working in Tree Died When a Tree Branch Supporting Rigging Rope Broke Below the Crotch and Struck His Head

Summary

In the fall of 2009, a male self-employed tree trimmer in his 50s died while he was removing a dead tree from a residential yard. The decedent was working approximately 30 to 40 feet above ground removing branches using a saddle belt, safety rope, and branch (natural) crotch rigging with a 3/4-inch rope. He was injured when a tree branch that had been used to support a rigging rope broke below the crotch and struck his head. The force of the blow from the falling branch rendered the decedent unconscious and knocked him from the tree.



Figure 1. Incident scene showing aerial bucket and ladder and portable ladder against tree

Emergency responders arrived three minutes after the call for assistance. The decedent hung from his safety harness for approximately eight minutes until emergency responders were able to support his body using a utility bucket truck. The emergency responders placed him on a backboard and then lowered him to the ground via the fire department ladder truck. He was driven by ambulance to a staging area and flown by helicopter to a nearby hospital where he died from his injuries two days later.

Factors that may have contributed to this fatal injury include:

- Tree branch anchoring point did not hold the decedent's weight.
- Rigging method did not support the branch removal activity.
- Decedent's head was not protected from falling objects.
- Ground worker inexperience in rigging methods.

RECOMMENDATIONS

- Tree trimmers/fellers should be properly trained in assessing and identifying hazardous trees.
- Using the information gained in the assessment, appropriate rigging techniques should be used to ensure a dynamic rigging system is in place to minimize friction and shock load during trimming operations.
- Tree trimmers/fellers should wear appropriate personal protective equipment during tree trimming/felling operations.

- Tree trimming employers should ensure ground workers have the training and experience necessary to perform work with rigging ropes and are trained to perform an aerial rescue if an emergency arises.
- The State of Michigan should require registration or licensure of individuals involved in tree care/tree trimming operations. Registration/licensure requirements should include an arborist accreditation by an organization such as the Tree Care Industry Association (TCIA) or the International Society of Arboriculture (ISA).

MIFACE also recommends that emergency responders wear required fall protection equipment when working from an elevated working surface, such as an elevated bucket or ladder.

INTRODUCTION

In the fall of 2009, a male self-employed tree trimmer in his 50s died while he was removing a dead tree from a residential yard. MIFACE learned of this death through a newspaper article. In November 2010, MIFACE conducted two site visits separately interviewing the decedent's sons and his spouse at the decedent's home. In April 2011, MIFACE conducted a site visit at the incident location and spoke with the chief of the responding fire department and the homeowner who contracted the decedent to remove the tree. In March 2012, MIFACE interviewed a certified arborist to gather information about the root causes of this incident and to assist in the development of prevention recommendations. Pictures used in Figures 1, 2, 3 and 5 of this report are courtesy of the responding fire department. The picture used in Figure 4 was taken with the permission of the family at the decedent's home. Pictures have been modified to preserve confidentiality.

Employer

The decedent was the owner of the company and had been in business for 17 years. He performed all of the elevated climbing and cutting and was the only individual who felled trees. He was a self-taught tree trimmer with 35 years of experience and performed residential tree trimming/felling and was also contracted by logging firms to fell trees. When he was 15 years old, he worked in his father's tree cutting business, and later worked with another individual who performed tree work.

His work schedule and number of employees were based on weather and time of year. Summer tended to be the busiest time of year, but at times, winter weather caused extensive tree damage and he would be busy in clean-up work. During the spring/summer/fall months the decedent had three to four employees, two of whom were his sons. During the winter months, the decedent would work with one of his sons.

His sons had been working for him for over 10 years. The decedent normally worked for six hours each day, 4-1/2 days/week. The decedent was routinely home by 4:00 p.m. His

sons indicated he was familiar with all tree types and sizes. His family indicated he had fallen from a tree and had been cut by a saw on several occasions.

Written Safety Program and Training

The decedent did not have a written safety program nor formalized training. His two sons both of whom worked with him indicated that the decedent verbally communicated hazards and safety instructions. One of his sons was responsible for training new employees. The decedent was not a certified arborist or member of an arborist association. His sons indicated the decedent did read some Michigan State University Extension publications about tree health.

Both sons indicated that if, during a job, the instructions were unclear or if a worker did not fully understand the job assignment or cutting procedure, the decedent would stop the job and explain the procedure a second time. The individuals hired by the firm were mostly experienced tree cutters, but the owner still provided any necessary answers to questions. His sons indicated the decedent encouraged anyone to ask him questions. While at the job site, the decedent designated who would be the ground workers and their work tasks.

There was a self-imposed disciplinary policy, but no written policy. Behaviors were corrected at the job site. Mostly, family and friends were tapped as workers and discipline was not necessary.

The decedent provided on-the-job training including chain saw training to individuals who used a chain saw. The decedent had reviewed the MSU Extension website and received MSU Extension publications regarding tree types and issues regarding these tree types.

His sons indicated the decedent wore safety glasses, but did not usually wear a hard hat or goggles due to fogging and sweating issues. His sons mentioned that when climbing, the hard hat falls off one's head and therefore would not provide head protection. This distinction was made by family members compared to trimmers working from a bucket truck.

Work Process

The decedent did not free climb unless it was required he do so. Each day, prior to a job, the decedent checked his rigging ropes, climbing equipment, and tree cutting equipment for frays, tears, and wearing out issues. His sons indicated he always kept his saws sharp and performed routine maintenance on all cutting equipment owned.

INVESTIGATION

The decedent had been contracted by a homeowner to cut down a dead silver maple tree in the front yard. The tree had died during the past year. The decedent's sons both remembered the tree was alive the previous year when they had cut down a tree in a neighboring yard. The tree branches were oriented over the home, the driveway and the sidewalk. The decedent was working with both of his sons on the day of the incident. On the first day of the work, the decedent climbed the tree, and he and his two sons "brushed out" the tree, removing branches that were two to three inches in diameter, leaving the larger limbs. The smaller limbs were placed on a trailer to be hauled away. The trailer was parked on a street with a low volume of traffic. The crew did not place traffic cones in the roadway to warn oncoming traffic nor were spotters used to keep traffic/pedestrians away from the trimming site. The crew had almost completed the brushing operation on Day 1.



Figure 2. Overview of incident scene showing tree architecture and position of bucket truck and aerial ladder truck

The incident occurred on the second day of work. The crew arrived at the site between 8:30 a.m. -9:00 a.m. A couple of hours later, the brushing operation was complete. The decedent donned his climbing saddle and secured his safety rope and climbed the tree to place the rigging rope. The type of rope used was unknown. From pictures taken at the scene by the fire department, the construction of the rope appeared to be a three-strand rope. The sons indicated the decedent used a 3/4-inch diameter rope. It is unclear how many crotches were utilized. The crotch shape(s) was unknown. According to his sons, the 3/4-inch rigging rope had been wrapped around the base of the tree; it is unknown how many wraps had been made. One son was responsible to handle the end of the rigging rope and control the limb descent after the limb was cut and the other son was responsible for clean-up, traffic control, etc.



Figure 3. Incident scene after rescue showing location of ladder truck, ladder leaning against tree and tree architecture

The incident occurred while the

crew was “pulling wood”, i.e., cutting 2- to 5-inch diameter branches and lowering them to the ground and piling them out of the way to pick up later.

On this day, the decedent had promised to be home early to paint a bedroom. The decedent climbed up the tree approximately 30 to 40 feet to begin cutting the branch located over the driveway. It appears that the decedent used the same type of rope for both climbing and rigging – a three-strand, 3/4-inch manila. It is unknown if the rigging rope and the climbing rope were one in the same. After positioning the rigging rope, he began to cut the remaining branches. Based on pictures, several branches had been cut and lowered prior to the



Figure 4. Climbing saddle worn by decedent

incident. His work position while cutting the branch involved in the incident is unknown. The type of tie (butt or tip) at the limb is unknown. At the time of the incident, he had cut an approximately six to eight foot section of a 16-inch diameter limb with an estimated weight of 300-400 pounds. When the cut was completed, it appears that the dynamic forces caused by the falling limb overloaded the branch/crotch, causing the branch to break and propel toward the decedent, striking the back of his head. His sons heard a “crack” and the rigging rope went slack.

A neighbor who had been watching the felling activity called for emergency response. The police department arrived first and then called for the fire department and ambulance and helicopter.

When the fire department received the dispatch call, they contacted the city, which had its own electrical cooperative for a bucket truck, and a nearby fire department for a ladder truck. Applicable city employees have been trained and work under a unified command system.

While waiting for the bucket truck and ladder truck to arrive, the fire department cleared the area of bystanders and made room for the bucket to pull up to the tree. The fire department placed a 24-foot extension ladder against the tree on the request of a neighbor to determine if the decedent could be reached. The fire department placed the ladder under the victim but the ladder did not come close to reaching him.

The decedent was hanging in the harness facing upward and his head and arms hanging back. His chain saw was hanging and was tied off. The bucket truck arrived approximately five minutes after the fire department arrival. When the bucket truck arrived the fire chief told the driver where to position the truck to permit access to the decedent. The city workers entered the bucket and began to raise the bucket to begin

emergency response operations. The Fire Chief determined that trained fire department personnel, a paramedic and an EMT should effect the rescue. The paramedic and EMT got into the bucket and raised the bucket into position to provide emergency aid to the decedent. The fire department personnel, in their haste to begin emergency response procedures, did not wear a safety harness and did not tie off to the bucket. Upon reaching the decedent, they positioned him to the edge of the bucket to take the weight off of his body and lifted his head in an attempt to open an airway. The ladder truck arrived and was positioned in a neighbor's yard. The ladder was raised next to the bucket truck and the decedent was cut away from his harness, placed on a stretcher, and then lowered to the ground using the ladder. He was placed in an ambulance and taken to the staging area for helicopter transport to a local hospital. He died two days later from complications of the head injury sustained when the branch struck his head.

A neighbor, who was watching the decedent and his crew work, told the fire chief who was the incident commander on the ground that she heard the decedent state "you will get somebody hurt if you don't keep tension on the rope". It is unknown when (and if) this statement was made (during the cutting of other limbs or just prior to the incident).

One of his sons returned to the incident site four days later to clean the yard of the brush and limbs remaining on the ground. While there, he found a jagged-edged piece of a tree limb with a crotch that he thought was from the branch that had broke and struck his father's head.

CAUSE OF DEATH

The cause of death as listed on the death certificate was left subdural hemorrhage due to or as a consequence of craniocerebral trauma. An autopsy was not performed.

Contributing Factors

- Tree branch anchoring point did not hold the decedent's weight.
- Rigging method did not support the branch removal activity.
- Decedent's head was not protected from falling objects.
- Ground worker inexperience in rigging methods

RECOMMENDATIONS/DISCUSSION

- Tree trimmers/fellers should be properly trained in assessing and identifying hazardous trees.

The American National Standards for Arboricultural Operations – Safety Requirements (ANSI Z133.1-2006), section 8.4 Rigging, details many requirements of the arborist in regards to rigging operations. Included in these requirements are the following:

- Arborists performing rigging operations shall inspect trees for their integrity to determine whether the trees have any visible defects that could affect the operation. If it is determined that the tree poses a risk of failure due to the forces

and strains that will be created by the design of the rigging operation, an alternate plan shall be used.

- Rigging points shall be assessed for their structural integrity by a qualified arborist. The rigging plan and the tree shall be considered relative to the forces being applied to any part of the tree, including branch attachments and anchoring roots, before a rigging point is chosen and established.
- Arborists performing rigging operations shall be educated to understand and trained to estimate the potential forces at any point in the rigging system being used. The system components shall comply with working-load limits relative to the operation and the maximum potential forces.
- Careful consideration shall be given to the potential forces resulting from the specific influences of rope angles as well as the number of lines and/or line parts that act on any rigging point.

The decedent had extensive tree trimming/felling experience, but, the extent of his education and training and understanding of how to assess the structural integrity and potential forces placed on a tree during a rigging operation was unknown. Also unknown was the thoroughness of the decedent's structural evaluation of the dead tree, including the limbs and the crotches used to support the rigging.

The Tree Care Industry Association (TCIA) *Best Practices for Rigging in Arboriculture* states in Chapter 1: "When done incorrectly, rigging can be one of the riskiest operations there is in tree care. One of the biggest opportunities for error is misjudging the tree. The safety and efficiency of the rigging operation is directly dependent on the condition and stability of the rigging tree(s). An accurate examination of the tree is necessary in order to determine the tree strength relative to the rigging loads expected on it. The qualified arborist/rigger must have specialized training to evaluate the tree for hidden as well as obvious defects that may affect the rigging procedure".

MIFACE recommends that arborists become certified and when involved in rigging operation(s) attend training and participate in professional organizations to improve their skills and to raise their awareness of new equipment and trends in tree care and safety. Training programs should be approved by organizations such as the National Arborist Association, the International Arborist Association and Tree Care Industry Association. Arborists should also be aware of MIOSHA regulations and American National Standards Institutes, Inc. (ANSI) standards.

- Using the information gained in the assessment, rigging techniques should be selected to ensure a dynamic rigging system is in place to minimize friction and shock load during trimming operations.

The decedent had used the natural crotch rigging system to successfully lower several loads prior to the incident load. When the incident occurred, the decedent had cut a bigger piece from the branch than he had earlier in the day. The branch used for rigging broke below the crotch when the larger limb was cut. One of the possible factors contributing to the branch breaking was the design of the rigging system, which may

have contributed to increased friction and shock load placed on the branch/crotch when the incident limb was cut and fell free from the tree. Issues such as the crotch shape (“U” shaped versus “V” shaped), rigging branch diameter, the rigging rope angles and length, rigging point distance from the number of rope wraps around the trunk, and the ability of the ground man to “let it run” are all unknowns.

Designing a rigging system to minimize friction, reduce forces on the tree, and positioning the rigging points to permit more rigging rope in the system to reduce the shock load is desirable. The work practice of establishing false crotches by use of arborist’s blocks and pulleys, and a friction device, such as a “Port-a-Wrap III” or a board-type lowering device, such as the “Hobbs Lowering Device” provide more consistent friction and minimizes rope wear. The advantages of using pulleys rather than natural crotches are: 1) reduces friction and forces on branches; 2) direction of the load over the landing zone.

Several resources have been developed to assist riggers in selecting the appropriate rigging techniques involved in tree trimming/removal. The International Society of Arboriculture (ISA) *Tree Climbers Guide*, 3rd Edition and the Tree Care Industry Association (TCIA) *Best Practices for Rigging in Arboriculture*, provide guidance to operators during rigging operations to remove a section of a tree.

- Tree trimmers/fellers should wear appropriate personal protective equipment during tree trimming/felling operations.

Although the decedent was self-employed and not governed by MIOSHA Safety and Health Standards, all self-employed individuals should be familiar with and follow these standards minimize injury and/or illness. MIOSHA General Industry Safety Standard, Part 53 - Tree Trimming and Removal mandates the use of safety glasses and hard hats for all workers at the tree trimming operation. The International Society of Arboriculture (ISA) *Tree Climbers Guide*, 3rd Edition, references the use of a Type II hard hat and eye protection, such as goggles and face shield to further protect the face. Additionally, MIFACE recommends hearing protection, as the decibel level of chain saws would require only 15 minutes of use before the TWA for noise has been reached.

Wearing all appropriate personal protective equipment should be practiced by all tree trimmers and ground personnel at the site. Although it is unknown if the decedent would have survived the head strike by the falling branch if he had been wearing a hard hat, wearing appropriate head protection could have lessened the impact of the limb and the fatal injury may have been avoided. The family members indicated that the decedent did not wear a hard hat because the hard hat would fall off his head while working. Chin straps that attach to the hard hat’s suspension are available for many models. Chin straps can prevent hard hats from falling from or bumped off a worker’s head, or dislodged due to high winds or awkward work positions (e.g. bent over).

- Tree trimming employers should ensure ground workers have the training and experience necessary to perform work with rigging ropes and are trained to perform an aerial rescue if an emergency arises.

Ground workers are an essential component of a rigging operation. Ground workers assist in setting up friction devices, run lines, detach ropes and send equipment and lines up to the climber, and “running the ropes”. One of the emergency responders was told by a neighbor that the decedent stated “you will get somebody hurt if you don’t keep tension on the rope”. Once a piece is cut and begins to fall, it will create a dynamic load on the rigging line. An experienced ground person can minimize this effect by gradually letting out more rigging line into the system before bringing the piece to a stop (“letting it run”). The comment, as overheard by the neighbor, may indicate that the ground person did not have enough experience to “let it run” when the larger limb was cut, causing an increased load on the line and the crotch.

The ISA recommends that all crew members receive training in first aid and cardiopulmonary resuscitation (CPR). Additionally, ISA recommends that anytime a climber is in a tree, there should be a second worker on the site who is capable of performing an aerial rescue. Neither of the ground persons at the site was trained in aerial rescue.

- The State of Michigan should require registration or licensure of individuals involved in tree care/tree trimming operations. Registration/licensure requirements should include an arborist accreditation by an organization such as the Tree Care Industry Association (TCIA) or the International Society of Arboriculture (ISA).

The decedent, although he had many years of experience, was not a certified arborist. Certified arborists are familiar with the recommended safe work practices for tree removal including trimming, rigging methods, and regulatory requirements. Since 2001, in Michigan at least 25 individuals have been killed while performing tree trimming work (excluding loggers). Most were not certified arborists. The hazards of tree trimming work and the methods to perform tasks safely have been identified by the tree trimming trade organizations, such as the TCIA and ISA. To minimize the number of future deaths in this profession, tree trimming work should be considered a licensed profession in Michigan and as a requirement for the license the individual and/or firm owner should be a certified arborist. License monitoring should be delegated to the Michigan Department of Licensing and Regulatory Affairs (MDLARA) Licensing Division.

MIFACE also recommends that emergency responders wear required fall protection equipment when working from an elevated working surface, such as an elevated bucket or ladder.

The fire department’s emergency responders were performing their rescue duties from an elevated working surface. MIOSHA General Industry Safety Standards, Part 58 – Aerial Work Platforms and Part 74 – Firefighting both require workers to utilize fall protection.

Part 58 requires the employer to provide, and the employee to use, a safety harness that has a lanyard which is in compliance with Construction Safety Standard Part 45 “Fall Protection” and which is affixed to attachment points provided and approved by the manufacturer if the employee is working in a vehicle mounted or boom supported elevated work platform. Part 74, Rule 7424 requires an employee be secured with a safety belt if working from an aerial ladder. In their haste to provide emergency care, the emergency responders did not remember to don a safety harness and appropriately tie off, thus exposing themselves to a fall injury, MIFACE recommends that fire fighters wear a fall protection harness and tie off appropriately to minimize the chance of falling and subsequent injury during emergency response activities when working from an elevated position, such as in a bucket truck.



Figure 5. Emergency responders not wearing fall protection while elevated during rescue

RESOURCES

MIOSHA standards cited in this report may be found at and downloaded from the MIOSHA, Michigan Department of Licensing and Regulatory Affairs (MDLARA) website at: www.michigan.gov/mioshastandards. MIOSHA standards are available for a fee by writing to: Michigan Department of Licensing and Regulatory Affairs, MIOSHA Standards Section, P.O. Box 30643, Lansing, Michigan 48909-8143 or calling (517) 322-1845.

- MIOSHA General Industry Safety Standard, Part 54, Tree Trimming
- MIOSHA General Industry Safety Standard, Part 58, Aerial Work Platforms
- MIOSHA General Industry Safety Standard, Part 74, Fire Fighting
- *Tree Climbers' Guide, 3rd Edition*. International Society of Arboriculture. P.O. Box 3129, Champaign, IL 61826-3129. <http://www.isa.arbor.com>
- *Best Practices for Rigging in Arboriculture*. Tree Care Industry Association. 136 Harvey Road, Suite 101, Londonderry, NH 03053. <http://www.tcia.org>
- *Safety Requirements for Arboricultural Operations*. American National Standards Institute. ANSI Z133.1-2006.
- California FACE Program Inspection Report #10CA002: Tree Trimmer Dies When He Is Crushed by Palm Tree Branches. <http://www.cdc.gov/niosh/face/stateface/ca/10ca002.html>
- New Jersey FACE Program Inspection Report #96NJ074: Tree Trimmer Killed When a Branch to Which He Was Tied Broke and His Lifeline Failed. <http://www.cdc.gov/niosh/face/stateface/nj/96nj074.html>
- California FACE Program Inspection Report #09CA010: A Tree Trimmer Dies When He Falls From a Tree and is Struck By a Limb. <http://www.cdc.gov/niosh/face/stateface/ca/09CA010.html>

Key Words: Tree trimming, Struck by, Rigging system, Arborist,

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