

**UNITED STATES
DEPARTMENT OF LABOR
MINE SAFETY AND HEALTH ADMINISTRATION
Metal and Nonmetal Mine Safety and Health**

REPORT OF INVESTIGATION

**Surface Nonmetal Mine
(Sand & Gravel)**

**Fatal Machinery Accident
April 25, 2003**

**Power Screen 215 Portable #2
F.L. Merrill Construction Inc.
Pembroke, Merrimack County, New Hampshire
MSHA ID No. 27-00332**

Investigators

**Kenneth A. Amati
Mine Safety and Health Inspector**

**Thomas J. Shilling
Mine Safety and Health Inspector**

**James L. Angel
Mechanical Engineer**

**Gharib Ibrahim
Civil Engineer**

**Eric J. Gottheld
Civil Engineer**

**Linda E. Herbst
Mine Safety and Health Specialist**

**Originating Office
Mine Safety and Health Administration
Northeast District
Thorn Hill Industrial Park, 547 Keystone Drive, Suite 400
Warrendale, Pennsylvania 15086-7573
James R. Petrie, District Manager**

OVERVIEW

Randy W. Twombly, equipment operator, age 39, was fatally injured on April 25, 2003, when the Komatsu excavator he was operating slid over an embankment, causing it to fall onto its side and trap him inside the cab.

The accident occurred because the ground that the excavator was working on failed under the weight of the machine. Gravel material had been removed from the base of the same bench that the excavator was positioned on. Mining methods used did not ensure that bank and slope stability was maintained for the type of equipment used. Operating the excavator with the tracks parallel to the edge of the embankment also contributed to the accident.

Twombly had total of 2 years mining experience, 4 weeks at this mine. He had a total of 22 years experience operating an excavator.

GENERAL INFORMATION

Power Screen 215 Portable #2, a surface sand and gravel operation, owned and operated by F. L. Merrill Construction, Inc., was located at 830 N. Pembroke Road, Pembroke, New Hampshire. The principal operating official was Frank L. Merrill, president. The mine normally operated one, 10-hour shift per day, Monday through Thursday, and one 8-hour shift on Fridays. Total employment was 8 persons.

Sand and gravel was mined from an open pit with excavators and front-end loaders, and placed directly into a crusher or onto stockpiles. The material was hauled to the plant by front-end loaders and trucks where it was screened for size. The finished product was sold for use in the construction industry.

The last regular inspection of this operation was conducted on April 8, 2003. A regular inspection was conducted following the investigation.

DESCRIPTION OF THE ACCIDENT

On the day of the accident, Randy W. Twombly (victim) arrived at the mine site at approximately 7:00 a.m., his regular starting time. Twombly began his assigned tasks by removing the sand overburden with the excavator, until about 12:00 p.m., when he stopped for lunch. After lunch, he returned to the area and continued to remove the sand overburden. At about 2:30 p.m., Twombly moved the excavator into position on top of the lower bench where the gravel deposit was exposed. He then began to remove material from the base of the bench and dump it in the area being mined by a Caterpillar excavator. The Caterpillar excavator, operated by Christopher Weeks, was positioned on an adjacent bench. Weeks was mining the material between the two benches and feeding a crusher that was positioned on the other side of the bench that he was operating from.

After Twombly had removed two or three buckets of material from the base, Douglas Messier, front-end loader operator, observed a small amount of material slough off under Twombly's excavator and tried to warn Twombly. At the same time, Weeks observed Twombly grab onto both hand controls and brace himself. A large amount of material under the left track of the excavator failed. The machine slid down the embankment and fell on its side, crushing the cab.

Weeks rushed to the excavator and began digging with his hands to free Twombly. Messier radioed the scale-house for help and ran to the crusher to retrieve a shovel. Jack Deguise, pit manager, phoned 911. Jeffrey Drew and William Smith, truck drivers, also responded to the scene and began digging the material from the cab. Drew checked Twombly's condition and found that his pulse was intermittent and he was having difficulty breathing. Drew removed two pieces of glass from Twombly's head and chest area, while the other employees continued to remove the gravel material from around him. A short time later Drew checked Twombly's condition and found that he did not have a pulse and was not breathing. The police department first responded to the

accident scene. Local paramedics and the coroner arrived a short time later. Twombly was pronounced dead at the scene by the coroner. The cause of death was mechanical asphyxia.

INVESTIGATION OF ACCIDENT

MSHA was notified of the accident at 2:50 p.m. on April 25, 2003, by a telephone call from Jack Deguise, pit manager, to Carl Liddeke, field office supervisor. An investigation was started the same day. An order was issued pursuant to Section 103(k) of the Mine Act to ensure the safety of the miners. MSHA's accident investigators traveled to the mine, conducted a physical inspection of the accident scene and equipment involved, interviewed employees, and reviewed conditions and work practices relevant to the accident. MSHA conducted the investigation with the assistance of mine management and the miners.

DISCUSSION

Accident Scene

The accident occurred in the southwest section of the sand and gravel pit. The height of the deposit was approximately 29 feet above the mine floor level at the accident site. The deposit consisted of two layers of material. The uppermost stratum consisted of approximately 6 to 8 feet of relatively clean sand. The lower stratum was a deposit of gravel approximately 21 feet thick. The gravel sizes varied from less than 1 inch, to more than 3 feet in diameter, mixed with small amounts of sand.

Earlier in the year, the southwestern area of the pit was stripped of vegetation and cleared of tree stumps in preparation to mine the sand and gravel deposit. On April 22, 2003, the company began to set up equipment to start mining in this area. The next day, mining began in the southwestern area of the pit. Work to remove sand from the bench, where the accident occurred, had started on the day of the accident.

At the time of the accident, Twombly was operating the excavator on a bench on top of the lower stratum of gravel material, situated 21 feet above the pit floor. There were two steep faces of unconsolidated gravel on the northern and western sides of the bench. The excavator was positioned in the furthest northwest corner of the bench. The tracks of the excavator were parallel to the near-vertical slope. Tread marks from the excavator tracks were consistent with witnesses' statements that the excavator had been approximately parallel to the edge. The front-end loader operator had removed gravel material from the bottom (floor level) of the western side of the bench.

The surface of the bench was relatively level. Following the accident, it measured approximately 12 feet wide at both ends, was 31 feet wide in the middle, and was approximately 47 feet at its longest dimension (in a northeasterly direction).

Twombly had excavated 2 or 3 buckets of gravel material from the northern side of the bench and dumped it westward, across the pit floor, towards the Caterpillar excavator.

The Caterpillar excavator, operated by Weeks, was situated west of Twombly on a separate bench of gravel material. The distance between the benches was approximately 30 feet.

The near vertical gravel bench that failed under the excavator was along its western side. The northern side had an angle of approximately 40 degrees from horizontal (1.2Horizontal:1Vertical) near the outside (western) corner. The material that made up the bench was a gravel deposit. Remaining portions of the highwall appeared to be near vertical and overhanging near the top. Cracks were observed along the edge of the bench in the sand and gravel material where the failure occurred. These cracks were primarily oriented parallel to the edge of the bench, varying in length and width.

An angle of repose of approximately 35 degrees was measured for the gravel material. However, slopes in this material can temporarily remain much steeper due to capillary tension in the soil. As the moisture in the soil dries out, the slope will eventually slough to its angle of repose.

Weather on the day of the accident was clear.

Equipment

The mining practice employed in this area used two track-mounted excavators (Komatsu PC400LC-5 and Caterpillar CAT 345 BL), a rubber-tired loader (Caterpillar CAT 980G), and an off-road haul truck. Two portable crushers (Komatsu BR 550 JG and Pegson 1300 MAX TRAX mobile crusher) were used to process the gravel.

The excavator involved in the accident was a 1994 Komatsu model PC400LC-5, having an operating weight of approximately 94,000 pounds and a bucket capacity of 2.1 cubic yards. The maximum reach of the boom was 30 feet. The tracks were about 18 feet long, with 42-inch shoes, and a contact area of approximately 53 square feet. The overall width of the excavator was approximately 12 feet (measured from the outside edges of the track shoes). When the slope failed, the boom was extended to its full length in a northern direction.

Mining Methods

The mining method used in the pit was to use one excavator (Komatsu) to remove the top 6 to 8 feet thick layer of clean sand, to expose the gravel deposit. The sand was placed in piles behind the excavator for screening. A second excavator (Caterpillar) removed the underlying stratum of gravel material, and loaded it into a portable crusher. The portable crusher was placed in a "box" cut created by mining the sand and gravel from the pit level, located adjacent to the working bench. Both excavators were positioned on top of the deposit while mining material from below. The loader operator loaded the processed gravel from the crusher into the haul truck and operated the portable crusher by remote control. The loader operator also removed the sand and gravel that had sloughed off and accumulated at the base of the bench.

This mining method resulted in the excavators mining from an elevated bench of material. The crusher was located on one side of the excavator, the previously mined area on the second side, and the active mining area on the third side.

Training

Twombly had received training in accordance with 30 CFR, Part 46.

ROOT CAUSE ANALYSIS

A root cause analysis was conducted and the following causal factors were identified:

Causal Factor: The mining method used resulted in the excavator operating near the edge of a gravel bench with more than one open side, compromising the stability of the material to support the weight of the excavator. This mining method resulted in the excavator removing the very material used for support.

Corrective Action: A mining plan with procedures that ensure bench height, width, and stability should be established.

Causal Factor: A risk assessment that would have identified possible ground condition hazards had not been conducted prior to working in this area.

Corrective Action: Risk assessments should be conducted to identify ground conditions that may be hazardous. Mobile equipment travel should be prohibited in areas where ground conditions may create a hazard.

Causal Factor: The gravel bench had not been thoroughly examined for unsafe conditions prior to the Komatsu excavator performing work in the area.

Corrective Action: A policy should be established that requires experienced supervisors or other designated persons to examine the bench areas, prior to work being performed, to identify ground conditions that pose hazards. Corrective actions should be taken and work cycle procedures should be discussed before work is performed.

Causal Factor: The excavator was positioned near the edge of the bench, which contributed to the failure of the ground.

Corrective Action: Develop a mining plan that would avoid having excavators near the edge of the gravel bench.

CONCLUSION

The accident occurred because the gravel material, that the excavator was positioned on, failed under the weight of the machine. Gravel material was being mined from the base of the same bench that the excavator was positioned on. Mining methods used did not ensure that that bank and slope stability was maintained for the type of equipment used. Operating the excavator with the tracks parallel to the edge of the embankment also contributed to the accident.

Root causes identified during the investigation also included failure to conduct a risk assessment, and failure to examine the bench area prior to positioning the excavator on it.

VIOLATIONS

Order No. 6008004 was issued on April 25, 2003, under the provisions of Section 103(k) of the Mine Act:

A fatal accident occurred at this operation on April 25, 2003, when an excavator operator was stripping overburden. This order is issued to assure the safety of all persons at this operation. It prohibits all activity in the affected area until MSHA has determined that it is safe to resume normal mining operations in the area. The mine operator shall obtain prior approval from an authorized representative to recover and/or restore operations to the affected area.

This order was terminated on June 6, 2003. The conditions that contributed to the accident have been corrected and normal mining operations can resume.

Citation No. 6008017 was issued on June 12, 2003, under the provisions of Section 104(a) of the Mine Act for a violation of 30 CFR 56.3130:

A fatal accident occurred at this operation on April 25, 2003, when an equipment operator was crushed in the cab of the excavator that he was operating. The victim was using the machine near the edge of sand and gravel bench in the pit. The ground under the excavator failed under the weight of the machine, causing the machine to slide down the embankment, fall on its side, and crush the victim inside the cab. Material was being mined from the base of a 21-foot bench while the excavator was sitting on top of it. Mining methods were not used that insured that bank and slope stability was maintained for the type of equipment used. Normal mining methods at this operation required the excavators to operate on top of the sand and gravel benches, and remove the material around them. The method resulted in the excavators operating from a peninsula with three sides of the bench exposed, and decreased the support capabilities of the bench when subjected to the loads.

This citation was terminated on June 6, 2003. The company has implemented a mining plan that will ensure that future placement of mining equipment will be located on stable, well supported ground that is capable of holding the weight of the equipment used.

Approved by:

Date: August 27, 2003

James R. Petrie,
District Manager

APPENDICES

- A. Persons Participating in the Investigation
- B. Persons Interviewed

APPENDIX A

Persons Participating in the Investigation

F.L. Merrill Construction Inc.

Frank L. Merrill	president
Jack Deguise	pit manager

R.C. Hazleton Company Inc. (Komatsu)

David Leger	field technician
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Pembroke NH Police Department

Glen Northrup	sergeant
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New Hampshire Department of Labor

Thomas O'Neil	safety inspector
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Mine Safety & Health Administration

Kenneth A. Amati	mine safety and health inspector
Thomas J. Shilling	mine safety and health inspector
James L. Angel	mechanical engineer
Gharib Ibrahim	civil engineer
Eric J. Gottheld	civil engineer
Linda E. Herbst	mine safety and health specialist

APPENDIX B

Persons Interviewed

F.L. Merrill Construction Inc.

Christopher Weeks

Douglas Messier

William Smith

Jeffrey Drew

Frank L. Merrill

Jack Deguise

equipment operator

crusher/front-end loader operator

truck driver

truck driver

president

pit manager