Miniature Excavator

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The 101st Airborne Division (Air Assault), Fort Campbell, Kentucky, is "capable of executing air assault operations at various echelons to achieve speed, surprise, and lethality across terrain and the full spectrum of sustained combat operations."[1] Within each infantry brigade combat team, there is a brigade engineer battalion (BEB) that supports maneuver battalions.

Engineers from the 326th BEB, 1st Brigade Combat Team, 101st Airborne Division, have identified and attempted to rectify a critical shortfall with their modified table of organization and equipment (MTOE). Current 326th BEB MTOE engineer equipment is too heavy to be used in an air assault operation. Through conversations with multiple Chinook (CH-47) pilots, the engineers learned that the total weight of all sling-loaded equipment should be less than 15,000 pounds. While the aircraft is capable of lifting more weight than that, that is the maximum weight limit for a combat-equipped aircraft to fly a meaningful distance. The high-mobility engineer excavator (HMEE), which is the primary equipment used for individual fighting positions in the defense, weighs 18,000 pounds. The inability to conduct air assault means that units must rely on a ground lines of communication for movement; this increases risk to the mission. Field Manual (FM) 3-99, *Airborne and Air Assault Operations*, notes that "Ground tactical movement subjects the entire organization to the threat of improvised explosive devices or ground attack,"[2] which emphasizes the need for air assault operations for engineer units in support of their maneuver counterparts.

This need for air assault operations drove innovative thinking amongst 326th BEB engineers. The engineers assessed the situation and developed a problem statement in January 2022. They sought a useful piece of engineer equipment that was light enough to sling-load for use in a combat operation. Initial discussions focused on miniature excavators and skid steers. Miniature excavators, commonplace in civilian construction, weigh much less than HMEEs with similar capabilities. Skid steers, another lightweight option, are already part of the 326th BEB inventory but are rarely used. The engineers hoped that one of these two pieces of equipment could be sling-loaded to a secured area and immediately used to dig fighting positions, allowing engagement area development to begin while waiting for other engineer vehicles to arrive via ground assault convoy. Support platoons acquired and assessed miniature excavators and skid steers over a series of exercises, culminating with their integration into a battalion level air assault to defense. The experiment was ultimately considered a success, and the 326th BEB is currently in the process of writing an operational needs statement for the use of miniature excavators at the Joint Readiness Training Center, Fort Polk, Louisiana, and in future operations.

Methodology

In February 2022, the 326th BEB began its proof of concept with two 6,500-pound miniature excavators and one 7,500-pound tracked skid steer with auger bit. It was important to test the ability of the skid steer to dig fighting positions since the vehicle is already on the BEB MTOE and is light enough to sling-load. During this iteration of testing, Soldiers practiced digging with the equipment and rigging it on container roll-in/-out platforms for future sling-load validation.

The miniature excavators and skid steer were first put through a series of tests, including tests on on- and off-road

driving speed, speed and ability to dig in an open field, speed and ability to dig in dense vegetation, and maneuverability in restricted terrain. These tests showed that the driving speeds of the miniature excavators were significantly slower than that of the skid steer, with travel at 2 miles per hour versus 10 miles per hour for the skid steer. However, the skid steer auger bit was easily entangled in root systems and driving the skid steer through dense vegetation was very awkward. The miniature excavator was easy to operate, and digging with it was very similar to digging with the HMEE, on which Soldiers are trained to dig fighting positions. In ideal conditions, operators could dig a machine gun fighting position in less than 20 minutes using the miniature excavator. The tests allowed engineers to rule out the use of skid steers for sling loading for use in combat operations due to their inability to complete the required digging mission.

Testing the ability of a miniature excavator to dig in an open field

The next test, rigging the miniature excavators, also served as an important learning experience. Instructors from the Sabalauski Air Assault School, Fort Campbell, Kentucky, recommended chaining the excavators to a container roll-in-out platform. Soldiers rigged and certified the load in accordance with procedures outlined in Technical Manual (TM) 4-48.11, *Multiservice Helicopter Sling Load: Dual-Point Load Rigging Procedures*.[3] Loading the excavators on either end of the container roll-in/-out platform left space in the middle of the platform for an initial set of Class IV barrier materials, which could be used to help maneuver units begin building their fighting positions. (Based on requirements outlined in Army Techniques Publication [ATP] 3-21.8, *Infantry Platoon and Squad*,[4] 116 sandbags, 11 U-shaped pickets or eight wooden 4 x 4s, and one sheet of plywood are required for one fighting position. Depending on the materials used, this equates to 170–284 pounds of material per position.)

Additionally, engineers configured a sled for the miniature excavator so that the Class IV barrier materials could

be dragged from the helicopter landing zone to defensive positions. The sled, which weighed 150 pounds, consisted of two 4 x 4s, a sheet of plywood, 2 x 4 braces, and side hooks for the tie-downs. A tow strap or chain could be run through two slots in the front of the sled and around the body of the miniature excavator. All Class IV barrier materials were tied down on the sled so that, upon landing, the sled could immediately be downloaded and the materials dragged where needed.

The next equipment test involved load configuration; following that test, and with the help of the Illinois National Guard, the load was certified and able to be flown. Despite the imperfect configuration, the flight was a success and the 326th was able to offer the capability to support a maneuver battalion in an operational environment.

Integration

On 22 March 2022, support platoons from the 326th BEB, conducted a movement coordination exercise in parallel with the 506th Infantry Regiment "Red Currahee." The Red Curahee mission consisted of a battalion level air assault into an area defense for Companies A and D. For this mission, the 326th BEB rigged, sling-loaded, and dug with two 4,000-pound miniature excavators. Due to canalized mobility corridors, miniature excavators effectively tracked from the helicopter landing zone to the defensive line to support mechanical digging. Their small size and ability to maneuver in tight areas rendered them more efficient than HMEEs. The excavators proved to be excellent assets for digging several types of fighting positions. Over the course of 14 hours, the two miniature excavators were used to dig 15 fighting positions for the maneuver companies. These positions were 2 feet wide and 5 to 6 feet deep, depending on the needs of the Soldiers occupying the position. Due to austere conditions (severe rain, wind, and the need for use of night vision devices), coupled with inhibited travel time between positions due to muddy conditions, the speed of the operation was greatly degraded and the dig rate for the test was only one fighting position per hour. While it is possible to move faster and dig quicker with HMEEs, the miniature excavators proved superior in their ability to

traverse through wooded terrain—and they were still capable of digging the necessary fighting positions.

Based on an assessment of overall mission and applicability, miniature excavators are a beneficial asset for supporting an infantry brigade combat team in the defense. One constraint that was identified was the limited power of the vehicles. Difficulties were encountered with the rubber-tracked miniature excavators in the woods under the adverse weather conditions. In one case, a miniature excavator threw track and it took an experienced operator 45 minutes to recover the vehicle from the muddy terrain. The open cab of the excavator also posed a threat to the operator, who had no protection from external hazards. Further iterations of integration testing revealed that it took more than 30 minutes to load and unload the miniature excavators on the trailers, which also significantly slowed progress.

Conclusion

Altogether, miniature excavators are useful dig assets that can be used to accomplish the mission of rapid engineer support via air assault. The ability to quickly transport miniature excavators via air increases the amount of dig time available to the maneuver unit before the "no-later-than" defend time. These assets should be allocated to the supported unit from the onset of the operation, offsetting the delay in further assets arriving via ground. The major constraint is that miniature excavators are not included in the BEB MTOE or Army inventory. Possible resourcing solutions include submitting a request for needed equipment to the division acquisition review board. Through this process, types of equipment not currently residing in the unit are reviewed and may be validated and approved for funding. The addition of miniature excavators could provide the BEB with the adaptability necessary for diverse missions and the capability of restructuring to compete in future large-scale combat operations.

Endnotes:

[1]*101st Airborne Division (Air Assault) Gold Book*, U.S. Army, February 2019.

[2]FM 3-99, *Airborne and Air Assault Operations*, 6 March 2015, p. 8-2.

[3]TM 4-48.11, *Multiservice Helicopter Sling Load: Dual-Point Load Rigging Procedures*, 5 July 2013.

[4]ATP 3-21.8, *Infantry Platoon and Squad*, 12 April 2016.

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[2]*Standing Well Back* website, <https:\\standingwellback.com>, accessed on 1 September 2022.

[3]Glenn K. Otis, "Threat to the Rear: Real or Myth?" Land Warfare Paper No. 2, Association of the U.S. Army, November 1989, <https://www.ausa.org/sites/default/files/LWP-2-Threat-to-the-Rear-Real-or-Myth.pdf>, accessed on 2 September 2022.

[4]Mark Gilchrist, "Reconsidering Rear Area Security—The 101st Airborne Experience During Operation Market Garden," *The Strategy Bridge*, 17 September 2017, <https://thestrategybridge.org/the-bridge/2017/9/17/reconsidering-rear-area-security>, accessed on 1 September 2022.

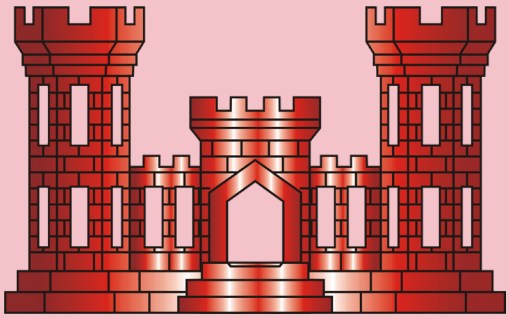
[5]Lester Grau and Charles Bartles, *The Russian Way of War: Force Structure, Tactics, and Modernization of the Russian Ground Forces*, Foreign Military Studies Office, Fort Leavenworth, Kansas, 2016.

[6]Marc Tranchemontagne, "The Enduring IED Problem: Why We Need Doctrine," *Joint Force Quarterly 80*, 1st quarter, 2016, <https://ndupress.ndu.edu/JFQ/Joint-Force-Quarterly-80/Article/643235/the-enduring-ied-problem-why-we-need-doctrine/>, accessed on 1 September 2022.

[7]ADP 3-37, *Protection*, 31 July 2019.

[8]*Defense Science Board Report*, March 2006, <https//dsb.cto.mil>, accessed on 9 September 2022.

[9]Marine Corps Order (MCO) 3502.10, *Counter-Improvised Explosive Device Training and Education Program*, 11 December 2018, <https://www.marines.mil/News/Publications/MCPEL/Electronic-Library-Display/Article/1714284/mco-350210/>, accessed on 9 September 2022.

[10]"C-IED Strategy Lines of Effort," U.S. Army, 2022, <https://www.milsuite.mil/book/community/spaces/apf/counter-ied>, accessed on 9 September 2022.

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