

What is old is new again

Field artillery in megacities

By Capt. Geoff Ross

"In the future, I can say with very high degrees of confidence, the American Army is probably going to be fighting in urban areas. We need to man, organize, train and equip the force for operations in urban areas, highly dense urban areas, and that's a different construct. We're not organized like that right now."

- Gen. Mark Milley

In 2014, 54 percent of the world's population lived in urban areas. That number is growing 1.84 percent per year between 2015 and 2020, 1.63 percent per year between 2020 and 2025, and 1.44 percent per year between 2025 and 2030.¹ Milley is correct in his assessment that large urban areas are a looming challenge for the United States Army. In the future it will fall upon Soldiers and their equipment to close with and destroy the enemy in this new dimension the Army currently has failed to address in military operations on urbanized terrain training. This article contends that the field artillery, as a core component of the combined arms force, must train and address the unique challenges created

by city-fighting. The argument entails a return to one of the least trained arts of American artillery, direct fire.

Throughout 2016 and 2017, coalition field artillery provided the assist to advise and assist, with American M777A2 and M109A6 units. They fired precision and near-precision rounds in support of Iraqi Security Forces fighting to liberate Mosul from ISIS. The precision M982 and M982A1 Excalibur (EXCAL) projectiles provided outstanding, limited collateral damage munitions to target everything from vehicle-borne improvised explosive devices, to snipers, to command and control nodes. EXCAL provides flexibility, scalability, and all-weather responsiveness in support of ground force commanders (GFCs).

¹ http://www.who.int/gho/urban_health/situation_trends/urban_population_growth_text/en/



Soldiers from C Battery, 2nd Battalion, 82nd Field Artillery, conduct direct-fire training at Udairi Range, Kuwait, during Operation Spartan Shield. (Courtesy photo)

Near-precision Precision Guidance Kits (PGKs) allow the GFC to use a wider suite of artillery projectiles, specifically the M795 High Explosive and M549A1 High Explosive Rocket-Assisted rounds. PGK is a more cost effective option to EXCAL in situations where a low-trajectory round will achieve the desired effect instead of the high trajectory offered by the EXCAL. With indirect Fires and close air support, the coalition has destroyed, neutralized and suppressed hundreds of ISIS positions and destroyed critical enemy equipment. The capabilities precision and near-precision munitions provide will continue to be required as the Army fights in megacities. However, there is a gap in doctrine and equipment which the field artillery can address against what could be called urban mountains, the buildings which dominate the skylines of major cities around the world.

C Battery, 2nd Battalion, 82nd Field Artillery encountered this issue in June 2017 while attached to 2nd Brigade, 82nd Airborne supporting Iraqi forces fighting in western Mosul. The Jamouri Hospital Complex, located on the west side of the Tigris River in the northern half of the city, was one such challenge 82nd Airborne and their Iraqi counterparts faced. The centerpiece of the complex was an eight-story, reinforced concrete building standing on 50-meter high bluffs above the river. ISIS fighters had

commandeered it as a command and control node with robust fighting positions and the Iraqi Army was locked in an intense, uphill-fight to rid the building of enemies. To help the Iraqis break through their defenses, C Battery conducted a reconnaissance, selection and occupation of position artillery to determine the feasibility of conducting a direct fire raid with two M109A6 Paladins into the fields north of the complex. The purpose of the raid was to fire 155 mm rounds into specific windows, marked on a grid reference guide, as fighters appeared and engaged friendly forces. The Paladin crews staged in hidden locations out of enemy observation (i.e., “hides”) behind concrete buildings and move to firing points before engaging targets identified by U.S. advisors operating in concert with Iraqi forces. Though the raid was cancelled following a change in the friendly scheme of maneuver, it provided the battery leadership a view into the future of urban warfare and the problems inherent in using artillery as a direct fire weapon system.

The first concern was the range-to-target for the guns. Direct fire optics for artillery are designed for the defense of the guns from a direct attack while positioning area artillery at targets less than 1,000 meters. Because of this, they lose resolution at the ranges which they were tasked to engage, mainly 1,500 to 1,800 meters. Additional-

ly, the optimum engagement range for 155 mm artillery direct fire is 800 meters. The acceptable engagement range is 800 to 1,200 meters, and the least preferred range is out to 2,000 meters. Talking with experienced noncommissioned officers in the battery, the command assessed with high probability that as range-to-target increased, the chance of dispersion of rounds increased as well, necessitating walking rounds onto the target, potentially losing the surprise effect of an accurate round.

The second issue was brought by the advisor teams based on their on-the-ground, situational awareness. Concerns were raised that the building may be degraded internally to the point that a large caliber round, such as a 155 mm, fired from the north could pass through the building and continue to its ballistic impact point beyond – a point potentially occupied by civilians or friendly forces. Consequently, C Battery, looking to the fire direction center (FDC), computed the minimum time settings to ensure that the rounds would function on the target face, inside, or immediately beyond the building. To estimate the time fuze settings required, the FDC used range-to-target referencing the trajectory charts in the back of the tabular firing table (an imprecise science), to find the approximate range at altitude of the target, and extracted the time fuze setting. Since time fuzes

default to point detonation, the leadership assessed that should a round fail to impact a surface of the building, a maximum time setting would ensure it did not continue forward. Variance between target altitudes and ranges from the howitzer would result in different settings; they would need to be changed by section chiefs, between rounds, based on spottings on the target. Fire direction is an exact science, but in this operation the time settings would have been adjusted based on approximations and best guesses.

The final issue, and most concerning to commanders at all levels, was force protection. To get within range to engage the complex, the guns needed to be within 1,500 to 1,800 meters, well within the threat bubble of known ISIS anti-tank guided missiles (ATGMs) which were assessed as being present in the target structure. The guns could not have moved into position, stopped, found their target, fired and displaced to cover before being engaged by ISIS ATGMs. Paladins are tough, but they are not main battle tanks (MBTs) and a hit from an ATGM would have likely resulted in a catastrophic kill. Limited by their optics and the lack of long-range firing tables, C Battery was at high risk of casualties to accomplish this mission. The adjusted scheme of maneuver and the Iraqis' motivation to liberate Mosul meant the battery did not conduct the raid.

As President Dwight D. Eisenhower said, "Plans are worthless, but planning is everything."² Using the planning for the C Battery direct fire raid as a case study leads to other questions on the nature of field artillery training from the crew to staff levels to plan and execute such operations, and to the development of equipment (including munitions) to mitigate issues of urban warfare while increasing mission success.

Currently, the Army fields three howitzers, the M119A3 105 mm towed howitzer, the M777A2 155 mm towed howitzer, and the M109A6 155 mm self-propelled howitzer. Each piece brings different capabilities and limitations to the battlefield. The M119A3 and M777A2 are easily transportable by air or ground, and can rapidly move to new locations hundreds of kilometers away, while the M109A6 Paladin can be driven across a myriad of terrain, carry ammunition, provide a level of protection, and a degree of organic, on-the-move defense. The greatest limitations when providing di-

rect Fires into a megacity is that howitzers have to be towed into position and, once in place, have no organic protection from small arms or fragmentation for the crews. Other combat forces must be allocated for their defense, limiting the GFC's offensive close fighting capabilities. The M109A6 in contrast lacks easy mobility without heavy equipment transports and must be driven into the vicinity of its firing location before being put into action. With these factors in mind, it is reasonable to state that the preferred megacity direct fire artillery system is the venerable M109A6 (in the future, the M109A7) because of its organic protection. However, light, airborne or air assault infantry—those units most suited to urban combat—are the very units lacking in armored, self-propelled artillery support. Without exception, the organic artillery elements in these light infantry units consists of towed artillery pieces.³ Before addressing the tactics and equipment required to successfully direct fire artillery into tall buildings it is important to address the need for direct-fire artillery support. Currently, the joint force has at its disposable a variety of air and ground-delivered munitions. Despite all of these, there is an inherent complexity to engaging a specific floor or group of windows with weapons, particularly if the fire needs to be continuous or repeated. For the last 16 years of conflict, the United States military has become proficient at dropping bombs and firing artillery to impact at a vertical or near-vertical angle. This is effective against buildings with a few floors, but it loses its punch as buildings grow taller with increasing space between the roof and the target. Simply put, the resiliency built into modern megastructures to resist natural disasters, such as earthquakes, toughen them as well against vertical or near-vertical attacks by conventional munitions.

For example, an enemy firing down from the 20th story of a 50-story building can be engaged in multiple ways. Bombs can be dropped or artillery fired to hit the roof, but there are plenty of floors between the impact and the target to protect them from the effects, much like sandbags protect the top of a field bunker from fragmentation. An aircraft could glide a bomb into the side of the structure, guided by either GPS coordinates or laser, and cause potentially serious damage to the building and

its integrity. However, air attack with precision munitions has its drawbacks: if a re-attack is needed, if the bomb is off target, if the enemy moves to a new floor, or if there are non-combatants in the area, it would require an aircraft with a limited payload to make a second pass. This becomes a problematic proposition in any airspace contested with purpose built anti-aircraft weapons.

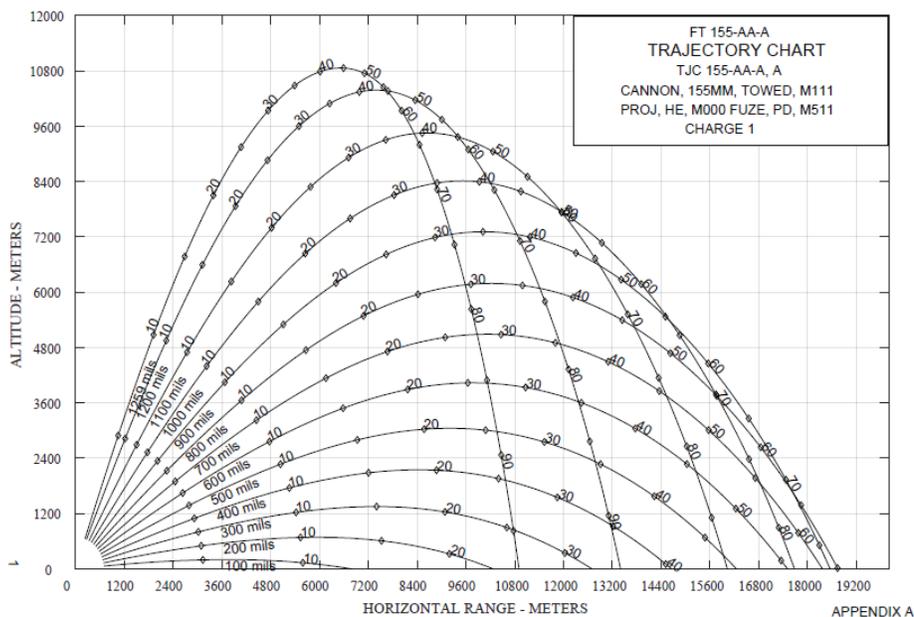
MBTs or infantry fighting vehicles can shoot direct fire into buildings, but limitations on the maximum weapon elevation and the fact that many current weapons are designed for engaging vehicles reduces these systems' effectiveness against an enemy occupying one or multiple floors of a tall building. Additionally, the widespread proliferation of cheap ATGMs and even traditional weapons (anti-tank grenades, mines/improvised explosive devices, and the century-old Molotov cocktail fuel grenade) in urban environments means heavy losses should be expected for armored forces operating at close range in cities. As the Russian Army discovered while fighting in Gronzy on New Year's Eve, 1994, determined defenders can easily make an armored force suffer extreme casualties in a short time with easily available infantry anti-tank weapons. It is estimated the Chechnyan defenders killed between 1,500 and 2,000 Russian soldiers while the Russians "lost more tanks in Grozny than they did in the battle for Berlin in 1945."⁴ This paper proposes the use of self-propelled artillery in a similar fashion to how it was employed by the Soviets on the Eastern Front during World War II, where guns in urban and near-urban environments see the target and engage it with direct fire. A 155 mm projectile can have devastating effects on an enemy inside of a building, from an extended range while not causing severe structural damage. Unlike the munitions of the 1939-1945 war, modern artillery munitions are more accurate and dependable, capable of hitting targets even in a closely packed urban environment. The key to meeting this challenge is in the evolution of U.S. Army Field Artillery tactics, techniques and procedures (TTPs), and developing equipment for specialized urban fighting.

Fortunately, the basis for the field artillery's evolution exists inside of published manuals and training. All howitzer crews are assessed on their ability to conduct

2 <http://www.presidency.ucsb.edu/ws/?pid=10951>

3 https://armypubs.army.mil/ebooks/DR_pubs/DR_a/pdf/web/atp3_09x23.pdf

4 <https://archive.nytimes.com/www.nytimes.com/books/first/g/gall-chechnya.html>



A generic 155 mm, low charge trajectory chart produced for this paper by the United States Army Armament Research, Development and Engineering Center, Firing Tables and Ballistics Division. It can be extrapolated that by firing higher charges and using rocket assisted projectiles the quadrant elevation can continue to be lowered while achieving greater ranges. (Courtesy illustration)

direct fire drills as part of their Artillery Table V and VI crew certifications and qualifications. However, this is designed to assess their ability to engage targets on the ground at ranges out to 2,000 meters and at similar elevation in terms of altitude above the ground from the gun. The Paladin Digital Fire Control System (PDFCS) is an amazing computer and can generate direct fire firing data for the gun, but only provides assistance to the crew in engaging same-level targets. In a megacity, it can be reasonably expected for targets to be dozens or hundreds of meters above the gun and potentially thousands of meters away.

The last appendix of the 155 mm firing tables, the often neglected “trajectory charts,” may provide an answer. It is a visual representation of the flight of a projectile in terms of altitude (in meters) over the horizontal range to target. Looking at the apogee, the point at where a round ceases its vertical flight and begins to descend, it shows a 155 mm cannon can gain considerable standoff from a target and fire rounds to strike at a variety of altitudes, allowing the rounds to be walked up and down a structure to achieve the desired effects. Though this chart is generic and for reference only, it can be inferred that a 155 mm projectile fired at less than 200 mils of quadrant elevation (QE) with a low charge (while not accounting for non-standard

variables) will have an apogee occurring between 3,000 and 7,000 meters from the gun and at an altitude of about 500 meters. Though the vast majority of buildings around the world are shorter than 500 meters, it can be seen that by adjusting the QE and increasing the charge, a round can be fired into a variety of building altitudes at a ranges which give a degree of protection to the crew and vehicle.

Two minor upgrades and changes to doctrine can be done to allow Paladins to successfully direct fire artillery into buildings in a megacity. First, the Army should introduce a direct fire firing table which has QEs for various ranges to and heights of buildings. In addition, time settings for fuzes need to be listed so they are set to either detonate immediately in front of the building to maximize fragmentation into the structure, or to delay the detonation to have effects inside of the walls. This ensures the round explodes before fully passing through a building reaching the ballistic impact point beyond the target. This table should have the entry argument of range to target and subsequent columns with quadrant and time settings for various altitudes based on 10-meter increments in building height.

Second, Paladins need to receive equipment which allows them to identify and engage targets rapidly with existing mu-

nitions. Most importantly, the vehicles will require an optic which provides a reasonable level of detail at ranges at and beyond 10,000 meters so a crew can quickly reference a target card to engage specific portions of a building. For example, “20th story, five windows in from the western face,” would be one such entry. With an integrated laser range finder, similar to the one found on an M1 Abrams MBT, the howitzer would be able to tell the crew the exact grid, altitude and range to the target, allowing the system to compute the proper QE and time settings to achieve the desired effects. The PDFCS provides the framework which, with some coding, could bring all this data in and output a good firing solution.

Self-propelled howitzers can provide a unique capability to future maneuver commanders conducting operations inside of megacities. They can fire traditional indirect fire with precision, near-precision and conventional munitions from outside the cities, destroying targets of opportunity, and denying the enemy key infrastructure. Additionally they can, if TTPs and equipment evolve, provide effective Fires to high-rises and skyscrapers from outside the threat envelope of a vast majority of anti-tank weapons. Self-propelled howitzers are not tanks. Their armor is designed to protect against small arms and fragmentation, but they have the mobility and firepower which commanders of the future will need to win in megacities. If adapted, these simple changes to current doctrine and training can minimize the risk to friendly armored forces and provide the overwhelming and accurate fire superiority that is the heritage of the field artillery.

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