Indirect Fire in MOUT

forum

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A unit that must fight in urban terrain can expect to encounter certain operational problems it will meet nowhere else. Among them are several that have to do with indirect fire support.

The close spacing of the buildings, for example, usually makes it most difficult to select, camouflage, and defend firing positions. Communications are difficult to put in and maintain. There are also magnetic influences in urban terrain that will affect compasses and aiming circles. But the basic ballistic problems involved in the employment of indirect fire may be the most serious ones.

The first and most basic of these ballistic problems is the inability of indirect fire weapons to reach a large number of targets in a city. This is caused by a combination of the angle of fall of a projectile from an indirect fire weapon and the height of the buildings. This combination leaves indirect fire deadspaces of varying size that no reasonable amount of ammunition can overcome.

Determining the size of a particular deadspace requires a simple trigonometric calculation that is based on the contangent of the angle of fall (cot F) for a particular firing elevation and charge. Thus, the extent of the deadspace is obtained by multiplying the cot F by the height of the obstacle near the target in the line of flight. (The cot F is found in the supplementary data section of the applicable firing table.)

The firing elevations for the 81mm and 107mm mortars and for the 155mm howitzer at various values of cot F are shown in Figure 1. The deadspaces for buildings of various heights are shown in Figure 2, with the calculations based on the assumption that each story is five meters tall. But simply determining the extent of a deadspace is not enough for fire planning purposes. Some targets have to be engaged regardless, and since a building cannot be moved, other methods must be used.

One way to solve this problem is either to move the firing piece or to employ another weapon at a different location. This method is best when a single tall building is on one side of a target; it is not feasible when a target is surrounded by tall buildings.

The other fairly obvious method of firing into a deadspace is to reduce the cot F. As Figure 2 shows, when indirect fire weapons are fired at a cot F of .5 or less, large areas of deadspace fall within the effective bursting radius of their rounds. Too, while the three weapons listed in Figure 1 can fire with a cot F equal to .5, both the howitzer and the 81mm mortar can fire at .3 and .1 respectively. (Even the 107mm mortar could fire with a cot F of .3 if data were developed for firing it at an elevation of 1,100 mils, which is within the physical capabilities of the weapon.) But because the 55mm howitzer normally does not fire at this high an elevation, its firing tables are sketchy, but this could be easily remedied.

Although this method of dealing with the problem comes into direct conflict with the Army's current doctrine of firing at the lowest elevation to avoid counterbattery radar, it becomes an acceptable risk in a MOUT environment for two reasons. First, the ground clutter of the city interferes with the accuracy of counterbattery radar. Secondly, the increased firing elevation allows the weapons to be moved closer to high-rise buildings and thus into the deadspace of the enemy's indirect fire weapons. This is

FIRING ELEVATION IN MILS

cot F	*81mm*	*107mm*	*155mm*
.1	1405		
.3	1147		1156
.5	0937	1065	1017
.7	0800	0900	0746
.9		0800	0665
1.0			0615
3.0			0226
5.0			0145
10.0			0082
15.0			0057

Figure 1. Cot F of Various Weapons.

especially true of the Threat's most effective counterbattery weapons, the BM-21 multiple rocket system, which has a maximum firing elevation of about 885 mils. Also, because it is a rocket, this weapon should have a correspondingly greater cot F, which means more deadspace.

This bellying-up to a building for protection against counterbattery fire does bring up another problem: the need for a quick way of determining mask, or ground clearance (called *site in the field artillery*), for the flight of a round. But this problem is solved quite easily. Instead of waiting until their weapon is set up and then measuring the minimum firing elevation that will clear a mask, indirect fire crews should remember three simples rules of thumb: When the gun is being fired at 1,070 mils or more it must be at a distance of at least half the height of the structure away from the building; when fired at more than 800 mils it should be at least the height of the structure away; and when fired at more than 535 mils it needs to be at least twice the height of the building from the structure. (These rules are based on the properties of the 30-60-90 triangle.)

HEIGHT OF BUILDING IN STORIES

Cot F	*3*	*5*	*10*
.1	1.5	2.5	5.0
.3	4.5	7.5	15.0
.5	7.5	12.5	25.0
.7	10.5	17.5	35.0
.9	13.5	22.5	45.0
1.0	15.0	25.0	50.0
3.0	45.0	75.0	150.0
5.0	75.0	125.0	250.0
10.0	150.0	250.0	500.0
15.0	225.0	375.0	750.0

Figure 2. Deadspace in meters of various cot F.

Admittedly, sometimes large deadspaces cannot be avoided, and the size of open areas in a city is fairly restricted. As deadspaces increase in size they take up a significant amount of the already limited open space and thus the target areas decrease even further.

But indirect fire weapons are called "area weapons" in the first place because there is no way to pinpoint exactly where each of their rounds will land. Because of the many variables in the ballistic equation (such as wind speed and direction, air density and temperatures, and variations in weight of projectile and weapon wear), the best a crew can do is to define an area in which a round will probably land. This then is the concept of the probable error — one range probable error is defined as that distance added to or subtracted from the expected point of impact that will enclose 50 percent of the rounds fired at that data (Figure 3).

ONE RANGE PROBABLE ERROR IN METERS

RANGE	*81mm*	*107mm*	*155mm*
1000	7m	9m	7m
1500	9m	12m	7m
2000	11m	17m	7m
2500	13m	19m	7m
3000	15m	23m	8m
4000	19m	25m	8m
5000		30m	9m
7500			12m

Figure 3. One Range Probable Error at Selected Firing Data

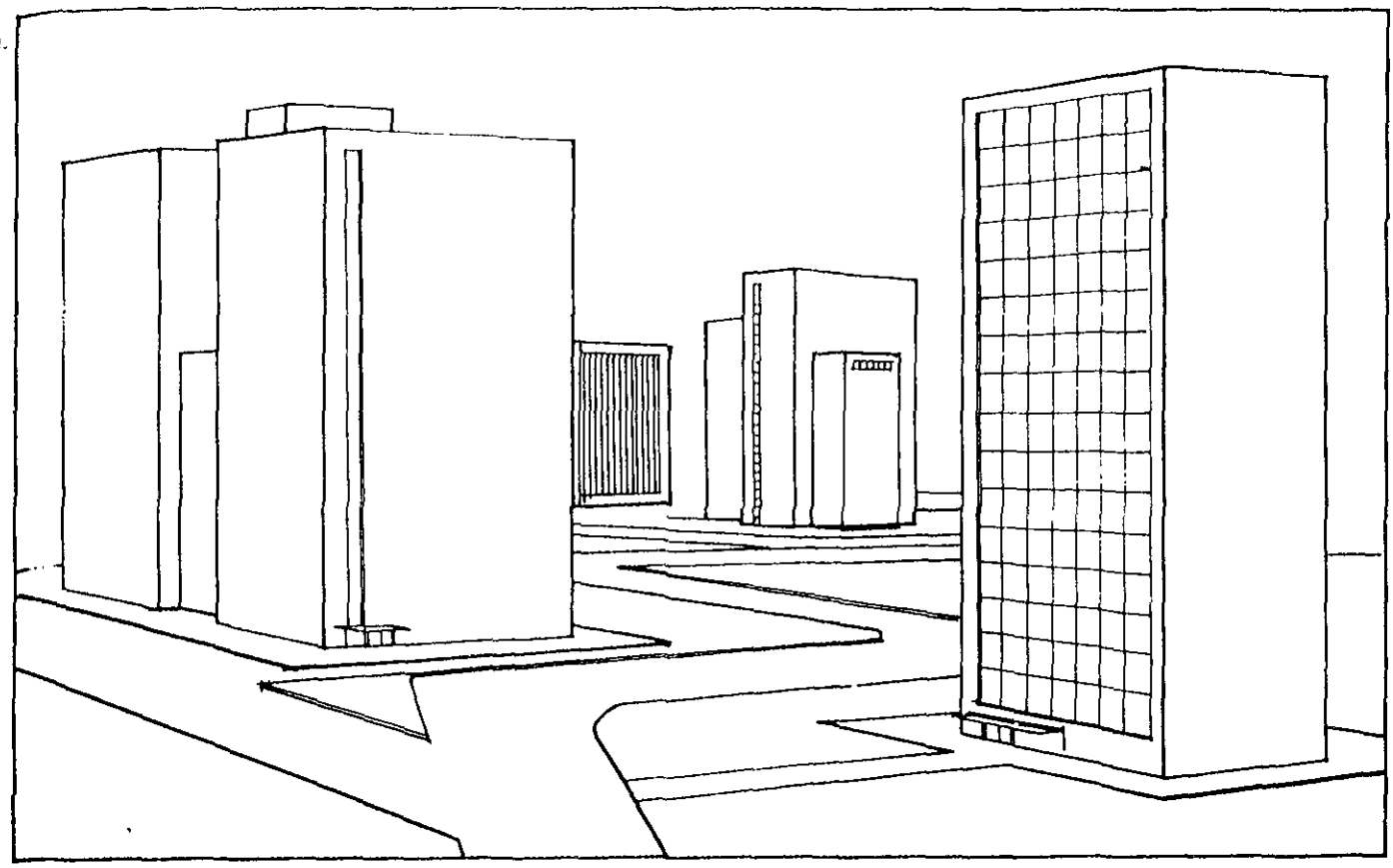
Given the combination of indirect fire deadspace, the lack of sizable open spaces in a city, and range probable error, the difficulty is clear. As the size of the deadspace increases, it quickly reduces the open space available for targeting. As the targeting area decreases, it rapidly approaches the size of the range probable error. When it decreases to just twice one probable error, a crew can expect that only 50 percent of the rounds it fires will land in a target area. And as a target area decreases in size, the percentage of rounds they can expect to land within it decreases to zero; that is, the deadspace then equals the size of the open space. This means that if they are to put the required number of rounds on a target, they must fire more rounds.

SUPPLY

Even if the Army had a perfect supply system with an unlimited number of rounds, this would cause some problems because the rounds that do not hit in the target area will still hit somewhere — half will fall long, half will fall short. Assuming that there are no friendly troops to the enemy's rear, the long rounds will do no harm and might have a detrimental effect on the enemy's plans. Unfortunately, though, the rounds that fall short of the target area will fall on or near friendly troops.

Another problem that needs to be considered is the effectiveness of indirect fire ammunition in MOUT operations, because the fuzes and the effects of the various types of munitions have been designed for conventional combat in open terrain. While no experimental data is available, certain effects can be expected when these munitions are used among buildings:

- High explosive ammunition will



produce a certain amount of secondary shrapnel when it hits on buildings, but this shrapnel will have a limited effect on even lightly armored vehicles. Also, the blast and shrapnel effect of HE ammunition that hits in rubble will be limited.

• White phosphorus and other types of smoke will be of little use. Because of the combination of unpredictable winds at street level and the total ineffectiveness of the rounds that hit on the tops of the buildings, a large number of rounds would have to be expended to establish and maintain conventional smoke screens. White phosphorus rounds could be used in an incendiary role against flammable chemical storage areas in the enemy rear area.

• Illumination rounds will be of limited use because of the canyon nature of the terrain. Direct illumination would be difficult to maintain because of the vagaries of the wind current and the shadows cast by the buildings. Illumination rounds could also be used effectively as incendiary rounds. In this respect, the 155mm canister would be better suited, because it has a greater chance of penetrating roofs and fuel tanks.

• All improved conventional munitions (ICMs) that depend on proximity fuzing suffer the same defect: premature detonation while passing over a building when the target is on the street below. Terminally guided munitions (Copperheads) will remain effective as long as they can "see" the laser signature. When this signature is hidden behind some building, these projectiles become nothing more than very expensive HE rounds. One way to decrease this problem is to fire the shell at an extremely high elevation so that it can "see" more of a street.

These various effects that restrict the performance of indirect fire ammunition only add to the other ballistic problems encountered in urban terrain — the combination of angle of fall and height of buildings, which creates deadspace, and the combination of the limited amount of clear terrain and the range probable error of the weapons, which leads to an excessive expenditure of ammunition and to increased danger to friendly troops.

For all of these reasons, the Army must devote time and attention to the employment of its indirect fire weapons if they are to offer effective support in urban areas.

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