

CHAPTER 8

EMPLOYMENT AND EFFECTS OF WEAPONS

This chapter supplements the technical manuals and field manuals that describe weapons capabilities and effects against generic targets. It focuses on specific employment considerations pertaining to combat in built-up areas, and it addresses both organic infantry weapons and combat support weapons.

8-1. EFFECTIVENESS OF WEAPONS AND DEMOLITIONS

The characteristics and nature of combat in built-up areas affect the results and employment of weapons. Leaders at all levels must consider the following factors in various combinations when choosing their weapons.

a. Hard, smooth, flat surfaces are characteristic of urban targets. Rarely do rounds impact perpendicular to these flat surfaces but at some angle of obliquity. This reduces the effect of a round and increases the threat of ricochets. The tendency of rounds to strike glancing blows against hard surfaces means that up to 25 percent of impact-fuzed explosive rounds may not detonate when fired onto rubble areas.

b. Engagement ranges are close. Studies and historical analyses have shown that only 5 percent of all targets are more than 100 meters away. About 90 percent of all targets are located 50 meters or less from the identifying soldier. Few personnel targets will be visible beyond 50 meters and usually occur at 35 meters or less. Minimum arming ranges and troop safety from backblast or fragmentation effects must be considered.

c. Engagement times are short. Enemy personnel present only fleeting targets. Enemy-held buildings or structures are normally covered by fire and often cannot be engaged with deliberate, well-aimed shots.

d. Depression and elevation limits for some weapons create dead space. Tall buildings form deep canyons that are often safe from indirect fires. Some weapons can fire rounds to ricochet behind cover and inflict casualties. Target engagement from oblique angles, both horizontal and vertical, demands superior marksmanship skills.

e. Smoke from burning buildings, dust from explosions, shadows from tall buildings, and the lack of light penetrating inner rooms all combine to reduce visibility and to increase a sense of isolation. Added to this is the masking of fires caused by rubble and man-made structures. Targets, even those at close range, tend to be indistinct.

f. Urban fighting often becomes confused melees with several small units attacking on converging axes. The risks from friendly fires, ricochets, and fratricide must be considered during the planning phase of operations and control measures continually adjusted to lower these risks. Soldiers and leaders must maintain a sense of situational awareness and clearly mark their progress IAW with unit SOP to avoid fratricide.

g. Both the firer and target may be inside or outside buildings, or they may both be inside the same or separate buildings. The enclosed nature of combat in built-up areas means that the weapon's effect, such as muzzle blast and backblast, must be considered as well as the round's impact on the target.

h. Usually the man-made structure must be attacked before enemy personnel inside are attacked. Therefore, weapons and demolitions can be

chosen for employment based on their effects against masonry and concrete rather than against enemy personnel.

i. Modern engineering and design improvements mean that most large buildings constructed since World War II are resilient to the blast effects of bomb and artillery attack. Even though modern buildings may burn easily, they often retain their structural integrity and remain standing. Once high-rise buildings burn out, they are still useful to the military and are almost impossible to damage further. A large structure can take 24 to 48 hours to burn out and get cool enough for soldiers to enter.

j. The most common worldwide building type is the 12- to 24-inch brick building. Table 8-1 lists the frequency of occurrence of building types worldwide.

TYPE OF BUILDING	FREQUENCY OF OCCURRENCE (Percentage)
30-inch Stone	1
8- to 10-inch Reinforced concrete	6.9
12-to 24-inch Brick	63
6-inch wood	16
14-inch steel and concrete (heavy clad)	2
7-inch steel and concrete (light clad)	12

Table 8-1. Types of buildings and frequency of occurrence.

8-2. M16 RIFLE AND M249 SQUAD AUTOMATIC WEAPON/MACHINE GUN

The M16A1/M16A2 rifle is the most common weapon fired in built-up areas. The M16A1/M16A2 rifle and the M249 are used to kill enemy personnel, to suppress enemy fire and observation, and to penetrate light cover. Leaders can use 5.56-mm tracer fire to designate targets for other weapons.

a. **Employment.** Close combat is the predominant characteristic of urban engagements. Riflemen must be able to hit small, fleeting targets from bunker apertures, windows, and loopholes. This requires pinpoint accuracy with weapons fired in the semiautomatic mode. Killing an enemy through an 8-inch loophole at a range of 50 meters is a challenge, but one that may be common in combat in built-up areas.

(1) When fighting inside buildings, three-round bursts or rapid semi-automatic fire should be used. To suppress defenders while entering a room, a series of rapid three-round bursts should be fired at all identified targets and likely enemy positions. This is more effective than long bursts or spraying the room with automatic fire. Soldiers should fire from an underarm or shoulder position; not from the hip.

(2) When targets reveal themselves in buildings, the most effective engagement is the quick-fire technique with the weapon up and both eyes

open. (See FM 23-9 for more detailed information on this technique.) Accurate quick fire not only kills enemy soldiers but also gives the attacker fire superiority.

(3) Within built-up areas, burning debris, reduced ambient light, strong shadow patterns of varying density, and smoke all limit the effect of night vision and sighting devices. The use of aiming stakes in the defense and of the pointing technique in the offense, both using three-round bursts, are night firing skills required of all infantrymen. The individual laser aiming light can sometimes be used effectively with night vision goggles. Any soldier using NVG should be teamed with at least one soldier not wearing them.

b. Weapon Penetration. The penetration that can be achieved with a 5.56-mm round depends on the range to the target and the type of material being fired against. The M16A2 and M249 achieve greater penetration than the older M16A1, but only at longer ranges. At close range, both weapons perform the same. Single 5.56-mm rounds are not effective against structural materials (as opposed to partitions) when fired at close range—the closer the range, the less the penetration.

(1) For the 5.56-mm round, maximum penetration occurs at 200 meters. At ranges less than 25 meters, penetration is greatly reduced. At 10 meters, penetration by the M16 round is poor due to the tremendous stress placed on this high-speed round, which causes it to yaw upon striking a target. Stress causes the projectile to break up, and the resulting fragments are often too small to penetrate.

(2) Even with reduced penetration at short ranges, interior walls made of thin wood paneling, sheetrock, or plaster are no protection against 5.56-mm rounds. Common office furniture such as desks and chairs cannot stop these rounds, but a layer of books 18 to 24 inches thick can.

(3) Wooden frame buildings and single cinder block walls offer little protection from 5.56-mm rounds. When clearing such structures, soldiers must ensure that friendly casualties do not result from rounds passing through walls, floors, or ceilings.

(4) Armor-piercing rounds are slightly more effective than ball ammunition in penetrating urban targets at all ranges. They are more likely to ricochet than ball ammunition, especially when the target presents a high degree of obliquity.

c. Protection. The following common barriers in built-up areas stop a 5.56-mm round fired at less than 50 meters:

- One thickness of sandbags.
- A 2-inch concrete wall (unreinforced).
- A 55-gallon drum filled with water or sand.
- A small ammunition can filled with sand.
- A cinder block filled with sand (block will probably shatter).
- A plate glass windowpane at a 45-degree angle (glass fragments will be thrown behind the glass).
- A brick veneer.
- A car body (an M16A1/M16A2 rifle penetrates but normally will not exit).

d. **Wall Penetration.** Although most structural materials repel single 5.56-mm rounds, continued and concentrated firing can breach some typical urban structures (see Table 8-2).

(1) The best method for breaching a masonry wall is by firing short bursts (three to five rounds) in a U-shaped pattern. The distance from the gunner to the wall should be minimized for best results—ranges as close as 25 meters are relatively safe from ricochet. Ballistic eye protection, protective vest, and helmet should be worn.

(2) Ball ammunition and armor-piercing rounds produce almost the same results, but armor-piercing rounds are more likely to fly back at the firer. The 5.56-mm round can be used to create either a loophole (about 7 inches in diameter) or a breach hole (large enough for a man to enter). When used against reinforced concrete, the M16 rifle and M249 cannot cut the reinforcing bars.

TYPE	PENETRATION	ROUNDS (REQUIRED)
8-Inch reinforced concrete	Initial loophole	35 250
14-Inch triple brick	Initial loophole	90 160
12-Inch cinder block with single-brick veneer	Loophole Breach hole	60 250
9-Inch double brick	Initial Loophole	70 120
16-Inch tree trunk or log wall	Initial*	1 to 3
12-Inch cinder block (filled with sand)	Loophole	35
24-Inch double sandbag wall	Initial*	220
3/8-Inch mild steel door	Initial*	1
*Penetration only, no loophole.		

Table 8-2. Structure penetration capabilities of the 5.56-mm round against typical urban targets (range 25 to 100 meters).

8-3. MEDIUM AND HEAVY MACHINE GUNS (7.62-mm and .50-caliber)

In the urban environment, the Browning .50-caliber machine gun and the 7.62-mm M60 machine gun provide high-volume, long-range, automatic fires for the suppression or destruction of targets. They provide final protective fire along fixed lines and can be used to penetrate light structures—the .50-caliber machine gun is most effective in this role. Tracers from both machine guns are likely to start fires, but the .50-caliber tracer is more apt to do so.

a. **Employment.** The primary consideration impacting on the employment of machine guns within built-up areas is the limited availability of long-range fields of fire. Although machine guns should be emplaced at the lowest level possible, grazing fire at ground level is often obstructed by rubble.

(1) The .50-caliber machine gun is often employed on its vehicular mount during both offensive and defensive operations. If necessary, it can be mounted on the M3 tripod mount for use in the ground role or in the upper level of buildings. When mounted on a tripod, the .50-caliber machine gun can be used as an accurate, long-range weapon and can supplement sniper fires.

(2) The M60 machine gun is cumbersome, making it difficult to use inside while clearing a building. However, it is useful outside to suppress and isolate enemy defenders. The M60 can be fired from either the shoulder or the hip to provide a high volume of assault and suppressive fires. The use of the long sling to support the weapon and ammunition is preferred.

(3) Because of their reduced penetration power, M60 machine guns are less effective against masonry targets than .50-caliber machine guns. However, their availability and light weight make them well suited to augment heavy machine gun fire or to be used in areas where .50-caliber machine guns cannot be positioned, or as a substitute when heavy machine guns are not available. The M60 machine gun can be employed on its tripod to deliver accurate fire along fixed lines and then can quickly be converted to biped fire to cover alternate fields of fire.

b. **Weapon Penetration.** The ability of the 7.62-mm and .50-caliber rounds to penetrate are also affected by the range to the target and type of material fired against. The 7.62-mm round is affected less by close ranges than the 5.56-mm; the .50-caliber's penetration is reduced least of all.

(1) At 50 meters, the 7.62-mm ball round cannot penetrate a single layer of sandbags. It can penetrate a single layer at 200 meters, but not a double layer. The armor-piercing round does only slightly better against sandbags. It cannot penetrate a double layer but can penetrate up to 10 inches at 600 meters.

(2) The penetration of the 7.62-mm round is best at 600 meters but most urban targets are closer. The longest effective range is usually 200 meters or less. Table 8-3 explains the penetration capabilities of a single 7.62-mm (ball) round at closer ranges.

RANGE (meters)	PINE BOARD (inches)	DRY LOOSE SAND (inches)	CINDER BLOCK (inches)	CONCRETE (inches)
25	13	5	8	2
100	18	4.5	10	2
200	41	7	8	2

Table 8-3. Penetration capabilities of a single 7.62-mm (ball) round.

(3) The .50-caliber round is also optimized for penetration at long ranges (about 800 meters). For hard targets, .50-caliber penetration is affected by obliquity and range. Both armor-piercing and ball ammunition penetrate 14 inches of sand or 28 inches of packed earth at 200 meters, if the rounds impact perpendicular to the flat face of the target. Table 8-4 explains the effect of a 25-degree obliquity on a .50-caliber penetration.

THICKNESS (meters)	100 METERS (rounds)	200 METERS (rounds)
2	300	1,200
3	450	1,800
4	600	2,400

Table 8-4. Number of rounds needed to penetrate a reinforced concrete wall at a 25-degree obliquity.

c. **Protection.** Barriers that offer protection against 5.56-mm rounds are also effective against 7.62-mm rounds with some exceptions. The 7.62-mm round can penetrate a windowpane at a 45-degree obliquity, a hollow cinder block, or both sides of a car body. It can also easily penetrate wooden frame buildings. The .50-caliber round can penetrate all of the commonly found urban barriers except a sand-filled 55-gallon drum.

d. **Wall Penetration.** Continued and concentrated machine gun fire can breach most typical urban walls. Such fire cannot breach thick reinforced concrete structures or dense natural stone walls. Internal walls, partitions, plaster, floors, ceilings, common office furniture, home appliances, and bedding can be easily penetrated by both 7.62-mm and .50-caliber rounds (Tables 8-5 and 8-6).

TYPE	THICKNESS (Inches)	HOLE DIAMETER (Inches)	ROUNDS REQUIRED
Reinforced concrete	8	7	100
Triple brick wall	14	7	170
Concrete block with single brick veneer	12	6 and 24	30 and 200
Cinder block (filled)	12	*	18
Double brick wall	9	*	45
Double sandbag wall	24	*	110
Log wall	16	*	1
Mild steel door	3/8	*	1
*Penetration only, no loophole.			

Table 8-5. Structure penetrating capabilities of 7.62-mm round (NATO ball) against typical urban targets (range 25 meters).

(1) The M60 machine gun can be hard to hold steady to repeatedly hit the same point on a wall. The dust created by the bullet strikes also makes precise aiming difficult. Firing from a tripod is usually more effective than without, especially if sandbags are used to steady the weapon. Short bursts of three to five rounds fired in a U-type pattern are best.

(2) Breaching a brick veneer presents a special problem for the M60 machine gun. Rounds penetrate the cinder block but leave a net-like structure of unbroken block. Excessive ammunition is required to destroy a net since most rounds only pass through a previously eroded hole. One or two minutes work with an E-tool, crowbar, or axe can remove this web and allow entry through the breach hole.

(3) The .50-caliber machine gun can be fired accurately from the tripod using the single-shot mode. This is the most efficient method for producing a loophole. Automatic fire in three- to five-round bursts, in a U-type pattern, is more effective in producing a breach.

TYPE	THICKNESS (Inches)	HOLE DIAMETER (Inches)	ROUNDS REQUIRED
Reinforced concrete	10	12	50
		24	100
	18	7	140
Triple brick wall	12	8	15
		26	50
Concrete block with single brick veneer	12	10	25
		33	45
Armor plate	1	*	1
Double sandbag wall	24	*	5
Log wall	16	*	1
*Penetration only, no loophole.			

Table 8-6. Structure penetrating capabilities of .50-caliber ball against typical urban targets (range 35 meters).

8-4. GRENADE LAUNCHERS, 40-MM (M203 AND MK 19)

Both the M203 dual-purpose weapon and the MK 19 grenade machine gun fire 40-mm HE and HEDP ammunition. Ammunition for these weapons is not interchangeable, but the grenade and fuze assembly that actually hits the target are identical. Both weapons provide point and area destructive fires as well as suppression. The MK 19 has a much higher rate of fire and a longer range; the M203 is much lighter and more maneuverable.

a. **Employment.** The main consideration affecting the employment of 40-mm grenades within built-up areas is the typically short engagement range. The 40-mm grenade has a minimum arming range of 14 to 28 meters. If the round strikes an object before it is armed, it will not detonate. Both the HE and HEDP rounds have 5-meter burst radii against exposed troops,

which means that the minimum safe firing range for combat is 31 meters. The 40-mm grenades can be used to suppress the enemy in a building, or inflict casualties by firing through apertures or windows. The MK 19 can use its high rate of fire to concentrate rounds against light structures. This concentrated fire can create extensive damage. The 40-mm HEDP round can penetrate the armor on the flank, rear, and top of Soviet-made BMPs and BTRs. Troops can use the M203 from upper stories to deliver accurate fire against the top decks of armored vehicles. Multiple hits are normally required to achieve a kill.

b. **Weapon Penetration.** The 40-mm HEDP grenade has a small shaped charge that penetrates better than the HE round. It also has a thin wire wrapping that bursts into a dense fragmentation pattern, creating casualties out to 5 meters. Because they explode on contact, 40-mm rounds achieve the same penetration regardless of range. Table 8-7 explains the penetration capabilities of the HEDP round.

TARGET	PENETRATION (Inches)
Sandbags	20 (double layer)
Sand-filled cinder block	16
Pine logs	12
Armor plate	2

Table 8-7. Penetration capabilities of the HEDP round.

(1) If projected into an interior room, the 40-mm HEDP can penetrate all interior partition-type walls. It splinters plywood and plaster walls, making a hole large enough to fire a rifle through. It is better to have HEDP rounds pass into a room and explode on a far wall, even though much of the round's energy is wasted penetrating the back wall (see Figure 8-1). The fragmentation produced in the room causes more casualties than the high-explosive jet formed by the shaped charge.

(2) The fragments from the HEDP round do not reliably penetrate interior walls. They are also stopped by office furniture, sandbags, helmets, and protective vests (flak jackets). The M203 dual-purpose weapon has the inherent accuracy to place grenades into windows at 125 meters and bunker apertures at 50 meters. These ranges are significantly reduced as the angle of obliquity increases. Combat experience shows that M203 gunners cannot consistently hit windows at 50 meters when forced to aim and fire quickly.

c. **Wall Penetration.** The M203 cannot reasonably deliver the rounds needed to breach a typical exterior wall. The MK 19 can concentrate its fire and achieve wall penetration. Firing from a tripod, using a locked down traversing and elevating mechanism, is best for this role. Brick, cinder block, and concrete can be breached using the MK 19; individual HEDP rounds can penetrate 6 to 8 inches of brick. The only material that has proven

resistant to concentrated 40-mm fire is dense stone such as that used in some European building construction. No precise data exist as to the number of rounds required to produce loopholes or breach holes with the MK 19. However, the rounds' explosive effects are dramatic and should exceed the performance of the .50 caliber machine gun.

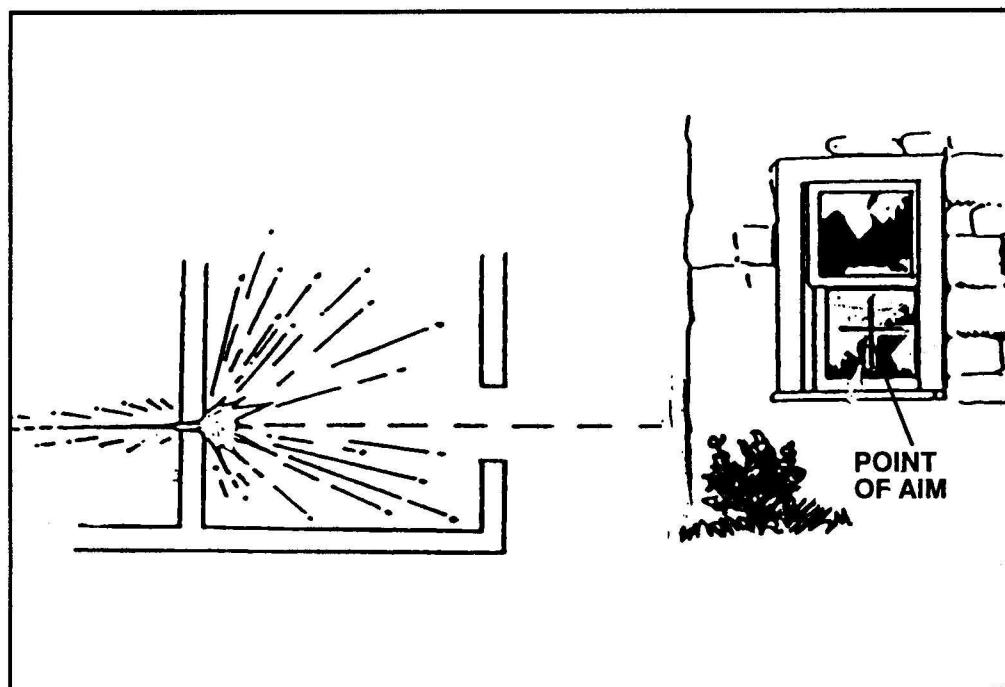


Figure 8-1. Aim point for 40-mm HEDP.

8-5. LIGHT AND MEDIUM RECOILLESS WEAPONS

Light and medium recoilless weapons are used to attack enemy personnel, field fortifications, and light armored vehicles. They have limited capability against main battle tanks, especially those equipped with reactive armor, except when attacking from the top, flanks, or rear. This category of weapons includes the M72 LAW; the AT4 or AT8; the M47 Dragon; the 90-mm and 84-mm recoilless rifles; the shoulder-launched, multipurpose, assault weapon (SMAW); and available foreign weapons such as the RPG-7.

a. **Employment.** Other than defeating light armored vehicles, the most common task for which light recoilless weapons are used is to neutralize fortified firing positions. Due to the design of the warhead and the narrow blast effect, these weapons are not as effective in this role as heavier weapons such as a tank main gun round. Their light weight allows soldiers to carry several LAWs or AT4s. Light recoilless weapons can be fired from the tops of buildings or from areas with extensive ventilation.

(1) Light and medium recoilless weapons, with the exception of the SMAW and AT8, employ shaped-charge warheads. As a result, the hole they punch in walls is often too small to use as a loophole. The fragmentation and span these weapons produce are limited. Normally, shaped-charge warheads do not neutralize enemy soldiers behind walls unless they are located directly in line with the point of impact.

(2) Against structures, shaped-charge weapons should be aimed about 6 inches below or to the side of a firing aperture (see Figure 8-2). This enhances the probability of killing the enemy behind the wall. A round that passes through a window wastes much of its energy on the back wall. Since these shaped-charge rounds lack the wire wrapping of the 40-mm HEDP, they burst into few fragments and are often ineffective casualty producers.

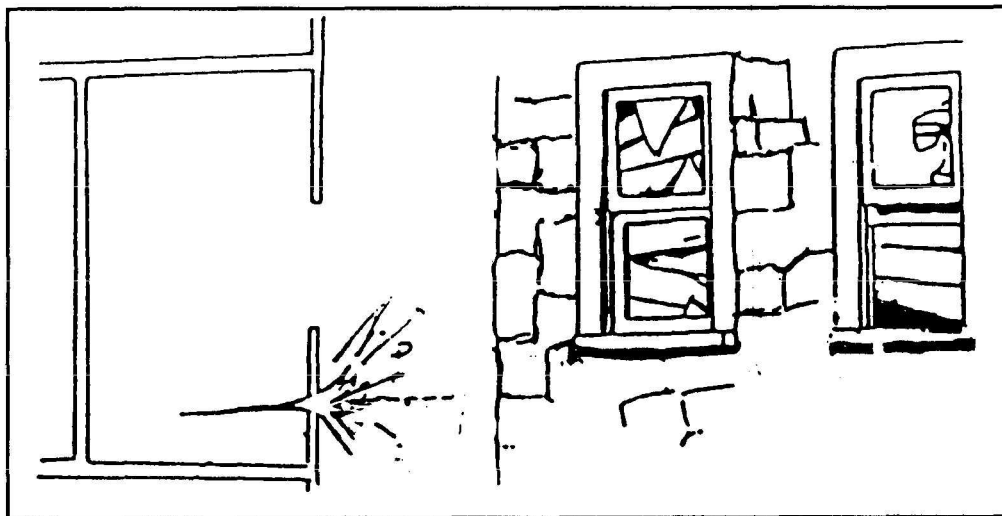


Figure 8-2. Point of aim for a shaped-charge weapon against a masonry structure.

(3) Sandbagged emplacements present a different problem (see Figure 8-3). Because sandbags absorb much of the energy from a shaped-charge, the rounds should be aimed at the center of the firing aperture. Even if the round misses the aperture, the bunker wall area near it is usually easiest to penetrate.

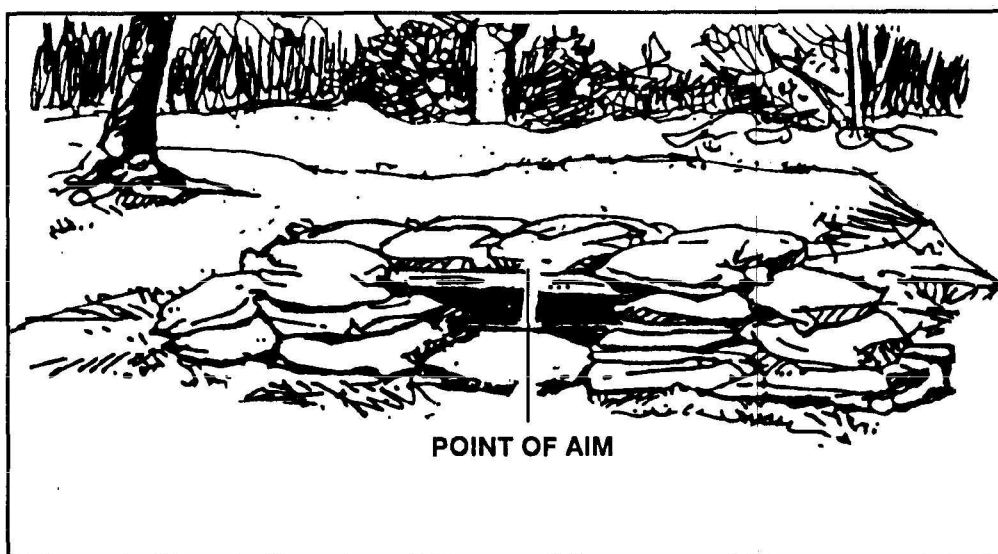


Figure 8-3. Point of aim for sandbagged emplacement.

(4) Light and medium recoilless weapons obtain their most effective short-range antiarmor shots by firing from upper stories, or from the flanks and rear. When firing at main battle tanks, these weapons should always be employed against these weaker areas in volley or paired firing. They normally require multiple hits to achieve a kill on a tank. Flanks, top, and rear shots hit the most vulnerable parts of armored vehicles. Firing from upper stories protects the firer from tank main gun and coaxial machine gun fire since tanks cannot sharply elevate their cannons. The BMP-2 can elevate its 30-mm cannon to engage targets in upper stories. The BTR-series armored vehicles can also fire into upper stories with their heavy machine gun.

(5) Modern infantry fighting vehicles, such as the BMP-2 and the BTR-80, have significantly improved frontal protection against shaped-charge weapons. Many main battle tanks have some form of reactive armor in addition to their thick armor plate. Head-on, ground-level shots against these vehicles have little probability of obtaining a kill. Even without reactive armor, modern main battle tanks are hard to destroy with a light antiarmor weapon.

(6) The easiest technique to use that will improve the probability of hitting and killing an armored vehicle is to increase the firing depression angle. A 45-degree downward firing angle doubles the probability of a first-round hit as compared to a ground-level shot (see Figure 8-4).

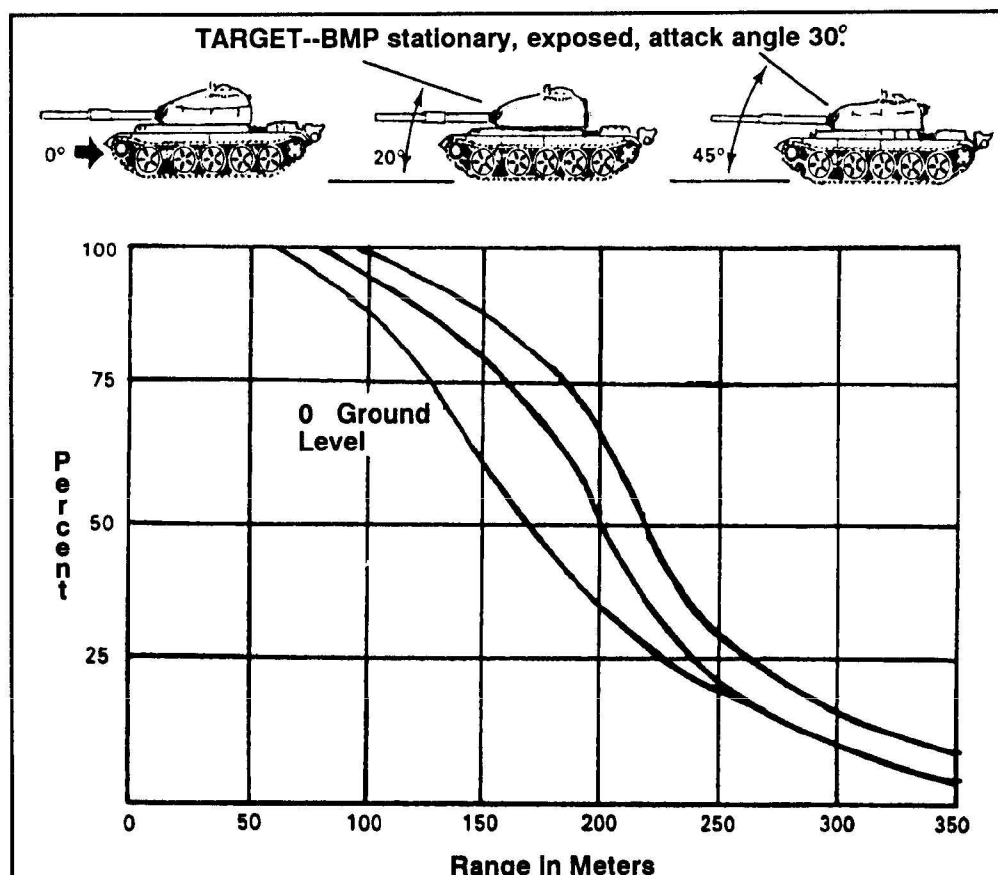


Figure 8-4. Probability of achieving a hit at different angles using an M72A2 LAW.

b. **Backblast.** Backblast characteristics must be considered when employing all recoilless weapons. During combat in built-up areas, the backblast area in the open is more hazardous due to all the loose rubble, and the channeling effect of the narrow streets and alleys. Figure 8-5 shows the backblast areas of United States light and medium recoilless weapons in the open.

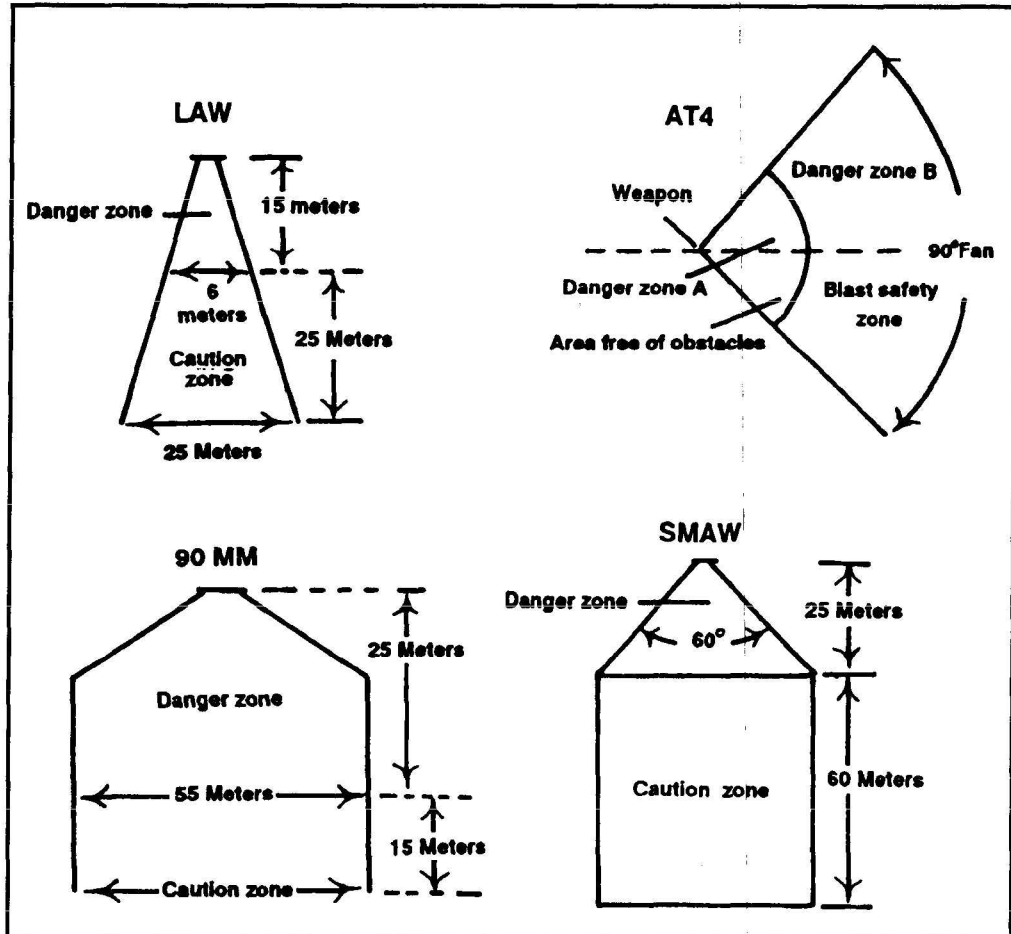


Figure 8-5. Backblast areas of light recoilless weapons in the open.

(1) When firing recoilless weapons in the open, soldiers should protect themselves from blast and burn injuries caused by the backblast. All personnel should be out of the danger zone. Anyone not able to vacate the caution zone should be behind cover. Soldiers in the caution zone should wear helmets, protective vests, and eye protection. The firer and all soldiers in the area should wear earplugs.

(2) Since the end of World War II, the US Army has conducted extensive testing on the effects of firing recoilless weapons from within enclosures. Beginning as early as 1948, tests have been conducted on every type of recoilless weapon available. In 1975, the US Army Human Engineering Laboratory at Aberdeen Proving Grounds, Maryland, conducted extensive firing of LAW, Dragon, 90-mm RCLR, and TOW from masonry and frame

buildings, and from sandbag bunkers. These tests showed that firing these weapons from enclosures presented no serious hazards, even when the overpressure was enough to produce structural damage to the building. The following were other findings of this test.

(a) Little hazard exists to the gunnery or crew from any type of flying debris. Loose items were not hurled around the room.

(b) No substantial degradation occurs to the operator's tracking performance as a result of obscuration or blast overpressure.

(c) The most serious hazard that can be expected is hearing loss. This must be evaluated against the advantage gained in combat from firing from cover. To place this hazard in perspective, a gunner wearing earplugs and firing the loudest combination (the Dragon from within a masonry building) is exposed to less noise hazard than if he fired a LAW in the open without earplugs.

(d) The safest place for other soldiers in the room with the firer is against the wall from which the weapon is fired. Plastic ignition plugs are a hazard to anyone standing directly behind a LAW or TOW when it is fired.

(e) Firers should take advantage of all available sources of ventilation by opening doors and windows. Ventilation does not reduce the noise hazard, but it helps clear the room of smoke and dust, and reduces the effective duration of the overpressure.

(f) The only difference between firing these weapons from enclosures and firing them in the open is the duration of the pressure fluctuation.

(g) Frame buildings, especially small ones, can suffer structural damage to the rear walls, windows, and doors. Large rooms suffer slight damage, if any.

(3) Recoilless weapons fired from within enclosures create some obscuration inside the room, but almost none from the gunner's position looking out. Inside the room, obscuration can be intense, but the room remains inhabitable. Table 8-8 shows the effects of smoke and obscuration.

BUILDING	WEAPON	FROM GUNNER'S POSITION LOOKING OUT	INSIDE THE ROOM	FROM OUTSIDE AT A DISTANCE
Masonry	LAW Dragon	None Slight	Moderate Moderate	Slight smoke Small flash
Bunker	Dragon TOW	None None	Slight Slight	Moderate flash Moderate smoke
Small frame	LAW Dragon	None None	Moderate Severe	Moderate Moderate
Medium frame	LAW Dragon	None None	Slight Severe	Moderate Slight flash
Large frame	LAW Dragon TOW	None Slight None	Slight Severe Severe	None Slight flash Slight smoke

Table 8-8. Smoke and obscuration.

(4) The Dragon causes the most structural damage but only in frame buildings. There does not seem to be any threat of injury to the gunner, since the damage is usually to the walls away from the gunner. The most damage and debris is from flying plaster chips and pieces of wood trim. Large chunks of plasterboard can be dislodged from ceilings. The backblast from LAW, Dragon, or TOW rarely displaces furniture. Table 8-9 shows the test results of structural damage and debris.

BUILDING	WEAPON	DAMAGE		DEBRIS MOVEMENT
		STRUCTURE	WALL COVERING	
Masonry	LAW Dragon	None None	Slight Slight	Slight Slight
Bunker	Dragon TOW	None None	None None	None Leaves and dust disturbed
Small frame	LAW Dragon	None Severe	Slight Severe	None None
Medlum frame	LAW Dragon	None Slight	None Slight	Slight Lamp and chair overturned
Large frame	LAW Dragon TOW	None Slight Slight	Slight Moderate Severe	Slight None None

Table 8-9. Structural damage and debris movement.

(5) To fire a LAW from inside a room, the following safety precautions must be taken (see Figure 8-6).



Figure 8-6. Firing a LAW from inside a room.

(a) At least 4 feet of clearance should exist between the rear of the LAW and the nearest wall.

(b) At least 20 square feet of ventilation (an open 7- by 3-foot door is sufficient) should exist to reduce or prevent structural damage to the building—the more ventilation, the better.

(c) All glass should be removed from windows.

(d) All personnel in the room should be forward of the rear of the weapon and should wear helmets, protective vests, ballistic eye protection, and earplugs.

(e) All combustible material should be removed from the rear of the weapon.

(f) Ceiling height should be at least 7 feet.

(6) To fire a 90-mm RCLR, AT4 or AT8, or SMAW from inside a room, the following safety precautions must be taken (see Figure 8-7).



Figure 8-7. Firing a 90-mm RCLR, AT4, AT8 or SMAW from inside a building.

(a) The building should be of a sturdy construction.

(b) The ceiling should be at least 7 feet high with loose plaster or ceiling boards removed.

(c) The floor size should be at least 15 feet by 12 feet. (The larger the room, the better.)

(d) At least 20 square feet of ventilation (room openings) should exist to the rear or side of the weapon. An open 7-by 3-foot door would provide minimum ventilation.

(e) All glass should be removed from windows and small, loose objects removed from the room.

(f) Floors should be wet to prevent dust and dirt from blowing around and obscuring the gunner's vision.

(g) All personnel in the room should be forward of the rear of the weapon.

(h) All personnel in the room should wear helmets, protective vests, ballistic eye protection, and earplugs.

(i) If the gunner is firing from the prone position, his lower body must be perpendicular to the bore of the weapon or the blast could cause injury to his legs.

c. Weapon Penetration. The most important tasks to be performed against structures are the neutralization of fortified firing positions, personnel, and weapons behind barriers. Recoilless weapons can be used in this role; none, however, is as effective as heavy direct-fire weapons or standard demolitions. Each recoilless weapon has different penetrating ability against various targets. Penetration does not always mean the destruction of the integrity of a position. Usually, only those enemy soldiers directly in the path of the span from a HEAT round become casualties. Other soldiers inside a fortification could be deafened, dazed, or shocked but eventually return to action.

(1) *M72 LAW.* The LAW, although light and easy to use, has a small explosive charge and limited penetration. It can be defeated by a double-layer brick wall backed by 4 feet of sandbags since it cannot produce a loophole in this type construction. The LAW requires at least 10 meters to arm. If it hits a target before it arms, it usually does not detonate. (The LAW is being replaced by the AT4 in the US Army inventory of munitions.) The LAW can penetrate—

- 2 feet of reinforced concrete, leaving a dime-sized hole and creating little span.
- 6 feet of earth, leaving a quarter-sized hole with no span.
- 12 inches of steel (flanks, rear, and top armor of most armored vehicles), leaving a dime-sized hole.

(2) *M136 84-mm Launcher (AT4).* The AT4 is heavier than the LAW with a diameter of 84 millimeters, which gives the warhead much greater penetration. The AT4 can penetrate more than 17.5 inches (450 mm) of armor plate. Its warhead produces highly destructive results behind the armor. Tests against typical urban targets are still ongoing, but the AT4 should penetrate at least as well as the 90-mm recoilless rifle if not better. The AT4 has a minimum arming distance of 10 meters, which allows it to be fired successfully against close targets. Firers should be well covered by protective equipment when firing at close targets.

(3) *84-mm Launcher (AT8).* The AT8 is a lightweight disposable, multi-purpose, direct fire weapon designed especially for MOUT. Externally, the AT8 is almost identical to the AT4, and it is fired in the same manner. The AT8 was procured in limited amounts and issued to selected US Army and USMC units during the Persian Gulf War. Its fuze has the ability to distinguish between armor and soft earth, maximizing its capabilities against buildings, bunkers, or light armor. The warhead detonates immediately against hard targets, but delays detonation against soft targets and burrows into explode inside. The AT8 destroys earth and timber bunkers, blows large holes in light-armored vehicles, and breaches 8-inch reinforced concrete walls and 12-inch triple brick walls.

(4) *Recoilless rifles.* The 90-mm recoilless rifle is being phased out of the US Army inventory of weapons, but it is still used in engineer battalions. The 84-mm Ranger antiarmor weapon system (RAAWS) is issued to some light forces. The recoilless rifles' lightweight and maneuverability, combined with great penetrating power, make them useful weapons during combat in built-up areas.

(a) The 90-mm RCLR has an antipersonnel round that is effective against exposed enemy. The flechette projectiles fired by this antipersonnel round cannot penetrate structural walls but can pierce partitions and wooden-framed buildings. The antipersonnel round has no minimum range, but the HEAT round is not armed until it has traveled 35 to 50 feet. The 90-mm HEAT round can penetrate—

- 3 ½ feet of packed earth, leaving a 2-inch hole with no span.
- 2 ½ feet of reinforced concrete, creating a small loophole (less than 3 inches wide) with little span.
- 10 inches of armor plate, leaving a quarter-sized hole.

(b) The RAAWS has a HEAT round for use against armored targets and an HE and HEDP round for use against other targets. The HE round can be set for either air burst or impact burst. It contains 800 steel balls that are distributed in a lethal pattern upon detonation. The HE round is effective against troops in the open or behind vertical cover such as a low wall. The HEDP round is probably the most useful during MOU. It is effective against light-armored vehicles, thick concrete and brick walls, thin wood walls and field fortifications, and also unprotected troops. The RAAWS also fires illumination and smoke rounds. The smoke round is useful to cover friendly units as they cross small open areas. The HEAT round arms at 5 to 8 meters and may throw fragments back as far as 50 meters. The HE round arms at 20 to 70 meters and may throw its steel balls back as far as 250 meters. The HEDP round arms at 15 to 40 meters and produces only slight fragmentation out to 50 meters.

(5) *Shoulder-launched, multipurpose, assault weapon (SMAW).* The SMAW is being issued to US Marine Corps units. It has been type-classified and in time of war Army units could find it available. The SMAW is a lightweight, man-portable, assault weapon that is easily carried and placed into action by one man. It is used against fortified positions, but it is also effective against light-armored vehicles. The SMAW has a 9-mm spotting rifle and a 3.8-power telescope, which ensure accuracy over ranges common to combat in built-up areas. The SMAW has excellent incapacitating effects behind walls and inside bunkers, and can arm within 10 meters. It fires the same dual-mode fuzed round as the AT8, and it has another round designed for even greater effect against armored vehicles. The SMAW has the same penetration ability as the AT8—it can destroy most bunkers with a single hit. Multiple shots can create breach holes even in reinforced concrete.

(6) *RPG-7.* The RPG-7 is a common threat weapon worldwide. It is lightweight and maneuverable, and is accurate over ranges common to combat in built-up areas. In a conflict almost anywhere in the world, US forces must protect themselves against RPGs. The RPG warhead is moderately effective against armored vehicles particularly M113 armored personnel carriers. It is less effective against common urban hard targets. It has a

limited effect against reinforced concrete or stone. Typically, the round produces a small hole with little span. The RPG produces a small hole in earth berms with little blast effect and no span. A triple layer of sandbags is usually protection against RPG rounds. Because of its fuze design, the RPG can often be defeated by a chain-link fence erected about 4 meters in front of a position. Even without such a barrier, a high percentage of RPG rounds fired against urban targets are duds due to glancing blows.

d. **Wall Breaching.** Wall breaching is a common combat task in built-up areas for which light recoilless weapons can be used. Breaching operations improve mobility by providing access to building interiors without using existing doors or windows. Breaching techniques can also be used to create loopholes for weapons positions or to allow hand grenades to be thrown into defended structures. Breach holes for troop mobility should be about 24 inches (60 centimeters) in diameter. Loopholes should be about 8 inches (20 centimeters) in diameter (see Figure 8-8). None of the light recoilless weapons organic to maneuver battalions (with the possible exception of the AT8 and SMAW) provide a one-shot wall-breaching ability. To breach walls, a number of shots should be planned.

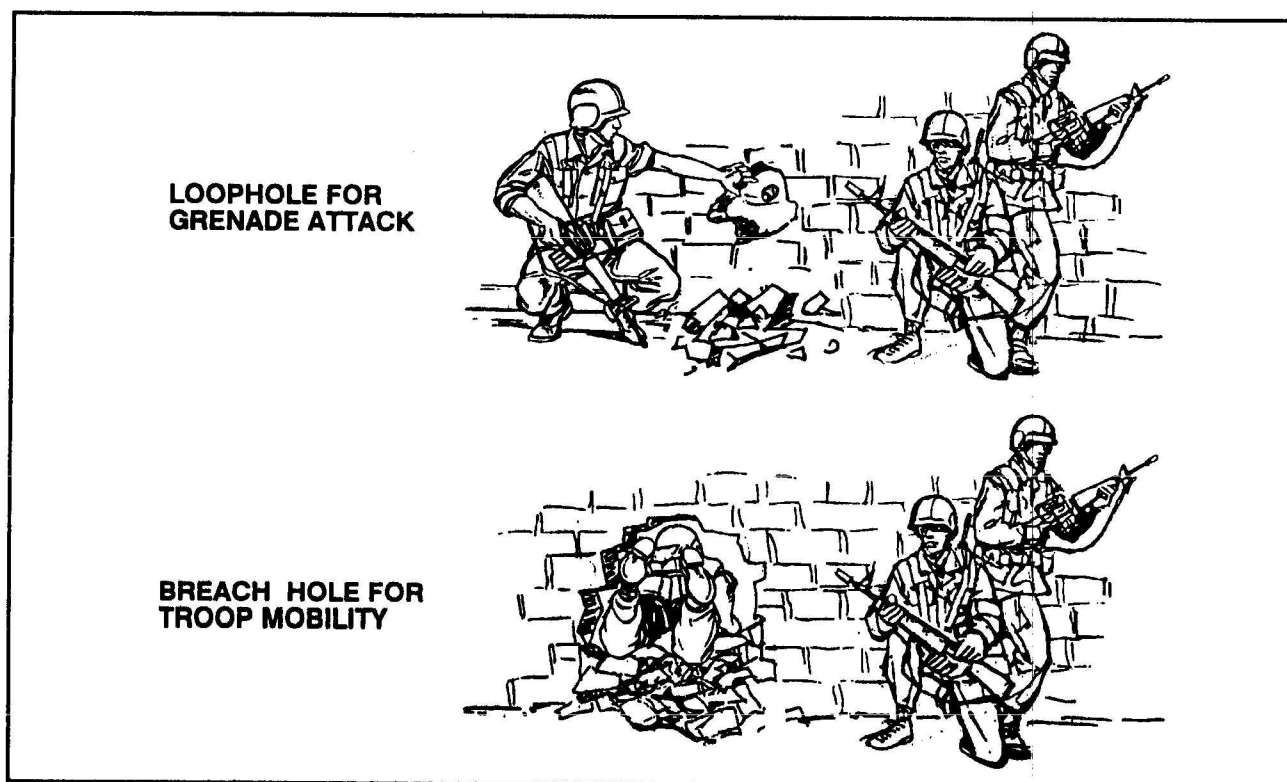


Figure 8-8. Tactical use of holes in masonry walls.

(1) Of all the common building materials, heavy stone is the most difficult to penetrate. The LAW, AT4 or AT8, 90-mm RCLR, and RPG-7 usually will not penetrate a heavy European-style stonewall. Surface cratering is usually the only effect.

(2) Layered brick walls are also difficult to breach with light recoilless weapons. Some brick walls can be penetrated by multiple firings, especially if they are less than three bricks thick. Five LAW rounds fired at the same spot on a 8-inch (double-brick) wall normally produces a loophole. Heavier weapons, such as the AT4 and 90-mm RCLR, may require fewer rounds. The AT8 and SMAW produce a hole in brick walls that is often large enough to be a breach hole.

(3) Wooden structural walls offer little resistance to light recoilless weapons. Even heavy timbered walls are penetrated and splintered. Three LAW rounds fired at the same area of a wood-frame wall usually produce a man-sized hole. The AT8 and SMAW have a devastating effect against a wood-frame wall. A single round produces a breach hole as well as significant span.

(4) Because of its high velocity, the AT4 may penetrate a soft target, such as a car body or frame building, before exploding.

(5) None of the light recoilless weapons are effective against structural walls as demolitions or heavier weapons such as tank main gun, field artillery, or combat engineer vehicle demolition guns. Of all the light recoilless weapons, the SMAW and AT8 are the most effective.

8-6. ANTITANK GUIDED MISSILES

Antitank guided missiles (ATGMs) are used mainly to defeat main battle tanks and other armored combat vehicles. They have a moderate capability against bunkers, buildings, and other fortified targets commonly found during combat in built-up areas. This category of weapons includes the TOW and Dragon missiles.

a. **Employment.** TOWs and Dragons provide overwatch antitank fires during the attack of a built-up area and an extended range capability for the engagement of armor during the defense. Within built-up areas, they are best employed along major thoroughfares and from the upper stories of buildings to attain long-range fields of fire. Their minimum firing range of 65 meters could limit firing opportunities in the confines of densely built-up areas.

(1) **Obstacles.** When fired from street level, rubble or other obstacles could interfere with missile flight. At least 3.5 feet (1 meter) of vertical clearance over such obstacles must be maintained. Figure 8-9, page 8-20 shows the most common obstacles to ATGM flights found in built-up areas. Power lines are a special obstacle that present a unique threat to ATGM gunners. If the power in the lines has not been interrupted, the ATGM guidance wires could create a short circuit. This would allow extremely high voltage to pass to the gunner in the brief period before the guidance wires melted. This voltage could either damage the sight and guidance system, or injure the gunner. Before any ATGM is fired over a power line, an attempt must be made to determine whether or not the power has been interrupted.

(2) **Dead space.** Three aspects of dead space that affect ATGM fires are arming distance, maximum depression, and maximum elevation.

(a) Both the Dragon and TOW missiles have a minimum arming distance of 65 meters, which severely limits their use in built-up areas. Few areas in the inner city permit fires much beyond the minimum arming distance—ground-level long-range fires down streets or rail lines and across parks or

plazas are possible. ATGMs may be used effectively from upper stories or roofs of buildings to fire into other buildings.

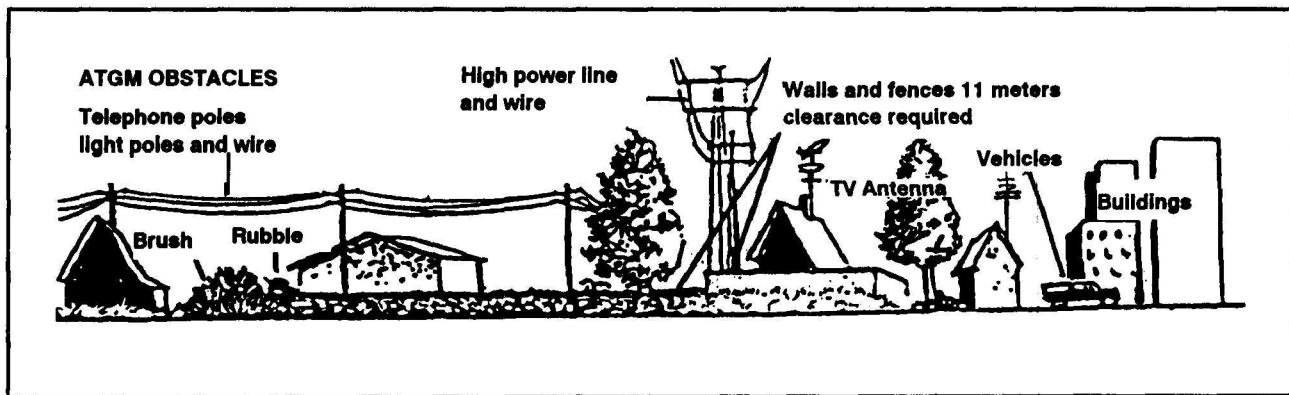


Figure 8-9. Common obstacles to ATGM flights.

(b) The TOW is limited much more than the Dragon by its maximum depression and elevation. The maximum depression and elevation limits of the TOW mount could result in dead space and preclude the engagements of close targets (see Figure 8-10). A target located at the minimum arming range (65 meters) cannot be engaged by a TOW crew located any higher than the sixth floor of a building due to maximum depression limits. At 100 meters the TOW crew can be located as high as the ninth floor and still engage the target.

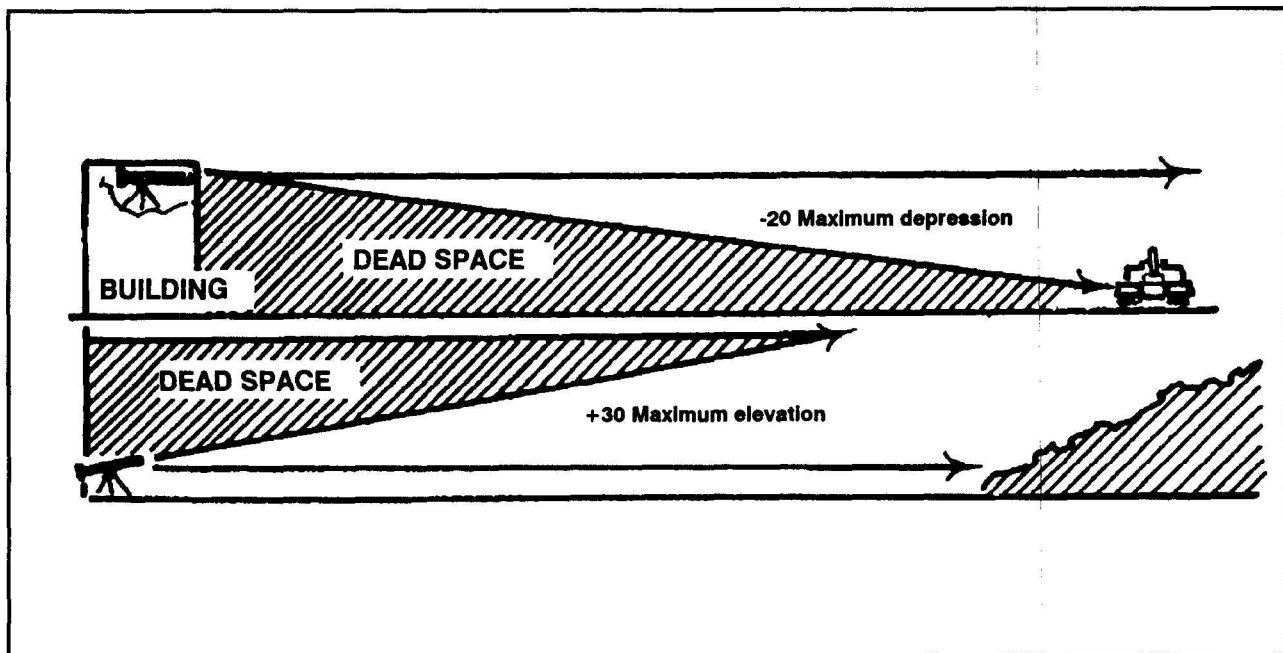


Figure 8-10. TOW maximum elevation and depression limitations.

(3) **Backblast.** As for the light recoilless weapons, backblast for ATGMs is more of a concern during combat in built-up areas than in open country. Any loose rubble in the caution zone could be picked up and thrown by the backblast. The channeling effect of walls and narrow streets is even more pronounced due to the greater backblast. If the ATGM backblast strikes a wall at an angle, it can pick up debris, or be deflected and cause injury to unprotected personnel (Figure 8-11). Both ATGMs can be fired from inside some buildings. In addition to the helmet and protective vest, eye protection and earplugs should be worn by all personnel in the room.

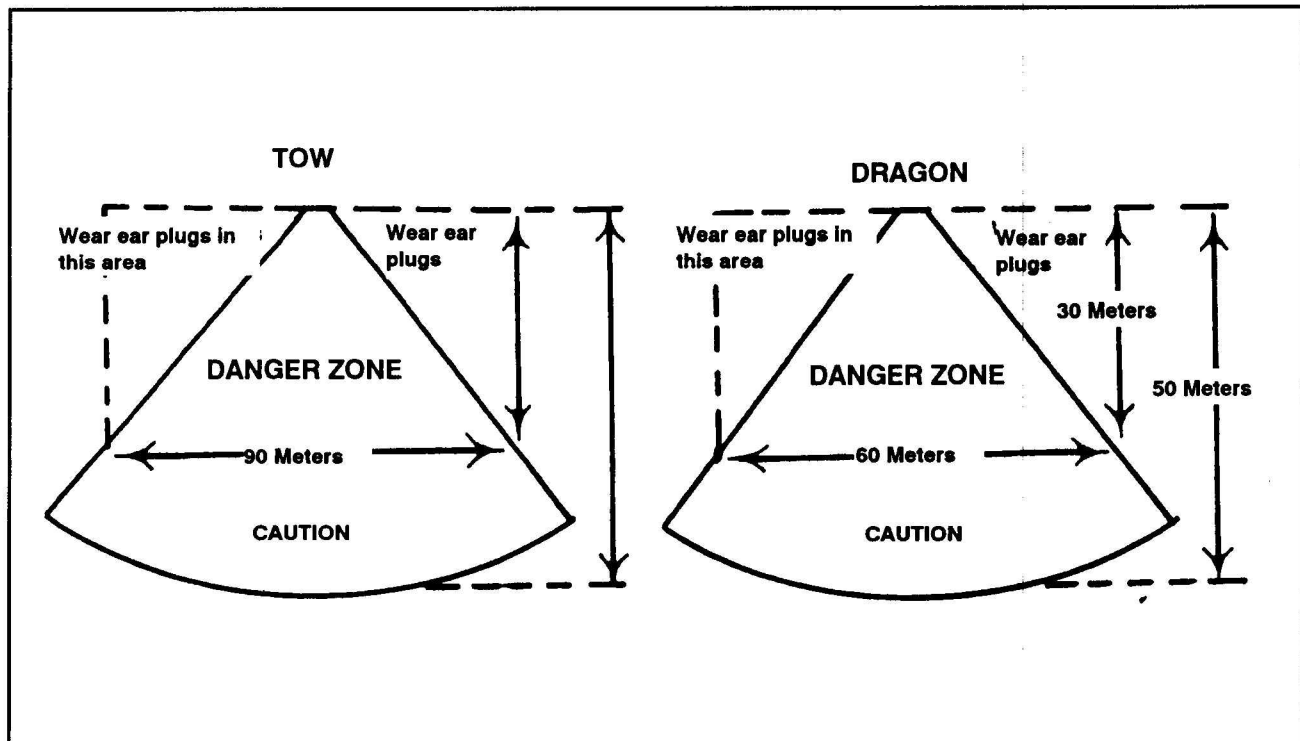


Figure 8-11. ATGM backblast in an open street.

(a) To fire a TOW from inside a room, the following safety precautions must be taken (Figure 8-12, page 8-22).

- The building must be of sturdy construction.
- The ceiling should be at least 7 feet high.
- The floor size of the room should be at least 15 by 15 feet; larger, if possible.
- At least 20 square feet of room ventilation should exist, preferably to the rear of the weapon. An open 7-by 3-foot door is sufficient. Additional ventilation can be created by removing sections of interior partitions.
- All glass must be removed from the windows, and all small loose objects removed from the room.

- All personnel in the room should be forward of the rear of the TOW.
- All personnel in the room should wear ballistic eye protection and earplugs.
- A clearance of 9 inches (23 centimeters) must be between the launch tube and aperture from which it is fired. (See AR 385-62 and AR 385-63 for more detailed safety information.)

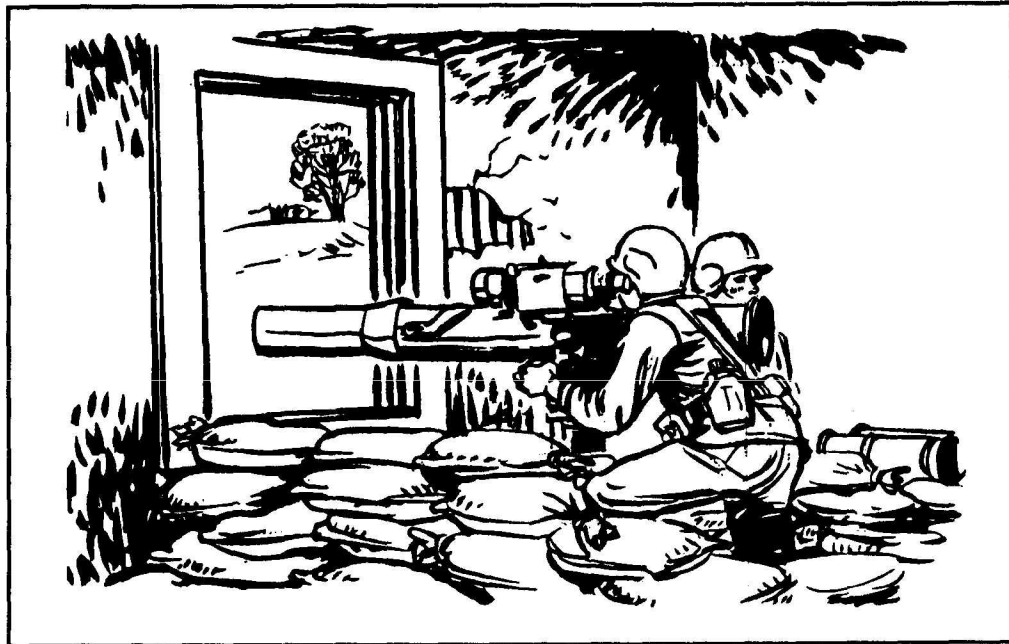


Figure 8-12. TOW fired from inside a room.

(b) To fire a Dragon from inside a room, the following safety precautions must be taken.

- The building must be of sturdy construction.
- The ceiling should be at least 7 feet high.
- The floor size should be at least 15 by 15 feet; larger, if possible.
- At least 20 square feet of ventilation should exist (room openings), preferably to the rear of the weapon. An open 7-by 3-foot door would provide minimum ventilation.
- All glass should be removed from windows, and small loose objects removed from the room.
- The room should be clean or the floors must be wet to prevent dust and dirt (kicked up by the backblast) from obscuring the vision of other soldiers in the room.

- All personnel in the room must be forward of the rear of the weapon.
- All personnel in the room must wear ballistic eye protection and earplugs.
- At least a 6-inch clearance must exist between the launch tube and aperture from which it is fired.

b. **Weapon Penetration.** ATGMs can penetrate and destroy heavily armored tanks. They have large warheads employing the shape-charge principle. Because of their size, these warheads can achieve significant penetration against typical urban targets. Penetration, however, does not mean a concurrent destruction of the structural integrity of a position. The shaped-charge warhead produces relatively little spall. Enemy personnel not standing directly behind or near the point of impact of an ATGM may escape injury.

(1) *Standard TOW missiles.* The basic TOW missile can penetrate 8 feet of packed earth, 4 feet of reinforced concrete, or 16 inches of steel plate. The improved TOW (ITOW), the TOW 2, and the TOW 2A all have been modified to improve their penetration. They all penetrate better than the basic TOW. All TOW missiles can defeat triple sandbag walls, double layers of earth filled 55-gallon drums, and 18-inch log walls.

(2) *TOW 2B.* The TOW 2B uses a different method of defeating enemy armor. It flies over the target and fires an explosively formed penetrator down onto the top armor, which is thinner. Because of this design feature; the TOW 2B missile cannot be used to attack nonmetallic structural targets. When using the TOW 2B missile against enemy armor, gunners must avoid firing directly over other friendly vehicles, disabled vehicles, or large metal objects such as water or oil tanks.

(3) *Dragon missile.* The Dragon missile can penetrate 8 feet of packed earth, 4 feet of concrete, or 13 inches of steel plate. It can attain effective short-range fire from upper stories, or from the rear or flanks of a vehicle. These engagements are targeted against the most vulnerable parts of tanks, and can entrap tanks in situations where they are unable to counterfire. Elevated firing positions increase the first-round hit probability. Firing down at an angle of 20 degrees increases the chance of a hit by 67 percent at 200 meters. A 45-degree down angle doubles the first-round hit probability, compared to a ground-level shot.

c. **Breaching Structural Walls.** Firing ATGMs is the least efficient means to defeat structures. Because of their small basic load and high cost, ATGMs are better used against tanks or enemy-fortified firing positions. They can be effective against bunkers or other identified enemy firing positions.

8-7. FLAME WEAPONS

Flame weapons are characterized by both physical and psychological casualty-producing abilities. Flame does not need to be applied with pinpoint accuracy, but it also must not spread to structures needed by friendly forces. Large fires in built-up areas are catastrophic. If they burn out of control, fires can create an impenetrable barrier for hours. The most common United States flame weapons are the M202 FLASH and the M34 white phosphorus

(WP) grenade. The M2A1-7 portable flamethrower is stored in war reserve status as a standard "C" item. Its availability is limited.

a. **Employment.** Flame weapons used against fortified positions should be aimed directly at the aperture. Even if the round or burst misses, enough flaming material enters the position to cause casualties and to disrupt the enemy occupants. The M34 WP grenade is difficult to throw far or into a small opening such as a bunker aperture. However, its effects are dramatic when thrown into a room or building.

b. **Effects.** The three standard flame weapons have different effects against typical urban targets.

(1) **M202 FLASH.** The M202 FLASH can deliver area fire out to 500 meters. In combat in built-up areas, the range to targets is normally much less. Point targets, such as an alleyway or bunker, can usually be hit from 200 meters. Precision fire against a bunker aperture is possible at 50 meters.

(a) The FLASH warhead contains a thickened flame agent that ignites when exposed to air. The minimum safe combat range is 20 meters, which is the bursting radius of the rocket warhead due to splashback. If the projectile strikes a hard object along its flight path and breaks open, it will burst into flames even if the fuze has not armed. M202 rocket packs must be protected from small-arms fire and shell fragments that could ignite them. The M202 has a backblast that must be considered before firing (see Figure 8-13). Urban conditions affect this backblast exactly the same as the LAW (see paragraph 8-5). The same considerations for firing a LAW from an enclosed area apply to the M202.

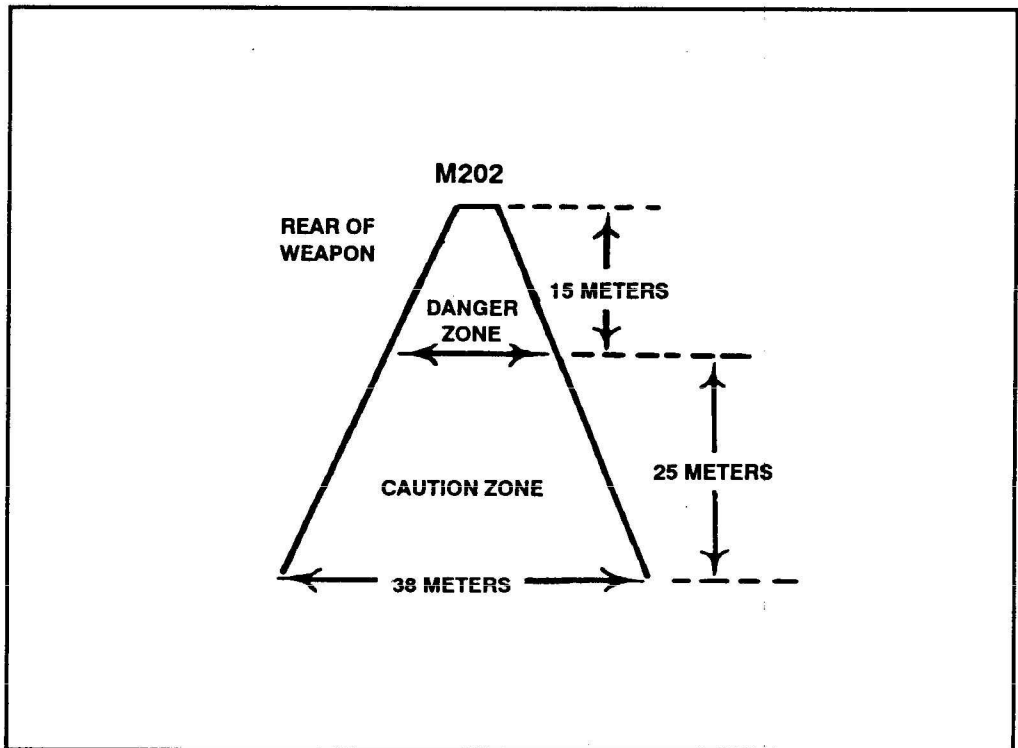


Figure 8-13. Backblast area of an M202 FLASH.

(b) The M202 FLASH is not effective in penetrating typical urban targets. It can penetrate up to 1 inch of plywood at 200 meters, and at close range it can penetrate some wooden doors. The rocket reliably penetrates window glass. The M202 does not damage brick or cinder block construction. The flame agent splattered against the top, flanks, and rear of light armored vehicles can be effective. The psychological effect of hits by flame rockets on closed-in crewmen is significant.

(c) A round detonating near or on a vehicle's rear deck or engine compartment could set the vehicle on fire. A wheeled vehicle, such as the BTR, could have its tires severely damaged by the M202. Modern threat tanks and BMPs have an NBC protective overpressure system that could prevent flame from reaching the vehicle's interior.

(2) *M34 WP Hand grenade.* The M34 is used to ignite and destroy flammable objects, especially wooden structures. It is also used to create an immediate smoke cloud to conceal movement across a narrow open space such as a street. Its smoke is not toxic but can cause choking in heavy concentrations. (a) The grenade's explosion, bright flash, smoke, and burning WP particles all combine to make the M34 one of the most effective psychological weapons available. The M34 hand grenade throws WP fragments up to 35 meters from the point of detonation. These fragments can attach to clothing or skin and continue burning. Because of its weight, most infantrymen can throw this grenade only 30 to 40 meters.

(a) The soldier must avoid injury from friendly use of the M34. As with the M202, the M34 can ignite if the WP inside is exposed to the air. Bullets and shell fragments have been known to strike and rupture M34 grenades, therefore, grenades must be protected from enemy fire.

(b) The M34 WP grenade is an effective weapon against enemy armored vehicles when used in the close confines of combat in built-up areas. It can be thrown or dropped from upper stories onto enemy vehicles. The M34 can be combined with flammable liquids, detonating cords, blasting caps, and fuze igniters to create the eagle fireball, a field-expedient antiarmor device. (See FM 21-75, Appendix H.)

(c) The M34 is also excellent as a screening device. A grenade can be thrown from behind cover into an open street or plaza. When it explodes, the enemy's observation is temporarily obscured. Thus, friendly forces can quickly cross the open area—if the enemy fires, it is unaimed and presents less of a danger. If screening smoke is used to cover a squad's movement across short open areas, it will reduce expected casualties from small-arms fire by about 90 percent.

(3) *M2A1-7 Portable flamethrower.* Portable flamethrowers have a much shorter effective range than the M202 (20 to 50 meters) but require no special backblast consideration. The psychological and physical effects of the portable flamethrower are impressive. When used against troops behind a street barricade, the flamethrower can be fired in a traversing burst to cover a wide frontage. A blind-angle burst can be fired to exploit the splattering effect of the thickened fuel without exposing the gunner (see Figure 8-14, page 8-26).

(a) A burst of unlit fuel (wet shots) can be fired with the flamethrower and ignited with a subsequent shot, creating an intense fireball. This technique is effective in destroying captured equipment or for killing enemy

soldiers in sewers. If the enemy has established a position in a wooden building, the building can be burned down. Flame is also effective when fired onto the back deck of tanks or at vision blocks.

(b) Thickened fuel is difficult to extinguish, and, therefore, a commander must decide what will burn before he employs flame. Limits imposed on collateral damage, either political or tactical, are the most serious constraints to the use of flames. If the portable flamethrower is issued in combat in built-up areas, it will probably be used by specially trained personnel. The infantry leader must ensure the flame operator is provided adequate security as he approaches the target. The enemy will concentrate his fire on any flamethrowers he detects.

(c) Although pinpointing targets at night is difficult, commanders should consider using flamethrowers at night for the psychological as well as destructive effect on the enemy.

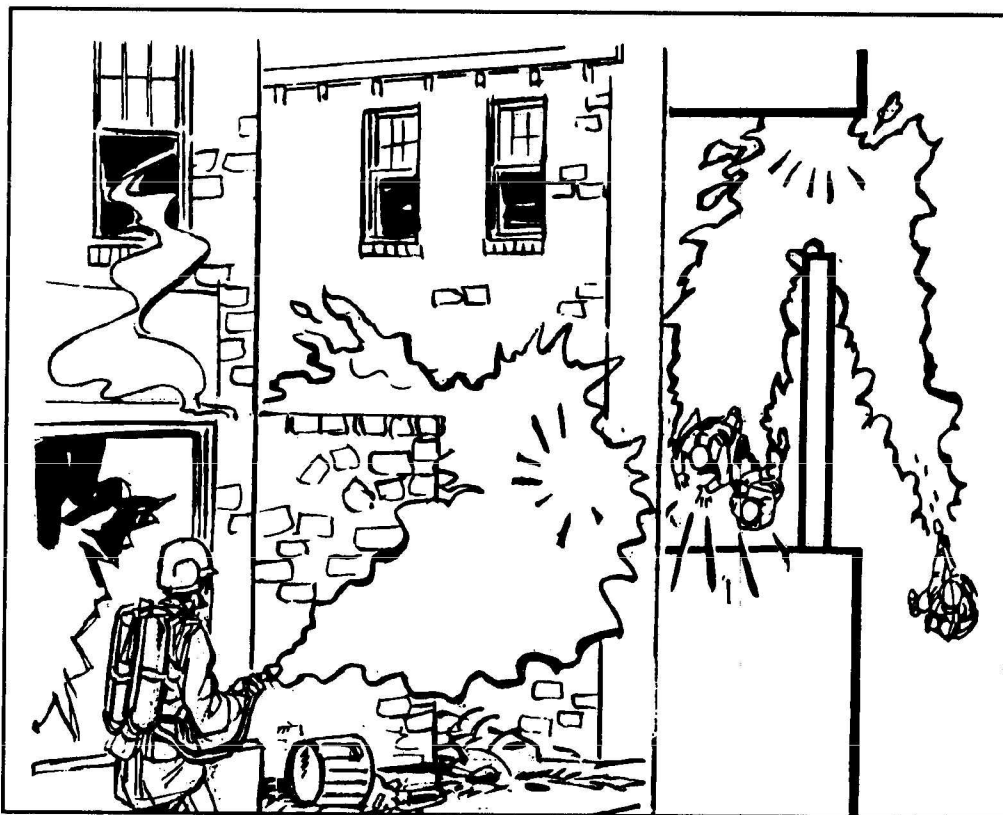


Figure 8-14. Blind-angle burst.

8-8. HAND GRENADES

Hand grenades are used extensively during combat in built-up areas. Smoke grenades are used for screening and signaling. Riot control grenades are used to drive the enemy out of deep fortifications. Fragmentation and concussion grenades are used to clear the enemy out of rooms and basements. They are the most used explosive munition during intense combat in built-up areas. In World War II, it was common for a battalion fighting in a city to use over 500 hand grenades each day.

a. **Employment.** Smoke and riot control grenades have similar employment techniques. Fragmentation grenades are used to produce enemy casualties.

(1) The AN-M8 HC grenade produces a dense white or grey smoke. It burns intensely and cannot be easily extinguished once it ignites. The smoke can be dangerous in heavy concentrations because it makes breathing difficult and causes choking. The M8 grenade is normally used for screening. It produces a slowly building screen of longer duration than the M34 WP grenade, without the problem of collateral damage caused by scattered burning particles.

(2) The M18-series smoke grenades produce several different colors of smoke, which are used for signaling. Yellow smoke is sometimes difficult to see in built-up areas. Newer versions of yellow smoke grenades are more visible than before.

(3) The M7A3 CS riot control grenade can be used to drive enemy troops out of fortifications when civilian casualties or collateral damage constraints are considerations. Built-up areas often create variable and shifting wind patterns. When using CS grenades, soldiers must prevent the irritating smoke from affecting friendly troops. The CS grenade burns intensely and can ignite flammable structures. Enemy troops wearing even rudimentary chemical protective masks can withstand intense concentrations of CS gas.

(4) The MK3A2 offensive hand grenade, commonly referred to as the concussion grenade, produces casualties during close combat while minimizing the danger to friendly personnel. For this reason, it is the preferred hand grenade during offensive operations in a MOUT environment. The grenade produces severe concussion effects in enclosed areas. It can be used for light blasting and demolitions, and for creating breach holes in interior walls. The concussion produced by the MK3A2 is much greater than that of the fragmentation grenade. It is very effective against enemy soldiers within bunkers, buildings, and underground passages,

(5) The fragmentation grenade is the most commonly available grenade during combat in built-up areas. It provides suppression during room-to-room or house-to-house fighting, and it is used while clearing rooms of enemy personnel. When used at close ranges, it can be cooked off for two seconds to deny the enemy the time to throw it back. The fragmentation grenade can be rolled, bounced, or ricocheted into areas that cannot be reached by 40-mm grenade launchers. Soldiers must be cautious when throwing grenades up stairs. This is not the most desired method of employment.

b. **Effects.** Each type of hand grenade has its own specific effect during combat in built-up areas.

(1) The urban area effects of smoke grenades are nominal. Smoke grenades produce dense clouds of colored or white smoke that remain stationary in the surrounding area. They can cause fires if used indiscriminately. If trapped and concentrated within a small space, their smoke can suffocate soldiers.

(2) The fragmentation grenade has more varied effects in combat in built-up areas. It produces a large amount of small high-velocity fragments, which can penetrate sheetrock partitions and are lethal at short ranges (15

to 20 meters). Fragments lose their velocity quickly and are less effective beyond 25 meters. The fragments from a fragmentation grenade cannot penetrate a single layer of sandbags, a cinder block, or a brick building, but they can perforate wood frame and tin buildings if exploded close to their walls.

(3) Fragmentation barriers inside rooms, consisting of common office furniture, mattress, doors, or books, can be effective against the fragmentation grenade. For this reason, a room should never be considered safe just because one or two grenades have been detonated inside. Fragmentation grenades detonated on the floor not only throw fragments laterally but also send fragments and span downward to lower floors. Predicting how much span will occur is difficult since flooring material varies, but wooden floors are usually affected the most.

(4) Some foreign grenades throw fragments much larger than those of the US-made M26. Light barriers and interior walls would probably be less effective against these grenades than against the M26. A major problem with the US-made fragmentation grenade is its tendency to bounce back off hard targets. Grenades are often directed at window openings on the ground floor or second floor. At ranges as close as 20 meters, a thrower's chances of missing a standard 1-meter by 1-meter window are high. The fragmentation grenade normally breaks through standard window glass and enters a room. If the grenade strikes at a sharp angle or the glass is thick plate, the grenade could be deflected without penetrating.

(5) Hand grenades are difficult weapons to use. They involve a high risk of fratricide. Commanders should conduct precombat training with hand grenades as part of normal preparations. Soldiers must be very careful when throwing hand grenades up stairs.

(6) The pins of both fragmentation and concussion grenades can be replaced if the thrower decides not use the weapon. This pin replacement must be done carefully (see FM 23-30).

(7) METT-T and ROE will dictate what type of grenade will be used to clear each room. Because of the high expenditure of grenades, units should use butt packs or assault packs to carry additional grenades of all types. Additional grenades can also be carried in empty ammunition or canteen pouches.

8-9. MORTARS

The urban environment greatly restricts low-angle indirect fires because of overhead masking. While all indirect fire weapons are subject to overhead masking, mortars are less affected than field artillery weapons due to the mortar's higher trajectory. For low-angle artillery fire, dead space is about five times the height of the building behind which the target sits. For mortar fire, dead space is only about one-half the height of the building. Because of these advantages, mortars are even more important to the infantry during combat in built-up areas.

a. **Employment.** Not only can mortars fire into the deep defilade created by tall buildings, but they can also fire out of it. Mortars emplaced behind buildings are difficult for the enemy to accurately locate, and even harder for him to hit with counterfire. Because of their light weight, even heavy mortars can be hand carried to firing positions that may not be accessible to vehicles.

(1) Mortars can be fired through the roof of a ruined building if the ground-level flooring is solid enough to withstand the recoil. If there is only concrete in the mortar platoon's area, mortars can be fired using sandbags as a buffer under the baseplates and curbs as anchors and braces. Aiming posts can be placed in dirt-filled cans.

(2) The 60-mm, 81-mm, and 107-mm mortars of the US Army have limited effect on structural targets. Even with delay fuzes they seldom penetrate more than the upper stories of light buildings. However, their wide area coverage and multi-option fuzes make them useful against an enemy force advancing through streets, through other open areas, or over rubble. The 120-mm mortar is moderately effective against structural targets. With a delay fuze setting, it can penetrate deep into a building and create great destruction.

(3) Mortar platoons often operate as separate firing sections during combat in built-up areas. The lack of large open areas can preclude establishing a platoon firing position. Figure 8-15 shows how two mortar sections, which are separated by only one street, can be effective in massing fires and be protected from counter-mortar fire by employing defilade and dispersion.

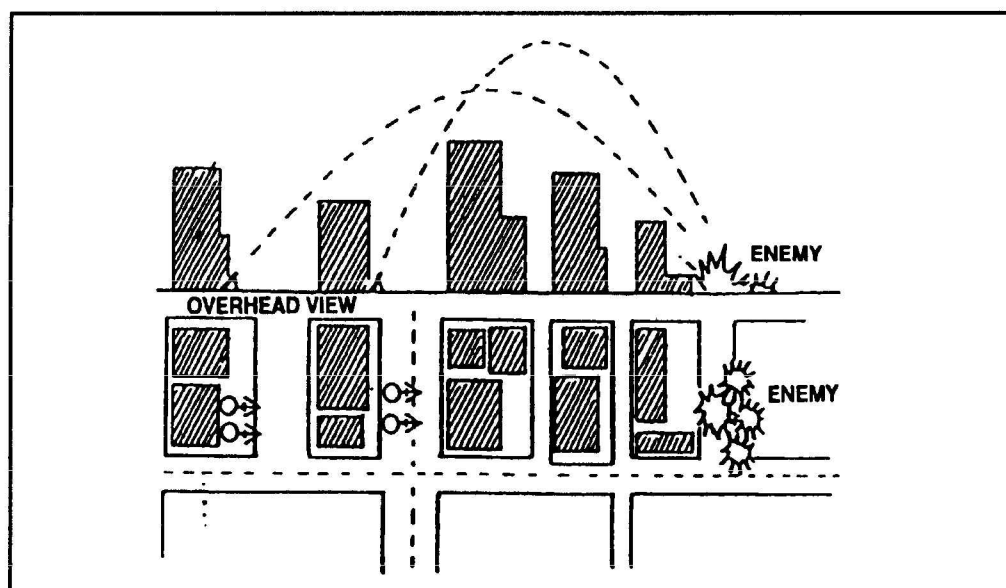


Figure 8-15. Split-section mortar operations on adjacent streets.

(4) All three of the standard mortar projectiles are useful during combat in built-up areas. High-explosive fragmentation is the most commonly used round. WP is effective in starting fires in buildings and forcing the enemy out of cellars and light-frame buildings, and it is also the most effective mortar round against dug-in enemy tanks. Even near-misses blind and suppress the tank crew, forcing them to button up. Hits are difficult to achieve, but are effective.

(5) Because the artificial roughness of urban terrain reduces wind speed and increases atmosphere mixing, mortar smoke tends to persist longer and give greater coverage in built-up areas than in open terrain.

(6) Urban masking impacts on the use of illumination. In built-up areas, it is often necessary to plan illumination behind friendly positions, which places friendly troops in shadows and enemy troops in the light. Illumination rounds are difficult to adjust and are often of limited use because of the deep canyon nature of the urban area. Rapidly shifting wind currents in built-up areas also affect mortar illumination, making it less effective.

b. Effects of Mortar Fire. The multi-option fuze on newer United States mortar rounds makes them effective weapons on urban terrain. Delay settings can increase penetration slightly, and proximity bursts can increase the lethal area covered by fragments. Tall buildings can cause proximity fuzed mortar rounds to detonate prematurely if they pass too closely.

(1) **60-mm Mortar.** The 60-mm mortar round cannot penetrate most rooftops, even with a delay setting. Small explosive rounds are effective, however, in suppressing snipers on rooftops and preventing roofs from being used by enemy observers. The 60-mm WP round is not normally a good screening round due to its small area of coverage. In combat in built-up areas, however, the tendency of smoke to linger and the small areas to be screened make it more effective. During the battle for Hue in South Vietnam, 60-mm WP rounds were used to create small, short-term, smoke screens to conceal movement across open areas such as parks, plazas, and bridges. Fragments from 60-mm HE rounds, landing as close as 10 feet, cannot penetrate a single sandbag layer or a single-layer brick wall. The effect of a 60-mm mortar HE round that achieves a direct hit on a bunker or fighting position is equivalent to 1 or 2 pounds of TNT. Normally, the blast will not collapse a properly constructed bunker but can cause structural damage. The 60-mm mortar will not normally crater a hard-surfaced road.

(2) **81-mm Mortar.** The 81-mm mortar has much the same effect against urban targets as the 60-mm mortar. It has a slightly greater lethal area and its smoke rounds (WP and RP) are more effective. A direct hit is equivalent to about 2 pounds of TNT. The 81-mm round cannot significantly crater a hard-surfaced road. With a delay setting, the 81-mm round can penetrate the roofs of light buildings.

(3) **107-mm Mortar.** The 107-mm mortar can affect moderately hard urban targets. It is more effective than the 81-mm mortar. Even when fired with a delay fuze setting, the round cannot penetrate deep into typical urban targets. The mortar's lethal fragment area is somewhat increased in built-up areas, because its blast picks up significant amounts of debris and throws it outward. The minimum range of the 107-mm mortar is the main constraint in its employment during battle in a built-up area. Out of all the United States mortars, the 107-mm is the least capable in reaching targets in deep defilade. The 107-mm mortar slightly craters a hard-surfaced road, but not enough to prevent vehicle traffic.

(4) **120-mm Mortar.** The 120-mm mortar is large enough to have a major effect on common urban targets. It can penetrate deep into a building, causing extensive damage because of its explosive power. A minimum of 18 inches of packed earth or sand is needed to stop the fragments from a 120-mm HE round that impacts 10 feet away. The effect from a direct hit from a 120-mm round is equivalent to almost 10 pounds of TNT, which can crush fortifications built with commonly available materials. The 120-mm mortar round can create a large but shallow crater in a road surface, which

is not deep or steep-sided enough to block vehicular movement. However, craters could be deep enough to damage or destroy storm drain systems, water and gas pipes, and electrical or phone cables.

(5) **160-mm Mortar.** The Soviet 160-mm mortar can inflict massive damage to almost any urban structure. Only large buildings and deep cellars offer protection against this weapon. Even well-built bunkers can be crushed by near-misses. The effect from a direct hit by this weapon is equivalent to over 15 pounds of TNT. The 160-mm mortar creates significant craters in urban road surfaces. These craters are several meters wide and are deep enough to interfere with vehicular movement. The 160-mm mortar can destroy storm drainage systems, water mains, and underground power lines.

(6) **240-mm Mortar.** The Soviet 2S4 240-mm mortar is designed to destroy heavy fortifications. Average buildings do not provide certain protection from this mortar. Its HE rounds weigh over 280 pounds. It has a concrete-piercing round for use in urban areas. The 2S4 can fire one round per minute. A round will do massive damage to urban road surfaces, breaking and heaving large slabs of road surface many yards from the point of impact.

8-10. 25-MM AUTOMATIC GUN

The 25-mm automatic gun mounted on the M2/M3 fighting vehicle and on the USMC LAV-25 offers infantrymen a new and effective weapon to aid them during combat in built-up areas. The primary roles of BFVs and LAV-25s during combat in built-up areas are to provide suppressive fire and to breach exterior walls and fortifications. (See paragraph 8-3 for the suppression effects and penetration of the 7.62-mm coaxial machine gun.) The wall and fortification breaching effects of the 25-mm automatic gun are major assets to infantrymen fighting in built-up areas.

a. **Obliquity.** The 25-mm gun produces its best urban target results when fired perpendicular to the hard surface (zero obliquity). In combat in built-up areas, however, finding a covered firing position that permits low obliquity firing is unlikely, unless the streets and gaps between buildings are wide. Most shots impact the target at an angle, which normally reduces penetration. With the APDS-T round, an angle of obliquity of up to 20 degrees can actually improve breaching. The rounds tend to dislodge more wall material for each shot but do not penetrate as deeply into the structure.

b. **Target Types.** The 25-mm gun has different effects when fired against different urban targets.

(1) **Reinforced concrete.** Reinforced concrete walls, which are 12 to 20 inches thick, present problems for the 25-mm gun when trying to create breach holes. It is relatively easy to penetrate, fracture, and clear away the concrete, but the reinforcing rods remain in place. These create a "jail window" effect by preventing entry but allowing grenades or rifle fire to be placed behind the wall. Steel reinforcing rods are normally $\frac{3}{4}$ inch thick and 6 to 8 inches apart—there is no quick way of cutting these rods. They can be cut with demolition charges, cutting torches, or special power saws. Firing with either APDS-T or HEI-T rounds from the 25-mm gun will not always cut these rods.

(2) **Brick walls.** Brick walls are more easily defeated by the 25-mm gun regardless of their thickness, and they produce the most span.

(3) *Bunker walls.* The 25-mm gun is devastating when fired against sandbag bunker walls. Obliquity has the least affect on the penetration of bunker walls. Bunkers with earth walls up to 36 inches thick are easily penetrated. At short ranges typical of combat in built-up areas, defeating a bunker should be easy, especially if the 25-mm gun can fire at an aperture.

c. **Burst Fire.** The 25-mm gun's impact on typical urban targets seem magnified if the firing is in short bursts. At close ranges, the gunner might need to shift his point of aim in a spiral pattern to ensure that the second and third bursts enlarge the hole. Even without burst fire, sustained 25-mm gun fire can defeat almost all urban targets.

d. **Weapon Penetration.** The penetration achieved by the two combat rounds (HEI-T and APDS-T) differ slightly—both are eventually effective. However, the best target results are not achieved with either of the combat rounds. At close range against structural targets, the training round (TP-T) is significantly more effective. The TP-T round, however, has little utility when used against enemy armored vehicles. It will rarely, if ever, be carried into combat.

(1) *APDS-T.* The armor-piercing, discarding, sabot with tracer round penetrates urban targets by retaining its kinetic energy and blasting a small hole deep into the target. The APDS-T round gives the best effects behind the wall, and the armor-piercing core often breaks into two or three fragments, which can create multiple enemy casualties. The APDS-T needs as few as four rounds to achieve lethal results behind walls. Table 8-10 explains the number of APDS-T rounds needed to create different-size holes in common urban walls.

TARGET	LOOPHOLE	BREACHHOLE
3-inch brick wall at 0-degree obliquity	22 rounds	75 rounds
3-inch brick wall at 45-degree obliquity	22 rounds	35* rounds
5-inch brick wall at 0-degree obliquity	32 rounds	50* rounds
8-inch reinforced concrete at 0-degree obliquity	22 rounds	75 rounds (Note: Reinforcing rods still in place)
8-inch reinforced concrete at 45-degree obliquity	22 rounds	40* rounds (Note: Reinforcing rods still in place)
*Obliquity and depth tend to increase the amount of wall material removed.		

Table 8-10. Breaching effects of APDS-T rounds.

(a) When firing single rounds, the APDS-T round provides the greatest capability for behind-the-wall incapacitation. The APDS-T round can penetrate over 16 inches of reinforced concrete with enough energy left to cause enemy casualties. It penetrates through both sides of a wood frame or brick veneer building. Field fortifications are easily penetrated by APDS-T rounds. Table 8-11 explains the number of APDS-T rounds needed to create different-size holes in commonly found bunkers.

TYPE BUNKER	OBLIQUITY	PENETRATION	LOOPHOLE	SMALL BREACHHOLE
36-inch sand/timber	0 degree	1 round	25 rounds	40 rounds
36-inch sand/ 6-inch concrete	0 degree	6 rounds	6 rounds	20 rounds

Table 8-11. Number of APDS-T rounds needed to create different size holes in bunkers.

(b) The APDS-T round creates a hazardous situation for exposed personnel because of the pieces of sabot that are thrown off the round. Personnel not under cover forward of the 25-mm gun's muzzle and within the danger zone could be injured or killed by these sabots, even if the penetrator passes overhead to hit the target. The danger zone extends at an angle of about 10 degrees below the muzzle level, out to at least 100 meters, and about 17 degrees left and right of the muzzle. Figure 8-16 shows the hazard area of the APDS-T round.

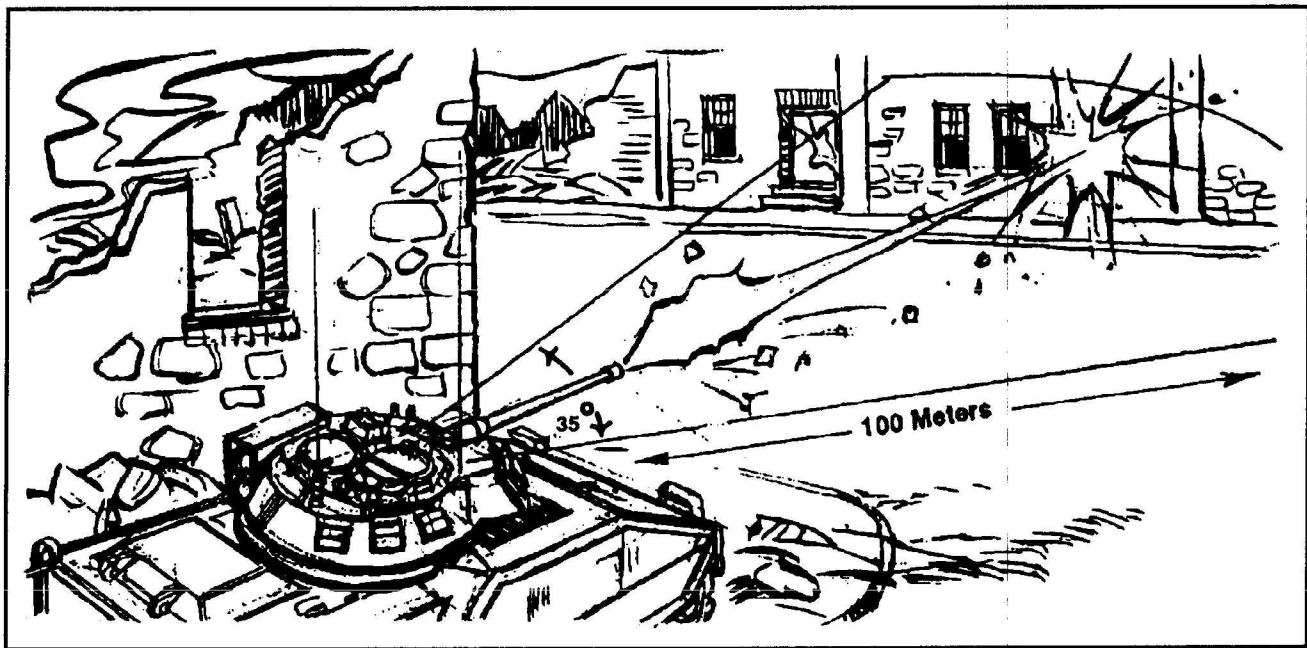


Figure 8-16. APDS danger zone.

(2) *HEI-T*. The high-explosive, incendiary with tracer round penetrates urban targets by blasting away chunks of material.

(a) The HEI-T round does not penetrate an urban target as well as the APDS-T, but it creates the effect of stripping away a greater amount of material for each round. The HEI-T does more damage to an urban target when fired in multiple short bursts because the accumulative impact of multiple rounds is greater than the sum of individual rounds. Table 8-12 explains the number of HEI-T rounds needed to create different-size holes.

TARGET	LOOPHOLE	BREACHHOLE
3-inch brick wall at 0-degree obliquity	10 rounds	20 rounds
3-inch brick wall at 45-degree obliquity	20 rounds	25 rounds
5-inch brick wall at 0-degree obliquity	30 rounds	60 rounds
8-inch reinforced concrete at 0-degree obliquity	15 rounds	25 rounds
8-inch reinforced concrete at 45-degree obliquity	15 rounds	30 rounds

Table 8-12. Number of HEI-T rounds needed to create different size holes.

(b) The HEI-T round does not provide single-round perforation or incapacitating fragments on any external masonry structural wall. It can create first-round fragments behind wood frame and brick veneer walls. HEI-T rounds cannot penetrate a bunker as quickly as APDS-T, but they can create more damage inside the bunker once the external earth has been stripped away. Against a heavy bunker, about 40 rounds of HEI-T are needed to strip away the external earth shielding and breach the inner lining of concrete or timber. The HEI-T round is also used for suppression against known or suspected firing ports, such as doors, windows, and loopholes.

8-11. TANK CANNON

The powerful, high-velocity cannon mounted on the M1, M1A1, M60, and M48 series tanks provides the infantryman with a key requirement for victory in built-up areas—heavy direct-fire support. Although the infantry assumes the lead role during combat in built-up areas, tanks and infantry work as a close team. Tanks move down streets after the infantry has cleared them of any suspected ATGM positions and, in turn, support the infantry with fire. The tank is one of the most effective weapons for heavy fire against structures. The primary role of the tank cannon during combat in built-up areas is to provide heavy direct-fire against buildings and strongpoints that are identified as targets by the infantry. The wall and fortification breaching effects of the 105-mm and 120-mm tank cannon are major assets to infantrymen fighting in built-up areas.

a. **Obliquity.** Tank cannons produce their best urban target effects when fired perpendicular to the hard surface (zero obliquity). During combat in built-up areas, however, finding a covered firing position that permits low-obliquity firing is unlikely. Most shots strike the target at an angle that would normally reduce penetration. With tank cannon APDS rounds, obliquity angles up to 25 degrees have little affect, but angles greater than 45 degrees greatly reduce penetration. For example, a 105-mm APDS round cannot penetrate a 2-inch reinforced concrete wall at an angle of obliquity greater than 45 degrees due to possible ricochet.

b. **Ammunition.** Armor-piercing, fin-stabilized, discarding sabot APFSDS) rounds are the most commonly carried tank ammunition. These rounds best against armored vehicles. Other types of ammunition can be

carried that are more effective against masonry targets. The 105-mm cannon has HEAT and WP rounds in addition to APDS. The 120-mm cannon has an effective high-explosive, antitank, multipurpose (HEAT-MP) round.

c. **Characteristics.** Both 105-mm and 120-mm tank cannons have two specific characteristics that affect their employment in built-up areas: limited elevation and depression, and short arming ranges. In addition, the M1 and M1A1 tanks have another characteristic not involved with its cannon but affecting infantrymen working with it—extremely hot turbine exhaust.

(1) The cannon of the M1 and M1A1 tank can be elevated +20 degrees or depressed -10 degrees. The M60 and M48-series tanks have upper limits of +19 degrees and lower limits of -10 degrees. The lower depression limit creates a 35-foot (10.8-meter) dead space around a tank. On a 16-meter-wide street (common in Europe) this dead space extends to the buildings on each side (see Figure 8-17). Similarly, there is a zone overhead in which the tank cannot fire (see Figure 8-18, page 8-36). This dead space offers ideal locations for short-range antiarmor weapons and allows hidden enemy gunners to fire at the tank when the tank cannot fire back. It also exposes the tank's most vulnerable areas: the flanks, rear, and top. Infantrymen must move ahead, alongside, and to the rear of tanks to provide close protection. The extreme heat produced immediately to the rear of the M1-series tanks prevents dismounted infantry from following closely, but protection from small-arms fire and fragments is still provided by the tank's bulk and armor. The M1-series tanks also have a blind spot caused by the 0-degree of depression available over part of the back deck. To engage any target in this area, the tank must pivot to convert the rear target to a flank-target.

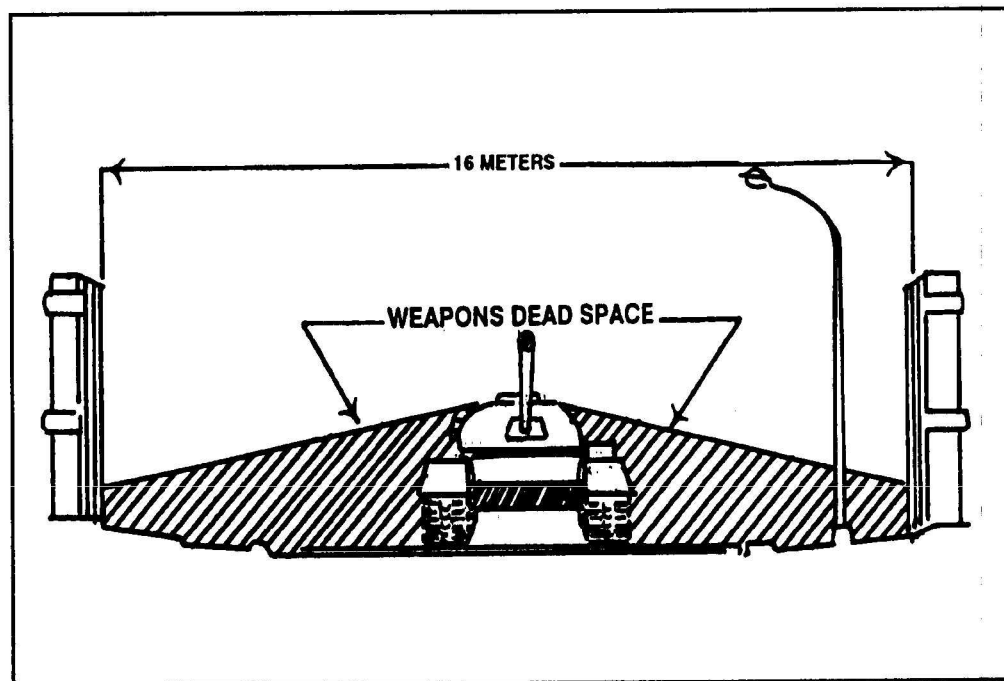


Figure 8-17. Tank cannon dead space at street level.

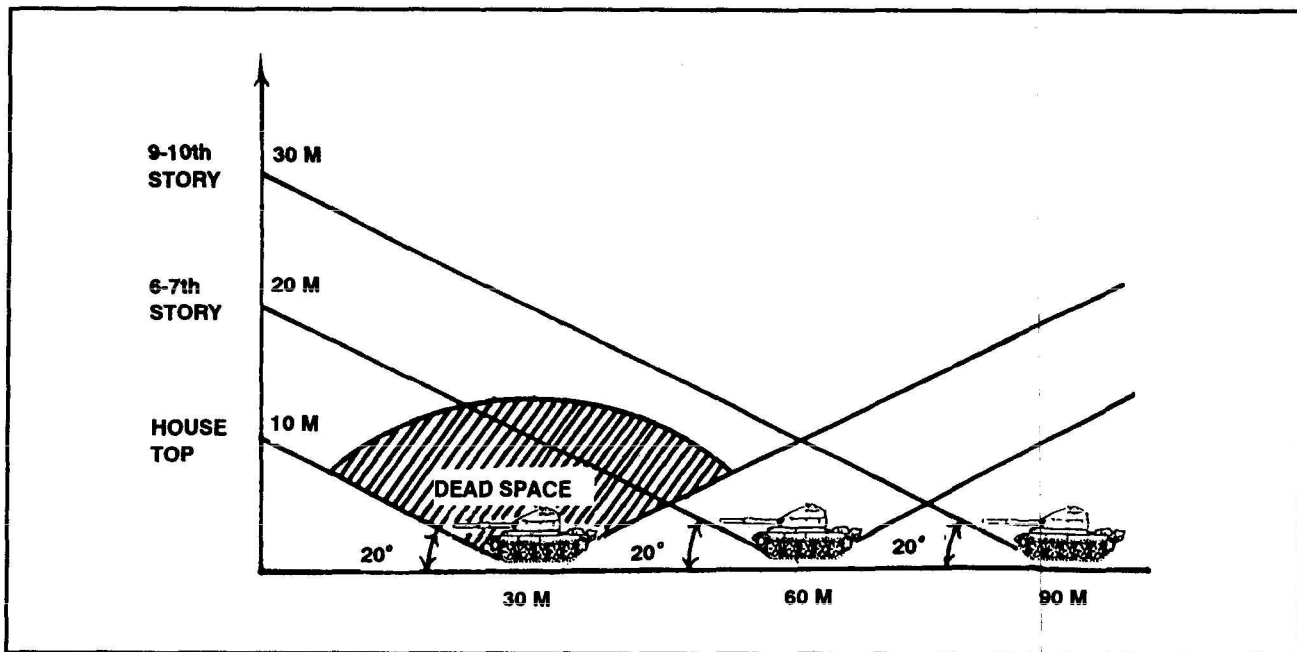


Figure 8-18. Tank cannon dead space above street level.

(2) The 105-mm HEAT round arms within 25 to 30 feet, and the 120-mm HEAT-MP round arms at about 36 feet. These arming distances allow the tank to engage targets from short ranges. The armor of the tank protects the crew from both the blowback effects of the round and enemy return fire. The APFSDS round does not need to arm and can, therefore, be fired at almost any range. The discarding portions of the round can be lethal to exposed infantry forward of the tank.

d. **Target Effects.** High-explosive, antitank rounds are most effective against masonry walls. The APFSDS round can penetrate deeply into a structure but does not create as large a hole or displace as much span behind the target. In contrast to lighter HEAT rounds, tank HEAT rounds are large enough to displace enough spall to inflict casualties inside a building. One HEAT round normally creates a breach hole in all but the thickest masonry construction—brick veneer and wood frame construction are demolished by a single round. Even the 120-mm HEAT round cannot cut all the reinforcing rods, which are usually left in place, often hindering entry through the breach hole (see Figure 8-19). Both HEAT and APFSDS rounds are effective against all field fortifications. Only large earth berms and heavy mass construction buildings can provide protection against tank fire.

e. **Employment.** Tank-heavy forces could be at a severe disadvantage during combat in built-up areas, but a few tanks working with the infantry can be most effective, especially if they work well together at the small-unit level. Tank, infantry, and engineer task forces are normally formed to attack a fortified area. Individual tanks or pairs of tanks can work together with rifle squads or platoons.

(1) Tanks need infantry on the ground to provide security in built-up areas and to designate targets. Against targets protected by structures, tanks should be escorted forward to the most covered location that provides a clear

shot. On-the-spot instructions by the infantry unit leader ensures that the tank's fire is accurate and its exposure is limited. The tank commander may have to halt in a covered position, dismount, and reconnoiter his route forward into a firing position.

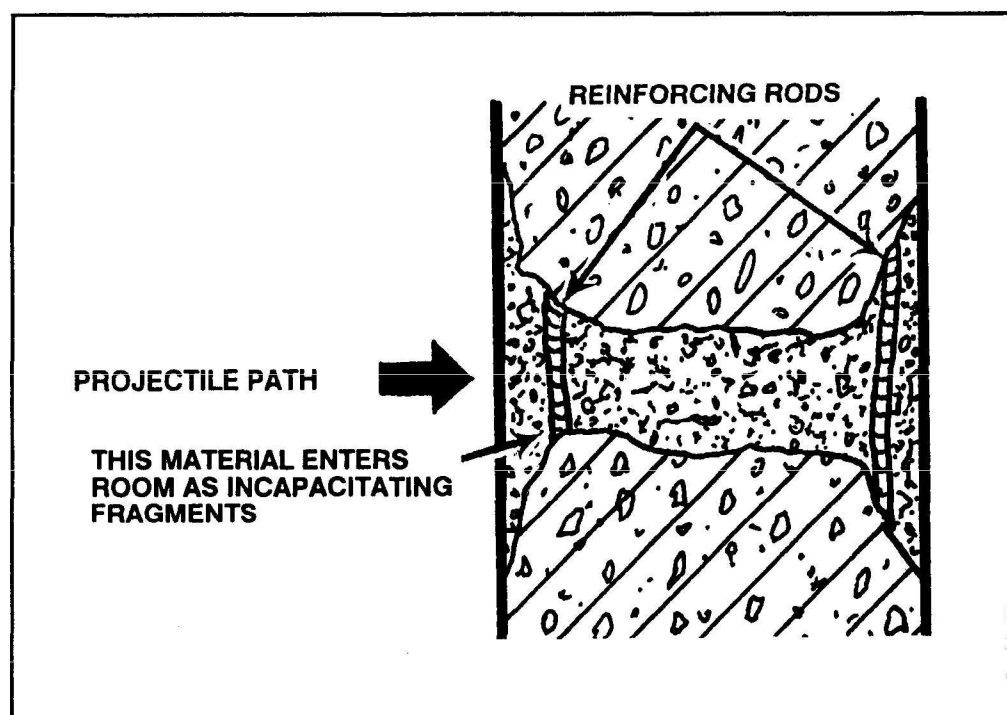


Figure 8-19. Tank HEAT round effects on reinforced concrete walls.

(2) When the tank main gun fires, it creates a large fireball and smoke cloud. In the confines of a built-up area, dirt and masonry dust are also picked up and add to this cloud. The target is further obscured by the smoke and dust of the explosion. Depending on the local conditions, this obscuration could last as long as two or three minutes. Infantry can use this period to reposition or advance unseen by the enemy. Caution must be exercised, however, because the enemy might also move.

(3) Tank cannon creates an overpressure and noise hazard to exposed infantrymen. All dismounted troops working near tanks should wear their Kevlar helmet and protective vest, as well as ballistic eye protection. If possible, they should also wear earplugs and avoid the tank's frontal 60-degree arc during firing.

(4) Tanks are equipped with powerful thermal sights that can be used to detect enemy personnel and weapons that are hidden in shadows and behind openings. Dust, fires, and thick smoke significantly degrade these sights.

(5) Tanks have turret-mounted grenade launchers that project screening smoke grenades. The grenades use a bursting charge and burning red phosphorous particles to create this screen. Burning particles can easily start uncontrolled fires and are hazardous to dismounted infantry near the tank. The tank commander and the infantry small-unit leader must coordinate

when and under what conditions these launchers can be used. Grenade launchers are a useful feature to protect the tank but can cause significant problems if unwisely employed.

(6) The tank's size and armor can provide dismounted infantry with cover from direct-fire weapons and fragments. With coordination, tanks can provide moving cover for infantrymen as they advance across small open areas. However, enemy fire striking a tank but not penetrating is a major threat to nearby infantry. Fragmentation generated by antitank rounds and ricochets off tank armor have historically been a prime cause of infantry casualties while working with tanks in built-up areas.

(7) Some tanks are equipped with dozer blades that can be used to remove rubble barriers under fire, breach obstacles, or seal exits.

8-12. COMBAT ENGINEER VEHICLE DEMOLITION GUN

The CEV is a special-purpose engineer equipment vehicle. It provides a heavy demolition capability. The CEV has a 7.62-mm machine gun that is coaxially mounted. It also has a .50-caliber machine gun in the commander's cupola, and a 165-mm main gun. The main gun fires a high-explosive plastic (HEP) round of great power. The weapon's maximum range is 925 meters.

a. **Target Effects.** The HEP round is very effective against masonry and concrete targets. The pushing and heaving effects caused by the HEP round's base detonating fuze and large amount of explosive can demolish barriers and knock down walls. One round reduces a 1-foot diameter hole in a 7-inch thick reinforced concrete wall. The round's effects against bunkers and field fortifications are dramatic, often crushing or smashing entire walls.

b. **Employment.** The CEV is normally used for special engineer tasks in direct support of infantry battalions. It must be given the same close infantry protection and target designation as tanks. Although the CEV consists of a tank hull and a short-barrelled turret, it is not a tank and should not be routinely used against enemy tanks. It is an excellent heavy assault support vehicle when used as part of a combined engineer-infantry team,

8-13. ARTILLERY AND NAVAL GUNFIRE

A major source of fire support for infantry forces fighting in built-up areas is the fire of field artillery weapons. If the built-up area is near the coast, naval gunfire can be used. Field artillery employment can be in either the indirect- or direct-fire mode.

a. **Indirect Fire.** Indirect artillery fire is not effective in attacking targets within walls and masonry structures. It tends to impact on roofs or upper stories rather than structurally critical wall areas or pillars.

(1) Weapons of at least 155-mm are necessary against thick reinforced concrete, stone, or brick walls. Even with heavy artillery, large expenditures of ammunition are required to knock down buildings of any size. Tall buildings also create areas of indirect-fire dead space, which are areas that cannot be engaged by indirect fire due to a combination of building height and angle of fall of the projectile (see Figure 8-20). Usually the dead space for low-angle indirect fire is about five times the height of the highest building over which the rounds must pass.

(2) Even when it is theoretically possible to hit a target in a street over a tall building, another problem arises because of range probable error (PE).

Only 50 percent of the rounds fired on the same data can be expected to fall within one range PE. of the target. This means that when firing indirect fire into built-up areas with tall buildings, it is necessary to double the normal ammunition expenditure to overcome the problem of a reduced target area and range PE. Also, up to 25 percent of all HE rounds are duds due to glancing off hard surfaces.

(3) Naval gunfire, because of its flat trajectory, is even more affected by terrain masking. It is usually difficult to adjust onto the target, because the gun-target line is constantly changing.

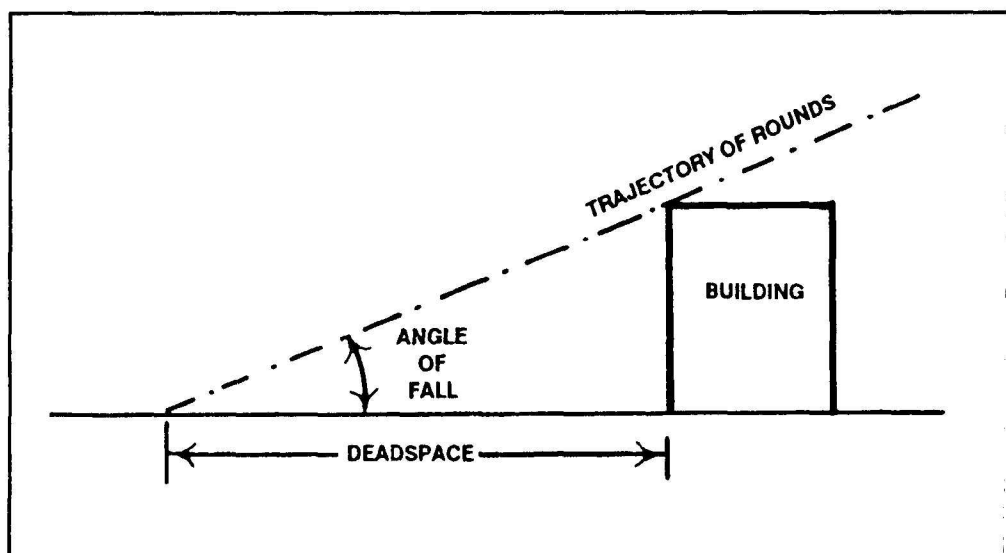


Figure 8-20. Indirect-fire dead space (low angle).

b. **Direct Fire.** Self-propelled artillery pieces are not as heavily armored as tanks, but they can still be used during combat in built-up areas if adequately secured by infantry. The most likely use of US artillery in an urban direct-fire role is to reinforce tank fires against tough or important urban targets. Because of their availability and habitual relationship with infantry, tanks remain a more common direct-fire support means than self-propelled artillery. Self-propelled artillery should be used in this role only after an analysis of the need for heavy direct fire and the tradeoff involved in the extreme decentralization of artillery firepower. It has the same need for close security and target designation as tanks.

c. **Target Effects.** Medium caliber (155-mm) and heavy caliber (203-mm) direct fire has a devastating affect against masonry construction and field fortifications. Smaller artillery pieces (105-mm) are normally towed and, therefore, are difficult to employ in the direct-fire mode. Their target effects are much less destructive than the larger caliber weapons.

(1) **155-mm Howitzers.** The 155-mm self-propelled howitzer offers its crew mobility and limited protection in built-up areas. It is effective due to its rate of fire and penetration. High-explosive rounds can penetrate up to 38 inches of brick and unreinforced concrete. Projectiles can penetrate up to 28 inches of reinforced concrete with considerable damage beyond the wall. HE rounds fuzed with concrete-piercing fuzes provide an excellent

means of penetrating strong reinforced concrete structures. One round can penetrate up to 46 inches. Five rounds are needed to reliably create a 1.5-meter breach in a 1-meter thick wall. About 10 rounds are needed to create such a large breach in a wall 1.5 meters thick. Superquick fuzing causes the rubble to be blown into the building, whereas delay fuzing tends to blow the rubble outward into the street.

(2) *203-mm Howitzers.* The 203-mm howitzer is the most powerful direct-fire weapon available to the Army. It has a slow rate of fire, but its projectile has excellent penetration abilities. One round normally creates a breach hole in walls up to 56 inches thick. The howitzer crew is exposed to enemy fire. The vehicle only carries three rounds on board, which limits its use.

(3) *Naval cannon.* The most common naval cannon used to support ground troops is the 5-inch 54 caliber gun. In either single or double mounts, this weapon has a high rate of fire and is roughly equivalent to the 155-mm howitzer in target effect. The heaviest guns used to engage land targets are the 16-inch guns of the recently renovated Iowa-class battleships. When used singly or in salvo, these massive guns can penetrate any structure common to a built-up area. Their blast effect is destructive to buildings up to a block away from the point of impact. Battleship gunfire rarely, if ever, is used for close support of ground troops. Its long range and destructive power can be controlled and adjusted ahead of advancing forces by aerial observers to clear or destroy enemy strongpoints and supporting artillery.

8-14. AERIAL WEAPONS

Both rotary- and fixed-wing aircraft can quickly deliver large volumes of firepower over large built-up areas. Specific targets are hard to distinguish from the air. Good ground-to-air communications are vital to successfully employing aerial firepower. Aviators have historically tended to overestimate the effects on defenders of high-explosive ordnance. Modern, large buildings are remarkably resistant to damage from bombs and rocket fire.

a. **Rotary-Winged Aircraft.** Armed attack helicopters can be used to engage targets in built-up areas. Enemy armored vehicles in small parks, boulevards, or other open areas are good targets for attack helicopters.

NOTE: The target effects of TOW missiles and 40-mm grenades carried by attack helicopters have already been discussed.

(1) The HELLFIRE missile has a larger warhead and greater range than the TOW, but it too is a shaped-charge warhead and is not specifically designed for use against masonry targets. Laser target designation for the HELLFIRE may not be possible due to laser reflections off glass and shiny metal surfaces. The use of attack helicopters to deliver ATGMs against targets in the upper stories of high buildings is sometimes desirable.

(2) The 2.75-inch folding fin aerial rocket and the 20-mm cannon common to some attack helicopters are good area weapons to use against enemy forces in the open or under light cover. They are usually ineffective against a large masonry target. The 20-mm cannon produces many ricochets, especially if AP ammunition is fired into built-up areas.

(3) The 30-mm cannon carried by the Apache helicopter is an accurate weapon. It penetrates masonry better than the 20-mm cannon.

b. Fixed-Wing Aircraft. Close air support to ground forces fighting in built-up areas is a difficult mission for fixed-wing aircraft. Targets are hard to locate and identify, enemy and friendly forces could be intermingled, and enemy short-range air defense weapons are hard to suppress.

(1) Because enemy and friendly forces can be separated by only one building, accurate delivery of ordnance is required. Marking panels, lights, electronic beacons, smoke, or some other positive identification of friendly forces is needed.

(2) General-purpose bombs from 500 to 2,000 pounds are moderately effective in creating casualties among enemy troops located in large buildings. High-dive angle bomb runs increase accuracy and penetration but also increase the aircraft's exposure to anti-aircraft weapons. Low-dive angle bomb runs using high drag (retarded) bombs can be used to get bombs into upper stories. Penetration is not good with high-drag bombs. Sometimes aerial bombs pass completely through light-clad buildings and explode on the outside.

(3) Aerial rockets and 20-mm cannons are only moderately effective against enemy soldiers in built-up areas since rockets lack the accuracy to concentrate their effects. The 20-mm cannon rounds penetrate only slightly better than the .50-caliber round; 20-mm AP rounds can ricochet badly; and tracers can start fires.

(4) The 30-mm cannon fired from the A-10 aircraft is an accurate weapon. It is moderately effective against targets in built-up areas, penetrating masonry better than the 20-mm cannon.

(5) The AC-130 aircraft has weapons that can be most effective during combat in built-up areas. This aircraft can deliver accurate fire from a 20-mm Vulcan cannon, 40-mm rapid-fire cannon, and 105-mm howitzer. The 105-mm howitzer round is effective against the roof and upper floors of buildings. The AC-130 is accurate enough to concentrate its 40-mm cannon and 105-mm howitzer fire onto a single spot to create a rooftop breach, which allows fire to be directed deep into the building.

(6) Laser and optically guided munitions can be effective against high-value targets. The USAF has developed special, heavy, laser-guided bombs to penetrate hardened weapons emplacements. Problems associated with dense smoke and dust clouds hanging over the built-up area and laser scatter can restrict their use. If the launching aircraft can achieve a successful laser designation and lock-on, these weapons have devastating effects, penetrating deep into reinforced concrete before exploding with great force. If launched without a lock-on, or if the laser spot is lost, these weapons are unpredictable and can travel long distances before they impact.

8-15. DEMOLITIONS

Combat in built-up areas requires the extensive use of demolitions. All soldiers, not just engineer troops, should be trained to employ demolitions. (See FM 5-25 for specific information on the safe use of demolitions.)

a. Bulk Demolitions. Bulk demolitions come in two types, TNT and C4. Exposed soldiers must take cover or move at least 300 meters away from bulk explosives that are being used to breach walls.

(1) TNT comes in $\frac{1}{4}$ -, $\frac{1}{2}$ -, and 1-pound blocks. About 5 pounds of TN are needed to breach a nonreinforced concrete wall 12 inches thick if

the explosives are laid next to the wall and are not tamped. If the explosives are tamped, about 2 pounds are sufficient.

(2) C4 comes in many different sized blocks. About 10 pounds of C4 placed between waist and chest high will blow a hole in the average masonry wall large enough for a man to walk through.

b. **Shaped Charges.** There are two sizes of US Army shaped charges, a 15-pound M2A3 and a 40-pound M3A3. The M3A3 is the most likely shaped charge to be used in built-up areas. It can penetrate 5 feet of reinforced concrete. The hole tapers from 5 inches down to 2 inches. The amount of span thrown behind the target wall is considerable. There is also a large safety hazard area for friendly soldiers.

c. **Satchel Charges.** There are two standard US Army satchel charges: the M183 and the M37. Both come in their own carrying satchel with detonators and blasting cords. Each weighs 20 pounds. The M183 has 16 individual 1 ¼-pound blocks that can be used separately. When used untamped, a satchel breaches a 3-foot thick concrete wall. Satchel charges are very powerful. Debris is thrown great distances. Friendly troops must move away and take cover before detonation.

d. **Cratering Charges.** The standard US Army cratering charge is a 43-pound cylinder of ammonium nitrate. This explosive does not have the shattering effect of bulk TNT or C4. It is more useful in deliberate demolitions than in hasty ones.

CI, FM 90-10-1

Change 1

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, DC, 3 October 1995

AN INFANTRYMAN'S GUIDE TO COMBAT IN BUILT-UP AREAS

1. Change FM 90-10-1, 12 May 1993, as follows:

Remove old pages

i through ii
v through vii
F-5 through F-6
G-1 through G-10

Glossary 1 through Glossary 5

Insert new pages

i through ii
v through vii
F-5 through F-6
G-1 through G-7
J-1 through J-10
K-1 through K-24
L-1 through L-4
M-1 through M-8
N-1 through N-4

Glossary 1 through Glossary 5

2. A star (*) marks new or changed material.
3. File this transmittal sheet in front of the publication.

DISTRIBUTION RESTRICTION: Approved for public release;
distribution is unlimited.

By Order of the Secretary of the Army:

Official:



JOEL B. HUDSON

Acting Administrative Assistant to the
Secretary of the Army

00822

DENNIS J. REIMER
General, United States Army
Chief of Staff

DISTRIBUTION:

Active Army, USAR, and ARNG: To be distributed in accordance with
DA Form 12-11E, requirements for FM 90-10-1, An Infantryman's Guide to
Combat in Built-Up Areas (Qty rqr block no. 1232).

APPENDIX A

NUCLEAR, BIOLOGICAL, AND CHEMICAL CONSIDERATIONS

Current US policy regarding lethal or incapacitating agents is that their use against an armed enemy requires approval at the national command authority level. Potential enemies may not operate under the same restrictions. Field commanders must be prepared to assume an adequate NBC defensive posture when engaged in urban fighting. Leaders must be aware of how the built-up environment affects the protection, detection, and decontamination process. Buildings are usually not strong enough to provide shelter from a nuclear explosion but do provide some protection against fallout. They also have unique characteristics concerning the use of biological and chemical agents. Personnel who must move through a contaminated built-up area should employ the procedures outlined in FM 3-3, FM 3-4, FM 3-5, and FM 3-100.

A-1. PROTECTION FROM NBC

The lowest floor or basement of a reinforced concrete or steel-formed building offers good protection from nuclear hazards and liquid chemical contamination. Tunnels, storm drains, subway tubes, and sewers provide better protection than buildings. Tanks, BFVs, and APCs also provide protection.

a. Biological attacks are difficult to detect or recognize. Biological agents can be disseminated by using aerosols, vectors, and covert methods (see FM 3-3 for more detailed information.) Since biological agents can be sprayed or dropped in bomblets, personnel who observe such indicators should promptly report them. Prompt reporting and treatment of the sick speeds the employment of medical countermeasures. Although buildings and shelters provide some protection against spraying, they provide little protection against biological agents.

b. Chemical agents cause casualties by being inhaled or by being absorbed through the skin. They may afford soldiers a few seconds to mask. Buildings have a channeling effect and tend to contain the effects of an agent, causing great variation in chemical concentration from room to room or from budding to building. Chemical agents usually settle in low places, making sewers and subways hazardous hiding places. A prepared defender should include some collective protective measures in the defensive network. Personnel using fans may be able to put enough overpressure into tunnels to keep some chemical agents from entering. The individual protective mask and battle dress overgarment provide the best protection against chemical agents.

c. Personal hygiene is a critical defensive measure against infection and disease. Unfortunately, built-up areas are characterized by sophisticated sanitation systems. When those systems are destroyed, the resulting sanitary conditions become much worse than those in areas where sanitary facilities do not exist. Commanders must ensure that personnel employ sanitation measures and that their immunizations are current.

d. Commanders should plan their MOPP realizing that built-up area logistics also apply to NBC equipment. Protective clothing, detection and decontamination equipment, and sealed containers of food and water must be stockpiled the same as other supplies. When operating in protective clothing, commanders must make allowances for the strenuous activities normally associated with combat in built-up areas.

(1) *Detection.* After an NBC attack, battalions should dispatch their detection and survey teams. Detection in built-up areas is complicated by the containing nature of buildings. Teams should conduct tests and surveys of major streets, intersections, and buildings in their area for inclusion in initial NBC reports. A systematic survey of all buildings, rooms, and underground facilities must be accomplished before occupation by unmasked personnel. All data should be forwarded using the appropriate NBC report.

(2) *Decontamination.* Personnel must begin decontamination operations as soon after an NBC attack as the mission allows. Personnel should conduct individual decontamination of themselves and their personal equipment. Unit commanders must determine the need for MOPP gear exchange and the requirements for a hasty or deliberate decontamination operation.

(a) *Radiological.* Personnel should wear wet-weather gear for certain decontamination operations (hosing down buildings) to prevent radioactive material from touching the skin.

(b) *Chemical and biological.* Roads, sidewalks, and other hard surfaces are best decontaminated by weathering, if time permits. Agents can also be covered with several inches of dirt or sand to provide protection. Fragment testing should be conducted periodically to ensure that the agent has not seeped through the covering. For critical sections of roads a truck-mounted M12A1 (power-driven decontaminating apparatus [PDDA]) can be used to spray STB slurry; this aids rapid decontamination. Buildings are difficult to decontaminate, especially wooden ones. Some techniques for their decontamination are scrubbing with STB slurry washing with hot, soapy water; washing or spraying with a soda solution; and airing.

A-2. SMOKE OPERATIONS

To stay combat effective when faced with many complications caused by NBC operations, commanders must plan before combat. The use of smoke as an integral part of either offensive or defensive operations can complement missions in built-up areas. Chemical support could be needed from smoke generator units for both offensive and defensive operations. In the offense, smoke can support the maneuver of combat elements and deception operations. Smoke employed in the defense obscures enemy air and ground observation, limiting the accuracy of enemy fires and target intelligence.

a. Smoke should not be used when it degrades the effectiveness of friendly forces. Likewise, an extremely dense concentration of smoke in a closed room displaces the oxygen in the room, smothering soldiers even when they are wearing protective masks.

b. Smoke pots, generators, or artillery smoke munitions should be used to cover the withdrawal of defending forces or the movement of attacking forces. Artillery-delivered white phosphorus can also be effective on enemy forces by causing casualties and fires. The incendiary effects of both white

phosphorus and base ejection munitions on the litter and debris of built-up areas must be considered.

c. Smoke grenades can be massed to provide a hasty screen for concealing personnel movement across streets and alleys. Smoke grenades can also be used for signaling; those launched by an M203 can be used to mark targets for attack helicopters or tactical air.

d. The use of smoke in built-up areas is affected by complex wind patterns caused from buildings. When covering a built-up area with a smoke haze or blanket, personnel must include all buildings. Failure to obscure tall buildings, towers, and steeples provides enemy observers with reference points for fire placement within the built-up area.

A-3. RIOT CONTROL AGENTS

Riot control agents, such as CS and CN, can be used to drive enemy troops from proposed positions or to deny them areas for occupation. Riot control agents are incapacitating but have no lasting effects. They are appropriate when preventing civilian casualties is a planning consideration. However, riot control agents are not effective against an enemy well trained in chemical defense.