# Targeting in an Urban Environment: Why Weaponeering and Tactics Matter

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Israel's ongoing urban operations in Gaza have drawn extensive international scrutiny. Critics have focused on the number of reported civilian casualties, with many attributing Israel's use of large, high-explosive free-fall bombs in an urban environment as the cause of extensive collateral damage. For example, in May, President Joe Biden referred to Israel's bombing campaign as "indiscriminate" and withheld a U.S. transfer of 2,000-pound bombs to Israel because "civilians have been killed in Gaza as a consequence of those bombs."

More recently, the UN Office of the High Commissioner on Human Rights (OHCHR) released a Thematic Report, which analyzed six Israeli strikes and documented the OHCHR's "concerns regarding Israel's use of explosive weapons with wide area effects in densely populated areas." The report concluded that the "large and heavy munitions used" in such areas "would have in all likelihood resulted in an indiscriminate attack," because "[e]xplosive weapons with such wide-area effects cannot be directed at a specific military object in densely populated areas of Gaza, and the effects cannot be limited, resulting in military objects, civilians and civilian objects being struck without distinction" (p. 11). Israel pushed

back on the Thematic Report, stating that wide area effects weapons are often the only weapon capable of accomplishing a military objective, and that the Thematic Report lacked the "operational expertise and the facts on the ground" to make a proper assessment.

The use of explosive weapons in the urban environment, especially those having so-called "wide area effects," has long been a topic of controversy (see e.g., here and here). While some have advocated for limiting or banning the use of these weapons in urban environments, under the law of armed conflict (LOAC), the lawfulness of using a particular weapon is primarily determined by its foreseeable effects in the specific environment in which it is employed. Those effects depend on the weapon's capabilities, the nature of the target and surrounding area, and how the weapon was used. Therefore, the assessment of whether a weapon was used lawfully is almost always a contextual determination.

In this post, we discuss several weapons in the United States' inventory that are also being used in urban warfare in Gaza and Ukraine. Our goal is not to draw conclusions about the lawfulness of their use, but rather to describe them so readers can better inform their own assessments. To do this, we start by briefly describing the challenge of urban operations. Next, we highlight the applicable law of targeting. We then turn to the weapons themselves, explaining their means of guidance, their relative effects, and other key characteristics. A discussion of the tactics by which they are employed to neutralize a target and avoid collateral damage follows.

**The Urban Battlefield**

What makes urban warfare unique is its environment. The urban environment is characterized by an increased presence of man-made physical terrain, large population and population densities, and infrastructure. Like other environments (e.g., jungle or forest), urban battlefields offer defenders areas to hide, frustrating an attacker's ability to find and strike targets. However, in an urban environment, the robust infrastructure allows defenders to hide well above ground (e.g., in high-rise buildings), at street level, or even below ground (e.g., in tunnels and sewers), creating a unique set of challenges for an attacker.

In addition to concealment, the man-made physical terrain of urban areas provides the defender cover (i.e., protection from a weapon's effects), impacting the effectiveness of an attacker's weapons. Complicating urban operations further is the proximity—and often interconnectedness—between military objectives and civilians and civilian objects. Given these characteristics, conducting operations in such an environment is inherently complex. In particular, it challenges an armed force's ability to navigate physical (e.g., terrain) and policy (e.g.,rules of engagement) constraints (see Spencer).

The paradigmatic example of such complexity is the conflict between Hamas (and other organized armed groups) and the Israel Defense Forces (IDF) in the Gaza Strip. With roughly the same landmass as Seattle, Washington, it is home to three times the inhabitants;

about 21,000 people per square mile, 78 percent of whom live in urban population centers. Hamas exploits Gaza's physical and human density by dressing like civilians and basing its fighters and equipment in, and operating from, civilian structures, including those that are specially protected. Thus, distinguishing and then precisely targeting military objectives while minimizing collateral damage becomes exceedingly difficult.

In addition to explaining *why* targeting in an urban environment is challenging, these characteristics also provide context for assessing the lawfulness of the operations. Although the law of targeting is the same regardless of the environment, context can affect its application. Therefore, it is important to understand both the law and the context before assessing whether a particular strike was lawful, or the use of a specific weapon system was permissible.

**The Law of Targeting**

Professor Michael Schmitt and Brigadier General Eric Widmar have observed that "The law of targeting lies at the heart of international humanitarian law (IHL). As such, it is the fulcrum around which discussion of combat operations revolves." Most of the treaty law governing targeting appears in the 1977 Additional Protocol I (AP I) to the 1949 Geneva Conventions. Although it only binds parties to the instrument (Israel and the United States are not), some of the rules it sets forth on targeting are generally considered to reflect customary law binding on all States in both international and non-international armed conflicts. While the law of targeting—and all its nuance—deserves extensive reflection, here we highlight three critical components: distinction, feasible precautions in attack, and proportionality.

The principle of distinction is the cornerstone of the law of targeting. It provides that parties to a conflict must always "distinguish between the civilian population and combatants and between civilian objects and military objectives" (AP I, art. 48; Department of Defense (DoD), *Law of War Manual*, § 5.5). Only military objectives, which include both people (i.e., combatants, members of an organized armed group, and civilians who take a direct part in hostilities) and objects, may be attacked (AP I, art. 51 and art. 52(2); DoD *Law of War Manual*, § 5.6.2 and § 5.6.3). In the discussion that follows, we assume that the attack in question is directed at a "military objective," as LOAC defines the term.

If an attack is directed at a civilian object or is indiscriminate (e.g., blindly firing unguided munitions into an area in which civilians and military objectives are co-mingled), it is unlawful (AP I, art. 51(2),(4)). Article 51(5)(a) of AP I is of particular importance in the urban warfare context, as is deems indiscriminate "an attack by bombardment by any methods or means which treats as a single military objective a number of clearly separated and distinct military objectives located in a city, town, village or other area containing a similar concentration of civilians or civilian objects … ." Put differently, area targeting is not permitted if civilians or civilian objects are collocated with multiple military objectives in the area, *and* it is feasible to target the military objectives individually.

Once an attacker identifies the military objective, they must, *inter alia*, take "feasible precautions in the choice of means and methods of attack" to avoid or minimize civilian harm (AP I, art. 57(2)(a)(ii)). Accordingly, feasible precautions include assessing the risk of collateral damage, selecting the appropriate weapon, and adjusting tactics to minimize civilian harm (DoD, *Law of War Manual*, § 5.11). Importantly, an attacker is not required by the rule to elect an option that sacrifices an expected military advantage. For instance, the attacker need not select a different weapon if that weapon will lower the probability of mission success.

Even if an attacker has taken all feasible precautions, the attack still must comply with the rule of proportionality. Codifying this rule, Article 51 of AP I prohibits "an attack which may be expected to cause incidental loss of civilian life, injury to civilians, damage to civilian objects, or a combination thereof, which would be excessive in relation to the concrete and direct military advantage anticipated" (see also DoD, *Law of War Manual*, § 5.10).

As Professor Schmitt and Brigadier General Widmar noted, proportionality "is assessed based upon the information reasonably available to the attacker at the time the attack was planned, approved, or executed. It is not determined by the collateral damage or military advantage that actually resulted; the assessment is *ex ante* rather than *post factum*." Therefore, extensive civilian casualties *alone*, while informative, cannot establish a violation of the rule without considering the information reasonably available to the attacker at the time of the attack. Complicating after-the-fact external assessments, an attacker may not be able to disclose the anticipated military advantage and expected civilian harm associated with a particular attack. For instance, a strike upon an enemy's vital command and control node may rely on highly classified intelligence that cannot be revealed lest the enemy could then preclude the source's future use.

Furthermore, it is generally understood that "direct harms foreseeably resulting from the attack" factor into the proportionality calculation (DoD, *Law of War Manual*, § 5.12.1.3). While universal consensus is lacking on whether indirect harms are included, ultimately, the more remote or unforeseeable the effect, "the less likely they will be seen as necessary to include in the proportionality calculation" (Schmitt, *Situations*, p. 16).

The text of the rules requiring feasible precautions and mandating proportionality makes it clear that civilian harm only includes "incidental loss of civilian life, injury to civilians and damage to civilian objects." Thus, for instance, under the rule of proportionality, an attacker is not required to consider the potential economic harm to the civilian population (e.g., the loss of jobs and wages) caused by an attack on an enemy's weapons manufacturing facility (DoD, *Law of War Manual*, § 5.12.1.3).

Finally, the application of both rules is affected by uncertainty (explored in depth by Professor Schmitt and Lieutenant Colonel Michael Schauss here). During combat, an attacker's assessments as to compliance must often be based on imperfect information, especially in

the urban environment. For example, in an urban environment with high concentrations of civilians, there is always the possibility that a transient civilian will wander into a target area during the short window of time between a weapon's release and its impact.

To adequately apply the law of targeting, especially in the urban environment where minimizing collateral damage can often be highly challenging, combatants must understand the weapons (the means) and tactics (the methods) used, as both dictate the weapons' ultimate effects. We turn first to the weapons.

**The Weapons**

In modern combat, many weapons are precision-guided. We therefore begin by explaining precision-guided munitions (PGMs) generally, and then turn to two types that have been heavily used in the ongoing conflicts in Gaza and Ukraine: the Joint Direct Attack Munition (JDAM) and the Small Diameter Bomb.

A PGM is defined—rather simply—as "a guided weapon intended to destroy a point on a target and minimize collateral damage." It is a broad category that includes weapons, discussed below, launched by air (e.g., JDAM, Hellfire, and Long Range Anti-Ship Missile (LRASM)), ground (e.g., Army Tactical Missile System (ATACMS) and Guided Multiple Launch Rocket System (GMLRS)), and ship (e.g., Tomahawk). PGMs leverage guidance systems including global positioning system (GPS), laser guidance, and inertial navigation systems (INS). While many are familiar with GPS, which uses radio signals and satellites to navigate, laser guidance relies on a high-intensity laser beam to designate a target, a laser seeker (attached to the weapon) to recognize this designation, and a control system to steer the weapon accordingly. INS guidance uses gyroscopes and accelerators to adjust the weapon's position in relation to a known starting point.

A guided bomb unit (GBU) is a type of air-delivered PGM. While there are different types of GBUs, the most common ones use unguided, free-fall bombs (i.e., dumb bombs) as the warhead to which a guidance system and control surfaces are attached. For example, the widely-used JDAM is a "guidance tail kit" that attaches to various sizes of free-fall bombs. This tail kit leverages both INS and GPS to significantly improve the accuracy of the previously unguided bombs. Once the JDAM tail kit is installed onto the "dumb" warhead, the weapon is designated a GBU.

Each type of GBU is identified by a numerical designator (e.g., GBU-31, GBU-32, etc.). For the purposes of the JDAM, the GBU numerical designator changes based upon the size of the unguided bomb to which the tail kit is attached. For instance, when a JDAM is paired with a 2,000-pound Bomb Live Unit (BLU)-117/Mark (Mk)84 unguided bomb it becomes a GBU-31. Likewise, the GBU-32 uses a 1,000-pound BLU-110/Mk 83 unguided bomb and GBU-38 uses a 500-pound BLU-111/MK 82. In addition, each GBU has subvariants within each class based on the specific type of unguided bomb used. For example, the GBU-31 may use either

the BLU-117/Mk 84 general-purpose unguided bomb or the BLU-109, which has a hardened shell designed to penetrate structures prior to detonating, earning it the nickname "bunker buster."

Another type of GBU that has been used heavily in both Gaza and Ukraine is the GBU-39, also known as the Small Diameter Bomb. The GBU-39, which is an entirely new weapon and not just a tail kit, is an air-delivered, GPS-guided, 250-pound class munition. Significantly smaller than the GBU-31 and 32, the GBU-39 is specifically "designed to limit collateral damage." The weapon shares the precision characteristics of the GBU-31 and 32 in a smaller configuration and offers additional variants, such as a carbon composite bomb body to minimize fragmentation and limit collateral damage in an urban environment.

It is also important to note that the munition's net explosive quantity (i.e., the amount of explosive material inside the warhead) differs from its overall weight. For example, the 2,000-pound BLU-109 contains about 550 pounds of explosives, while the 250-pound GBU-39 only contains 50 pounds of explosives. The rest of the munition's weight primarily consists of the metal casing surrounding the explosive and the guidance system. In addition, the net explosive quantity can vary between the subvariants of each munition. Therefore, broadly referencing a weapon's overall weight ignores its actual explosive quantity and overall capability.

Unlike the air-delivered PGMs discussed above, the Ground Launched Small Diameter Bomb (GLSDB) is an example of one of the ground-launched weapons found on today's urban battlefield. The GLSDB adds a "rocket booster motor from a 227mm-caliber M26 artillery rocket" to the GBU-39, allowing it to be fired from a M142 High Mobility Artillery Rocket System (HIMARS) or M270 Multiple Launch Rocket System (MLRS). The United States recently provided Ukraine with the GLSDB, allowing Ukraine to take advantage of the GBU-39's precision and low collateral damage in situations in which they cannot use aircraft (e.g., denied air space).

A PGM's ability "to minimize collateral damage" makes it a critical tool for combatants in an urban environment—like Gaza and many parts of Ukraine—where military objectives are in close proximity to civilians and civilian objects. As the UN OHCHR's Thematic Report notes, PGMs "can be precisely programmed, or guided, directly onto the target with a very high degree of accuracy."

Notably, as Professor Schmitt explains in detail here, accuracy and precision are not synonymous. *Precision* refers to "the ability to locate and identify a target, strike it accurately in a timely fashion, and determine whether desired effects have been achieved or restrike is needed," whereas *accuracy* "refers to a weapon's capacity to strike a specific aimpoint" (see Precision Air Warfare and LOAC, p. 670). Accuracy is "measured in terms of circular error probable (CEP), the radius of a circle within which one-half of the weapons will fall" (Precision Attack and IHL, p. 446). Relevant here, the JDAM system reportedly has a CEP of

less than sixmeters, or about 20 feet, whereas the GBU-39 has a CEP between five and eight meters, or about 16–26 feet. Although different characteristics affect a weapon's CEP (e.g., whether the JDAM is leveraging laser guidance in addition to GPS), these statistics demonstrate the tremendous accuracy of the modern PGM.

Still, recent urban warfare demonstrates that the use of modern PGMs does not negate the potential for extensive, or even potentially excessive, collateral damage. However, weight class alone (e.g., use of a 2,000-pound bomb) is insufficient to assess the expected effect of a weapon on a particular target and any nearby collateral concerns. Instead, assessing expected collateral damage requires an understanding of the weapon's characteristics, including method of delivery (e.g., air vs. ground launched), guidance system(s), and variants (e.g., BLU-109 vs. BLU-117), as well as those of the target against which it is employed. These distinct weapon characteristics assist commanders in tailoring a weapon's effects to neutralize a military objective while minimizing collateral damage. However, a weapon's effects are also largely dependent on the method of employment (i.e., the tactics).

**The Tactics**

As a general example of how tactics impact weapon effects, during combat operations against ISIS in Iraq, U.S. military forces began using 2,000-pound BLU-109 GBU-31s against "less traditional hardened target sets," including tunnel networks and above-ground buildings. Despite using a large weight class bomb, this tactic leveraged the BLU-109's delayed fuze (which we discuss in greater depth below) and its hardened shell to delay the primary blast until the bomb buried itself deep within the desired point of impact, thereby minimizing collateral damage to adjacent structures and their occupants. Moreover, achieving the intended effect on the target after burying the blast depended on the use of a larger weight class. Such usage demonstrates that the size of the warhead alone does not directly correlate to the expected civilian harm.

Consequently, under U.S. doctrine, both weapon selection and method of employment are methodically determined through a process known as the joint targeting cycle. Targeting experts, or targeteers, use their knowledge and training on the various weapons available to develop—along with other staff members (e.g., intelligence and legal)—recommended targeting solutions to a commander who has the authority to engage the target (known as the target engagement authority). This joint targeting cycle consists of six phases: (1) determining the end state and commander's objective; (2) target development and prioritization; (3) capabilities analysis; (4) commander's decision and force assignment; (5) mission planning and force execution; and (6) assessment. Targeteers consider various employment options primarily during the "capabilities analysis" phase.

The primary purpose of the capabilities analysis phase is to determine the amount of force needed "to create the desired effects while minimizing collateral damage and waste of resources." The analysis produces estimates—typically multiple estimates per target—of the

physical damage from a planned attack against a desired point of impact. During this process, targeteers conduct two distinct analyses: weaponeering; and collateral damage estimates (CDE).

Per joint doctrine, weaponeering is "the process of determining the specific means required to create a desired effect on a given target." On the other hand, CDE "is intended to characterize the level and extent of collateral damage risk for a commander" (*Joint Publication (JP) 3-60*, p. II-15). When presented together, weaponeering results and CDE inform a commander's proportionality assessment.

Based on the CDE, a commander may impose target restrictions that require further weaponeering. As the DoD *Law of War Manual* states,

Depending on the circumstances, the process of "weaponeering" in a strike against a target can be used to reduce the risk of harm to civilians and civilian objects … . For example, it may be advantageous to employ incendiary weapons in attacking an adversary's repository of biological weapons so as to prevent the biological agents from adversely affecting the civilian population (§ 5.11.6).

To be sure, the United States does not *only* use weaponeering to match the requisite munition necessary to neutralize a target (if it did, commanders would nearly always employ the warhead with the greatest effects). Instead, weaponeering is a method of tailoring an attack to provide the commander with an acceptable targeting solution; that is, one that will neutralize a target while also addressing "concerns about inflicting unintended casualties among noncombatants and civilians" under LOAC (*JP 3-60*, p. II-15).

The U.S. military's Collateral Damage Methodology (CDM) explicitly incorporates the obligation to take feasible precautions by requiring commanders to consider whether they can "mitigate damage to those collateral concerns by striking the target with a different weapon or with a different method of engagement, yet still accomplish the mission." Moreover, the CDM offers five collateral mitigation techniques: delay fuze/warhead burial; variable time/proximity fuze; delivery heading restrictions; shielding; and aimpoint offset.

Delay fuzing (for warhead burial) allows the attacker to delay the blast effect until the bomb is in the ground or inside the targeted structure, resulting in an effective tactic for "mitigating warhead fragmentation" and thus reducing the risk of collateral damage in certain circumstances. Therefore, like the "bunker busters" used by U.S. forces in Iraq, delay fuzing is sometimes an effective option for reducing "the risk of serious or lethal injury to unprotected civilians and noncombatants in the vicinity of the target." Although seemingly counterintuitive, a larger bomb may minimize the risk of collateral damage if it is effectively weaponeered. However, before employing this tactic, targeting teams must consider that delay fuzing risks producing "secondary debris hazards … from the resulting crater."

The opposite of delay fuzing is variable timing or proximity fuzing. Variable timing allows the attacker to detonate the warhead in the air before contacting a structure or the ground. Detonating prior to contact disperses the primary blast in the air and, therefore, minimizes the effect on structures. While it may decrease the risk to collateral structures, the increased fragmentation pattern increases the risk to civilians in the open. Consequently, this tactic is ideal for minimizing harm to civilians sheltered in structures during the attack.

In addition to the detonation timing, an attacker can mitigate collateral damage by adjusting the delivery heading. Delivery heading restrictions allow targeting teams to dictate the direction of a particular weapon's release (e.g., require the aircraft to fly in a specific direction so that the munition, when released, moves *away* from civilians and civilian objects). An attacker might employ this method to direct the munition's blast and fragmentation away from the collateral concerns or minimize the chance of collateral damage in the event of a delivery error. However, such restrictions may not be practical considering enemy threats or other conditions in the area.

Shielding refers to using "intervening structures, significant vegetation, and, in some very rare cases, terrain [to] shield collateral concerns from weapon effects … [by] mitigating warhead fragmentation, blast, and debris." For example, a commander could delay striking a moving vehicle until the vehicle is next to a concrete wall, shielding nearby civilian houses from the munition's blast and fragmentation. However, while this tactic can be highly effective, it depends heavily on the "target's presentation in the physical environment."

Finally, aimpoint offset, refers to altering the desired point of impact. Commanders can use this tactic to target a specific part of a military objective while moving the blast effects further away from collateral concerns. However, like shielding, this tactic depends on the target's presentation in the physical environment and risks decreasing the desired effects on the target.

As illustrated above, a commander can use a variety of tactics to employ a particular weapon in a manner that effectively neutralizes or destroys a military objective while minimizing collateral damage. Accordingly, although the "blast and fragmentation radius" of a weapon—a criterion for "wide area effect" weapons—plays a role in assessing expected collateral damage, it *must* be paired with consideration of the method of employment to effectively analyze the lawfulness of the weapon's usage.

**Conclusion**

In an urban environment, where military objectives and the civilian population are often in proximity, striking a balance between military necessity and humanitarian considerations can be very challenging. While the use of high-explosive munitions in an urban environment undeniably raises significant concerns of civilian harm, the lawfulness of a strike requires consideration of more than just the generic class or overall weight of the munition used. As

illustrated above, the situation, environment, weapon characteristics, and method of employment, when combined, determine the direct and indirect effects of the weapon and, ultimately, the lawfulness of the strike.

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