Cavalry Mortars — A Better Way

Adopting turreted, breech-loading mortars
Capable of both direct and indirect fire
Would double their value to Cav units

Editor's Note: The author, who prefers to remain anonymous, is a retired ordnance engineer with a broad background in the defense industry. He has no financial interest in any decision the government might make in regard to the weapons described in this article.

I read with interest Captain Prior's article in the November-December 1993 issue, "Cavalry Mortars — Training and Tactics." In the article, Captain Prior states that difficulties in live-fire training in the indirect fire role compromise the important mission of the cavalry mortars, particularly under peacetime safety regulations. The upshot of this is that, "The mortar section of the cavalry troop is probably the least-used asset in the unit," which is the very first sentence of the article.

Captain Prior clearly knows the limitations of training to use a muzzle-loading mortar buried down inside the confines of a metal box. I believe that there is another way to provide effective mechanized mortar fire, and not just for the cavalry. It is a way to simplify training in indirect fire and to make mechanized mortars effective in a wider variety of roles than just indirect fire. The approach I describe here is not confined to the U.S. M106-series of vehicles, but is applicable to a wider variety of systems, including vehicles of the APC and MICV type, as well as amphibian tractors. I further submit that a lightly armored vehicle armed with such a versatile weapon would make an invaluable contribution to combined arms teams and would be readily deployable by air.

The way to accomplish all this is to use a turret-mounted, breech-loading, dual purpose (DP) mortar (with appropriate fire control) capable of firing in both the indirect *and the direct fire* roles.[1]* The vehicle will also be equipped with IVIS and GPS, and the turret will be armored to at least the level of the chassis.

Weapon characteristics proposed are:

- Turret-mounted, continuous traverse.
- Breech-loaded. (Breech type not relevant to this article.) Muzzle-loading is not an option.
- Elevation angle from<->5° to +80°.
- Recoil mechanism, probably hydro-pneumatic.
- Smoothbore or rifled? Not relevant to this article. It depends on the type of mortar ammunition chosen, or which is already in the national inventory.
- Ammunition:
  - Conventional mortar ammunition.
  - Anticipated 'smart' rounds.
  - HEP/HEAT or other special-purpose rounds designed for direct fire.
  - Caliber - Not relevant to this article. Any specific caliber chosen is dependent upon vehicle size and weight class, maximum range and terminal effects desired, minimum number of rounds to be carried, and the type of mortar ammunition that may already be in inventory. However, since so many people insist upon dwelling on the caliber issue, I suggest a caliber range of approximately 60mm minimum to 120mm maximum.

There are several reasons why mechanized mortars be turret-mounted, breech-loading, and capable of indirect and direct fire.

The tactical reasons — the most important — are:

- It provides both an offensive capability and a self-defense capability.
- A mechanized muzzle-loading mortar, when faced with a target that cannot be effectively engaged with indirect fire (i.e., an encounter with a direct fire threat at a close range) has *a system engagement effectiveness level of **zero***. It is nearly helpless, in spite of the long-term investment in vehicle, crew, and training. If this same vehicle had a dual purpose weapon and appropriate fire control, it would be capable of not only surviving, but having a good chance of winning the encounter. Conversely, a mechanized, muzzle-loading mortar that's never used in a battle because it has no indirect fire targets also has a system engagement effectiveness of zero.
- A turret can rapidly swing through any arc to quickly engage targets of opportunity, rather than having to turn the entire vehicle, as one would have to do with a system like the M106. In the indirect fire role, the time to get 'steel on target' will be substantially reduced, as compared to the time needed by a conventional muzzle-loading mortar.
- There are many suitable direct fire, as well as indirect fire, targets for a DP weapon.

The technical/functional reasons are:

- A turret-mounted weapon's turret drives make it much faster and easier to control traverse and elevation. Furthermore, the gunner will be looking through a magnifying sight pointing in the same direction as the barrel. This is far superior to squatting down inside a metal box and squinting into a mortar sight.
- A turret provides overhead armor protection, internal mounting surfaces for fire control, coaxial MG, and crew equipment, external surfaces for a pintle-mounted MG and crew equipment, and protection from muzzle blast and fumes.

**Numbered superscripts refer to Notes and lettered superscripts refer to References (see last page of this article).*

- Properly designed, an enclosed turret will provide CBR protection.
- By designing the weapon to be capable of breech-loading only (rather than including the option of muzzle-loading, as some do), the bore diameter can be made smaller than the standard mortar barrel diameter (for any given caliber), which will enhance accuracy and range with standard mortar ammo. The reason for this is that a typical muzzle-loading mortar barrel must be larger in diameter than the projectile to allow the air trapped in the barrel (and 'behind' the projectile) to escape, so as to let the projectile fall freely to the bottom of the tube. Not only must the air escape, but it must do so quickly enough for the projectile to be able to fall fast enough to set off the primer. The difference in diameter between the bore and projectile of a muzzle-loading mortar is called 'windage,' and it is the windage that allows both balloting (wobbling) in the tube and variation in muzzle velocity because of escaping propelling gases (a.k.a.: 'blow-by'). Balloting and variations in muzzle velocity lead to inaccuracy.
- Reducing windage will slightly *increase* muzzle velocity, hence range, because blow-by will be reduced. A breech-loaded weapon can have a longer barrel, for any given caliber, than a muzzle loader. This will reduce muzzle flash, blast, and smoke. It will also provide a slight increase in muzzle velocity, hence slight additional range. Increased barrel length will ensure more uniform combustion of propellant and will decrease variation in muzzle velocity, resulting in decreased round-to-round dispersion.
- A breech-loaded weapon cannot be double-loaded, unless by an ingenious idiot.

When speaking of close combat direct fire targets for cannon-caliber weapons, one usually thinks of armored targets; in particular, armored vehicles, whether of the MICV or tank class. Weapons used to defeat armored targets are typically flat trajectory, high velocity, high kinetic energy weapons of the 20-50-mm class used to attack IFVs; and a weapon of *at least* 90-mm caliber is ordinarily used to attack tanks. A proposal to enhance direct fire weaponry of these two classes of weapons is frequently oriented toward increasing their armor-defeating capability. Considering the fact that such weaponry is based upon a highly developed technology (i.e., we are *way out* on the 'learning curve'), increases in armor-defeating capability will only come at the expense of additional weight, volume, and cost.

Close Combat Targets

Vehicles: (moving targets)	• Heavy protection: tanks. • Medium protection: MICV. • Light protection: APC, LAVs, LVTs, some HMMWV & MICV. • No protection: some HMMWV, trucks, jeeps, radar vans.	
Dismounted troops: ("not moving")	• Heavy protection: in concrete bunkers, some buildings. • Medium and light protection: in log bunkers, dug-in positions w/sandbags, ATGM, AAA, towed artillery, mortars, command & control centers. • No protection: troops in attack: prone and standing.	
Aircraft: (fast moving)	• Light protection • No protection	• fixed wing • rotary wing

Now, to see the targets that are vulnerable to our DP weapon, just delete from the above array those targets that can only likely be defeated by some combination of high kinetic energy, high velocity, and/or flat trajectory weapons. These targets are tanks, heavily protected concrete bunkers and a few other buildings, and aircraft. After deleting them, the remaining targets are:

Vehicles: (moving targets)	• Medium protection: MICV. • Light protection: APC, LAVs, LVTs, some HMMWV & MICV. • No protection: some HMMWV, trucks, jeeps, radar vans.
Dismounted troops: ("not moving")	• Medium & light protection: in log bunkers, dug-in positions w/sandbags, ATGM, AAA, towed artillery, mortars, command & control centers. • No protection: troops in attack: prone and standing.

Figure 1

There is a double irony here in the perception of what the threat target really is. The first irony has been the presumption of the ever-increasing armored threat, which is a vestige of the days when our concern was the possibility of a horde of 'technologically advanced,' armor-led Soviet forces thundering across the Fulda gap. The threat briefings we were all exposed to in those days stressed the advances in technology that we could expect in order to meet those threat forces. Without dwelling on the issue of whether or not those threat briefings were overdrawn, it should not be difficult to accept the fact that the current Russian state is not now in a position to be producing a 'technology' that the Soviet Union could not field in its heyday. For example, there are those who say that the protection level of the 'BMP-3,' or whatever it is called now, requires a weapon more powerful than the 25mm. This is a simple case of threat escalation — that vehicle is obviously a 'swimmer' and it has no swim curtain to provide the extra buoyancy needed by a system that is more heavily armored than vehicles of the general class of a BMP-2, Piranha LAV, M113, etc. No swim curtain, no extra armor. (It's a good thing that Archimedes' Law cannot be classified, or someone would have tried by now.)

The second irony is that, since not all direct fire targets are armored, an advance in combat capabilities is not necessarily based on more powerful antiarmor weapons. In today's world, we sometimes see the combat capability of fighting vehicles being sensibly upgraded with improved command and control systems — not larger caliber or more powerful weapons. In reality, we are well armed with excellent weapons having a *demonstrated* capability of defeating likely threat *armor,* now and well into the future. The real issue we should be addressing is: *"How do we increase the overall offensive and defensive capability of our close combat forces?"* This must include a readily

deployable capability. One of the ways to do this is to consider (i.e., 'model') how various combinations of weapons (including dual purpose weapons) and tactics will work against the really wide variety of targets to be encountered. The point of my argument is not that this DP weapon can replace the existing superior antiarmor weapons, including missiles. It cannot. However, there are more, and better, ways to increase overall combat capability than to keep increasing the weight, volume, and cost of the mechanized antiarmor weapons (including ammo), which will in turn impose exponential weight, volume, and cost penalties on the combat vehicle *systems*. Another point that I wish to make is my belief that the U.S. has been over-focused on just how many of the targets to be encountered are really *armored* targets.

What are all these close combat targets? The array in Fig. 1 is a reasonable list of most close combat targets. I have divided the target list into those targets that are: moving, not moving (essentially, as compared to a bullet), and 'fast moving' (at least, as compared to ground vehicles and dismounted troops). Within each of these target velocity classes, I have divided them further by level of protection.

I submit that the above list of remaining targets for our DP weapon comprises a very large number of likely close combat targets. A combat vehicle armed with a DP weapon and appropriate fire control can perform the role of the mechanized mortar as well as engage direct fire targets when necessary. Such a vehicle will make an excellent, versatile member of the combined arms team and will justify the investment in personnel, time, and money.

The reader may ask, "If this DP weapon is such a good idea, then how or when has it been done in the past, if at all? Who is doing it now, if anyone?"

Look first at the historical background:

- The U.S. successfully used howitzers in WWII that were mounted in the turrets of tanks and more lightly armored vehicles, where they were used in both indirect and direct fire roles. In both these cases cited, the vehicle was originally fitted with a higher velocity weapon of smaller caliber than the howitzer. A few specific examples are the M4 tank with 105-mm howitzer, which was originally armed with a 75-mm gun; and the LVT(A)4 amphibian tractor with 75-mm howitzer, which was originally armed with a 37-mm gun. Both of these vehicles were extensively and successfully used in combat.
- Weapons seldom considered as 'dual-purpose,' but which really were, were the tracked tank destroyers of WWII, such as the M10 with 3-inch gun, M18 with 76-mm gun, and the M36 with 90-mm gun. Because these systems had powerful, long-range weapons, and because they also had both the fire control capability and the crew training for indirect fire, they were often used in such roles.[a]
- In the immediate post-WW II period, a version of the M26 tank was fitted with a 105-mm howitzer and renamed M45. The M45 saw some service in Korea.[b] Later, a variant of the LVT(P)5 amphibian tractor was mounted with a special turret armed with a 105-mm Howitzer and was called the LVT(H)6. The LVT(H)6 was successfully used in Southeast Asia.
- Speaking of Southeast Asia and DP weapons, a really creative and inexpensive DP mobile application, the 81-mm mortar Mk2 Mod 1, was created by the Louisville Naval Ordnance Station for use during our period of involvement there. It was a light deck mount, installed on small naval craft, which mounted both an 81-mm mortar and a .50-Cal. MG. The mortar could be trigger fired as well as drop-loaded, and could be used for both indirect and direct fire. I note that creativity and usefulness are not always a function of how much money and time were invested. Sometimes, there seems to be an inverse relationship.

Later, American interest in DP weapons languished while we struggled with the design and production of innumerable specialized weapons (including mines, grenades, cannons and missiles, guided and otherwise) intended to defeat armor; even to the extent of fielding antiarmor warheads for artillery. Examples of this are the 155-mm M483 ICM projectile that contains dual purpose (*this* 'dual-purpose' is a different kind of 'dual-purpose') armor-defeating and antipersonnel grenades, and the MLRS (replacing the 8-inch howitzer) whose very large warhead uses a larger quantity of the same grenades.

Now let's look at contemporary systems:

- Two contemporary systems available on the commercial market are both Thomson Brandt 60-mm breech-loading mortars with hydraulic recoil

DUAL-PURPOSE U.S. WEAPONS OF THE PAST

The M45, at right, was an M26 tank with 105-mm howitzer. Some were used in the Korean War.

At lower right, the Marines' LVT(H)6 of the Vietnam era mounted a 105-mm howitzer.

Another Vietnam-era multipurpose weapon was the Navy's deck-mounted combination of an 81-mm mortar and .50-cal machine gun, seen below.

systems. These weapons, called 'gun mortars' by Thomson Brandt, can fire standard 60-mm mortar ammunition for high angle fire, as well as special purpose ammo intended for direct fire. (The standard mortar ammo can, of course, be used against most direct fire targets.) There are two versions of this mortar, the shorter range version, the MCB 60, and the longer range version with a barrel extension known as the LR Gun Mortar. Both these gun/mortars have been mounted in several commercially available turrets.[c] The LR is shown at right in a Hispano-Suiza turret, mounted coaxially with a .50-cal. MG.

- Thomson Brandt also has an 81-mm breech-loading weapon known as the MCB 81 Gun Mortar. Like the 60s above, it has a hydraulic recoil mechanism and has been turret-mounted. One version is the GIAT AMX-10 TMC 81 81-mm Mortar Gun Carrier.[c]
- Another system, which has been around for a while, is the Russian SO-120 Airmobile Assault Weapon, which is a 120-mm breech-loading gun/mortar that is turret-mounted on a modified BMD chassis. Like the Thomson Brandt weapons above, it is capable of direct and indirect fire.
- A new effort now in development is the Royal Ordnance 120-mm Armoured Mortar System. It is a turret-mounted, breech-loading gun/mortar (call it what you will) that can be mounted on a light or medium armored vehicle chassis. It will have an integrated fire control with LRF and IR, and will be GPS-aided.

DUAL-PURPOSE BREECHLOADING MORTARS IN MODERN USE

In top photo, the Thomson Brandt 60mm LR Gun Mortar is mounted in a Hispano-Suiza turret with a coaxial 50-mm machine gun. There is also a similar 81-mm version from the French manufacturer. Both have hydraulic recoil mechanisms.

Directly above, the Russian SO-120 combines a 120-mm breechloading mortar with a light, airmobile chassis.

Above, the Royal Ordnance 120-mm armored mortar system, seen here on an LAV chassis. This option integrates fire control, laser rangefinder, and GPS

Why is the U.S. not using Dual Purpose systems?

Now that I have shown the reader that DP weapons have existed in the past, and I have shown some contemporary ones, let's examine some of the potential reasons why the US is not using them now:

Fixation on armored targets? Yes, but we've already covered that.

Too much faith in 'studies'? We Americans dearly love to see the results of computerized effectiveness and optimization studies (computer models), which shows how little we understand them. Next-generation weapons are usually replacements for an existing one, which has sponsorship from the existing hierarchy, so the new system is almost guaranteed to be a product improvement of what we have now. Real innovation is hard to cope with in system-level studies because it would introduce new ideas and concepts *that could not be quickly and readily modeled in a computer*. Perhaps it could be done, but how many dissenting opinions would there be as to whether it was done properly? Without validation from the rest of the analytical community it wouldn't be worth much. Furthermore, the hassle would go on forever.

Another limitation on studies is that they focus on predictable targets and most likely scenarios, and so focus our perception of 'what's needed' onto single-purpose systems. This is because any DP system will be a compromise and will have capabilities for which we will have paid a price and which are not needed to defeat the 'optimum' target (whatever that illusion is).

The facts are, that the next time we have to go to war, the time, the place, the enemy, and his capabilities will have been unknown to us in the 10- to 15- year period between the time when the development project was initiated and when it finally was fielded. The time when the system will then be used in war may be anywhere from zero to

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more than 30 years after the fielding date. What we really need is a flexible, multi-role DP system to *supplement* tanks, MICVs, and artillery. It will be adaptable in employment against now unknown enemies, targets, and terrain, at an unknown time in the future. For maximum flexibility in employment, the DP system should be readily transportable by air and sea.

More complex training? Crews for these DP systems will need to be trained in both direct and indirect fire gunnery practice. This is not the difficulty that it used to be, now that we have computerized fire control techniques, CITV, IVIS, GPS, and POSNAV. I refer the reader to Captain McVey's excellent article, "The M1A2, IVIS, and NTC — A Company Commander's Perspective," that appeared in the same issue of ARMOR as Captain Prior's article.[d] This article showed just what could be done with a *tank*, that classic direct fire weapon, properly equipped to call in *in*direct fire. I also point out that the indirect fire control techniques used for the mechanized mortars (Captain Prior's article) are nowhere near as advanced as those now available to a *tank* (Captain McVey's article.) It is not written in stone that a CITV can only be mounted on a tank!

Just as the infantry commander has had to learn to be an armored combat vehicle commander (MICVs with automatic cannons), he may also have to learn some indirect fire techniques as well. I am surely not the first to say that the traditional infantry, armor, cavalry, and artillery roles may need updating, and not for the first time in history. Before WWII, during the Spanish Civil War in the late 30s, the German *Condor Legion* volunteer 88mm flak units attacked surface targets as well as aircraft targets.[f] In WWII, the German 88 mm flak units provided not only air defense support, but they also provided support against ground targets, including tanks.

"At the fronts, the flak guns were assigned other combat tasks such as antitank use, attacking bunkers, supporting troops under pressure in ground combat, and on the coasts they even fired on sea targets and fought off attempts to land. In the western campaign, the 88mm flak was the only weapon that penetrated the heavy French tank armor. Great demands were made of flak units, which accompanied the panzer troops on their fast advances and received alternating air-protection and ground-combat assignments. That often meant moving their positions two or three times a day, including the work of trenching [emplacement?]. *Very often in this action, motorized units of the armor had to be caught and passed, so as to guarantee gap-free protection against air attacks along the advance route. On the other hand, single 88mm flak guns were used by so-called flak battle troops to wipe out enemy points of resistance."*[f]

The method of employing the 88s, as described above, was clearly dual-purpose, if not triple purpose — that is, there may have been indirect fire missions against surface targets, but I am not certain. I believe that it was the ubiquitous nature of the 88 that originally gave it its fearsome reputation — it seemed to be everywhere, shooting at everything. The early WWII design of the American 90mm AA gun was a single-purpose AA mount, but it was modified later in WWII into a multipurpose mount capable of attacking surface targets in either direct or indirect fire.[g,h] Surely, if it was feasible even before WWII, there is no reason now why more new weapons can't be designed for multipurpose roles. Can't we expect that computerized fire control techniques will drastically reduce both the need for specialized computations and the training necessary to do the remaining computations?

If, in the press of combat, the same weapon and crew performed in the same day all three roles of air defense, fire support, and close combat, then shouldn't we consider now organizing to do just that — rather than wait until we're in the war? Wouldn't that be one of the 'force multipliers' the military keeps talking about? If we are going to seriously reevaluate the traditional roles of infantry, armor, cavalry, and artillery, we will have to solve these issues:

Conflict in traditional roles and missions? What will be the MOS and career fields of the commanders and crews? Of course, a DP mortar, firing either direct or indirect fire, is still a close combat system, but what happens if a 120-mm caliber is chosen? It may still be a mortar and 'close combat,' but how does such a weapon differ in appearance, and even in use, from SP artillery? What is it when it is firing in direct fire? Who says indirect fire, other than mortars, must be a fire support role? Until the early 20th Century, the artillery fired direct fire, not indirect.[i] And this leads us to —

Funding priorities? In today's world, all programs compete with one another, and any 'tracked combat vehicle' line in the budget competes all the more so with other such vehicles. The DP system that I propose will not be inexpensive, so every dollar spent on it will be that much less for tanks, APCs, MICVs, and SP artillery. This is certainly more of a problem for the military to sort out than for anyone else — the vehicle system and weapon designers and manufacturers should be just as happy to continue producing a variant of their production chassis with a new turret with new weapons on it. On the positive side of the cost issue for the systems proposed, a multipurpose system capable of handling more than one role offers the opportunity of needing fewer systems and fewer personnel to man them. There can also be a considerable reduction in the amount and cost of air and sealift needed if there are fewer specialized systems to be shipped.

Conclusion: The DP combat vehicle system proposed has the promise of becoming a 'multi-role'[2] system that can not only engage a much wider range of targets than current combat vehicles, but will be more deployable by air than many of the more heavily armored of those same combat vehicles. It will be

a valued member of the 'crisis-deployable combined arms team.'[3]

Notes

[1]A purist might want to argue the validity of describing as a 'mortar' a weapon intended for direct fire, even if it is an alternative role, since one of the *many* definitions of a mortar is that it is a weapon intended to be fired at elevation angles exceeding 45°. Regardless, I believe that calling such a DP weapon a 'breech-loading mortar' is too well established for me to struggle to coin a new expression that will satisfy the purists — and confuse everyone else.

[2]A good term by Ralph Zumbro. See Reference e.

[3]Inspired again by Ralph Zumbro, same reference. Mr. Zumbro has a way with words.

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