Mortar Ammunition: an International Survey

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Based on presentations given to the IQPC Future Mortar Systems Conference October 2015 and the NDIA Armament Systems Forum, April 2016

With acknowledgments to Nic Jenzen-Jones for his assistance

This is intended to provide a general overview of where we are now with mortar developments, how we got here and where we might be going.

Before I start I must apologise for the fact that any description of modern mortar systems involves wading through a very deep alphabet soup. This really can't be avoided, but I'll try to ensure that translations are provided so you will have a permanent record of them and, with a little practice, will be able to amaze and intimidate your colleagues with your grasp of the terminology.

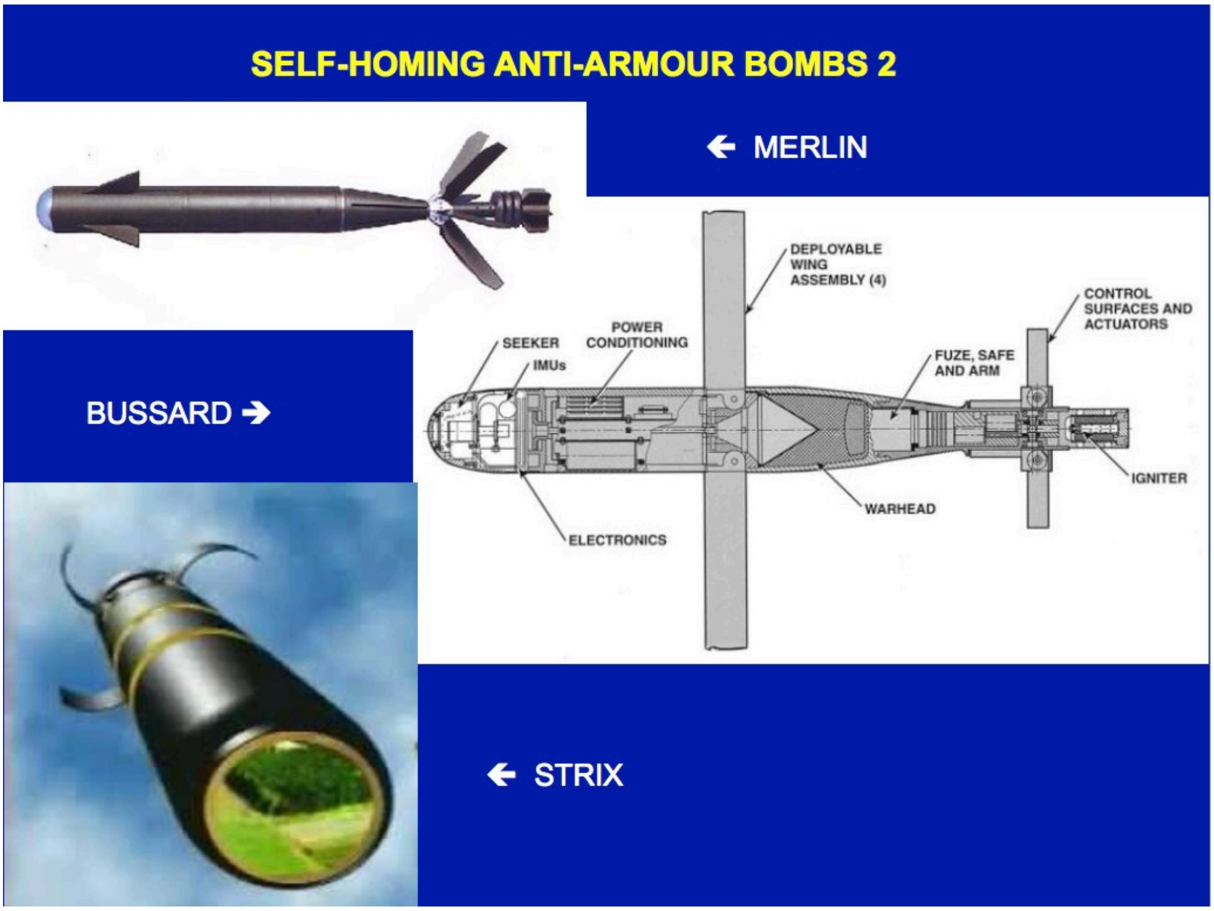
The Scope of the presentation

- Cold War developments: the first PGMs (Precision Guided Munitions)
- Asymmetric warfare and SAL (Semi-Active Laser)
- Purpose-designed PGMs: GPS (Global Positioning System), and INS (Inertial Navigation System – a kind of autopilot)
- PGKs (Precision Guidance Kits)
- The return of purpose-designed PGMs?
- Developments elsewhere in the World
- Other developments in mortar bombs

The Cold War

First let's take our minds back to the Cold War – suppose it had turned hot? NATO expected to be assaulted by massed tank armies, advancing quickly, under dense air cover and preceded by heavy artillery bombardments from both guns and rocket launchers. The emphasis would have been on high-intensity warfare using high-tech weapon systems.

In this scenario, the mortar would have had a relatively minor role, as a low-tech piece of kit of limited range and accuracy. There were some efforts to make it more useful by introducing ammunition with precision guidance, but not in the form that we are seeing today. Self-homing guidance systems were developed which functioned in the second half of the mortar bomb's trajectory, enabling it to detect and home in on enemy vehicles, whether stationary or moving. One example was the experimental British 81 mm Merlin, which used active microwave radar guidance; another was the Diehl 120 mm Bussard which in modified form later featured in the US Army's PGMM (Precision Guided Mortar Munition) project of the 1990s; this used passive infra-red homing as did the only one to enter service, the Swedish 120 mm STRIX (from SAAB Bofors Dynamics), which was manufactured in the mid-1990s and is still in service in Sweden. These bombs of course all used a top-attack profile and were fitted with HEAT warheads.



Bombs like these were a great idea for dealing with mass attacks when every large, hot, moving metal object the wrong side of the front line was an enemy fighting vehicle; the mortarmen really didn't care *which* vehicle the bomb decided to home in on, they got a prize every time. However, this approach is *not* such a good idea when you need to pick out the one vehicle carrying terrorists among various non-combatants in the vicinity, as has recently been the case; in those circumstances, the self-homing bombs would have "collateral damage" written all over them. This idea has accordingly fallen out of fashion. Instead, attention has been given to more selective targeting, using SAL and/or GPS guidance.

Asymmetric warfare and PGMs (Precision Guided Munitions)

Roll forward to the the post-Cold War period, and two things coincided: a very different kind of warfare, and technological advances in guidance systems.

The kind of fighting in which western armies were mainly engaged in Iraq and Afghanistan required considerable weapon precision to ensure that the right target was hit – and only that target. Aircraft, increasingly including UAS (Unmanned Aircraft Systems), made extensive use of PGMs which proved extremely successful: so much so that the RAF reportedly no longer uses any dumb munitions (except for 27 mm cannon shells). Many of the aircraft PGMs use SAL guidance controlled by means of a sensor and illuminating pod on board the aircraft. This enables the planes to engage moving as well as fixed targets, and their altitude gives the pilots an excellent view of the target – atmospheric conditions permitting.

There are some problems with using SAL guidance for artillery or mortar projectiles. The most obvious one is that the target will rarely be visible to the gunners or mortarmen, so they could not provide their own SAL guidance; they needed someone with a laser illuminator to get within line of sight of the target. Additional problems which don't affect aircraft PGMs is that space on board an artillery shell or mortar bomb is very limited, and the munition is subjected to violent acceleration on firing, which the guidance system must be able to tolerate.

Despite these problems, the first successful precision guided artillery shell used SAL guidance. The US 155 mm M712 CLGP (Cannon Launched Guided Projectile), better known as Copperhead, dates from the Cold War. It was not fielded in large numbers, but its unique capabilities meant that it was occasionally used in combat as late as the 2003 Iraq War.

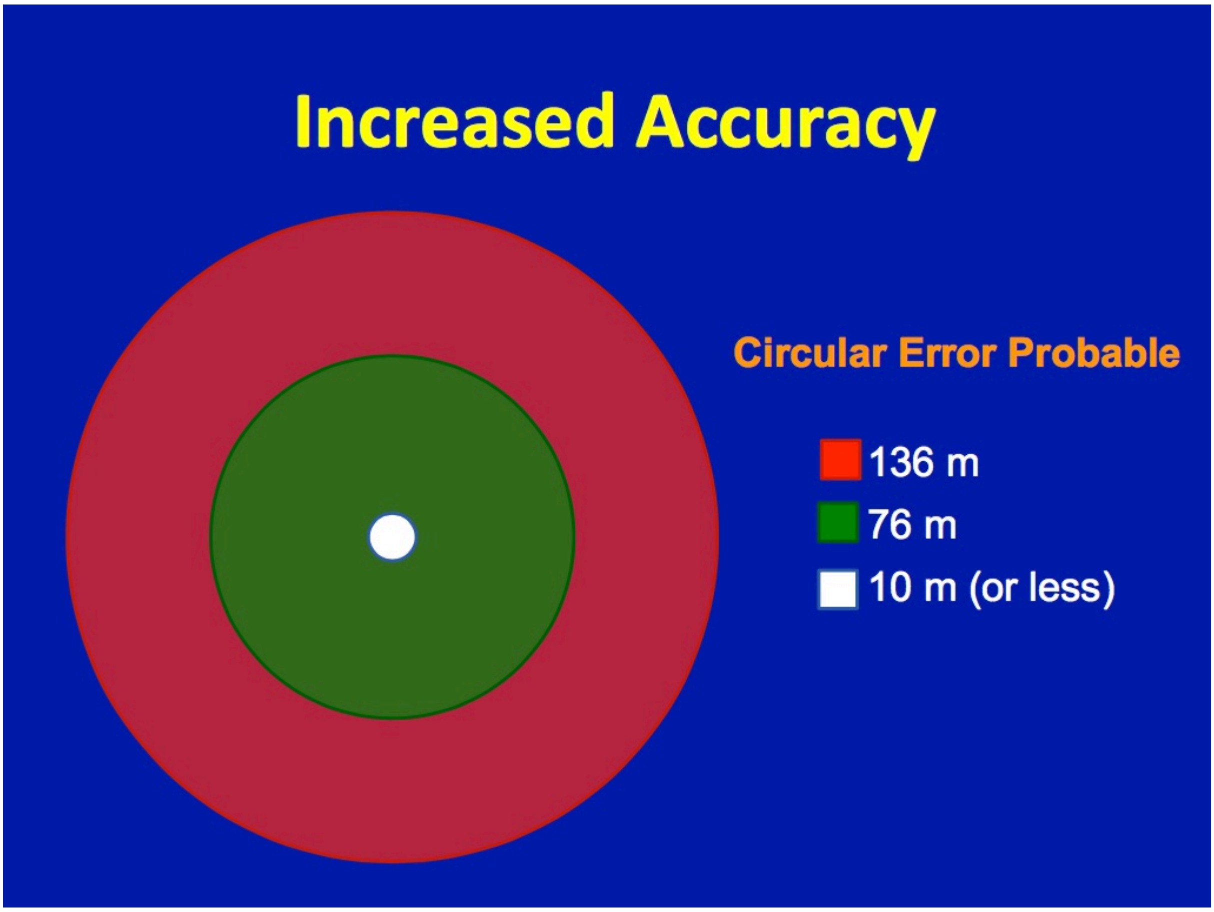
Purpose designed precision guided munitions

Several technical developments made precision guidance for artillery and mortars much more feasible. One has been the high rate of miniaturisation and cost reduction in electronics, which are also now much more resistant to acceleration forces. Another has been the development of small UAS which are able to carry sensors and laser illuminators to make SAL guidance much more practical, weather permitting. A third has been the development of low-cost guidance based on GPS, which has the benefit of needing no illuminator at all.

GPS does have two disadvantages compared with SAL – it cannot be used against moving targets, and it is less accurate, with a claimed CEP (Circular Error Probable) of around 10 m compared with about 1-2 m for SAL. On the other hand, it can be used in all weathers and visibility conditions, as long as the target coordinates are known. On the third hand, GPS can be jammed and there is an intense tussle going on between the jammers and the counter-jammers which could prevent the use of GPS in any specific instance. As a result, some guidance systems also incorporate INS which operates independently of any form of external guidance.

One point which should be mentioned is that GPS is vital in pinpointing the precise location and altitude of the mortar as well as of its target, and this alone enhances accuracy even with dumb munitions. The CEP for unguided traditional 120 mm smoothbore mortar fired at maximum range is about 136 m; with precision location and a ballistic computer the CEP shrinks to 76 m. Rifled 120 mm mortars such as the

TDA used by the USMC are more accurate, with CEPs estimated to be around 76 m in traditional mode and 42 m with a ballistic computer; there will be no significant difference with guided munitions.



The first attempts to produce guided mortar bombs involved purpose-designed bombs, mostly with flip-out fins large enough to provide some gliding ability to extend the range. Examples are the IMI GMB, subsequently developed in cooperation with Raytheon into the 120GM DAGGER. Both of these used GPS guidance but a further development from IMI and Raytheon, the GMM (Guided Mortar Munition) features dual mode guidance – GPS and SAL – with the operator choosing which is appropriate in the circumstances, as does a rival product, the IAI FireBall.

The front fins incorporated into these munitions don't just aim the bomb, they also provide aerodynamic lift to extend the range, and they permit trajectory shaping, typically used to ensure that the final stage of the trajectory is vertical, enabling the bombs to hit small targets surrounded by obstacles such as high buildings or trees and also ensuring an even pattern of fragment dispersion from airburst bombs.

Such purpose-designed bombs are highly effective, with just one problem – cost. Manufacturers are extremely cagey about quoting costs unless you wave a fat chequebook at them, but these munitions have typically cost in the $50,000+ range, a far cry from the mortar's humble, low cost origins. Perhaps that explains why few have yet got into service, although the Israeli Army has recently ordered the GMM under the name Patzmi.

The simpler solution: guidance kits and GPS

Armies accordingly started looking for a cheaper way to improve the accuracy of mortar bombs, and soon discovered that the miniaturisation of electronics enabled the development of guidance kits which could be fitted to existing conventional bombs, in the same way that air forces have converted dumb bombs into smart ones.

The history of the US Army's guided mortar bomb programme illustrates what happened: the PGMM (Precision Guided Mortar Munition) programme of the 1990s has already been mentioned. By 2004 this had resulted in the purpose-designed XM395 PGMM which featured SAL guidance and side-thrusters within the body for steering; this ATK project (now Orbital ATK) was successfully tested in 2008 but the Army then changed its mind and asked for a simpler solution which could enter service more quickly. This was the APMI (Accelerated Precision Mortar Initiative) which, as an urgent request, did not pass through the traditional acquisition process. ATK successfully proposed a Mortar Guidance Kit (MGK) that consisted of an existing mortar bomb body with a fuze-cum-guidance unit replacing the fuze, and folding extensions to the rear fins – an approach which is now standard for such kits. Somewhat confusingly, this retained the XM395 designation (and it may not be the last to do so). The first batch was deployed in Afghanistan in 2011, and nearly 5,500 MGKs were delivered to the Army. It can hit within 10 m of a target, and often hits within 4 m, out to a range 6,300 m. Despite its extensive combat use it retains the XM designation as it is not a “program of record” (i.e. “taken into core” = not formally adopted).

This form of conversion kit is now becoming popular, since it costs in the region of $10,000 and enables existing stocks of mortar bombs to be used productively. General Dynamics developed a rival kit called RCGM (Roll Controlled Guided Mortar), which lost out to the MGK but is still being developed and marketed. Like the GMG 120 by Expal of Spain, the guidance and control module fits in between the bomb body and the fuze, so that standard fuzes can be used.Such developments are not limited to the top end of the market, with Krusik Holding Corporation of Serbia offering the CC (Course Correcting) bomb, apparently with a simpler control system, possibly effective in range only.

All of these low-cost solutions are limited to GPS guidance, but there is one offered by Elbit Systems of Israel, the LG^{2}MK (Laser & GPS Guided Mortar Kit) which consists of a new nose cone added on to a standard bomb body and fuze. This provides enough volume to allow for two guidance systems plus snap-out forward fins to permit trajectory shaping. This appears to be a more economical way of providing capabilities equivalent to those of purpose-designed munitions, at a cost somewhere in between these and the other guidance kits.

Up to now all of the guided bombs have been in 120 mm calibre, presumably because the guidance costs will be the same regardless of calibre, and with 120 mm you get the most bang for your buck: bombs typically weigh around 15 kilos and contain about 2-3 kilos of HE, whereas an 81 mm bomb is only one-quarter of the weight. However, there is one application in which the lighter weight of the 81 mm might be an advantage: arming small UAS. GD-OTS and BAE Systems have combined to offer GD's RCGM kit fitted to BAE's 81 mm L41 mortar bomb. The fuze has to be altered for this application, as it is normally armed by the set-back forces on firing. This has been successfully dropped from a Micro-UAV flying at roughly 2,500 m altitude, in response to the US Army's PAGM (Precision Air-dropped Guided Munition) requirement. The RCGM hit within 2 m of a target that was offset by several hundred metres. In ground firing trials a few years ago, the 81 mm RCGM was successfully tested with 16 rounds fired, achieving an average miss distance of roughly 7 m at ranges of between 1,000 and 4,000 m.

Clearly, all of these developments allow more effective use to be made of existing stocks of 120 mm mortar bombs, and potentially of 81 mm as well. No-one so far has tested precision guidance technology in 60 mm mortars as far as I know; as these bombs are only about a third of the weight of 81 mm I suspect that it is hardly worth the cost, and the guidance kits are much the same size as the bomb body.

The return of purpose-designed PGMs?

Despite the current emphasis on conversion kits, there is continuing interest in the advantages of purpose-designed guided mortar bombs: their versatility in guidance modes, their extended range, trajectory shaping and greater precision. I have already mentioned the IMI/Raytheon PGMM being selected for Israeli service; the next up seems likely to the USMC's PERM (Precision Extended Range Munition).

Some years ago the US Marine Corps chose a 120 mm rifled mortar from TDA Armements of France (now a subsidiary of Thales), to meet its EFSS requirement, designating the mortar the M327 and the ammunition the M1100 series. This entered service in 2009, and only a couple of years later they issued a requirement for a XM1109 PERM to be fired from the M327, able to engage point targets at ranges of 16-20 km.

For once, those perennial rivals ATK and GD-OTS signed a teaming agreement to develop PERM, with ATK the prime contractor for the EMD (Engineering and Manufacturing Development) programme and responsible for guidance fuze technology, and GD providing the propulsion and warhead systems. This show of unity lasted for an impressive three days, before GD announced that it would also submit another proposal, based on its RCGM guidance system combined with its ERRAP (Extended-Range Rocket-Assisted Propulsion) technology. This would combine a standard M934A1 mortar warhead and M734A1 fuze components with GD’s GPS-equipped RCFC (Roll-Controlled Fixed Canard) guidance system. A rocket-assisted projectile fired from the M327 rifled mortar demonstrated that it could achieve ranges of 17-18 km in 2009. Another competitor for this contract was Raytheon, partnered once again with IMI of Israel. Raytheon and ATK were shortlisted with tests conducted in December last year and down selection expected in February 2016. The photo shows the ATK proposal on the right of the screen, next to their APMI round. Evidently it relies on rocket assistance to achieve the range target rather than the folding wings used by the more conventional-looking Raytheon proposal. This USMC competition was won by Raytheon/IMI at the end of 2015.

The US Army is also working on a purpose-designed 120 mm mortar bomb under the designation HEGM (High Explosive Guided Mortar). Confusingly, the HEGM is referred to in some presentations as the XM395; either this is the US Army's all-purpose designation for all experimental mortar PGMs of any type, or some of the presenters are even more confused than I am. The requirements are similar to PERM, but in addition the round should be able to engage targets moving at up to 15 mph, so will have SAL guidance (presumably in addition to GPS). It is anticipated that a "full and open competition" will be held in 2018, with production of the winner commencing in 2021. Some 14,000 rounds are expected to be procured.

To meet this requirement, it was announced in 2015 that ARDEC are working on a 120 mm Guided Enhanced Fragmentation Mortar (GEFM), described as a high-accuracy, GPS-guided mortar concept. The GEFM is the proposed government solution for the 120 mm High Explosive Guided Mortar (HEGM) program. That program will eventually release a request for proposals that asks industry to propose their own solutions for a smart mortar.

These are not the only alphabetisms floating around the US Army's future mortar plans: I have also encountered ERM (Extended Range Mortar), FERA (Family of Extended Range Ammunition), and VAPM (Very Affordable Precision Mortar). If anyone can explain how all of these projects relate to each other, I will be very grateful.

Looking further ahead, there is also interest in extending the advantages of purpose-designed PGMs to smaller calibres. For example, the USMC 81 mm ACERM project – Advanced Capability Extended Range Mortar – with a 10 km Threshold and 20 km Objective range target without rocket assistance, and featuring trajectory shaping. Dual-mode guidance is specified, with CEPs of 10 m (GPS) and 1 m (SAL). The threshold cost is $15,000, with the objective of reducing this to $10,000. Minimum modifications should be needed to suit this for dropping from a UAS, with a 10-20 km gliding range. They are also planning an 81 mm ACERM-X with rocket assistance to achieve a 40-60 km max range. In the longer term, there are ambitions for a 60 mm version.

Developments elsewhere

Not all mortar developments have taken place in the USA and Israel.

NORINCO of China offers the 120 mm GP4 TCMP thereby proving that they are just as good as Americans at devising alphabetisms. This is a purpose-designed bomb using SAL guidance and with course correction via impulse charges around the centre of the bomb. Maximum range is said to be 6,000 m with a CEP of no more than 5 m.

Russia's KBP offers the 120 mm Gran (Facet) KM-8, also a purpose-designed laser-guided projectile. It is about double the weight, and carries double the HE payload, of a conventional mortar bomb, can be fired from both rifled and smoothbore mortars, ou to a maximum range of around 7,000-9,000 m. It is rocket assisted and steered by small thruster rockets.

The BAMD-81 (Bomba Asistate de Module Dirijare calibru - 81 mm: Bomb Assisted Steering Module) is being developed by Carfil of Romania, a subsidiary of the state-owned RomArm company, in conjunction with the US company Rockwell-Collins. It contains a proximity fuze, the warhead (a standard 81 mm mortar bomb body), a guidance module incorporating a GPS receiver produced by Rockwell-Collins, four guidance fins around the nose, six folding fins around the tail, and a solid-propellant rocket motor. The rocket, which may be removed if it is not required, is designed to ignite in the upper part of the trajectory. A CEP of less than 10 m is expected, with a maximum range of 8,500 m.

with thanks to Maxim Popenker

I can't leave the subject of guided mortar rounds without mentioning the big daddy of them all: the Russian 240 mm Smelchak ('Daredevil), technically known as the 3F5, which is fired from the Cold War SP mortar, the 2S4 Tulpan (which rather charmingly means ‘Tulip’). The Smelchak uses SAL guidance and weighs 134 kilos including 30-40 kilos of HE (depending on the version). Maximum range is variously given as 5,000-7,000 m, and small rocket motors are used to adjust the trajectory in its final stages. The Smelchak round was developed in the 1980s and has reportedly been successfully used in combat. This mortar also fires the 3F2, a heavier, rocket-assisted dumb round with a range of 19,000 m, and during the Cold War the 3BV4 round was fielded, which needed no guidance of any kind as it contained a 2 KT nuclear bomb.

Breech-loading turreted mortars

Russia and China also have in service breech-loading rifled 120 mm mortar-howitzers, suitable for mounting in light to medium-weight AFVs, and intended for both indirect and direct fire support with ammunition developed accordingly. The first was the Russian tracked 2S9 Nona, which weighs just under 9 tons and entered service in 1981. The same armament was fitted to the wheeled 2S23 Nona SVK a few years later for motorised forces, weighing around 14-15 tons, and very recently the 2S31 Vena based on the BMP-3 and weighing around 19 tons. The Chinese Army adopted a very similar system more recently, the PLL05 weighing 16-17 tons. PLZ-05A is a tracked variant, based on the hull of the ZBD-08 infantry fighting vehicle and similar in concept to the Russian Vena. There is also the Type 07PA, a wheeled export version based on an 8x8 armored personnel carrier. The Type W01 ammunition developed for them includes HEAT for the direct fire anti-armour role (shown on the right), along with conventional fin-stabilised bombs and (to achieve a longer range, greater accuracy and destructive effect) artillery-style projectiles with pre-rifled driving bands. The HEAT round weighs 10 kg, has ranges of 600 m (point targets) and 1,200 m (area targets), and is claimed to penetrate 180 mm RHA at 68° impact. The conventional HE mortar bombs weight achieve 8,500 m range, while the heavier artillery-style projectiles are reach out to 9,500 m. These systems are available for export.

For some years the only western equivalents were the two 120 mm Patria systems, the single-barrel NEMO and twin-barrel AMOS, although these have smoothbore barrels and fire conventional mortar bombs. They have a partly automated loading system and I have observed a NEMO fire ten rounds in 60 seconds in direct fire mode at a target 600 metres away – the effect at the target end looked rather impressive even with inert practice bombs.

These systems are gradually beginning to achieve sales. The long barrels (3 m instead of 2 m), a feature of turreted mortars, increase maximum range, and breech-loading mortars have one less-obvious but significant extra advantage: the crews are protected from the muzzle blast which is proving to be a major headache with muzzle-loaders as it results in long-term hearing damage regardless of how good the ear protection may be.

More recently, two other western 120 mm systems designed for vehicle mounting have emerged: the Polish automated 120 mm Rak for which a contract has been signed by the Polish Army; and the Mjölner (Thor's Hammer) by BAE Systems, a rather strange twin-barrelled mounting using muzzle loading via an automated system, which is intended for Sweden.

There were others not long ago: a decade ago the US ARDEC developed the XM325 automated breech-loading mortar intended for turret mounting, and Royal Ordnance, now BAE Systems, showed a breech-loaded turreted 120 mm mortar on a Warrior and also on an 8 x 8 vehicle at DSEi 2003. This type of system would seem to provide very versatile fire support for medium armoured units, while being relatively simple and low-cost.

Other developments in mortar bombs

While the focus in recent years has been on the dramatic accuracy improvements of precision guidance, various other developments have been taking place more quietly. These include:

- Insensitive Munitions (in line with other battlefield munitions) to reduce the probability of propellant and explosives being accidentally initiated by battle damage.

- Infra-Red illumination bombs matched to night vision equipment.

- Multi-function fuzes with proximity modes are becoming more common, providing airburst capability – particularly useful against dismounted forces, especially in conjunction with bombs designed to deliver a fragmentation pattern biased towards a forwards cone.

- Improved aerodynamics to increase the range, by making the bombs longer which also increases their capacity.

- Rocket assistance to further increase range – of little use so far as it turns a not very accurate medium-range system into an even less accurate long-range one, but as we have seen its time might have come by combining it with precision guidance.

- Cargo bombs carrying submunitions were growing in use but this has now almost stopped as a result of the international agreement over small cluster munitions.

- Optimised bomb structure to improve fragmentation effects, e.g. MAPAM from SAAB-Bofors, with the explosive surrounded by ball bearings. This one is in 60 mm calibre, but 81 mm is also available. The 60 mm round weighs 1.88 kg (0.254 kg HE), and reaches 3,500 m. The 81 mm weighs 4.25 kg (0.61 kg HE) and ranges to 5,500 m. ARDEC is also looking at an enhanced warhead development process (EFC – Enhanced Fragmentation Cartridge) in 81 mm calibre with optimised fragmentation, ballistic shape and propellant to produce a technical data package. Hirtenberger have developed their ConFrag technology (Controlled Fragmentation) to maximize the lethality of the 60 mm HE Mk 3, with 81 mm and 120 mm versions to follow.

An interesting feature has been the development of a non-lethal 81 mm mortar bomb by the USMC and a number of other agencies. The Non-lethal InDirect Fire Munition (NL-IDFM) is designed to be fired from the US M252/A1 81 mm or similar mortar system. Once the round has been fired, the fuze is initiated at the pre-set distance and 14 flash-bang submunitions are dispersed at a height above the target. The payloads then fall to the ground to give the desired effect similar to the M84 flash-bang grenade. There are two parachutes tethered to the projectile, as well as the tail fin, which open up after the payload has been dispersed, to prevent lethal injury from falling debris.

- Finally, silent mortars. These are very much a niche product but of considerable technical interest and potential usefulness to special forces. These work on a sealed piston basis. The diagram of the Rheinmetall Fly-K shows how they work: the tail of the bomb is a cylinder open at the base. The launcher consists of a steel rod which fits into the tail cylinder. The bomb is slid down over the rod. The propellant is held between the top of the cylinder and a small piston. When it is fired, the propellant gas pushes the piston violently down the cylinder, sending the bomb flying off the rod.

The piston is then trapped at the bottom of the tail cylinder. The point of this system is that the propellant gas remains trapped inside the cylinder, so there is no flash or blast associated with firing (and therefore no risk of hearing damage among the users). As a bonus, the bomb takes all of the hot gases away with it, so the launcher stays cool.

The 51 mm Rheinmetall FLY-K has a range of between 200 and 800 metres and is in service with France and the UAE. The bombs weigh about 800 g (about half that of a 60 mm mortar bomb) and contain 140 g HE (about three times that of a 40 mm HV grenade), while the launcher weighs only 4.8 kg compared with 21 kg for the 60 mm M224. The Chinese appear to have copied the system with their QLT89 which has a similar performance, while the Russians have recently shown an 82 mm version, the 3VO35 for their Burevestnik 2B25 silent mortar. The bombs weigh 3.3 kg, have a 1.9 kg warhead and a range of 1,200 m.

The future

How will advances in ammunition bolster the tactical and strategic role of mortars in future theatres? Crystal ball gazing is a wonderful exercise as long as you aim at a future which is far enough away that you have safely retired by the time you are proven to be completely wrong. Fortunately that's not too far away as far as I'm concerned.

Clearly, the availability of precision guidance transforms the accuracy and usefulness of 120 mm mortars and its use is likely to spread to smaller calibres. The ability to destroy targets with only a small fraction of the number of dumb rounds normally required not only provides tactical advantages but also substantial logistics ones, since far fewer rounds have to be supplied to where they are needed, enhancing mobility. This is further helped by the fact that it may no longer be necessary to fire "bedding in" rounds to stabilise the platform. The high accuracy also makes some missions possible which would otherwise be impossible because of the risk of collateral damage or friendly fire incidents. The extended range and trajectory shaping of purpose-designed projectiles permit the attack of more targets. The more precise SAL guidance also makes new tasks possible, such as hitting moving vehicles and anti-armour use – provided HEAT warheads are available.

However, I think it is unlikely that we will see the wholesale replacement of dumb munitions, at least in the medium term. The main attraction of mortars is that they provide in a relatively lightweight system a fast and and inexpensive way of delivering a useful quantity of HE – or smoke, or illuminating flares – where it can be of greatest benefit. That does not necessarily mean that pinpoint accuracy is always required. Locating the enemy precisely enough to drop a bomb on his head may not be that easy, but a few bombs arriving in his general area might be enough to persuade him that what he is doing might be a very bad idea. For cost reasons PGMs, at least in the short term, are likely to be issued in relatively small quantities for use when their extra precision is required.

The ACERM and ACERM-X projects show that the expected cost of purpose-designed PGMs with dual-mode guidance is expected to reduce considerably, so the future seems likely to lie with these rather than precision guidance kits.

Of course, we mustn't look at mortars in isolation. An important question today is: what effect will new ways of delivering fire support have on the usefulness of mortars? The main alternative which is developing rapidly is UAS. These can carry PGMs (which may include modified mortar bombs), allow the remote pilots to monitor the situation on the ground over a long period (visibility permitting), to select and illuminate a target for a laser-guided munition, and strike withing one metre of that target. Small UAS may have integral warheads and be used in a kamikaze role.

Mortars will I think retain the advantages of being operable in any conditions of weather or other visibility constraints such as smoke, and can respond almost immediately to requests for fire support. Their bombs are also much more difficult to intercept than UAS as this requires sophisticated C-RAM systems, currently only used to defend major bases, to detect and destroy them.
