Airbase hardening in the Western Pacific

Dr Carlo Kopp

Iraqi Hardened Aircraft Shelter at Balad.

The Information Age could be described as a blessing and a curse, clearly evident in the domain of strategy. Profound changes are underway, as the globalised market for military equipment absorbs a generation of new technologies, including Precision Guided Munitions (PGM), or 'smart weapons' and a plethora of digital Intelligence Surveillance Reconnaissance (ISR) systems. These technologies, developed initially in the West, are now being manufactured by numerous players, most notably Russia and China, and are now available to any nation with the cash, if not under concerted UN embargo.

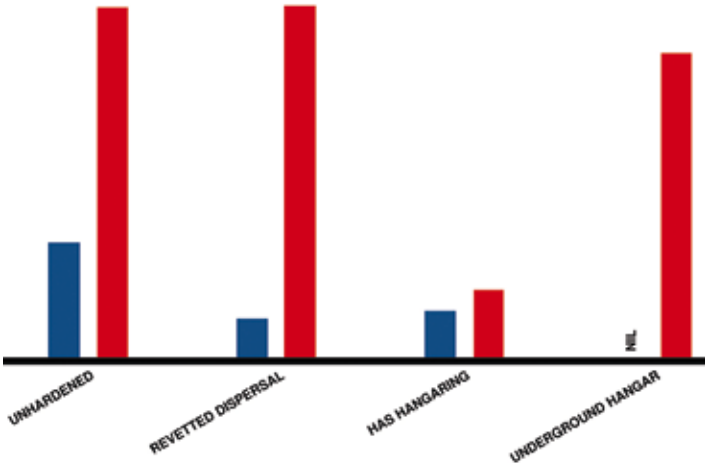
In a world of pervasive PGM use, the nation with better infrastructure hardening gains an asymmetic advantage over its opponents with less hardened infrastructure, as the reduced effect of PGM use in turn impacts the combat effectiveness of the attacking force. This is a replay of the 70 year old contest between tank guns and armour, resolved by the PGM, as no warship or tank has yet been built capable of withstanding the direct impact of a smart bomb.

A popular but dangerous misconception in most Western defence establishments is that somehow PGMs and modern digital ISR systems are an exclusive feature of Western military forces, and that the rest of the world remains mired in the era of 'dumb' bombs, 'dumb' artillery rounds and wet film ISR technology. This imaginary view of the outside world is so deeply ingrained that in many Western nations fundamental planning decisions continue to be made on this basis.

The effect of PGMs is impressive, as even a basic smart munition has typically ten times the 'kill probability' of its dumb sibling, just as a basic digital ISR sensor is ten times or more faster in transmitting target data to a weapon system. That a US, EU or Israeli-built PGM or ISR system might be more accurate and more technologically sophisticated misses the key point that those advantages might at best add a few per cent to an already high kill probability of a PGM targeted by digital ISR. In a globalised open arms market any nation state can procure Russian or Chinese PGMs and sensors, which are at least as good, if not much better, than the systems that devastated Saddam's Iraq during the Desert Storm campaign two decades ago.

Revetments are irrelevant in the era of PGMs. Global proliferation of weapons such as cruise missiles and smart bombs has fundamentally changed the operational environment.

The land attack 3M14E Sizzler variant is a standard weapon for late model Kilo-class SSKs, which are widely used across Asia, and is intended for attacks on airfields. It is highly effective against revetted aircraft.



Regional Comparison of Airbase Capabilities.

Infrastructure hardening has some profound implications for the present and future combat engagements. Not only must platforms be stealthier to evade engagements, and hardened to survive enemy fire in engagements, but also basing infrastructure must be more robust.

In the current global and regional contest in military infrastructure hardening, China is the winner. This has important implications, but remains to be appreciated by most Western strategic planners in assessing China's capabilities relative to both the United States and its regional allies in Asia.

Strategic Implications of Regional Airbase Hardening

The only nation in the region actively investing in airbase hardening over the past decade is China, which has incrementally expanded its inventory of underground hangars (UGH), while investing in HAS at multiple airfields. China's tally as of 12 months ago (http://www.ausairpower.net/APA-2011-01.html) was 7 x UGH sized for Badger bombers, capable of accommodating 138 – 145 aircraft (or many more fighters), 14 x UGH sized for Beagle bombers, capable of accommodating up to 668 Flankers, 17 x UGH sized for MiGs, capable of accommodating up to 723 J-10 fighters, for a total of 38 sites, with several further sites unused or abandoned. In addition, all other PLA fighter airfields are equipped with revetted dispersals, and a good number have been upgraded with HAS.

Japan has an inventory of 105 Cold War era HAS installations, based on the US TAB VEE designs, located at Chitose, Komatsu, and Misawa airbases, primarily to protect the F-15CJ/DJ fleet. The US Air Force has 15 TAB VEEs at Kadena AFB in Okinawa, and shares 141 modified TAB VEEs with the RoKAF at Kunsan and Osan AFBs. All remaining US Air Force, Navy and Marines Corps airfields are unhardened.

Taiwan has some well hardened underground basing but the small size of its air force and obsolete equipment yields negligible strategic weight.

Australia is not a player in the regional hardened airbase stakes, with roofed revetted dispersals installed at RAAF Bases Learmonth, Curtin, Darwin, Tindal and Scherger.

In strategic terms this yields an imbalance, between China's robust basing infrastructure with that of the United States and its principal Western Pacific allies, Japan and Australia.

The PLA has available around 150 military airfields, divided not quite evenly between super-hardened bases with underground hangars, bases equipped with revetments or HAS, and unhardened bases.

In a 'PGM-centric' warfighting environment, bases with revetments qualify as unhardened. With around seven times the number of military airbases available, the PLA has a major advantage over the US and its allies, in terms of its ability to rapidly relocate combat units, or redeploy if a base is severely damaged.

The number of super-hardened bases with underground hangars alone is around twice the total number of operational bases used by the United States, and its principal Western Pacific allies, Japan and Australia.

Whether we consider scenarios involving pre-emptive attacks, or sustained air wars of attrition, China has an enormous advantage over the United States and its allies.

In Australia, airbase hardening has yet to progress beyond the revetments of the 'dumb bomb' era. The important ADF Force Posture review interim report, released in January, 2012, states: "Defence to consider options for 'hardening' and resilience improvement at forward main bases and bare bases, commensurate with the risks associated with increasing capabilities in the Asia-Pacific region, including:

a. physical hardening, dispersal and deception measures;
b. emerging priorities such as electro-magnetic resilience; and
c. force structure enhancements such as airfield repair capabilities."

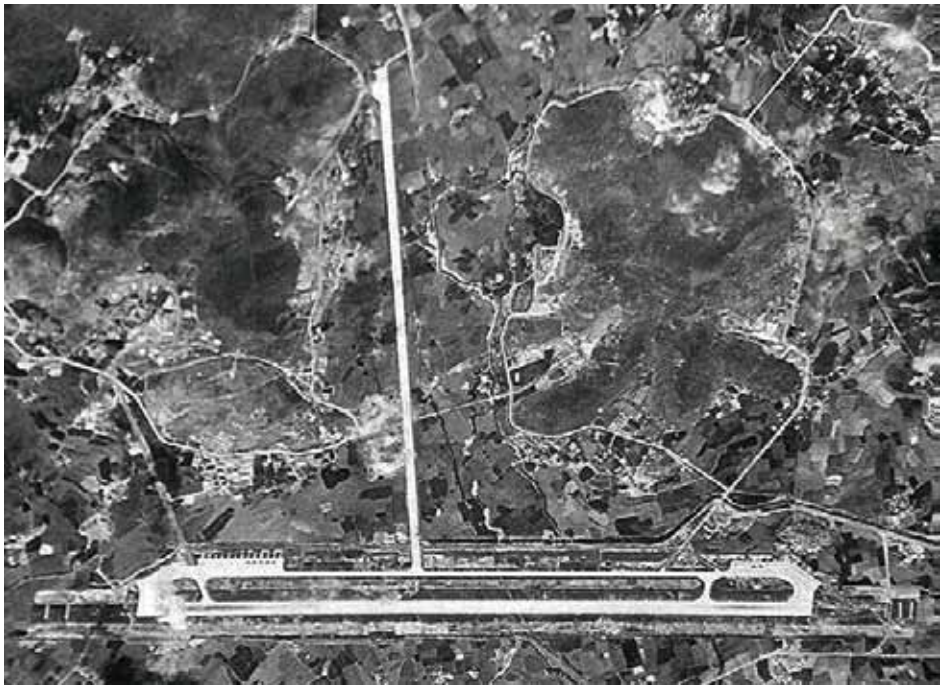
Whether Defence actually act upon this important recommendation remains to be seen, as the language in the ADFPR document leaves the choice of actions up to Defence alone.

How Much Hardening is Enough?

What the attacks in Iraq under Operation Desert Storm proved was that HAS were not a panacea, and even the best designs could be cracked by advanced concrete piercing bombs, where the opportunity to perform repeat attacks was available.

What was lost upon many observers was that an air force parked in revetments would have been annihilated with much cheaper munitions in the first two days of the war. Ordinary thin casing 500 lb bombs, cluster bombs and 1,000

The KTRV/GNPP KAB-1500 with a subcalibre concrete piercing warhead will be available with two different laser seekers, an electro-optical seeker, and satellite guidance. Depicted a test drop and a PLAAF Flanker G, both with the precision electro-optical variant.



1962 KH-2 Corona satellite image of the PLA An Ching airbase under construction. The wide taxiway north of the runway complex is used as an auxiliary takeoff only runway for aircraft, and connects to the apron in front of the primary tunnel entrance. Yet to be constructed is a taxiway to the east of the complex, to a second tunnel entrance.

lb cruise missile warheads would have worked more than adequately against revetment equipped airbases.

The value of HAS, despite their cost and limitations, is that they drive up the effort required by an attacker to defeat the airbase. A well built HAS may require one, two or more sorties, each requiring the delivery of two relatively expensive concrete piercing weapons. In turn, this requires that the airbase be overflown by a tactical fighter large enough to deliver such weapons. Standoff missiles, cruise missiles, and other lighter weapons will produce little effect against a well designed HAS.

The alternative to HAS, underground hangars, if built with proper entrance designs, deflection grids and blockers, can resist repeat attacks with tactical fighter compatible concrete piercing bombs. Such targets require genuine 'earthquake bombs', such as the new 30,000 lb GBU-57/B Massive Ordnance Penetrator (MOP), no differently than 1940s superhardened basing requiring the 10,000 lb Tallboy and 22,000 lb Grand Slam weapons.

Concrete piercing bombs compatible with precision guidance kits are now widely available. The US will supply the 2,000 lb BLU-109/B, the replacement BLU-116 Advanced Unitary Penetrator (AUP), the thermobaric filler loaded BLU-118/B based on the BLU-109/B casing, and the 208 lb GBU-39/B Small Diameter Bomb warhead. The AGM-158 JASSM/JASSM-ER is to be supplied with a 1,000 lb class J-1000 penetrator, while the AGM-86D/E Block I/III cruise missile was to be fitted with the 1,000 lb class AUP-3M penetrator. The BLU-109/B and SDB warhead are built to defeat 2 m of reinforced concrete, while the newer BLU-116/B AUP and AUP-3M will defeat 2 – 4 m of reinforced concrete (HYPERLINK 'http://www.ausairpower.net/APA-2008-02.html'http://www.ausairpower.net/APA-2008-02.html).

Of much more concern are Russian exports of concrete piercing bombs. Some years ago GNPP in Moscow disclosed the existence of a subcalibre penetrating warhead for the large 3,000 lb KAB-1500 series guided bombs, available with semi-active laser homing, electro-optical correlator or datalink, and GPS/Glonass inertial guidance kits. It is claimed to defeat 2 m of reinforced concrete under 7 m of soil overburden.

The smaller 1,000 lb KAB-500 series is, with the exception of the fuel air explosive armed KAB-500Kr-OD variant, always equipped with a blast penetration warhead, but it is not specifically built as a deep penetrating bunker buster like the KAB-1500L-Pr warhead.

The KAB-1500 series have been widely exported as a standard weapon for Su-27/30/35 Flanker series fighters, which are the standard non-US tactical fighter across most of Asia today. Any nation flying any Flanker variant can drop this weapon, given a warstock, and a single heavy airlifter could deliver a useful warstock inside of a day.

China has developed a series of new guided bombs but has yet to disclose warhead details.

Historical Perspective

In Western nations, military basing infrastructure has cyclically evolved since the 1930s to reflect short term operational imperatives.

Prior to the Second World War, the Western world generally did not harden its airfields or army bases, although some coastal naval gun batteries were well hardened, and on the European continent, the Maginot Line of 45 concrete fortresses and its siblings were constructed to resist heavy artillery fire. The technology of air power and land manoeuvre forces allowed attackers to bypass these hardened sites and quickly prevail. Unhardened sites were wrecked by enemy air power, followed up by Blitzkrieg Panzer columns.

As the war progressed, the Allied Combined Bomber Offensive escalated, and Germany's military infrastructure was the primary target. As Germany's Luftwaffe lost control of the air over Europe, Germany resorted to constructing ever more hardened installations to resist the round the clock bombardment by Allied air forces. Many of these installations remain as benchmarks for hardened bomb resistant structures.

In France, the Germans constructed massive concrete shelters, termed 'submarine pens' or U-Bootbunkerwerft to protect Kriegsmarine U-Boats from Allied bombers. Until the British deployed the 12,000 lb Tallboy earthquake bomb, designed to penetrate rock and concrete, the results of bombing attacks were generally very poor. For all intents and purposes the 1940s submarine pen remains the benchmark in hardening for a widely deployed above ground concrete structure.

Other notable period structures include a number of reinforced concrete bunkers in France, built to deploy V-weapons, and the infamous multi-storey 'Flak Towers' in Berlin, Vienna and Hamburg.

The advent of nuclear weapons brought NATO nations and the Soviets back to hardened structures, primarily to protect ballistic missile launch sites and Launch Control Centres from nuclear armed ballistic missile attack. These were initially designed to protect from overpressure

The underground hangar complex at Luyang / Rhange-Zhen is no longer in operational use, and was never completed. It is unusual as it includes tunnels sized for Badger and Beagle bombers. The segmented blast doors were built to resist near miss nuclear attacks. The very recent upgrade of the Hainan Do airbase yielded a similar configuration.

produced by near-miss airbursts, but as ICBMs became more accurate and bomb yields increased, ICBMs were increasingly emplaced in buried vertical silos. This in turn led to the introduction of earth penetrating nuclear warheads, intended to produce localised earthquake effects to rupture the silos below ground, or produce sufficient shock effects to damage the lightly constructed missiles. Key command posts in the USSR and the US were constructed by tunnelling deep under mountains, typically of hard and tough volcanic rock. These sites remain the best hardened post Second World War structures built in the developed world.

During the Cold War nations not aligned with the Warsaw Pact or NATO opted frequently for deep underground airbases, typically constructed by tunnelling into hillsides or underground. These nations had small or technologically deficient air forces and expected to be unable to prevent massive bombing raids on their airbases.

Chinese underground hangars were built with three tunnel cross-sections, large enough to accommodate cloned MiG-15 Fagot, MiG-17 Fresco, MiG-19 Farmer and MiG-21 Fishbed fighters, cloned Il-28 Beagle bombers, and cloned Tupolev Tu-16 Badger theatre bombers. China's reasoning behind the construction of these underground fortresses was never disclosed, but clearly reflected fear of massive nuclear bombardment by the US and USSR, and potentially massive non-nuclear bombardment by the US Air Force.

The contest between NATO and the Warsaw Pact brought progressive improvements in airbase hardening, initially based on Second World War experience. Revetments became a standard feature of many NATO and especially Warsaw Pact airbases, with China copying the Soviet revetment and dispersal arrangement for those airbases which did not have underground hangars.

By the 1970s, it was clear to both sides that revetments were insufficient, as early laser guided bombs, cluster munitions, and both nuclear and non-nuclear tactical ballistic missiles were introduced. Both sides introduced Hardened Aircraft Shelters (HAS), typically steel or reinforced concrete bunkers sized for one or sometimes two tactical fighters. The NATO hardening program, designated the 'Tactical Air Base – Vulnerability' program, or TAB-V / TAB VEE, resulted in several generations of shelters being deployed, typically hardened sufficiently to survive the standard Soviet FAB-250 500 lb class dumb bomb, and cluster munitions. Many TAB-Vs were fitted to operate in a Nuclear Biological Chemical (NBC) environment, and the designs were also adapted and deployed at US Air Force bases in South Korea, and some JASDF airbases in Japan.

In parallel with the NATO/Warpac hardening contest, Israel's prowess in defeating Egyptian and Syrian airfields using low altitude strafing and dive bombing attacks led to a massive investment in HAS installations in Iraq, Saudi Arabia and Kuwait. Iraq's shelters were part of a much larger infrastructure hardening effort, and Yugoslavian engineers played a major role in designing and constructing Saddam's hardened airbase network. When Coalition air forces flew into Iraq in early 1991, they confronted the most extensively hardened airbase system ever built.

Saddam's hardened airbases proved ineffective, and Coalition tactical fighters destroyed 375 of 594 during the six week air campaign. With complete control of the air won within the first day, Coalition fighters were able to repeatedly attack HAS installations until they were cracked open. The pivotal weapon used was the American 2,000 lb BLU-109/B I-2000 Have Void concrete piercing bomb, fitted with either the GBU-10, GBU-24 or GBU-27 laser guidance kit. Typically two weapons were used per target, the intent being for the second round to punch into the hole made by the first round. While many HAS were punctured in an initial attack, many others required repeat attacks until fatal damage was inflicted. This absorbed a significant proportion of available Coalition sorties, as the limited number of F-111, Tornado, and Buccaneer aircraft equipped to laser illuminate targets set hard limits on daily sortie rates.

Iraqi Frogfoot and Flogger destroyed on the ground. Unprotected aircraft cannot survive where PGMs are employed.

The survivability of Iraqi HAS varied widely. The least robust HAS were destroyed with single rounds, others required multiple hits. Depicted HAS at Al Salem.

ANG F-16 in a HAS at Balad. Well constructed HAS survived the two air wars and remain in use.