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Flight Landing Strip

Assessment, Clearance, and Repair

Smart Card

AIRFIELD SEIZURE OVERVIEW:

The critical mission during an airfield seizure is airfield damage repair (ADR) and clearing a Minimum Operating Strip (MOS) on a Flight Landing Strip (FLS) so additional personnel and supplies can arrive into the theater, normally by C-130/C-17. Airfield seizure from an engineer perspective involves three basic tasks: assessment, clearance, and repair. The following information draws from numerous sources, to include portions of the battalion SOP. As Engineers we must bring all available technologies and assets to bear on the task of ADR and implementing best practices of the last 10 years of war.

Center for Army Lessons Learned
https://call2.army.mil/toc.aspx?document=7211

Airfield Assessment Team (AAT):

1. The team consists of at least two AAT personnel. One controls the cone penetrometer and reads the indicator for a possible reading of 1-15. The other person calls out the depth and records the reading.
2. The team determines the approximate location for two key areas (touch down and braking) and takes readings at the center, right, and left edges of the FLS. Readings are also taken at 200' intervals as the team moves behind the sapper platoon along the length of the FLS, and at suspected soft or trouble spots.
3. At each reading location five readings are taken in an "X" pattern within a 12" circle. The depth interval for readings is IAW:
   a. Normal soil: Take readings every 2 inches to a depth of 8 inches.
   b. Crusted soil: Take readings every 2 inches to a depth of 24 inches.

Readings for 0" and over 12" are thrown out and the remainder are averaged.

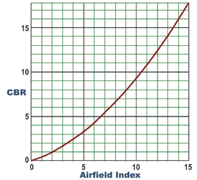
4. Mobility (motorbike, gator, other) for rapid assessment and survey
5. Robotics for rapid assessment and speed.

Cone Penetrometer:

A probe-type instrument that gives an index of soil strength. It uses 30-degree, right circular cone with a base diameter of ½ inch and an indicator that gives a reading directly in the terms of Airfield index.

Airfield Index (AI):

1. Minimum acceptable rating is 7.
2. Each unit of airfield index equals 10 psi.
3. C130 tire pressure is 80 psi; hence the requirement for an AI above 8.
4. C17 tire pressure is 138psi; hence the requirement for an AI above 13.
5. CBR (California Bearing Ratio): A measure of the bearing capacity of the soil based on its shearing resistance. CBR is calculated by dividing the unit load required to force a piston into the soil by the unit load required to force the same piston, the same depth, into a standard sample of crushed stone and multiplying by 100.



The AI then can be used to estimate a CBR value, as shown in the graph above. This correlation has been established to yield values of CBR that generally are conservative. The tendency towards conservatism is necessary because there is no unique relationship between these measurements and a wide range of soil types. The curve should not be used to estimate AI values from the CBR determination because these generally would not be conservative.

Assumptions:

All obstacles on the FLS can be removed with organic equipment.
No more than one piece of LARP equipment arrives in the airhead unserviceable.
Adequate backfill material and water are available in the vicinity of the FLS for crater repair.
The FLS/runway to be cleared is made of asphalt, concrete, or stabilized clay.

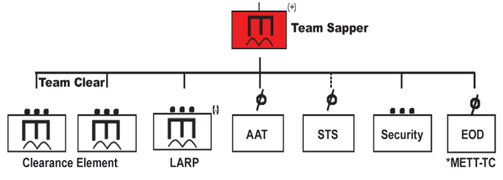
Assumption Mitigation:

Confirm or deny assumptions using pre-assault ISR. Use ISR to identify denied or damaged areas of the airstrip and select team assembly areas and heavy drops point of impact.

The Operation:

1. **Mission:** Battalion TF seizes and clears a Flight Landing Strip (FLS) in a forced-entry operation to facilitate air/land operations.

2. **Recommended Task Organization:**
   a. Assault / Security Force: composed of an infantry battalion.
      - Task: Breach defenses and seize objective(s).
      - Purpose: To eliminate enemy direct fire and observed indirect fire on the airfield.
   b. Clearance Force: composed of an engineer company (-), a Light Airfield Repair Package (LARP), and an Airfield Assessment Team (AAT). Team Clear will work very closely with the Air Force Combat Control Team (CCT) or Special Tactics Squadron (STS) to ensure that the runway meets Air Force requirements before Air Force aircraft will land; however, there is no specific command relationship. During the planning phase, it is important for the Company leadership to plan alongside the STS. Link-up location and TTPs must be coordinated. The leading edge of the landing strip or 'hammer head' is usually a practical link-up location.
      - Task: Assess, Clear, Repair
      - Purpose: Prepare FLS to receive follow-on forces.



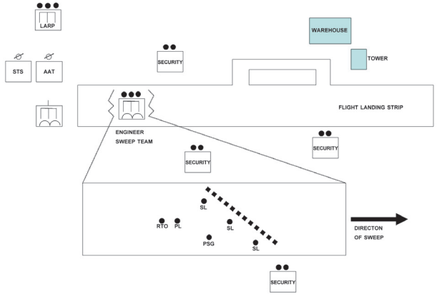
3. **Team Clear Engineer Tasks:**
   a. Confirm initial reconnaissance and assessment of the FLS, taxiways, turnarounds and aircraft parking areas.
   b. Conduct deliberate clearance operations; this is critical for dirt strips.
   c. Detect obstacles (such as mines, craters, wire, and abandoned vehicles) utilizing available equipment and kits.
   d. Conduct breaching/clearing operations on the FLS using all assets available to the unit. If necessary, use proven commercial off the shelf (COTS) equipment.
   e. Remove vehicles, equipment, and heavy drop debris from the FLS.
   f. Repair damage to the FLS and taxiway using the latest polymers and RRR kits available for repair and maintenance.
   g. Conduct link up with Air Force STS/CCT and cross talk all aspects of the reconnaissance and standards to get the airfield repaired and ready to receive follow-on forces.

4. **Team Clear Security Team Tasks:**
   a. Security of the FLS perimeter & LARP.
   b. Assist in removing vehicles, equipment, and heavy drop debris from the FLS and its perimeter.

5. **Sapper Company:**
   a. Use a 2-4 man engineer team jumping combat light to do an initial assessment of the FLS NLT P+0:30. This team should have a radio and be tactically cross-loaded so as to land at the end of the FLS opposite of the Team Clear assembly area. The recon teams will recon the FLS, marking and calling in locations of any obstacles, to include heavy drop pallets, enroute to Team Sapper's assembly area. This team is critical for the overall success of the mission. The accuracy of their sketches and ability to disseminate timely and accurate information at the link-up/rally point is critical.
   b. Sappers work with security provided by infantry. This will not be within line of sight, most of the time, but assault objectives providing area security and is important that Team Clear provides internal local security. While waiting for the FLS to be secured (normally NLT P+1:30), Team Sapper preps soldiers, weapons, and equipment in their assembly area. Recommend if the unit is not assembling on a Steiner Aid that the unit try to assemble on the hammer head on the FLS.
   c. Sappers move to the edge of the FLS to begin clearing as soon as minimum force (70%) is established (METT-TC dependent), usually based on the number of clearance teams present and the infantry have eliminated direct fire on the FLS. Recommend the following be present before initiating clearance operations:
      - PSS 14 or available hand held detectors
      - Talon 3 robots or the most up to date robotic system
      - Clearance kits
      - Tactical Explosive Detection Dogs if available: currently TEDDs are not utilized by conventional airborne forces. Can be part of follow-on forces in the B echelon.
      - Enough explosive capability to clear multiple mines/obstacles based off of IPB/S2 or LRS update
   d. One deliberate sweep of the landing strip should clear the runway of all mines and obstacles. Visual detection methods are adequate on all hard surfaces--concrete or pavement. Always clear any spoils or a major upheaval in the surface of the FLS with mechanical detection. Also, this is required for all soft surfaces. Mine detectors are required to clear the shoulders and islands between taxiways and runways.
   e. Progress is tracked and reported using an Airfield Assessment Matrix with timeline. All engineer leaders from CO down to Team Leader level should have this document. Additionally, the TF S3, ABE, and Brigade S3 should also have a copy.
   f. Check obstacles for booby traps and tripwires. AT mines detonated in place will create a 40" by 6" spall that will require repair.
   g. Begin clearance of FLS with priority of engineer effort to clearing a MOS of FLS long enough to land the appropriate aircraft 3,500 ft and 60 ft wide (90ft C-17) as a minimum with compaction ratio of 7-15 on the cone penetrometer.
   h. Engineers continue to sweep the taxiways, culverts, and aprons once the FLS is cleared. When the airfield clearance is complete, engineers move to clear internal airhead lines of communication.

Clearing Formations:

1. **Echelon:**
   a. Platoons form an echelon left or right. Always ensure that the sweep techniques are overlapping to ensure there is no dead space between detection heads. This is critical on dirt or clay strips.
   b. Each PL is the C2 for his platoon, however, one PL is overall in charge of the clearance team if there is more than one. The 240B gunner and the RTO stay with the PL in the middle of the echelon behind the last man.
   c. The PSG moves from the front to the rear of the formation and is responsible for spacing, proper mine detector sweeping, and is ready to evacuate casualties as necessary.
   d. Ensure fire control measures are coordinated between adjacent units and FLS objective. Responsibilities of fire control can vary based on METT-TC and must be considered during planning.
   e. There should be one supervisor (TL or SL) for every two mine detectors in the echelon. The supervisor observes the spacing, overlap of sweeps, and proper use of the mine detectors. SLs should be in the middle of their squads. All team members should be conducting 5/25m sweeps looking for the indication of explosive hazards (EH). If employing robotic devices for clearance purposes, within the teams, this will assist explosive hazard reduction operations. Remember to always apply minimum Safe Standoffs when using explosives by pounds of ordnance and explosives being utilized.
   f. EH/obstacle clearing teams are designated within the echelon. Each mine detector operator should have 30m between himself and the next operator or Soldier. The width that he sweeps is 1.5m. Careful attention must be paid to the amount of time a mine detector continuously operates the equipment, recommend no more than 20 minutes. Techniques such as draping the earpiece over the shoulder and switching ears can be used if the PL is forced to accept risk due to personnel shortages. Tying a 30m strip of engineer tape to each mine detector operator may be done to maintain proper interval and ensure the teams are moving in straight lines. When incorporating robotic operations for positive ID of EH's always use the best practices based on the type of equipment be utilized at the time of the clearance operation.



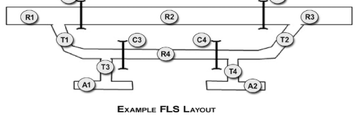
Clearing Formations: (cont.)

2. **Bypass:**
   a. This method utilizes two platoons on-line and is particularly effective on hard surface runways.
   b. The first platoon (A) moves forward on-line utilizing the same positioning of leaders and personnel as the echelon method.
   c. As the first platoon (A) encounters an obstacle, it marks, then clears a path in order to bypass the obstacle and continues until it reaches the next obstacle. Meanwhile, the second platoon (B) moves up to the bypassed obstacle and begins clearing it.
   d. After the obstacle is cleared, platoon (B) moves toward platoon (A) and bypasses platoon (A) if it is clearing an obstacle or follows behind if it is continuing in its movement. This method is designed for speed and focuses on maintaining momentum down the FLS. It can not be used if separate obstacles are closer than 100m to each other, as this will not provide the platoon in between the obstacles an adequate safe distance.
3. **Collapse:**
   a. This method is the same as the echelon method; however, the two platoons begin at opposite ends of the runway and meet in the middle.
   b. This method is designed for situations where it is advantageous to reduce the size of the clearing force in one location or if the runway is extremely long.
   c. This method is the least preferred method due to reduced C2 and the increased probability of fratricide.

AIRFIELD ASSESSMENT MATRIX **AS OF: _____**

	Clear	Assess	Repair	Mark	Remarks
Runway (Length)					
R1:	Ⓡ Ⓐ Ⓒ	Ⓡ Ⓐ Ⓒ	Ⓡ Ⓐ Ⓒ	Ⓡ Ⓐ Ⓒ	MOS=
R2:	Ⓡ Ⓐ Ⓒ	Ⓡ Ⓐ Ⓒ	Ⓡ Ⓐ Ⓒ	Ⓡ Ⓐ Ⓒ	MOS=
R3:	Ⓡ Ⓐ Ⓒ	Ⓡ Ⓐ Ⓒ	Ⓡ Ⓐ Ⓒ	Ⓡ Ⓐ Ⓒ	MOS=
R4:	Ⓡ Ⓐ Ⓒ	Ⓡ Ⓐ Ⓒ	Ⓡ Ⓐ Ⓒ	Ⓡ Ⓐ Ⓒ	MOS=
Taxiway					
T1:	Ⓡ Ⓐ Ⓒ	Ⓡ Ⓐ Ⓒ	Ⓡ Ⓐ Ⓒ	Ⓡ Ⓐ Ⓒ	
T2:	Ⓡ Ⓐ Ⓒ	Ⓡ Ⓐ Ⓒ	Ⓡ Ⓐ Ⓒ	Ⓡ Ⓐ Ⓒ	
T3:	Ⓡ Ⓐ Ⓒ	Ⓡ Ⓐ Ⓒ	Ⓡ Ⓐ Ⓒ	Ⓡ Ⓐ Ⓒ	
T4:	Ⓡ Ⓐ Ⓒ	Ⓡ Ⓐ Ⓒ	Ⓡ Ⓐ Ⓒ	Ⓡ Ⓐ Ⓒ	
Apron					
A1:	Ⓡ Ⓐ Ⓒ	Ⓡ Ⓐ Ⓒ	Ⓡ Ⓐ Ⓒ	Ⓡ Ⓐ Ⓒ	MOG=
A2:	Ⓡ Ⓐ Ⓒ	Ⓡ Ⓐ Ⓒ	Ⓡ Ⓐ Ⓒ	Ⓡ Ⓐ Ⓒ	MOG=
Culvert					
C1:	Ⓡ Ⓐ Ⓒ	Ⓡ Ⓐ Ⓒ	Ⓡ Ⓐ Ⓒ	Ⓡ Ⓐ Ⓒ	
C2:	Ⓡ Ⓐ Ⓒ	Ⓡ Ⓐ Ⓒ	Ⓡ Ⓐ Ⓒ	Ⓡ Ⓐ Ⓒ	
C3:	Ⓡ Ⓐ Ⓒ	Ⓡ Ⓐ Ⓒ	Ⓡ Ⓐ Ⓒ	Ⓡ Ⓐ Ⓒ	
C4:	Ⓡ Ⓐ Ⓒ	Ⓡ Ⓐ Ⓒ	Ⓡ Ⓐ Ⓒ	Ⓡ Ⓐ Ⓒ	

NOTE: Ⓡ = Arrived On Site Ⓐ = Work In Progress Ⓒ = Work Complete



Example FLS Layout

R(#): Runway (based on MOS); T(9): Taxiway; A(#): Apron; C(#): Culvert

Light Airfield Repair Package (LARP):

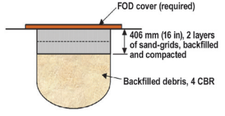
1. The LARP composition varies according to METT-TC, the type of FLS, number of pallets available, etc. It normally consists of 14 personnel and six heavy drop pallets.
2. The LARP team derigs its equipment (usually loader first), assembles their vehicles, and is escorted by infantry if available to a predetermined link-up site (normally the trail edge of the FLS or the Hammer Head). Progress is reported to the engineer company commander. All vehicles derigged NLT P+2 and marshaled by P+3 is a realistic goal for most airborne operations dependant on the enemy situation
3. Once damage to the FLS is identified, the LARP NCOIC conducts a reconnaissance and determines the equipment, materials and time required to complete the repair. Craters or spalls larger than 6" deep and 24" across require repair. The planning factor for repairing one crater is P+8. The P+8 being relayed to the TF commander is critical for tactical patience to be fully understood and so that B Echelon can be informed of a more realistic time for air lands with follow-on forces. Progress reporting is critical to keep the TF Commander informed in order for him to plan realistic time for air, land and follow-on forces.
4. The LARP does not begin its repairs until the area surrounding the damage is clear of all obstacles making it safe to operate vehicles. As soon as an adequate piece of equipment is ready to begin repairs and the area is clear, the vehicle is moved to the crater.

Airborne LARP:

Heavy Drop Dimensions	Length	Width	Height	Weight	Fuel	Platform
Loader**	354 in	108 in	100 in	32,723 lbs 37,200 lbs	58 gals	24'
Dump	372 in	108 in	95 in	15,873 lbs 34,100 lbs	58 gals	28'
DV-100 Deuce	328 in	110 in	101.5 in	35,500 lbs 40,340 lbs	90 gals	24'
Skid loader **	226 in	88 in	105 in	14,240 lbs	25	28'
FLU-117 SEE**	372in	108in	99 3/4in	21,624		28'
FAS Box	Load dependant	108	Load dependant	15,040-24,360lbs		16'-24'
RRR Kit	222"	84"	19.5"	15,040-24,360 lbs		20'-24'

** all secondary attachments must be part of each vehicle's load plan

Sand Grid Repair:



Repair Evaluation Methods:

1. Acceptance Criteria. Crater repairs must be evaluated before acceptance for aircraft operations. The following areas should be considered:
2. Repair Compaction. The strength of the backfill, debris, or subgrade materials must be verified. Depending upon the repair method used, the thickness and strengths of all surface and/or base course materials must also be verified. The soil structure should be tested using a dynamic cone penetrometer (DCP) to determine CBRs of each layer. These tests must be accomplished before placing the FOD covers, AM-2 matting, stone and grout, asphalt, concrete, or other surface materials that would prevent the use of the DCP.
3. Surface Roughness. The final grade of the repair must be checked using line-of-sight profile measurement stanchions, upheaval posts, or string lines to ensure the repair meets surface roughness criteria contained in T.O. 35E2-4-1. Procedures are described in T.O. 35E2-5-1, Crushed-Stone Crater Repair and Line-Of-Sight Profile Measurement for Rapid Runway Repair. In the case of a crushed stone repair without a FOD cover, the repair surface should be checked for loose aggregate or potential FOD.
4. Small Crater. Damage that penetrates into the base course from the airfield surface. Small craters have an apparent diameter of 6 meters or less.
5. Spall field. Cluster of spalls within an area requiring repair. May include 10 to several hundred spalls
6. Spall. Pavement damage that does not penetrate through the pavement surface to the underlying layers

Rapid Runway Repair (RRR) Matting:

1. Used to temporarily repair the surface of a concrete FLS.
2. The Air Transportable Airfield Damage Repair Kit: Air-droppable kit developed to provide all materials, hand tools and related ancillary items to conduct a successful crater repair for a 25' diameter crater. The kit weighs 5,310 lb and packaged is in an 18.5'x7'x19.5" container. Major end items include:
   a. Eight 20' x 8' sections of sand grid.
   b. Four full- and four half-panels of FRP matting.
   c. One 100' roll of 20' wide polyethylene membrane 6 mil thick.
   d. One roto hammer electric impact rotary drill.
   e. Thirty Wej-It concrete anchor bolts 7" x 5/8" diameter.
   f. Thirty-four auger anchors for asphalt pavement.
3. Fiberglass Reinforced with Polyethylene (FRP): A type of FOD prevention cover for RRR. The material consists of a layer of fiberglass, approximately 3/8" thick combined with a polyethylene resin. The resin gives the fiberglass a load-bearing capacity through stiffness.
   ***may include fast-setting caps utilizing polymer foam or bucket mixers with fast-setting quickcrete to cap.

FAS (Forward Aerial Supply) Box:

Includes additional sand grids; water for compaction; 50 repair parts from the Prescribed Load List (PLL) for LARP equipment; petroleum, oil, lubricants (POL) products; gas-powered hand tampers; generator; and assorted miscellaneous hand tools.

Minimum Operating Strip (MOS):

The smallest amount of area that must be repaired to launch and recover aircraft. Selection of the MOS will depend upon mission requirements, taxi access, resources available, and estimated time to repair. The length of the MOS will depend on the take-off or landing distance of the mission aircraft, whichever is greater. FLS Requirements Table (Training Dimensions from AFI 13-217, Assault Zone Procedures; 1 June 96) Minimum length does not include overrun.

	C-130	C-17	C-5
Minimum Length			
Training	3500 feet	3500 feet	6000 feet
Combat	3000 feet	3000 feet	5000 feet
Overrun Length	500 feet	500 feet	1000 feet
Combat	300 feet	300 feet	1000 feet
Clear Area Width	50 feet	50 feet	375 feet
Runway Width	60 feet	90 feet	98 feet
Shoulder Width	10 feet	10 feet	50 feet
Overrun Width	100 feet	100 feet	250 feet
Minimum Turnaround Area	63 feet x 63 feet	90 feet x 90 feet	110 feet x 110 feet

Surface Conditions:

1. Ditches: must be eliminated from all traffic areas if more than 6 inches deep.
2. Potholes: must be filled if >15 inches across at their widest point and 6 inches deep.
3. Rocks: in traffic areas rocks must be removed, embedded, or interlocked in a manner that will preclude displacement when traversed by aircraft.
4. Ruts: maximum rutting depth is 3 inches.
5. FLS surface thickness: 6 inches.
6. Transition areas: from runway to overrun must be smooth. Lips must be avoided.
7. Tree stumps: Must be cut within 2 inches of the ground. Outward clearance requirements are METT-TC dependent.

Maximum on Ground (MOG):

1. For non-USAF aircraft, minimum necessary space required is: length x wing span x 3.5.
2. Additional planning considerations are a 20-foot wing-tip clearance between parked aircraft; if parallel parking rows are utilized, the taxi-way between rows should be the wing span + 60 feet; if aircraft are parked parallel to a taxi-way, the clearance should be 50 feet. If aircraft are parked nose to tail the clearance should be 150-200 feet to facilitate off-loading.
3. Minimum Requirements for the following: C-130 3500' X 60', C-17 3500' X 90'. The runway must have a MOG 1 ability. That is to say that one C-130 or C-17 can land, turn around and unload, then take off again.

Flight Landing Strip:

The flight landing strip allows landing and takeoff of specific fixed-wing aircraft. It must be relatively flat with a surface that can support fully loaded, freed-wing aircraft. Proper site selection is based on minimal need for surface improvement and earthwork. The composition of the FLS (generally dirt or concrete) will have an impact on the type of equipment required by the LARP.

Mitigating Dust on Helipads – CH-47 and UH-60 Series:

A Method:

Apply 900 gallons of synthetic fluid topically to 150- by 150-ft helipad

What you will need:

1. MTVR (medium tactical vehicle replacement)
2. Hydroseeder or available spraying equipment
3. (4) 275-gal dust palliative (synthetic fluid)
4. (3) Soldiers

Procedure:

1. Survey and visibly establish area to be treated.
2. Place 900 gallons of synthetic fluid into hydroseeder.
3. Position the MTVR and hydroseeder on edge of helipad.
4. Use the tower gun and a long-distance nozzle to spray half of product to half of helipad.
5. Drive the MTVR to opposite side of helipad.
6. Spray the remaining product.
7. Helicopters can land immediately

Alternate Methods:

Membranes: membranes consist mainly of coated fabrics intended for use as airfield surfacing to dustproof and waterproof soil subgrades.

Mobi-Mat® Helipad is designed for the rapid and safe establishment of landing zones for expeditionary forward operating bases (FOBs), forward arming and refueling point (FARP), Drop Zone (DZ) and medical support operations (medical evacuation [MEDEVAC]). Mobi-Mat® Helipad is durable enough to sustain thousands of direct helicopter loads; reusable; easy to install without special tools; requires little training; is environmentally friendly; NVG-compatible; and low in cost. NSN: 5680-01-560-7582

References:

FM 90-26
FM 5-7-30
FM 5-430-00-1
FM 5-430-00-2
82d Airborne Division RSOP
UFC 3-270-07
ERDC/GSL SR006-07

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