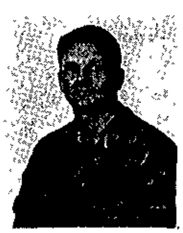
The preface to the School's drill field circulars compares drill training to football practice: Drills address individual tasks (blocking and tackling), leader tasks (skull sessions), and collective tasks (plays) before conducting ARTEP missions (scrimmages). Performing ARTEP mission training before drill training would be like scrimmaging on the first day of practice. Trying to react to METT-T conditions that require action without drills would be like formulating and calling out a play after the ball is snapped.

The final goal of training is to produce a ready unit that can respond rapidly and correctly to known or suspected enemy activity and defeat the enemy. Drill training is a key factor in achieving that goal.

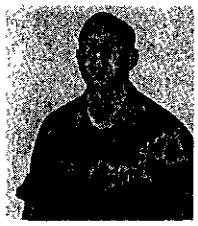
The Infantry School has prepared and distributed four new field circulars containing squad and platoon drills: FC 7-21 (M113), FC 7-21B (BFV), FC 7-22 (Infantry), and FC 7-15 (Light Infantry).

Instruction on drills is included in all the applicable resident courses taught at the School. In addition the School's New Equipment Training Team (NETT) presents drill instruction to CONUS-based units that are making the transition from the M113 to the Bradley fighting vehicle as part of the Doctrinal and Tactical Training (DTT) Program. (The 7th Army Training Command conducts the same training for USAREUR units converting to the Bradley.)

Users of the USAIS drill circulars are encouraged to submit any recommended changes or comments they may have. The School's objective is to standardize a core set of critical drills for all types of infantry as soon as possible. Comments should be sent to the Commandant, USAIS, ATTN: ATSH-I-V-T-C, Fort Benning, GA 31905 (AUTOVON 835-4848/1317/4759).



Major Royal A. Brown III is assigned to the Directorate of Training and Doctrine (DOTD) at the Infantry School. He previously served in various command and staff assignments at Fort Ord and in Vietnam. He is a graduate of the Naval Postgraduate School.



Captain Mark E. Crooks is also assigned to DOTD at the Infantry School. He is a 1977 ROTC graduate of The Citadel. His previous assignments include command and staff tours in Europe and at Fort Carson.

Mortars:
Able to Leap Tall Buildings

CAPTAIN STEWART E. GOESCH
CAPTAIN ROBERT A. LAMBERT

In spite of the continuing spread of urban areas throughout the world, the U.S. Army has no current doctrinal techniques for placing indirect fires into built-up areas in such a way as to avoid or overcome the masking effects of buildings on those fires.

A mortarman doesn't have to work with mortars long, however, to observe that a mortar round's steep angle of fall is almost a mirror image of its steep angle of ascent. If he had a way of determining the angle of fall necessary to get a mortar round over buildings and onto a target in the street below, then he could compute the elevation necessary to produce that angle of fall.

Here is such a method, one that is as mathematically correct and reliable as the firing tables now in use. In fact, it is derived from those tables. Two main phases or procedures are involved in making the needed calculations.

To explain the first procedure, a new term must be introduced — "required angle of entry." The required angle of entry is the minimum angle at which an incoming mortar round must travel to avoid the masking effects of buildings along either side of a street and still fall on the street. This angle is described from the edge of a street to the top of a building on the opposite side of the street (Figure 1). In the figure, Angle B is the required angle of entry for an incoming round.

Establishing a measure for this angle is remarkably simple, because the required angle of entry for any

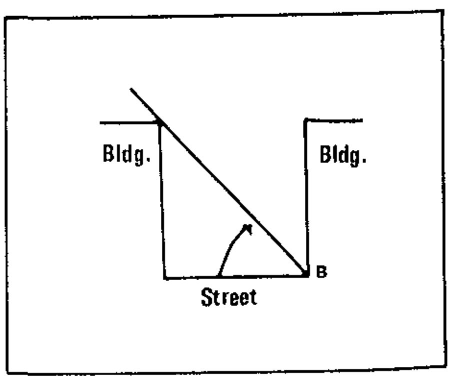


Figure 1

TANGENT VALUE	ANGLE OF ENTRY (in mils)
1.000	800
1.061	830
1.103	850
1.171	880
1.219	900
1.294	930
1.348	950
1.435	980
1.497	1000
1.596	1030
1.668	1050
1.786	1080
1.871	1100
2.011	1130
2.114	1150
2.286	1180
2.414	1200
2.631	1230
2.795	1250
3.078	1280
3.297	1300
3.684	1330
3.992	1350
4.558	1380
5.027	1400
5.936	1430
6.741	1450
8.449	1480
10.150	1500
14.530	1530
20.360	1550
50.920	1580
101.900	1590

CONVERSION TABLE FOR TANGENT VALUE TO ANGLE OF FIRE

Figure 2

street can be determined by dividing the height of the building in the target area by the width of the street. (These measurements can be provided to the fire direction center [FDC] through map data, reconnaissance, or a forward observer's estimate — along with the usual call-for-fire information.) The figure that results from this division is called the "tangent."

Using the conversion table in Figure 2, the FDC can then find the tangent value (in the left column) and opposite it (in the right column) the corresponding mil measure of the required angle of entry. (Any tangent value of less than 1,000 can be fired without concern for the masking effects of buildings.)

As long as the angle of fall of an incoming round is equal to or greater than the required angle of entry, the round will land where it is supposed to — on the street — and not on a roof top (Figure 3).

Once the required angle of entry is known, the FDC needs only to determine the necessary elevation and charge to produce the necessary range and angle of fall.

All of this data is in our current firing tables, but its arrangement makes it difficult to use for this type of calculation. In Figure 4 is a portion of a reconfigured 81mm firing table that is easier to use.

For example, given a fire mission with a range of 1,000 meters, a street width of 11 meters, and a building height of 55.3 meters, the FDC divides the street width into the building height to get a tangent value of 5.027. A glance at the conversion table (Figure 2) shows that the corresponding angle of entry is 1,400 mils. At a range of 1,000 meters, the first angle of fall greater than the 1,400 mils required for angle entry is under Charge 4, and the corresponding elevation is 1,393 mils.

This first procedure, though mathematically correct, deals with the theoretical, the ideal. But no two mortar rounds follow the same path, because each is subject to the effects of ran-

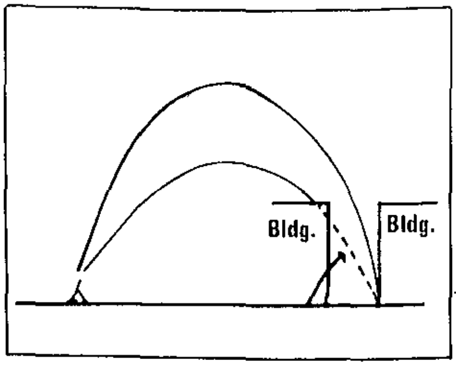


Figure 3

dom deviations in flight caused by a multitude of forces.

The second procedure, by using these random deviations, gives a commander or his FDC a practical way of judging how effective the unit's indirect fires are likely to be.

The random deviation, known as dispersion, is dealt with in the current firing tables under the term "probable error." For every range, the firing tables show a range probable error distance, which means that 25 percent of the rounds fired will land beyond the theoretical point of impact and 25 percent will land short of it, but within the range probable error distance shown. The rest, because of the random deviations in their flight paths, will land outside that area but in predictable percentages as they move away from the theoretical point of impact.

Why is this important?

Once the people in the FDC know the street width, they can compare it to the range probable error distance and compute with certainty the number of rounds that will reach the street. For instance, if the target street width is the same as the range probable error distance, then only 25 percent of the

MOUT FIRING TABLE

RANGE	PROBABLE ERRORS		CHARGES																			
	R	D	0		1		2		3		4		5		6		7		8		9	
			ANGLE OF FALL	ELEV	ANGLE OF FALL	ELEV	ANGLE OF FALL	ELEV	ANGLE OF FALL	ELEV	ANGLE OF FALL	ELEV	ANGLE OF FALL	ELEV	ANGLE OF FALL	ELEV	ANGLE OF FALL	ELEV	ANGLE OF FALL	ELEV	ANGLE OF FALL	ELEV
75	7	1	1511	1508	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
250	8	1	1282	1271	1468	1478	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
500	9	1	*	*	1365	1346	1445	1429	1488	1473	1513	1499	*	*	*	*	*	*	*	*	*	*
750	10	2	*	*	1222	1191	1362	1336	1430	1406	1469	1447	1494	1473	1511	1491	1523	1504	*	*	*	*
1000	11	2	*	*	991	945	1269	1231	1368	1335	1423	1393	1457	1429	1481	1454	1497	1471	1509	1484	1518	1493
1250	12	3	*	*	*	*	1153	1101	1302	1258	1375	1336	1420	1384	1450	1415	1471	1438	1486	1454	1497	1466
1500	13	3	*	*	*	*	931	865	1225	1169	1324	1274	1381	1336	1418	1375	1444	1403	1462	1423	1476	1438

Figure 4

MOUT PROBABILITY TABLE	
Street Width in Relation to Range Probable Error Distance	Percentage of Rounds to Reach Target
2.0 X	50.00%
2.5	60.05
3.0	68.84
3.5	76.19
4.0	82.26
4.5	87.03
5.0	90.80
5.5	93.62
6.0	95.74
6.5	97.18
7.0	98.16
7.5	98.84
8.0	99.30
8.5	99.60
9.0	99.76
9.5	99.87
10.0	99.92
10.5	99.96
11.0	99.98
11.5	100.00

Figure 5

rounds will reach the street even though all have been fired correctly. But if the street width is twice the range probable error distance, 50 percent of the rounds fired will reach their target (Figure 5).

Or, going back to the example used earlier with the MOUT firing table (Figure 4), the FDC knows that if Charge 4 is used with an elevation of 1,393 mils, the range probable error distance (R) is 11 meters. This means that the rounds will clear the buildings and 25 percent will fall within 11 meters of the intended range — that is, in the street. If all else is equal but the street width is 22 meters, then half of the rounds fired will reach the street. (For this fire mission, any charge of 4 or above will work, but with counter-battery radar, the lowest workable charge should be used.)

If they had this kind of information in hand, commanders and FDCs would know not only how to fire their mortar rounds but how many they would have to fire to produce a given effect, even in the narrowest of streets. In some situations, such information would tell them that they could not bring effective fire on a certain street without a great and inefficient expenditure of rounds — or that they could not bring effective fire on it at all. Guesswork would be eliminated.

The Army needs to incorporate these two procedures into its doctrine and teach them for all kinds of mortars. No new research or technology would be needed. By simply restructuring what is already available, we could vastly improve the effectiveness of our indirect fire assets in urban terrain operations.

We can't afford not to do it.

Captain Stewart E. Goesch, now a U.S. Army Reservist, served on active duty in Berlin as a mortar platoon leader, a company XO, and an assistant battalion S-3. He holds a master's degree from Brigham Young University.

Captain Robert A. Lambert has also served as a mortar platoon leader and, while assigned to the Infantry School, helped write a field manual on the tactical employment of mortars. He is a graduate of the University of Alabama and is now a company commander in the 1st Infantry Training Brigade at Fort Benning.

81mm Mortar Training — with 60mm Ammunition

CAPTAIN RODNEY W. JOYE

Sustaining combat readiness in any unit is a continuous process that includes equipment, personnel, maintenance, and training. All of these unit readiness criteria are important, but if unit personnel are not trained to perform their assigned missions, all the other categories of readiness become meaningless.

Gunnery training, in particular, has become increasingly difficult because of the rising costs of training ammunition, and this includes mortar training. Today, the Army simply cannot afford to conduct all of its mortar gunnery training with service ammunition. The cost of a current production 81mm high explosive (HE) round, for example, is $122, and the cost of the improved 81mm HE round is estimated at $225. In addition to the cost, the transition to the improved 81mm round has created a critical shortage in the ammunition available for training. Presently, almost all remaining stocks of the old ammunition are being held in war reserve, and the shortage for training purposes is expected to continue through Fiscal Year 1992.

If this situation is left unresolved, the Army is faced with two unacceptable choices: Either use war reserve stocks of 81mm ammunition for training or allow the combat effectiveness of its 81mm mortar sections to decline.

The logical solution to this dilemma, therefore, is to use training devices, scaled range ammunition, and subcaliber ammunition, along with service ammunition. The new POCAL scaled range ammunition, for example, can be used on local scaled ranges (up to 500 meters), sub-