CHAPTER 1

MINE FIELD

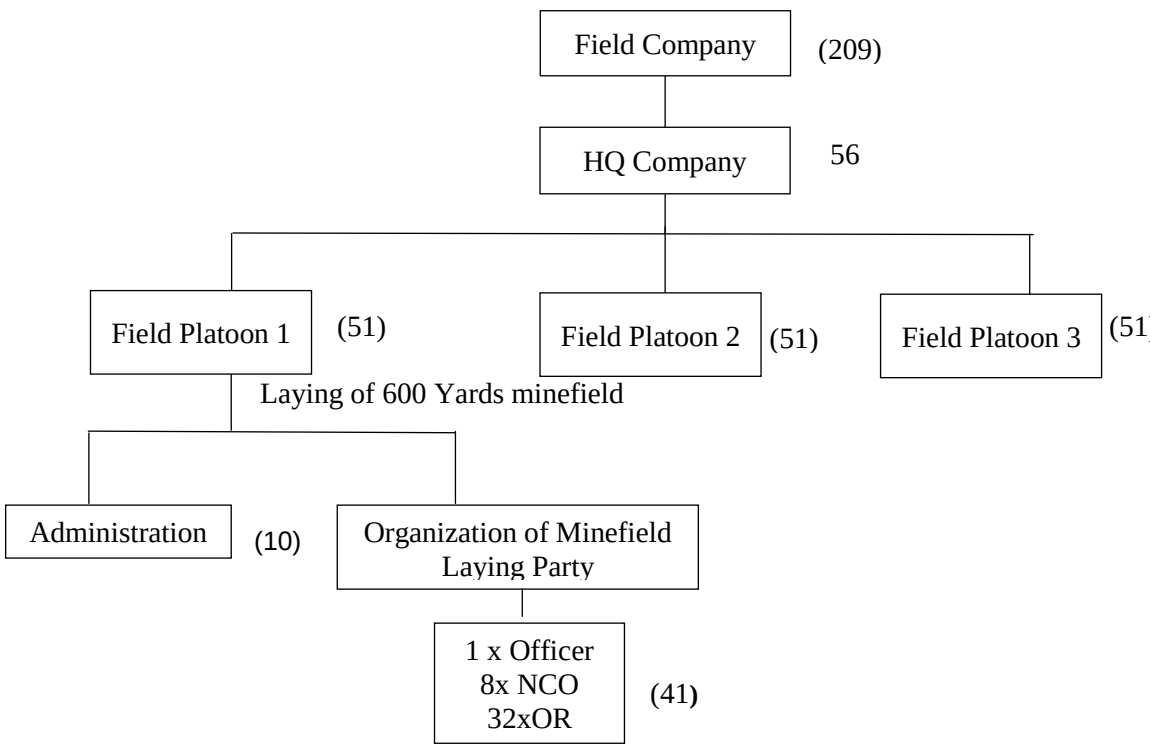
SECTION 1

MINEFIELD LAYING CALCULATION

0101. **Introduction.** Being sapper officers, we are entrusted with the task to counter enemy's mobility vis-a-vis to help own mobility. Mines when emplaced on ground help in counter mobility and when lifted or breached from ground help in mobility. A set drill for minefield laying ensures minimum time and order to execute a minefield laying operation. Drill reduces reaction time and increases execution speed in response to certain battlefield situations.

0102. A field company of a division engineer battalion can lay a minefield of 1800 yards in one night (ideal 10 hour). Three field engineer platoon of the company can lay 600 yards of minefield each.

0103. **Organization of Engineer Company.**



0104. **Organization.** The organization for normal drill for mine laying is as under:

Serial	Party	Personnel			Equipment (Note)	Remarks
		Officer	NCO	OR		
1.	Setting Out	1 (Officer In Charge)			Compass, Note book	Minefield record
			1(2IC)		Light(v), Compass, Prodder	Show the place of clusters
				2	Compass(i), Pickets, Lamps, Sledge hammer or maul	
2.	Carrying		1	6	Haversacks, Vehicles(i)	Mine Dump
3.	Digging		1	11	Shovels, Pick axes (ii)	NCO to take long prodder
4.	Anti Personnel (AP)		1	4	Dibbers, Shovels (iv), Pliers	NCO to take long prodder
5.	Irregular Outer Edge (IOE)		2	3	Compass, Shovels, Pick axes, Dibbers, Vehicles, Sledge hammer, Pickets, Pliers	
6.	Wiring		1	3	Sledge hammer or mauls, Pickets(i), Barbed Wire, Perimeter sign, Vehicles	
7.	Temporary protective Wire		1	3	Sledge hammer, Pickets (i), Barbed Wire, Perimeter signs	When Require

Note:
i. As per requirement.
ii. Not required in soft soil.
iii. Required only for anti-personal mine number 6.
iv. Required for shrapnel mine.
v. Required at night.

0105. **Formulas Required for Calculation**.

Serial	Calculation	Formula	Remarks
1.	Number of Strips	Desired density / Standard density	Standard Density =1/3
2.	Cluster per Strip	Frontage X 1/3 (Standard Density)	
3.	Anti Tank Mines	{(Number of mixed strip + Number of Anti Tank Strip) X Number of cluster/Strip+ number of IOE group X Number of IOE cluster/Group} + 10%	
4.	Anti Personnel Mines	(3 X number of mixed strip X Number of cluster/Strip + 3 X number of IOE group X Number of IOE cluster/Group) + 10%	
5.	Long Picket	{(Frontage + 2 X Depth) / 20} + 1} + 10%	The extra 1 picket is needed at one of the corners
6.	Short Picket	{(Frontage/20 + 2 X Total Troop + 2 X Number of strips) + (Number of strips X Frontage/100) + (2 X number of IOE groups)} + 10 %	
7.	Barbed Wire Coil	(3 X Frontage + 4 X Depth) / 100	A barbed wire coil has 130^{x} of wire. But for ease of calculation and omitting the 10% reserve, a factor of 100 can be used instead of 130.
8.	Perimeter Sign Posting	(2 X Frontage + 2 X Depth) / 40 + 10%	
9.	Tracing Tape	(Number of strips X Frontage + 2 X Depth + Length of guide tape)/50 + 10%	

0106. **Transportation**.

a. **For Equipment**. Transportation needed depends upon the amount of stores as calculated above. The following is a guideline to determine the number of 3 ton lorry needed for carrying the stores.

Serial	Equipment	Type	Weight	No per 3 ton
1.	Anti Tank mine	Anti Tank Mine Mark V	12 lbs	440
		Anti Tank Mine Mark VII	30 lbs	180
2.	Anti Personnel mine	Anti Personnel Mine Shrapnel Mark II	10 lbs	528
		Apers Mine No. 6	8 ozs	4500
3.	Barbed Wire	130 yard length	-	24 coils
4.	Long Pickets	-	-	100
5.	Short Picket	-	-	50
6.	Perimeter Signs	-	-	75

b. **For Manpower**.

(1) 1x 3-ton lorry: 28 person without equipment.
(2) 1x ¼-ton jeep: For Officer In Charge.
(3) 1x 1-ton pick up: For administration purpose.
(4) 1x Ambulance: For medical purpose.

0107. **Time Calculation**. One engineer platoon working in day, without enemy interference, in good ground and with a carry not exceeding 200 yards (from dump to site) can lay by hand:

Serial	Cluster	Without Trip Wire			With Trip Wire		
		Day	Moonlit Night	Night	Day	Moonlit Night	Night
1.	Anti Tank	200	133.33	100	-	-	-
2.	Anti Personnel	100	66.67	50	75	50	37.5
3.	Mixed	100	66.67	50	75	50	37.5

Note:
1. In case of night multiply the amount of the day by ½ and in moonlit night by 2/3.
2. The output of an infantry platoon is ½ that of an engineer platoon.
3. The output of an engineer platoon assisted by an infantry platoon is 1½ times that of an engineer platoon.

0107. **Example.**

a. **Given Data**.

(1) Frontage = 2500^x
(2) Depth = 900^x
(3) Density = $1\frac{2}{3} = \frac{5}{3}$
(4) Number of mixed strip = 2
(5) Number of IOE group = 6
(6) Number of Cluster per group = 8
(7) Total turning points = 5 per srip
(8) 30% of the mixed clusters of the outer row of mixed strip is trip wired
(9). Troops available = 3 x Field Engineer platoon.

b. **Calculation**.

(1) **Number of Strips**. We know,
Number of strips = desired density÷standard density

$$= \frac{5}{3} \div \frac{1}{3}$$
$$= 5$$

Number of mixed strip = 2
Number of Anti tank strip = (5-3) = 3

(2) **Number of Cluster Per Strip**. We know,
Cluster per strip = Frontage x Standard density

$$= 2500 \times \frac{1}{3}$$
$$= 833.33$$
$$\cong 834$$

c. **Mines**.

(1) **Anti Tank mines**. We know,
Number of Anti Tank mines = {(number of mixed strip + number of Anti-Tank strip)x number of cluster per strip + number of IOE group x number of IOE cluster per group} + 10%

$$= \{(2+3) \times 834+6x8\} +10\%$$
$$= 4218+10\%$$
$$= 4218 + 421.8$$
$$= 4639.8$$
$$= 4640 \text{ Anti tank mines.}$$

(2) **Anti Personnel Mines**. We know,

Number of Anti Personnel mines = (3x number of mixed strip x number of cluster per strip + 3 x number of IOE group x noumber of IOE cluster per group) + 10%

= (3x2x834+3x6x8) + 10%
= 5148 + 10 %
= 5148 + 514.8
= 5662.8
≅ 5663 Anti personnel Mines

d. **Store Calculation**.

(1) **Pickets**.

(a) **Long Picket**. We know,

Number of long pickets =[{(Frontage + 2 x Depth)÷ 20}+1]+10%
=[{(2500+2 x 900) ÷ 20}+1] + 10%
= {(4300÷ 20)+1}+10%
= (215+1)+10%
= 216+21.6
= 237.6
≅238 Long pickets.

(b) **Short Picket**. We know,

Number of short pickets = {(Frontage ÷ 20xTotal TP+2 x no of strips)+(no of strips x frontage ÷ 100)+(2 x no of IOE gps)} + 10 %
= {(2500÷ 20+2x5x5+2x5)+(5x2500÷ 100)+(2x6)}+10%
= {(125+50+10)+125+12}+10%
= 322+10%
= 322+32.2
= 354.2
≅ 355 Short pickets

(2) **Barbed Wire**. We know,

Barbed wire coil = (3 x Frontage + 4 x Depth) ÷ 100
= (3x2500+4x900) ÷ 100
= 11100 ÷ 100
= 111 Barbed Wire Coil

(3) **Perimeter Sign Posting**. We know,

Number of perimeter sign posting = (2x Frontage + 2 x Depth) ÷ 40+ 10%
$=\frac{2x2500+2x900}{40}$ + 10%
= 170+10%
= 170+17
= 187 Perimeter sign posting

(4) **Tracing Tape**. We know,

Number of roll of tracing tape requirement = (number of strips x frontage + 2 x depth+ Length of guide tape) + 50 +107

= (5 x 2500 + 2x 900 +200) + 50 + 10%
= 14500 + 50 + 10%
= 290+ 10%
= 290 + 29
= 319 roll tracing tape

Note: Assumed guide tape = 200^{x}

e. **Transport**.

(1). **Mines.**

We know, 440 Anti tank mines are carr in 1 3-ton
So, 4640 Anti tank mines are carry in $\frac{4640}{440}$ 3-ton
= 10.55
≅ 11 3-ton lorry

4500 Apers Mine No-6 are carr in 1 3-ton lorry
So, 5663 Apers Mine No-6 is carr in $\frac{5663}{4500}$3ton lorry
= 1.26
≅2 3-ton lorry.

(2) **Perimeter Fencing.** Combination of the stores that 1 3-ton lorry can carry are:

(a) Barbed wire = 24 coil.
(b) Long pickets = 100
(c) Short pickets = 50
(d) Perimeter signs = 75

Now dividing it to the require number of items we get,

(e) Barbed wire 111 ÷ 24
= 4.63 ≅5 3-ton lorry
(f) Long pickets 238 ÷ 100
= 2.38
≅3 3-ton lorry
(g) Short pickets 355 ÷ 50
= 7.1
≅8 3-ton lorry
(h) Perimeter Signs187 ÷75 = 2.49 ≅3 3-ton lorry,

Taking highest value, we get number of 3-ton lorry required = 8 3-ton

(3) **For Personnel**.

Total manpower available = 3 x 51
= 153

28 person can be carry in 1 3-ton lorry

So, 153 person can be carry in $\frac{153}{28}$
= 5.46
≅6-3ton lorry

f. **Time Required**.

(1) We are given with 3x Field Engineer Platoon.

(2) Laying capability.

(a) Anti tank cluster.
In moon lit = 3 x 200x $\frac{2}{3}$= 400 cluster per hour.
In dark night = 3 x 200x $\frac{1}{2}$= 300 cluster per hour.

(b) Mixed cluster.
In moon lit = 3 x 100x $\frac{2}{3}$= 200 cluster per hour.
In dark night = 3 x 100x $\frac{1}{2}$= 150 cluster per hour.

(c) Tripped wire cluster.
In moon lit = 3 x 75 x $\frac{2}{3}$= 200 cluster/hour.
In dark night = 3 x 75x $\frac{1}{2}$= 112.2 cluster/hour.

≅112 cluster/hour.

(3) **Moon Condition**.

(a) D-Day.
3rd quarter 3rd day
Moon light will not be upto = (52x3)= 156 minutes.

(b) D+1Day.
3rd quarter 4th day
Moon light will not be upto = (52x4) = 208 minutes

(4) **Outer Strip (Mixed Strip)**

Number of cluster = 834

Number of cluster in outer row = $\frac{834}{2}$ = 417.

No of tripped wire in outer strip = 471 x $\frac{30}{100}$

= 125.1

≅126

In dark night, 112 tripped wire cluster laid in 60 minutes

So, 126 tripped wire cluster laid in = $\frac{126\ x\ 60}{120}$ minutes

= 67.5 minutes

≅ 68 minutes

Dark hour left = (156-68) = 88 minutes.

In dark night,

In 60 minutes cluster (mixed) laid = 150

In 88 minutes cluster (mixed) laid = $\frac{88\ x\ 150}{60}$ minutes.

= 220 minutes.

Left clusters = 834 - (126+220)

= 834-346

= 488 cluster (mixed)

In moon lit night,

200 cluster laid in 60 minutes

So, 488 cluster laid in = $\frac{60\ x\ 488}{200}$ minutes.

= 146.4

≅ 147 minutes.

Total time required = (156+147) minutes.

= 303 minutes.

= 5 hours 3 minutes.

Time left with night = 11 hours -5hour 3 minutes.

= 5 hours 57 minutes.

(5) **2nd Strip (Anti Tank Strip)**.

Number of clusters =834

In moon lit,

400 Anti tank cluster laid in = 60 minutes

834 Anti tank cluster laid in = $\frac{60\ x\ 834}{400}$

= 125.1 minutes
≅ 126 minutes

Night hour left = 5 hr 57 minutes - 126 minutes

= 3 hr 51 minutes

(6) **3rd Strip (Anti Tank Strip)**

Number of clusters= 834

In moon lit,
400 Anti tank cluster laid in = 60 minutes
834 Anti tank cluster laid in $= \frac{60\ x\ 834}{400}$
= 125.1 minutes
≅126 minutes

Night hour left = 5 hours 57 minutes -126 minutes
= 1 hours 45 minutes
≅ 105 minutes

(7) **4th Strip (Anti Tank Strip)**

In moon lit,
In 60 min, Anti tank mines laid = 400
In 105 min, Anti tank mines laid $= \frac{400\ x\ 105}{60}$
= 700
Clusters left = (834-700) = 134
The next mines will be laid in D+1 day
In dark night,
300 clusters laid in 60 min
So, 134 cluster laid in $= \frac{60\ x\ 134}{300}$
= 26.8 minutes
≅ 27 minutes

(8) **Fifth Strip (Mixed Strip)**

Dark hour left = (208-27) minutes
= 181 minutes

In dark night,
112 tripped wire cluster laid in 60 minutes
126 tripped wire cluster laid in $= \frac{60\ x\ 126}{112}$
= 67.5 minutes
≅ 68 minutes

Dark hours left = (181-68) minutes
= 113 minutes

In dark night,
In 60 min mixed cluster laid = 150
In 113 minutes mixed cluster laid = $\frac{150 \text{ x } 113}{60}$
= 282.5
≅ 282

Cluster left = 834 (126+282)
= 426 mixed cluster.

In moon lit night,
200 cluster (mixed) laid in 60 minutes
426 cluster (mixed) laid in $= \frac{60 \text{ x } 426}{200}$

= 127.8 minutes
≅ 128 minutes

Total time required = (181+128) minutes
= 309 minutes
= 5 hour 9 minutes

. g. **Summary of Calculation**

(1) **Minefield Laying.**

(a)	Start Time.	1830 hours D-Day
(b)	Completion Time.	0006 D+1Day
(c)	Total Anti Tank Mine.	4640
(d)	Total Anti Personnel Mine.	5663
(e)	Transport Required.	23 3-ton lorry.

0108-0200 Reserve.