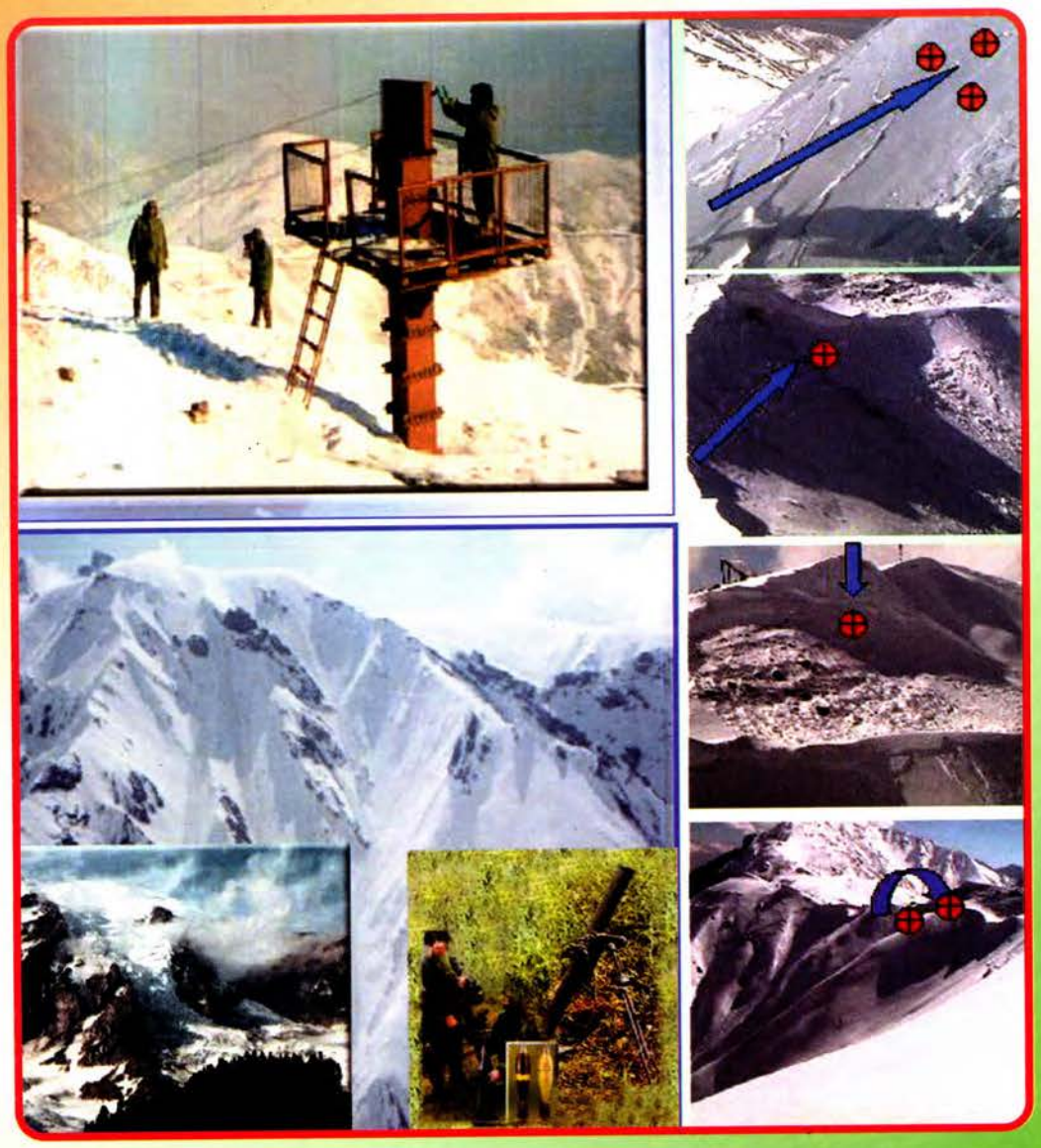
USER'S GUIDE ON CONTROLLED RELEASE OF AVALANCHES

(MARCH 2002)



SNOW & AVALANCHE STUDY ESTT.

MANALI (HP)

USER'S GUIDE

ON

CONTROLLED RELEASE OF AVALANCHES

SNOW & AVALANCHE STUDY ESTT.
MANALI (HP)

MARCH 2002

AFG / AT/1/2002-3

Copy No.....

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SASE

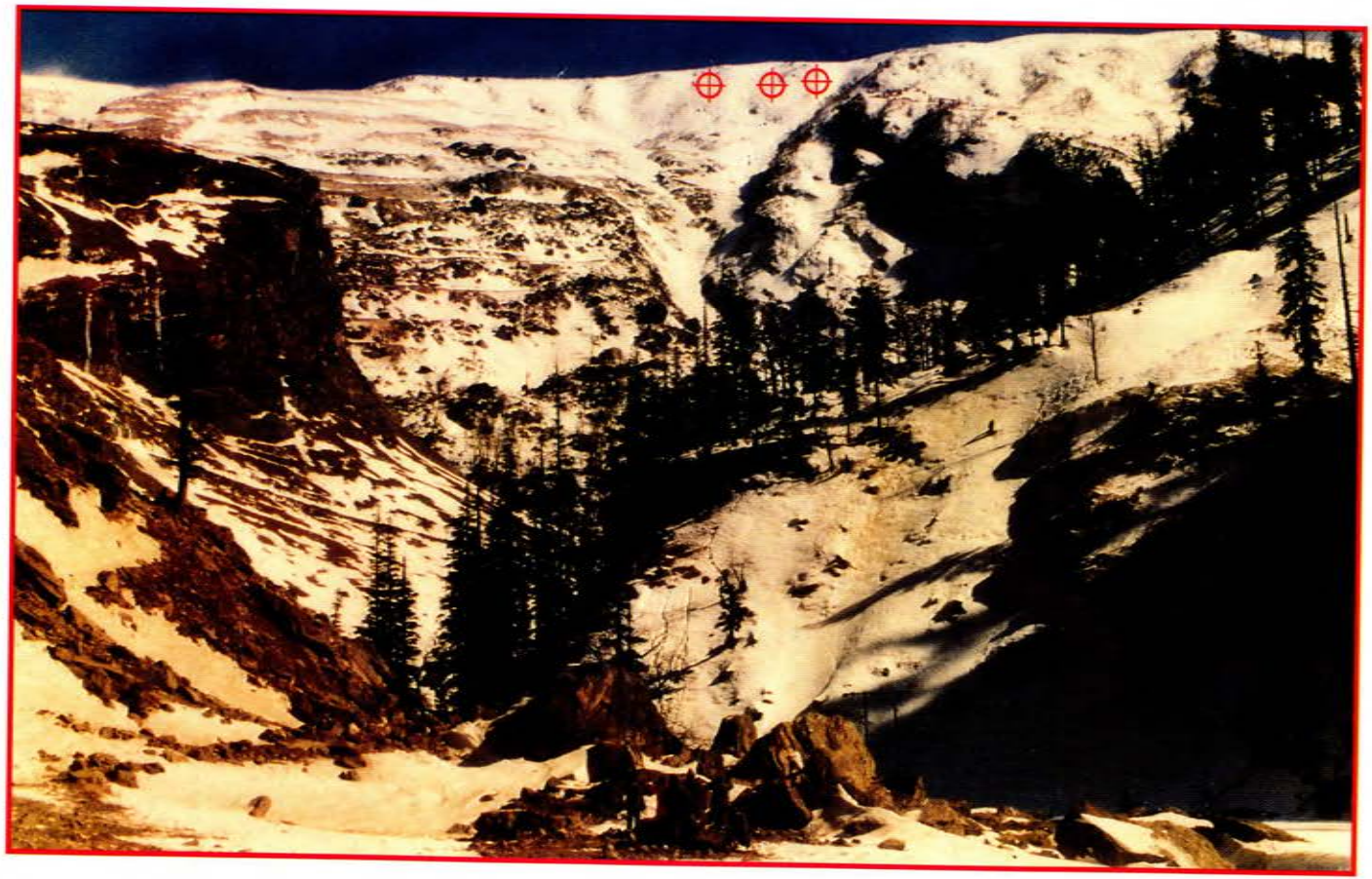
VISION

Let no jawan die in snow avalanche in Indian Himalaya

Develop avalanche awareness in the
Defence services
and to provide technological support for saving lives
and property of the civil and army personnel
operating in the snow bound region,
and to contribute in the
overall development
of the snowbound regions of our country

OUR MISSION

- **Avalanche forecast in Indian Himalaya for army and civil user**
- **Avalanche control by structures and explosives**
- **Basic Research and collection of snow and meteorological data of snowbound areas for mountain meteorology and snow cover information system**



FOREWORD

Avalanches are likely to occur whenever there are deep accumulations of snow on steep slopes. Avalanche hazard, however, develops only when people interact with it or when their facilities come in the path of an avalanche site.

In our context, Himalaya is one of the worst avalanche prone areas and our interaction with avalanches is unavoidable. These natural demons, therefore, need positive control to minimize their hazard potential.

Artificial triggering/controlled release of avalanches is one of the most effective and cheap methods of controlling avalanche problem. The methodology of artificial triggering of avalanches encompasses the entire spectrum of events from selection of targets to the triggering of avalanches. Pre-planting, hand placing and remote delivery of explosive are the common modes of artificially stabilizing the slopes. SASE has extensively tried the technique and met with reasonable success. Inaccessibility of avalanche formation zones, however, remains a severe limitation.

Artificial triggering of avalanches, is a widely practised control method in North American and European countries. This is the most effective means of combating avalanche danger and also the most convenient approach for undertaking hazard free movements in avalanche prone areas. The control programme envisages, identification of the area, gathering of information, selection of trigger mechanism and mode of explosive delivery, selection of targets, gun positions and determination of the time of firing.

This document aims at providing an overview of the Controlled Release of Avalanches with a special emphasis on ***Selection of Targets*** for artificial triggering of avalanches using explosives. It also gives some examples which can be taken up as the model examples. I am confident that this document will serve as a useful document to the officers deployed in avalanche prone areas in planning artificial triggering of avalanches.

HQ SASE, Manali, (HP)
April, 2001.

Maj Gen (Retd) SS Sharma
Director, SASE

सत्यमेव जयते
डॉ. वी.के. आत्रे
रक्षा मंत्री के वैज्ञानिक सलाहकार तथा सचिव

रक्षा अनुसंधान तथा विकास विभाग
रक्षा मंत्रालय
साऊथ ब्लॉक, नई दिल्ली - 110 011
Dept. of Defence Research & Development
Ministry of Defence
South Block, New Delhi-110 011 (India)

MESSAGE

It gives me great pleasure to inform that the Snow and Avalanche Study Establishment (SASE), Manali, HP is publishing a user's guide on "Controlled Release of Avalanches". This is a user-friendly document and is aimed at providing systematic information about controlled release of avalanches.

I am sure that this booklet will serve as a life saving document for the troops deployed in avalanche prone areas of various mountain ranges of Himalaya and will also help them in planning the movements through the difficult avalanche prone areas. I am glad to learn that such publications in past have been appreciated by the user and have been found helpful in reducing casualties due to avalanches.

I wish the SASE every success and congratulate the publication team and all members of SASE on this occasion.

New Delhi
Dated : 11 Oct. 2001

(DR. V.K. AATRE)
Scientific Advisor to D.M. & Secretary

एम. नटराजन
विशिष्ट वैज्ञानिक
मुख्य नियंत्रक अनुसंधान तथा विकास (एसीई)
M. NATRAJAN
Distinguished Scientist
Chief Controller Research & Development (ACE)

सत्यमेव जयते

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Defence Research & Development Organisation
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DHQ PO, New Delhi-110 011 (India)

MESSAGE

I am delighted to note that Snow and Avalanche Study Establish-ment (SASA) is publishing a user's guide entitled "Controlled Release of Avalanches".

This document will generate awareness about the artificial triggering of avalanches among the troops deployed in extremely difficult avalanche prone areas in our country. This booklet provides step-by-step information to the users about the artificial triggering of avalanches. I am sure that the efforts made by SASE for producing this valuable document will help the troops at the grass root level in planning movements through the difficult avalanche prone areas and will also help in reducing mishaps due to avalanches.

I congratulate the SASE publication team and wish this pioneering establishment all success in their endeavours.

M Natarajan.

(M NATARAJAN)
DS, Chief Controller R & D

New Delhi
Dated : 06 Nov. 2001

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उत्तर कमान मुख्यालय
Headquarters
Northern Command
C/o 56 APO

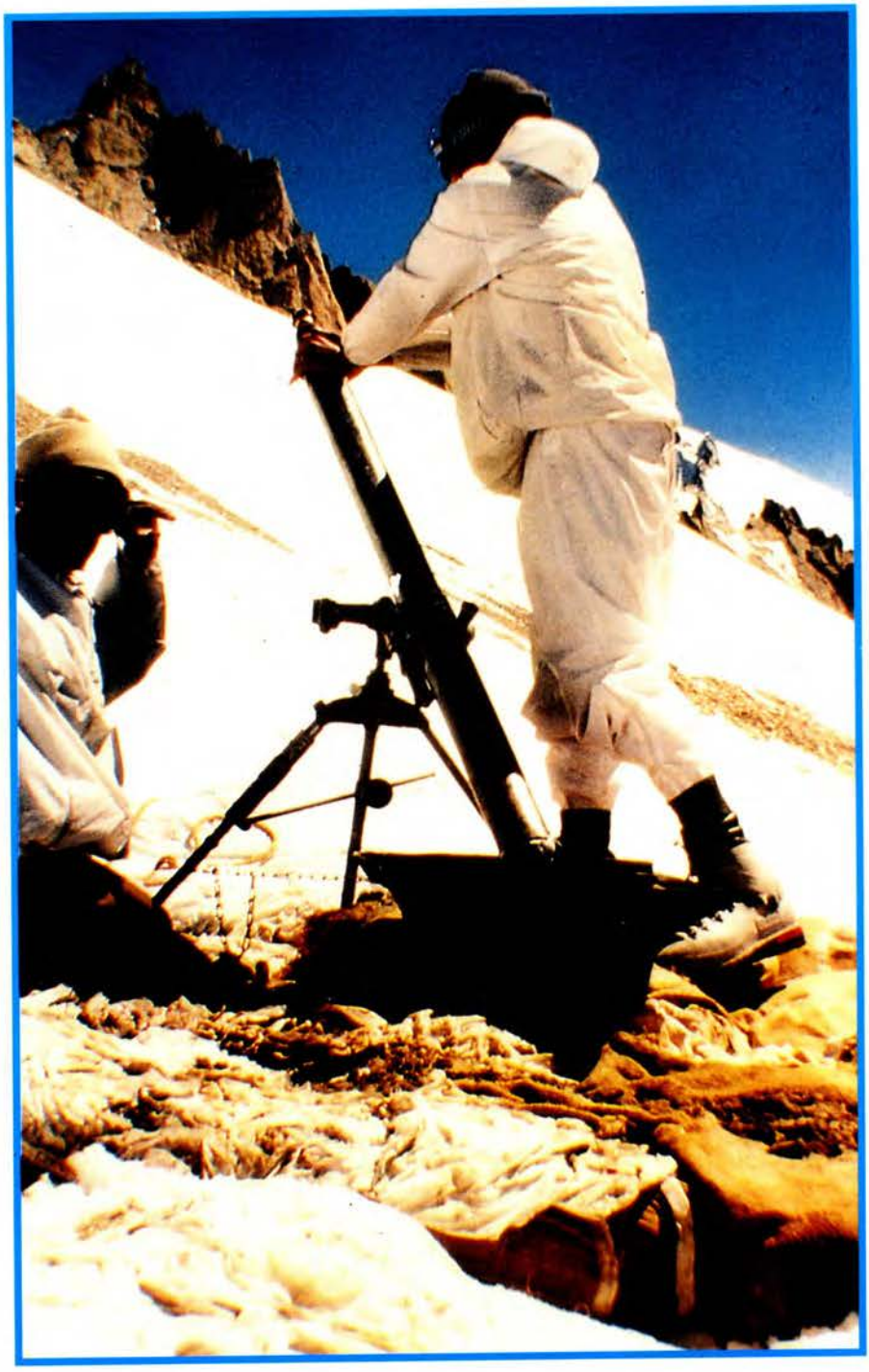
MESSAGE

1. For those of us who have to live and operate day after day in avalanche prone areas and for those of us who have been witness to the awesome fury and death dealing destruction of avalanches, this user's guide will be a welcome addition to our training libraries.

2. In Operation MEGHDOOT, in the Siachen Glacier alone, our avalanche-related fatalities have been reduced from a mean of 18 during the period from 1985 to 1996 to a low of 6 in the subsequent years - a remarkable saving of invaluable lives. The credit, in no small measure, must go to SASE. To the user I say, "Study this guide, 'teach it', during pre induction training and practise it thereafter. It may save your life".

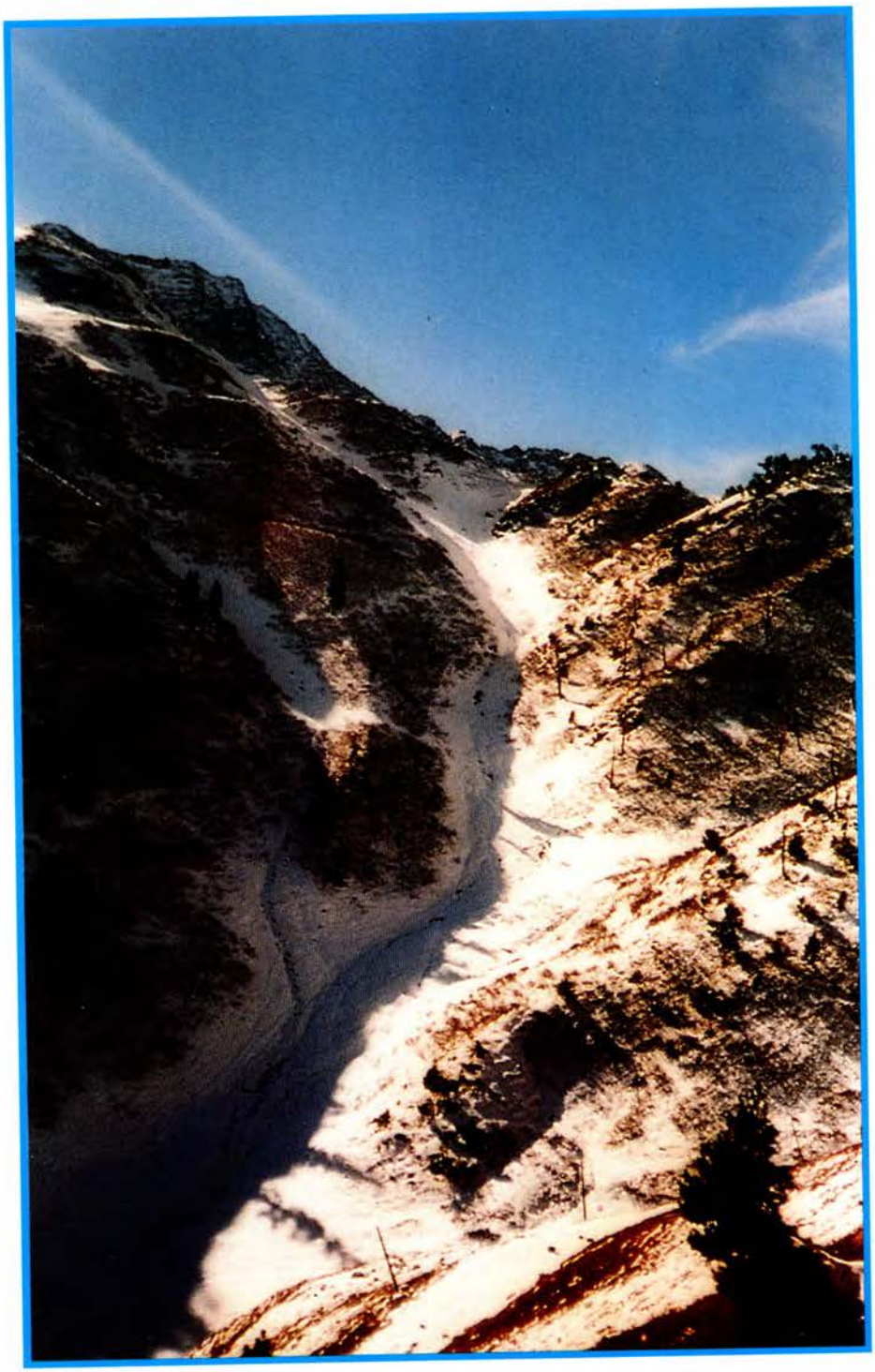
(RK NANAVATTY)
Lt General
General Officer Commanding-in-Chief
Northern Command

Dated : 23 Oct. 2001



CONTROLLED RELEASE OF AVALANCHES

CONTENTS



INTRODUCTION

1. Snow Avalanche is a sudden downward motion of snow mass. Avalanches are formed due to structural weaknesses within the snow cover. Accidents and damage from interaction of avalanches with human activities can be prevented by triggering avalanches, by allowing the passage of persons during safe period, or by placing the structures in the avalanche paths. Avalanche control methods include arresting the natural occurrence of avalanches, diverting avalanche flow pattern, preempting natural releases with explosives and retarding its motion. Locating the facilities in safe areas, designing facilities against avalanche forces, restricting the access of flowing mass to inhabited areas, and choosing safe routes for travel, work and recreation area are a few preventive measures used for evading avalanche hazard. Avalanche protection measures can be classified into temporary and permanent measures.

(a) Temporary measures. These measures are active measures applied for short periods when avalanches are expected to occur. The advantages are flexibility and low cost, but they require a continuous evaluation of hazards and application of safety measures.

(b) Permanent measures. These passive measures usually require high expenses for engineering works, which perform without the need for daily hazard evaluation. Since passive measures are very expensive and can not be adopted for all avalanche affected areas of Himalaya, hence their usage is restricted to a few places only.

2. Controlled release of avalanches by explosive is one of the most effective and cheap methods of controlling avalanche problem. This meets the desired objective and includes acceptable intangibles. Countries of Europe and USA have carried out a lot of work on artificial triggering and evolved different methods for controlled release of avalanches. We have also adopted the same techniques for controlled release of avalanches and gained valuable experience. Explosive are primarily used for avalanche control in snow safety work and are also used to test the stability of the snow pack.

3. **Aim.** The technique aims at the following:-

(a) Release unstable avalanche mass in small increments to avoid its build up to damaging proportions.

(b) To test the stability of snow pack.

4. **Controlled Release of Avalanches** is carried out when exposed area such as roads, tracks, patrol routes and ski runs are not occupied. The area may be opened after avalanche release. Frequent explosive control usually ensures that snow is brought down in several small avalanches, rather than a single large one. Smaller avalanches may not reach the facilities, and snow removal time on the road can be minimized, making closures shorter. Also, frequent avalanche release prevents large unpredictable natural avalanches later during the snow melt period.

5. **Snow Pack Stability.** Explosive should be applied when the snow stability is poor because little additional stress is needed for fracture propagation. If the snow above a weak layer is cohesive enough for a fracture to spread over a wide area, a slab avalanche is produced; and this should be done before the instability is deep, so that large avalanches are not produced. Identifying situations when small avalanches can be produced requires **careful evaluation of snow stability** and **accurate timing.** Application of explosive **too early** during a snowfall might **yield little or no avalanche. Late application produces avalanches larger than desired.** Snow remains unstable for a long time when the temperature is low, but it can get stabilized rapidly at moderate temperatures. In this case, the time for successful control may pass in a few hours.

6. **Timing** is delicate when snow loses fracture propagation potential by wetting or due to high temperatures, particularly with the onset of rain on new snow. Generally, explosives are much less effective in wet snow than in dry snow. Field evidence indicates that when the temperature rises there is short critical time period before the snow stiffness is reduced and failure layer is still dry. In such cases, the time for explosive application may be estimated by observing the air temperature increase, solar radiation (just after sun shine), and snow temperatures.

METHODS OF CONTROLLED RELEASE

7. Controll by explosives has a low cost and high flexibility associated with it, but it requires skilled personnel, snow stability evaluation and a safety plan. A safety plan includes descriptions of individual responsibilities, access to firing positions, suitable methods for controlled release of avalanches as per location/sites, procedure for closures and evacuation of areas and communication.

8. The person responsible for avalanche controlled release should be able to take decision about the time and location of explosive use. He should be knowledgeable and responsible about the hazards of explosives and avalanches and be a certified blaster.The methods for application of explosives are enumerated in the following paragraphs.

Hand Placing/Lobbing of Explosives.

9 This is one of the most suitable methods for the troops located at hill top/ridge where the nearby formation zones of avalanches are accessible or visible. The shot placements are predetermined. The routes are marked with posts having reflectors which facilitate orientation in bad weather and at night. A hand explosive consists of explosive usually 1 kg and sometimes larger, particularly for wet snow. Avalanche control persons often assemble charges at the operation base a short time before use and pack them into an area near the avalanche starting zones. At safe location the charges are ignited with a pull-wire igniter and tossed by hand to the desired spot in the formation zone of an avalanche area. To ensure that the explosive is detonated at exactly the pre designated spot it may even have to be attached to an anchor cord.

10. **Advantages.** Hand explosives are commonly used in areas where access to the formation /starting avalanche zones is easy. The cost of hand charges is low as no capital investment of mechanized delivery system is needed. The application is simple, flexible and safe when safety guidelines are followed.

HAND PLACING/ LOBBING OF EXPLOSIVES

Hand Placing

- Charges are placed by hand
- Person is secured by a rope

Lobbing

- Used when it is not possible to reach target location
- Charge is ignited and thrown by hand

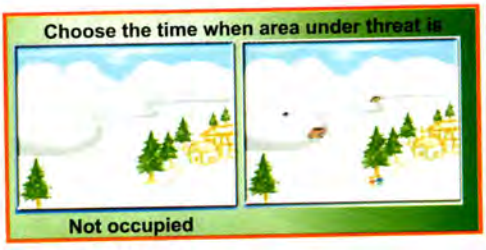
Remote Delivery.

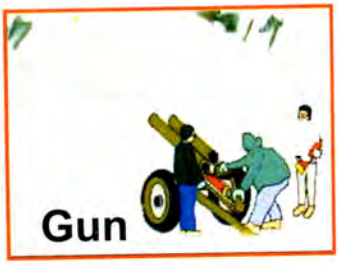
11. Infantry and artillery weapons are used for avalanche control which consist of bazookas, recoilless rifles, howitzers and mortars. The choice of a specific artillery weapon depends on the required range and availability of weapons and ammunition. In North America and Europe, the most commonly used military weapons include the 75, 105 and 106 mm recoilless rifles. However, for large areas and longer ranges, 105 mm Guns are also used. In India, we are using the following direct/indirect firing weapons for artificial triggering.

Sr. No.	Weapon	Amn	Max Range (m)	Payload (Kg)
1.	75/24 mm How	TNT Gde 1	8,800	0.787
2.	105 mm IFG	TNT	11,300	2.3
3.	81 mm Mortar	TNT	5,000	0.7
4.	51 mm Mortar	TNT	500	0.165
5.	106 mm RCL	RDX/TNT	3110	1.242
6.	84 mm RL	RDX/TNT	1000	0.4

12. Out of the above the weapons at serial 1 and 2 only have been used during trials.

13. **Advantage of Artillery Weapons.** Some of the advantages of artillery are that the gun allows quick firing at **numerous targets** with predetermined firing data. This method of remote delivery is very useful during **poor visibility, snow falls** and also **at night**. Also, the method is flexible because the **shot placements may be modified easily** and the distant inaccessible avalanche starting zones can be reached with judicious planning.





Avdhav Visphotak Vahan (Sprengbahn).

14. Sprengbahn is a German name, which means a carrier for explosive and is based on the **principle** of getting maximum blasting of a charge above the surface of snow. It has been seen that an explosive buried in the ground or in snow generates shock waves which are sufficient to make a crater in snow. A number of such craters in the rupture zone may release an avalanche, but quantity of explosives required and the risk involved are too much. At the same time, it has been seen that **small quantity of explosive fired in the air** with downward direction of detonation **gives a bigger cone** having more effect than the diameter of the crater, which would have been created by the equal quantity of the buried charge in snow.

15. **Description.** Avdhav Visphotak Vahan **(AVV)** consists of two wheels installed on two ends of an avalanche formation zone and a SWR running on the wheels. One of the wheels is installed at a place which is relatively easily accessible in any winter condition. This wheel is known as the **Near End Wheel** and is equipped with handles for its rotation. The **far end wheel** is a simple pulley, which is properly anchored and aligned. See in fig 1 and fig 2. The SWR running over the wheels is divided into pairs, viz. the lower SWR and upper SWR. A **sling** is attached to the lower SWR. The sling consists of the same material and diameter as that of the main SWR. The sling is 2 to 3 m long depending on the avalanche site.

16. **Operation.** With the sling a nylon cord 2-3 m long is hung. With this cord , an explosive charge of 1 to 2 kg weight , 6 to 10 cm diameter is hung. The dimensions depend on the extent of the avalanche slope. The explosive is initiated by means of 3-4 m of safety fuse to achieve sufficient delay for carrying the explosive at the rupture zone and for the safe deployment of the men operating the **AVV**. After initiating and hanging the charge, it is moved forward by means of the near end wheel till the charge reaches the required point on the rupture zone.

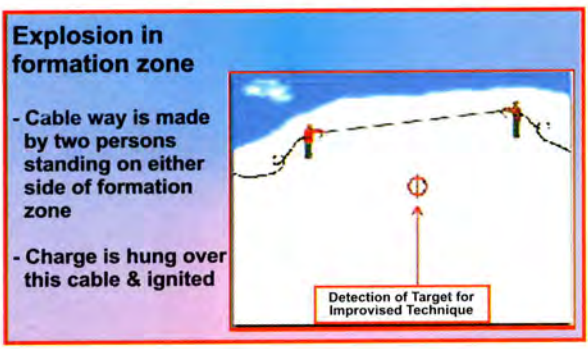
17. In case of poor visibility, the SWR is marked in such a way that the person operating the near end wheel **may find out the required position for the near end wheel without seeing the charge.** In case avalanches are likely to release from more than one avalanche zones, the **AVV** is so aligned that the charge can reach all the formation zones.Such avalanches can be tackled by putting charges simultaneously or separately.

Fig. 1

Fig. 2

18. **Characteristics Of AVV.**

- It is a very simple device, and does not involve any calculations and elaborate arrangement.
- It is very economical. There is some initial cost involved in the installation of the equipment, but additional costs are practically nil.
- **Hand operated AVV does not involve much of an expenditure.**
- It is very easy to install and operate.
- Most suitable for ski areas. It is also used for roads and populated areas on accessible avalanche slopes.
- No chance of failure and no nuisance of unexploded bombs.
- Very primitive device. There is a lot of room for modifications, and improvements, depending on the the site conditions.



IMPROVISED AVDHAV VISPHOTAK VAHAN (AVV)

MODIFIED AVV

Tragger.

19. This is a similar system to AVV. It **Consists of a single post/boom** as shown in figure3 and 4. The Charge is lowered to the starting zone from a boom that pivots out from a ridge, similar to a crane or fishing rod. The advantage is placement above the snow surface, but the desired targets must be close to the ridge.This device is very effective for cornice breakage and can be installed easily at the known place of cornice.

TRAGGER

Fig. 3

MODIFIED TRAGGER

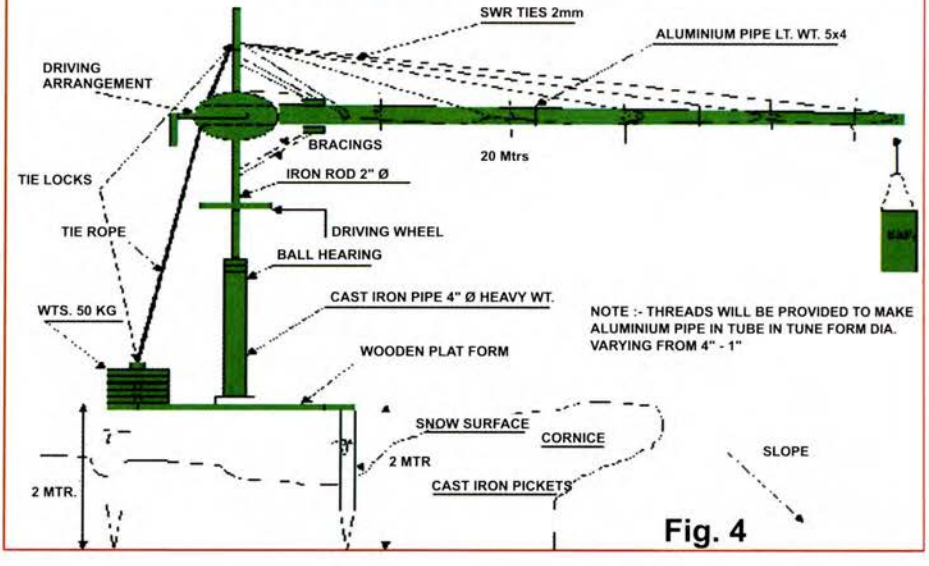


Fig. 4

SELECTION OF TARGETS AND GUN POSITIONS

20. **Firing/Gun Position**.

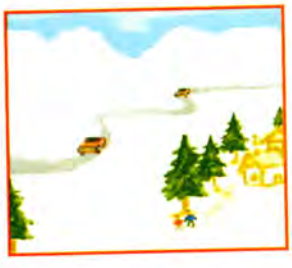
Gun position and target selection should be planned well in advance, during summer season. Blasters and artillery crews should be at a location that is safe from all surrounding avalanche slopes. In addition , access to firing positions should be safe. Gun position and target location should be planned with consideration for hazards to occupied areas, particularly when the possibility of overshooting the mountain ridges exists. Avoid those locations for gun/weapon position, which are under the direct threat of air borne avalanches or air blast, avalanches from opposite hills and adjacent avalanche slopes.

Gun position and target locations should be planned

Roped belays should be used whenever necessary

Blasters should be at a safe position from avalanche slopes

Areas may be opened after several hours if avalanche has not occured



21. **Likely Target Areas.** Target Selection is a time consuming process and involves detailed planning. Ideal targets are those areas in the snow pack which have maximum weaknesses. Evidently these are also the areas of maximum stresses. Convexities and concavities are the zones of maximum stresses. The areas of potential fracture zone/crown locations are given below:-

(a) Convexities/Concavities.

(b) Steep Inclines.

(c) Areas of abrupt changes of gradient.

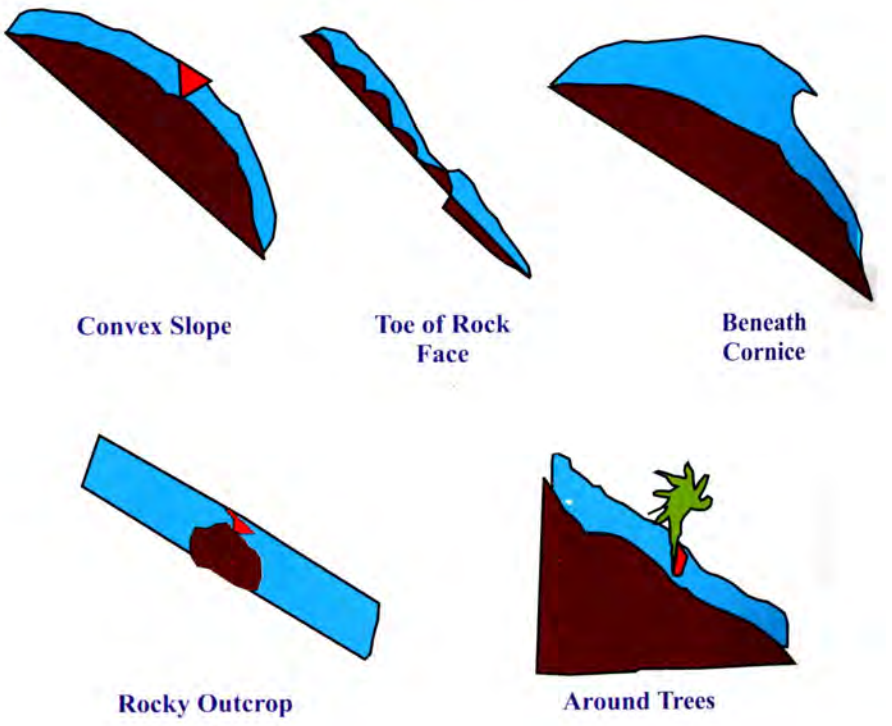
(d) Areas close to rocks/ vegetation, being source of heat and inducing hoar formation.

(e) Open slopes.

(f) Areas of uneven depth of snow.

(g) Points just below cornices.

POSSIBLE CROWN LOCATIONS



22. **Influence of Charge Placement.**

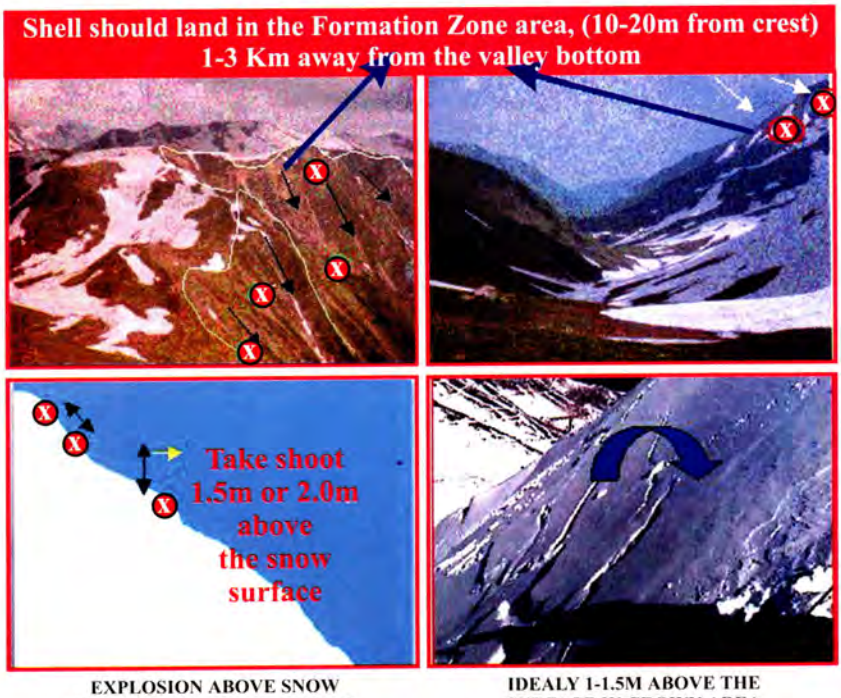
(a) Experience has shown that, as a first guess, explosive charges are best placed about 10-20 m below the expected crown of the slab avalanches. On a specific slope, shot location may be shifted depending on the wind direction.

(b) Shots on open slopes where shock waves may spread freely are more effective for releasing the snow slabs than on a rugged terrain interrupted by barriers such as ridges and rocks. In narrow, confined terrain e.g, rock gullies, explosive may start small avalanches that could trigger larger ones below.

(c) The explosive detonated above or on the snow surface have wider range than those exploded inside the snow cover. For optimum effect 1 to 2 kg charges should be detonated at about 1.5 m above the snow surface. The general guideline for detonation of explosive is given as under.

Sr. No.	Charge (Kg)	Detonation height w.r.t snow surface (m)
1	01	1.5 - 2.0
2	02	2.5 - 3.0
3	03	3.5 – 4.5
4	04	5.0

(d) Artillery shell has disadvantage of exploding on or just below snow surface. Sometimes artillery has better effect when aimed at exposed rocks above the surrounding snow surface as it can propagate a shock wave through the ground which helps in dislodging the unstable snow.



EXPLOSION ABOVE SNOW SURFACE HAS WIDER RANGE

IDEALY 1-1.5M ABOVE THE SURFACE IN CROWN AREA

Target Selection By DEM.

23. Various steps involved in selection of targets using Digital Elevation Model are as under:-

(a) Study and demarcation of the area on survey map.

(b) Identification and delineation of avalanche sites.

(c) Digitization of the map and preparation of DEM.

(d) Marking of the avalanche sites and the track on the DEM.

(e) Marking of flow lines.

(f) Draw L-section of each gulley.

(g) Identify tension and shear zones.

(h) Select preliminary target locations.

(i) Drape summer imagery with flow lines.

(j) Reconfirm targets and eliminate targets which lie in forested area.

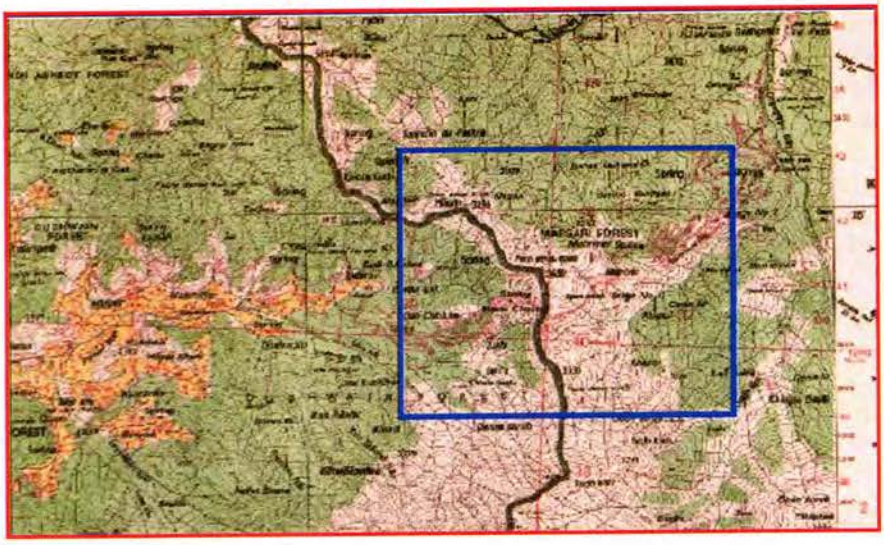
(k) Drape winter imagery and transfer the targets.

(i) Give sequence of target firing.

24. **Study and survey of map.** This step involves the study of maps / photographs and physical survey of the area for selection of targets.Normally 1:50,000 scale topographical maps with 40 m contour interval yield general information regarding the terrain geometry. Survey maps, aerial photographs of winter as well as summer, information from the locals and own observers form the mainstay in target selection. L and X-Sections of various **fall lines** of the formation zone are drawn to delineate points which exhibit sudden change in the slope geometry. Super - imposition of other information like existence of rock, broken ground, forest area and such like terrain perturbations on L and X-Sections help in **target selection.**

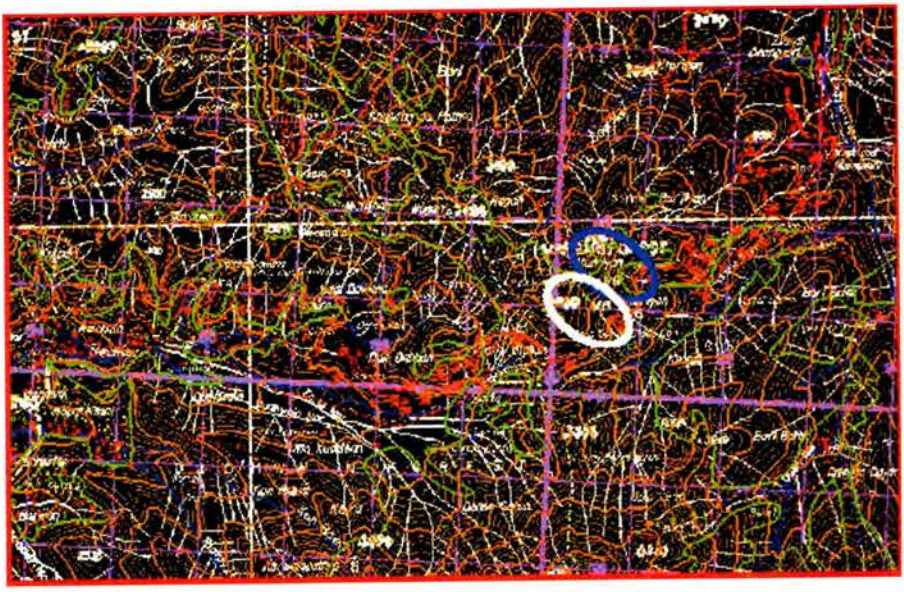
25. Remaining steps for the selection of targets are pictorially explained with the help of sketches/photographs in the subsequent pages.

STUDY AND DEMARCATION OF THE AREA ON SURVEY MAP



IDENTIFICATION AND DELINEATION OF AVALANCHE SITES

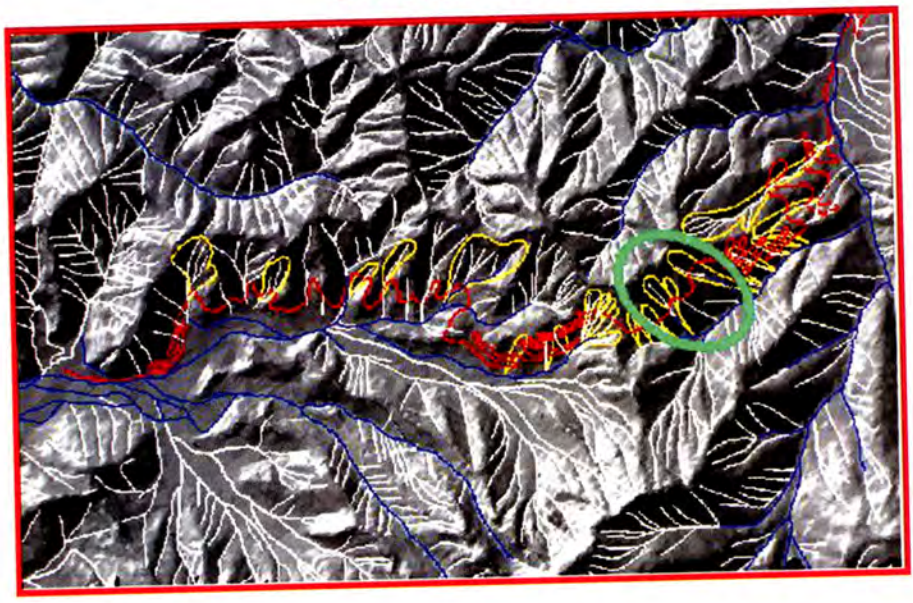
DIGITISATION OF THE MAP FOR PREPARATION OF DEM



MARKING OF THE AVALANCHE SITES AND TRACK ON DEM

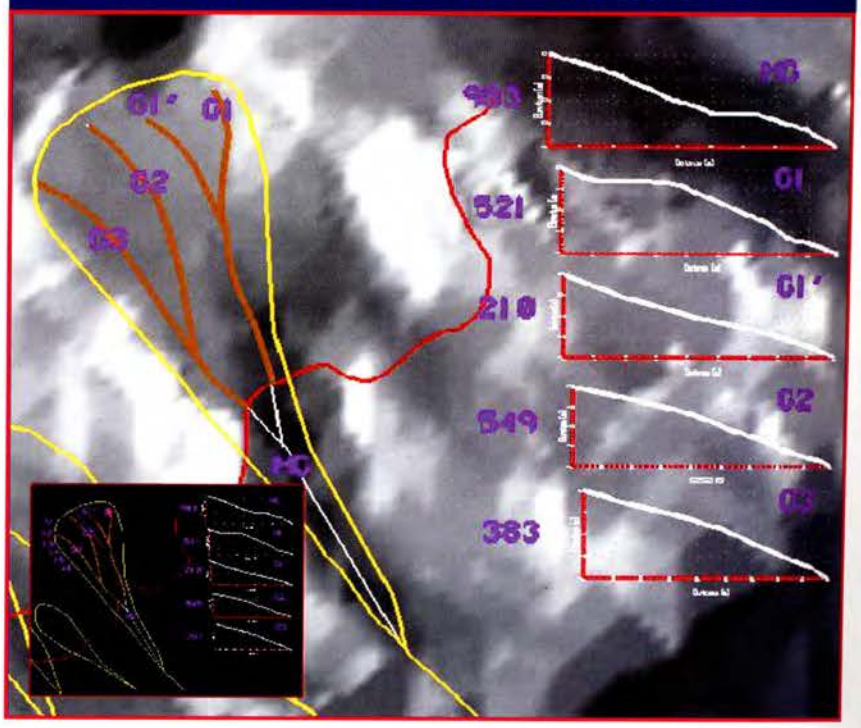
DIGITAL ELEVATION MODEL (DEM) OF
CHOWKIBAL - TANGDHAR ROAD AXIS (CT-AXIS)

DRAPING OF FLOW LINES ON THE DEM

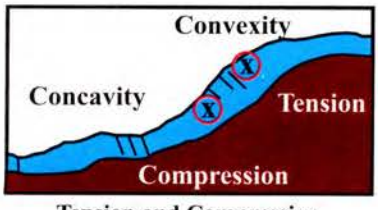


AVALANCHE SITES WITH FLOW LINES AND TOPO SHEET DRAPED ON THE DEM

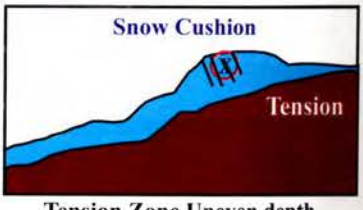
DRAW L - SECTION OF EACH GULLEY



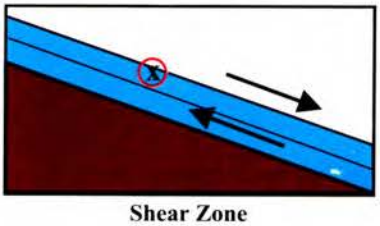
IDENTIFY TENSION, SHEAR AND COMPRESSION ZONES VISUALLY FROM THE SYNTHETIC DEM



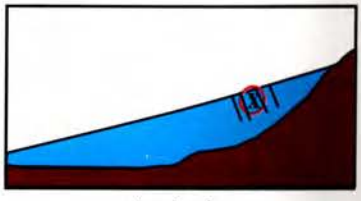
Tension and Compression



Tension Zone Uneven depth

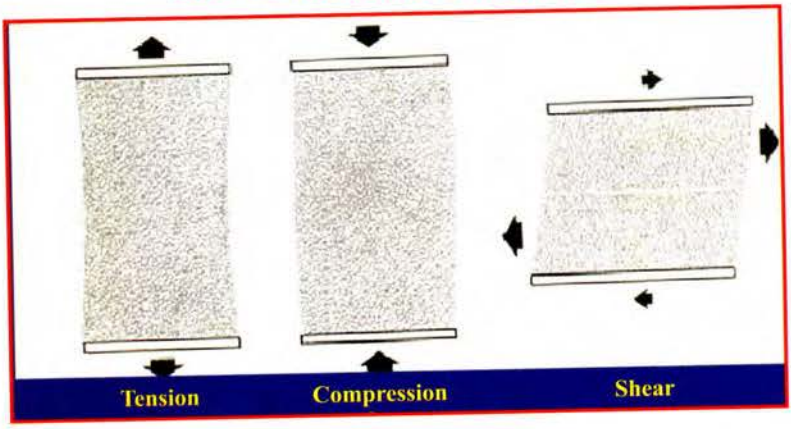


Shear Zone

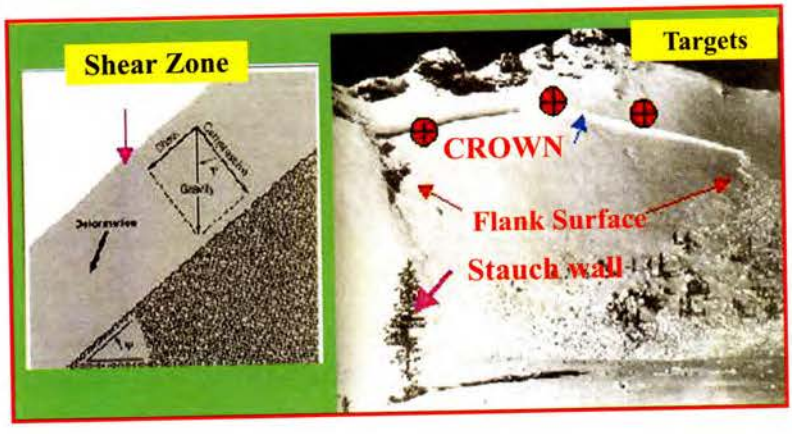


Anchoring

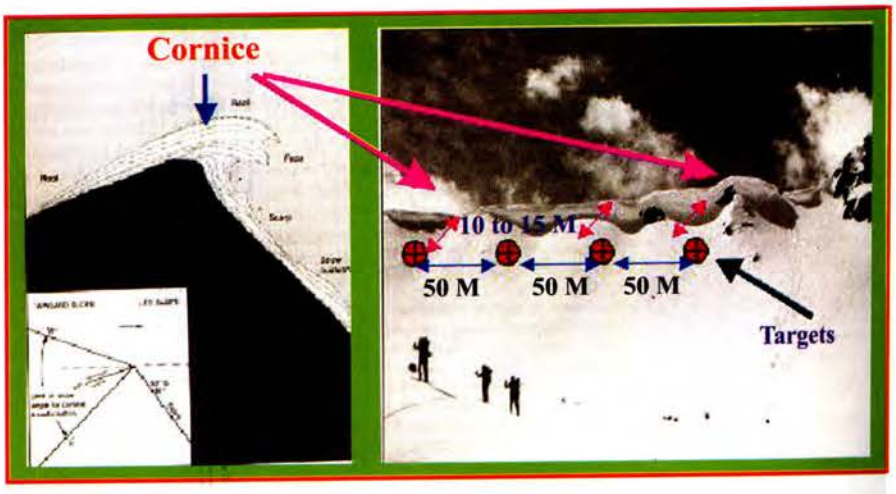
IDENTIFICATION OF SHEAR, TENSION AND COMPRESSION ZONES

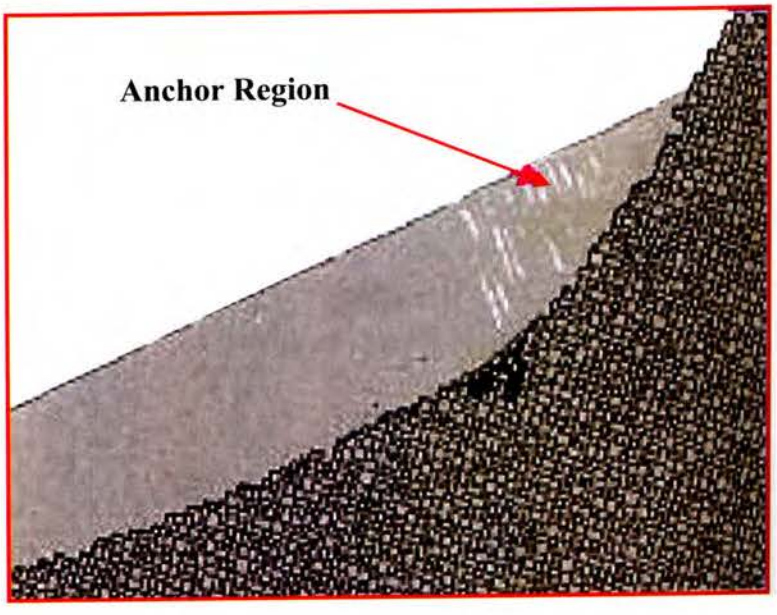


SHEAR ZONE



IDENTIFICATION OF CORNICE
&
ANCHOR REGION





SELECT PRELIMINARY TARGETS

PROBABLE LOCATIONS WHERE SHELL SHOULD LAND IN THE FORMATION ZONE AREA

A view of avalanche after Artificial Triggering

DRAPE SUMMER IMAGERY

WITH ROAD,

AVALANCHE SITES AND

FLOW LINES

SUMMER SATELLITE IMAGERY

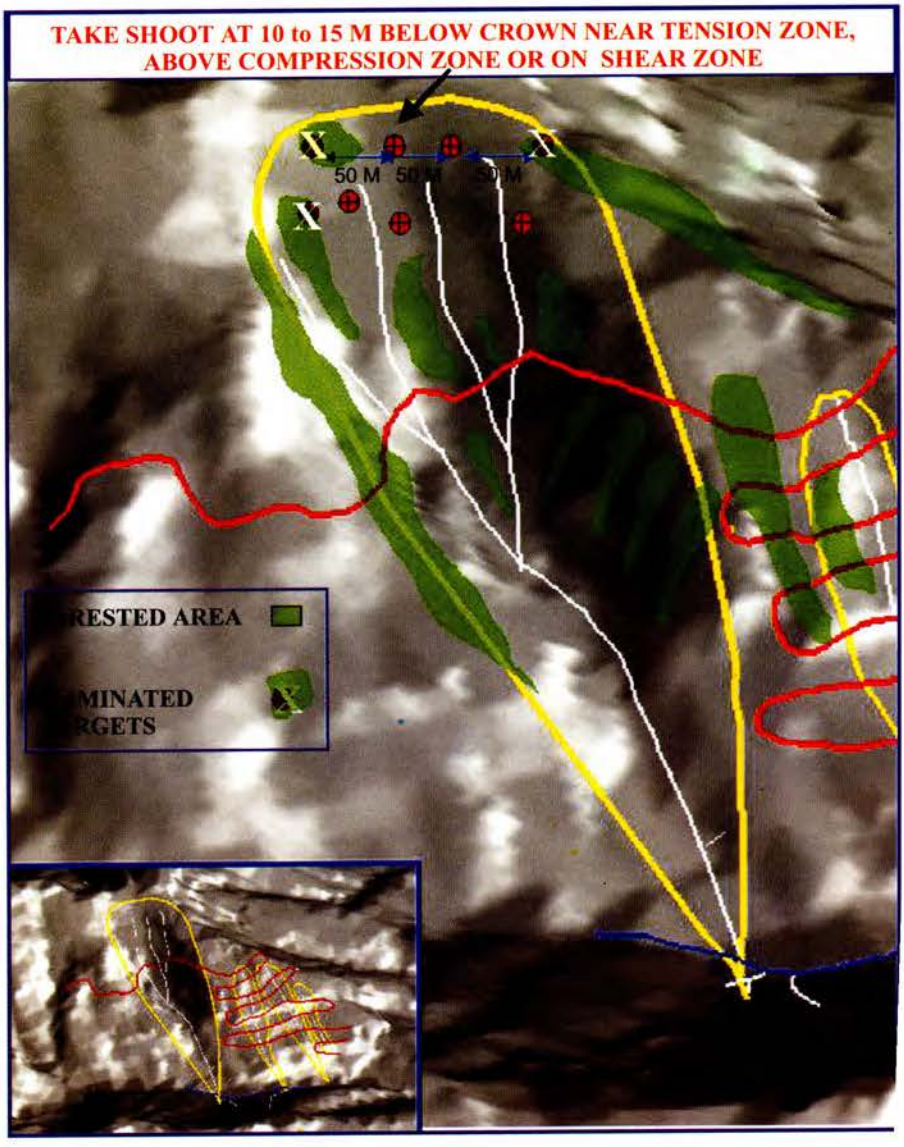
WITH

AVALANCHE SITES

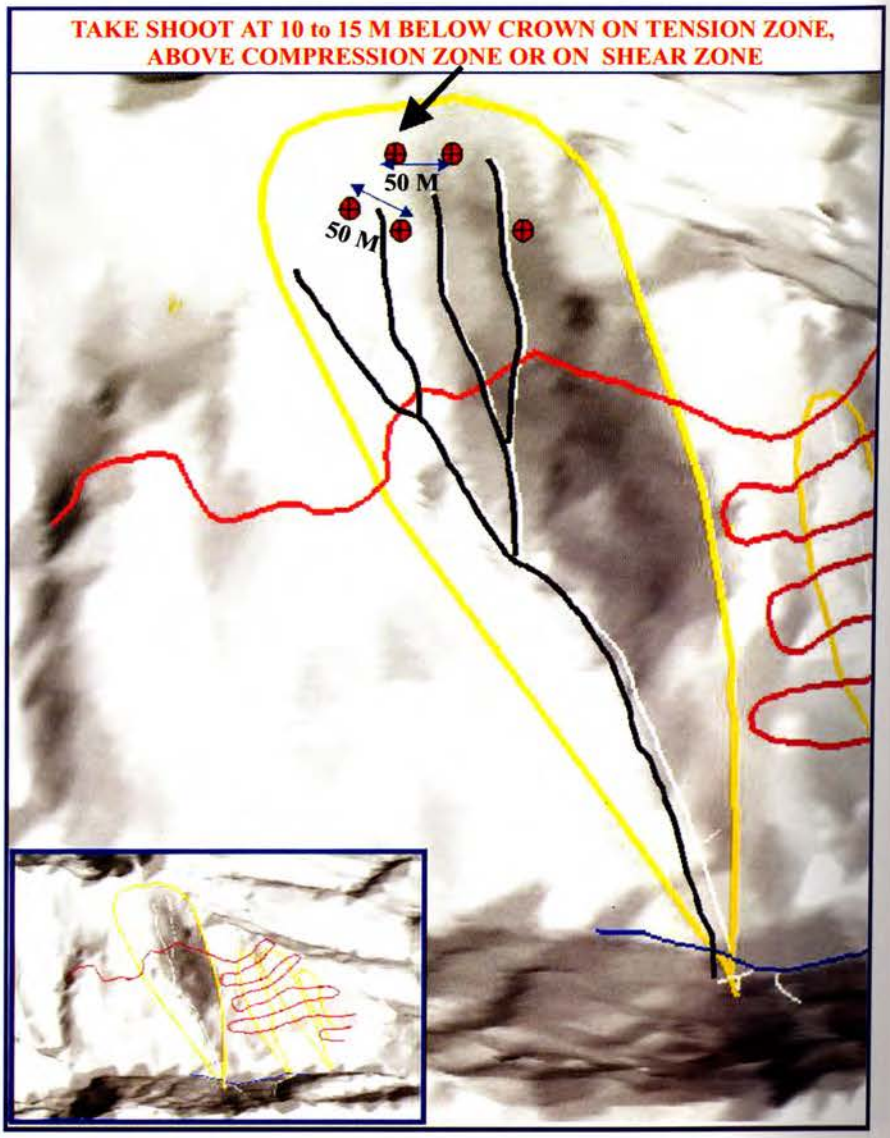
AND

ROAD DRAPED ON THE DEM

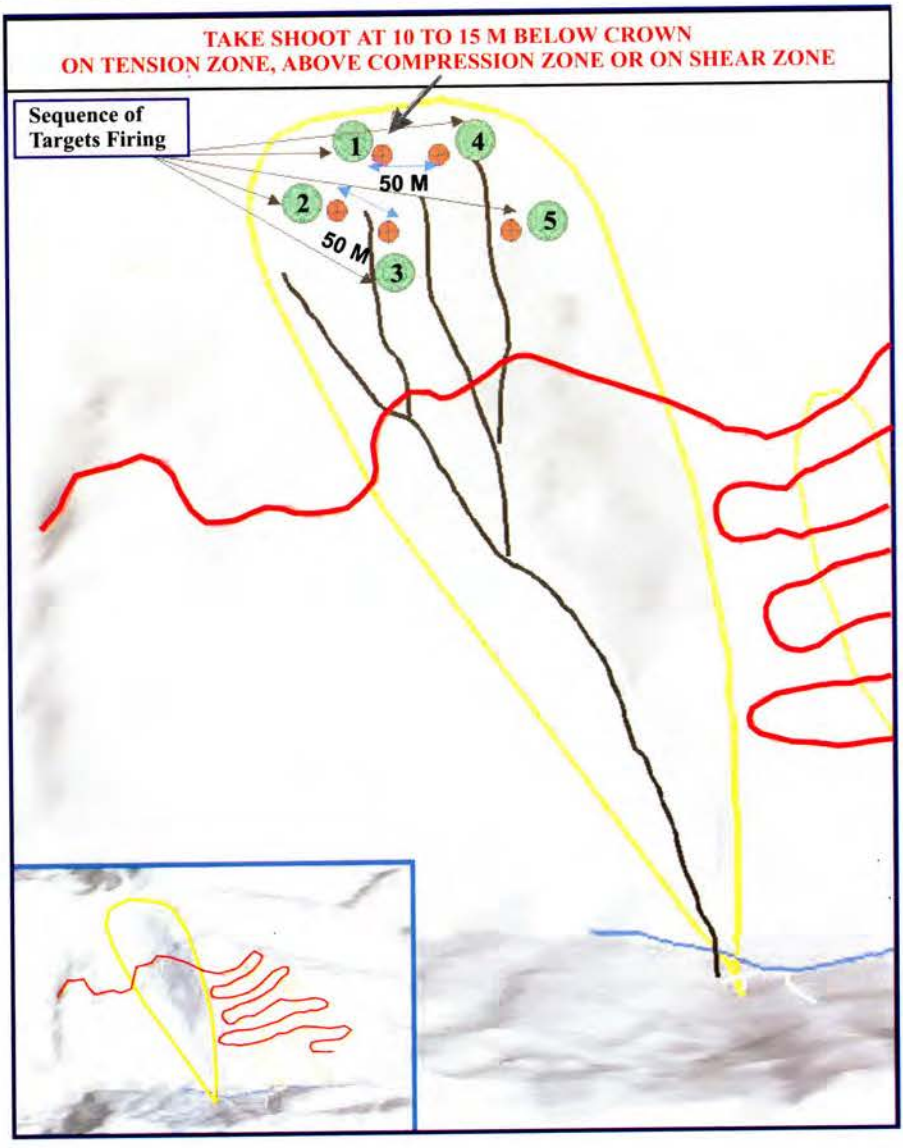
RECONFIRM THE TARGETS AND ELIMINATE THOSE TARGETS WHICH LIE IN FORESTED AREA



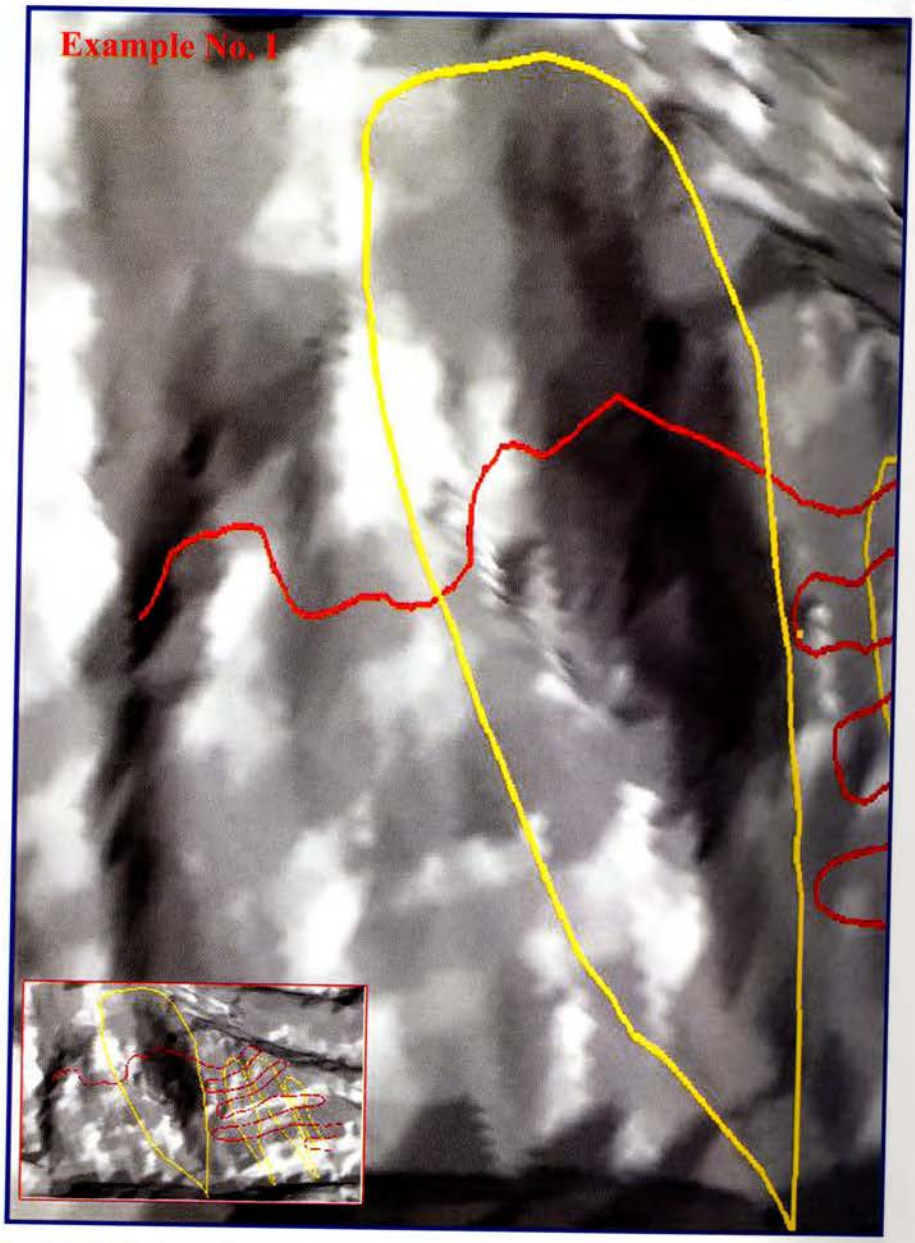
DRAPE WINTER IMAGERY AND TRANSFER THE TARGETS



GIVE SEQUENCE OF TARGETS FIRING

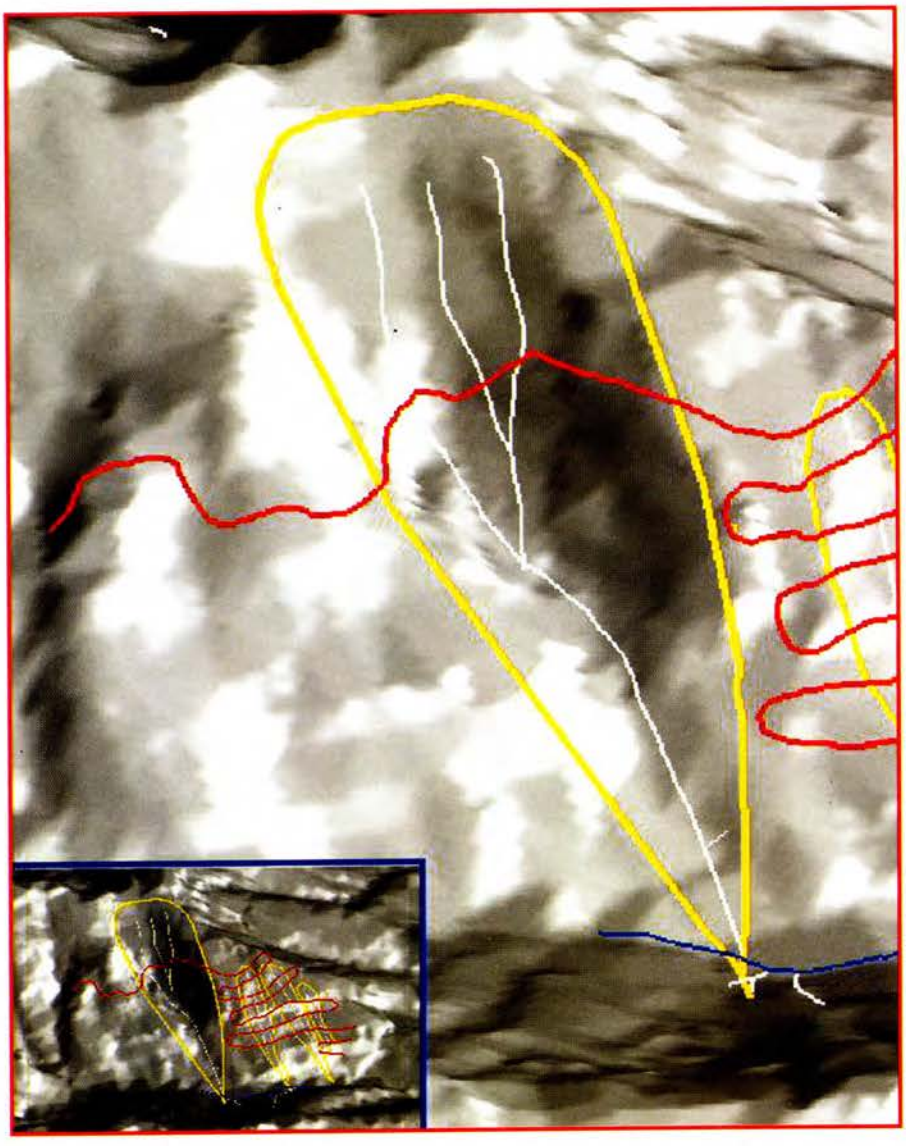


EXAMPLES

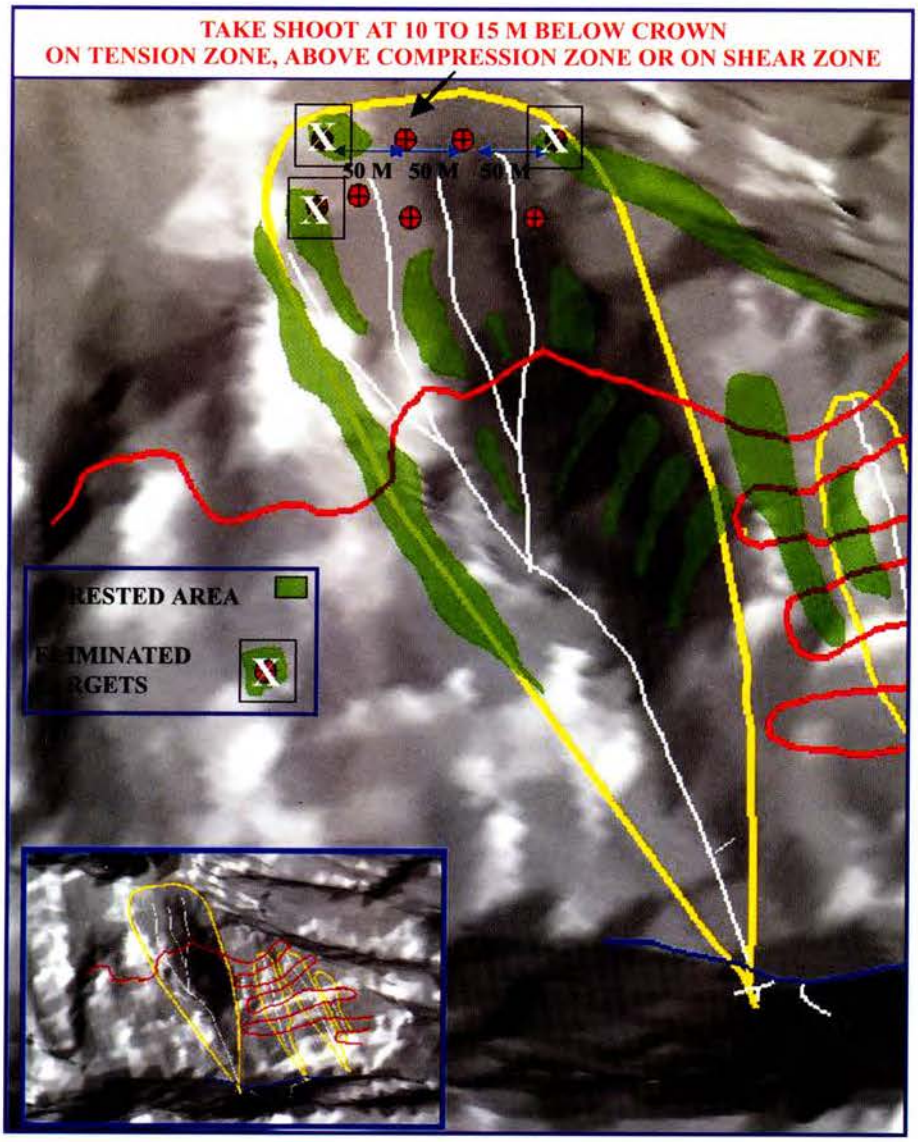


(i) An Avalanche Site on DEM

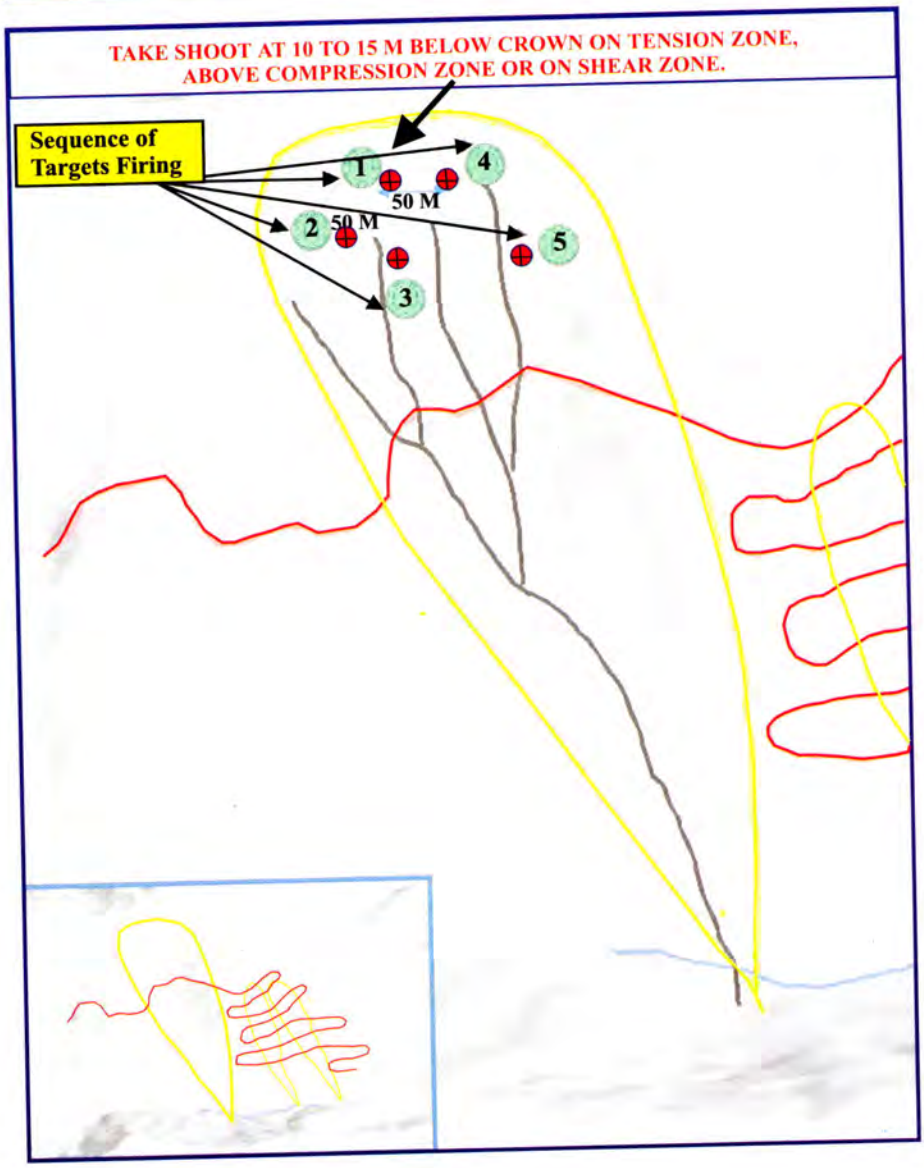
(ii) An Avalanche Site With Gulleys on DEM



(iii) Select and Reconfirm the Targets
(iv) Eliminate Those Targets Which Lies in Forested Area

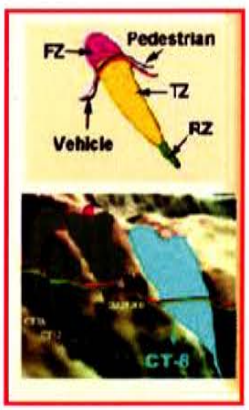


(v) Final Selection of Targets for firing after Draping Winter Imagery on the DEM

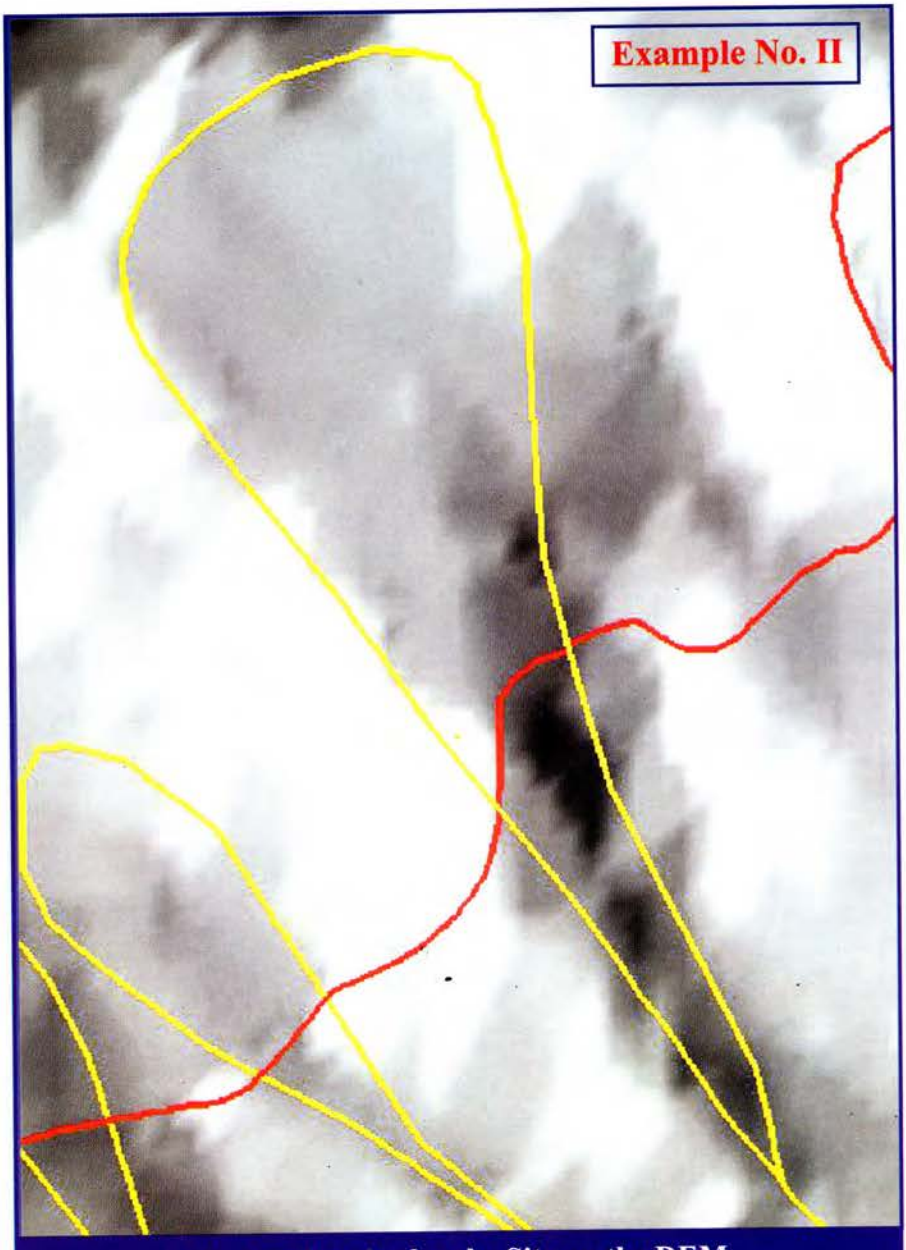


FOR FINAL SHOOT

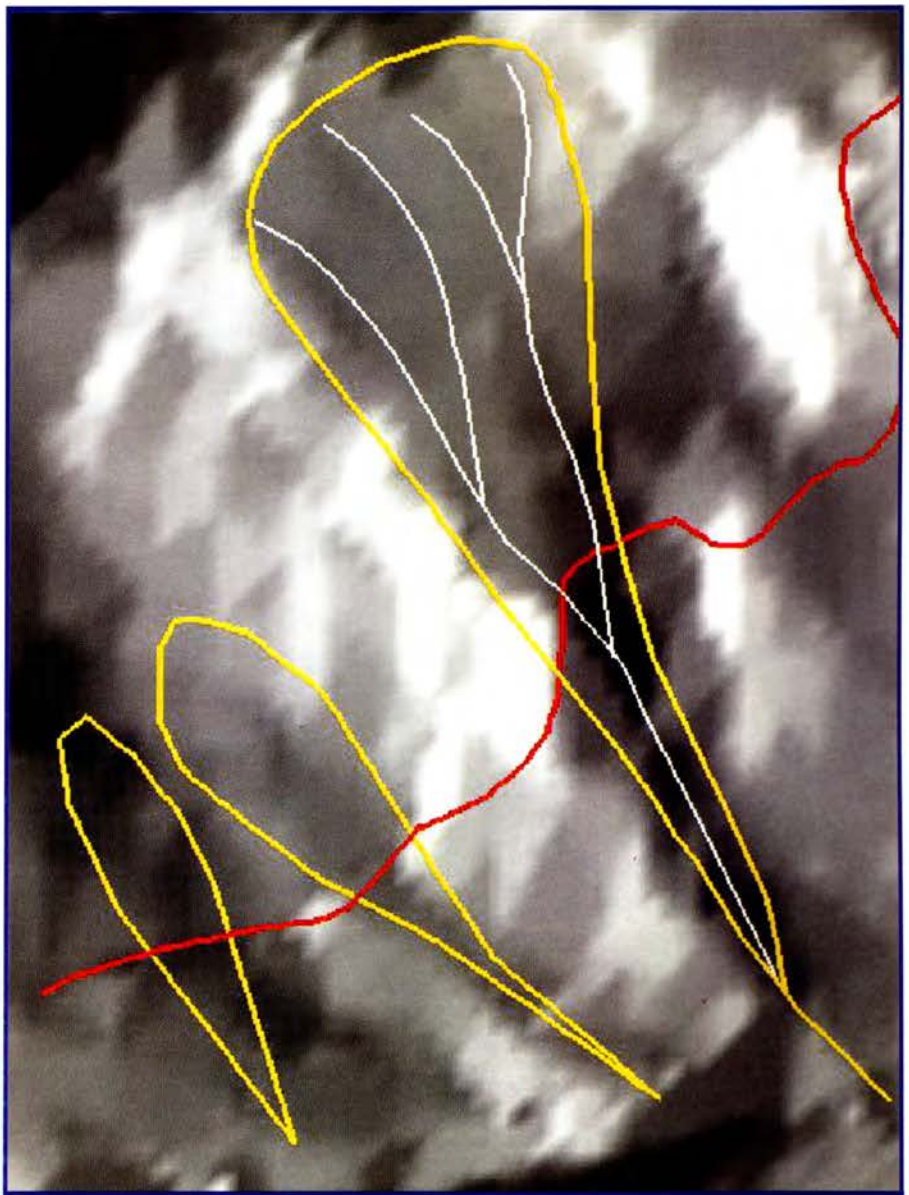
(vi) Select Targets on Summer Photograph of an Avalanche



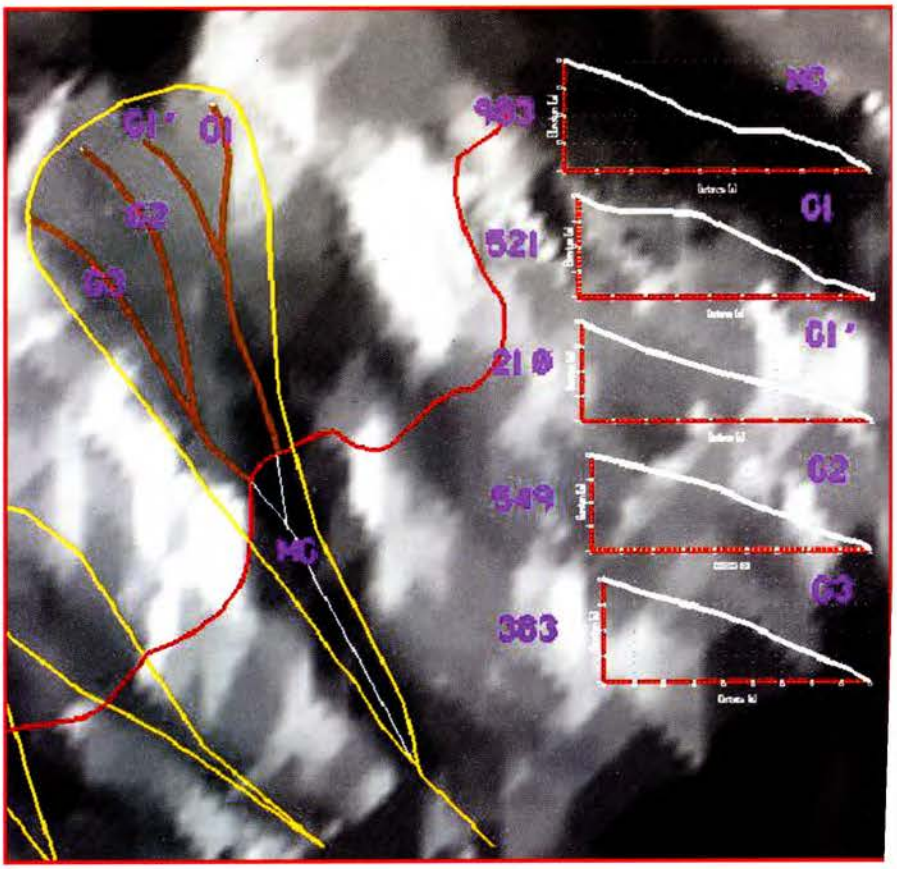
(vii) Select Targets on Winter Photograph of an Avalanche



(i) Another Avalanche Site on the DEM

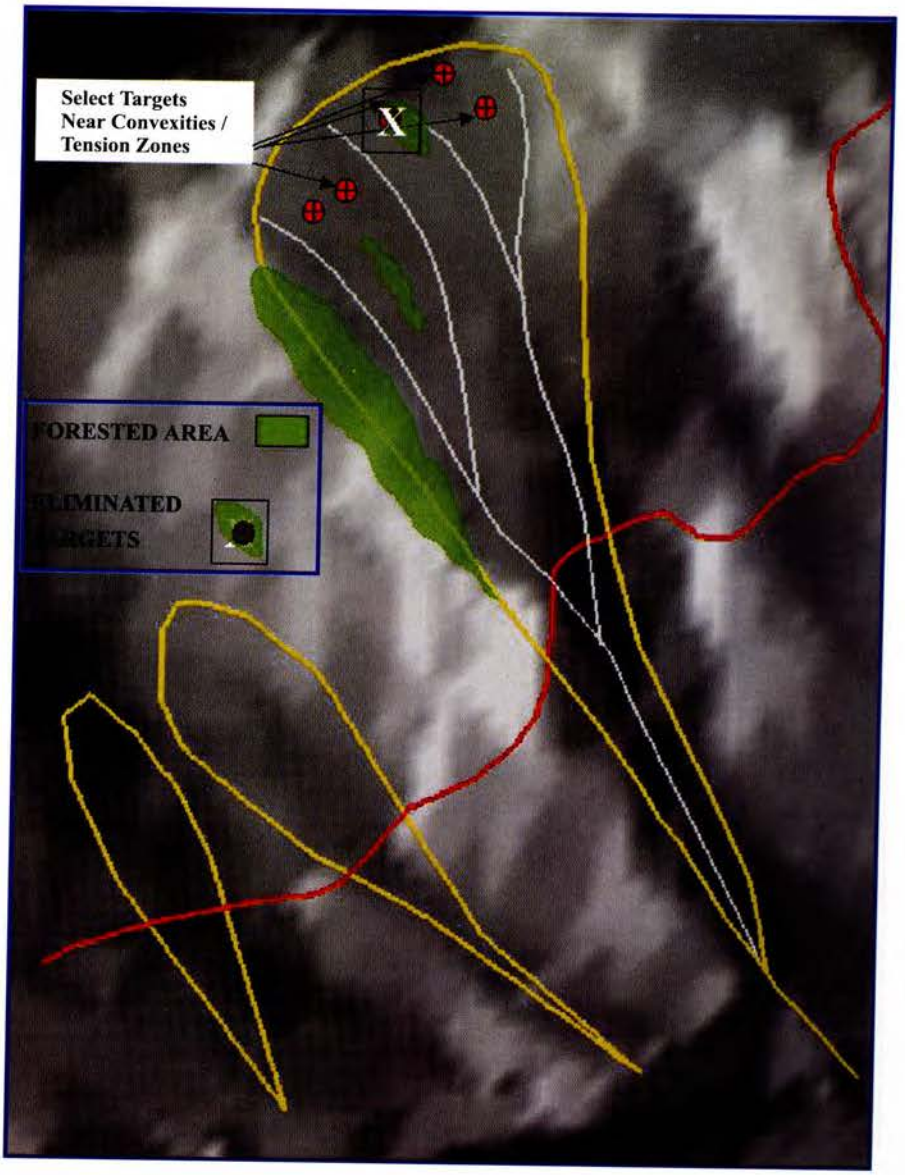


(ii) Another Avalanche Site with Gulleys on the DEM

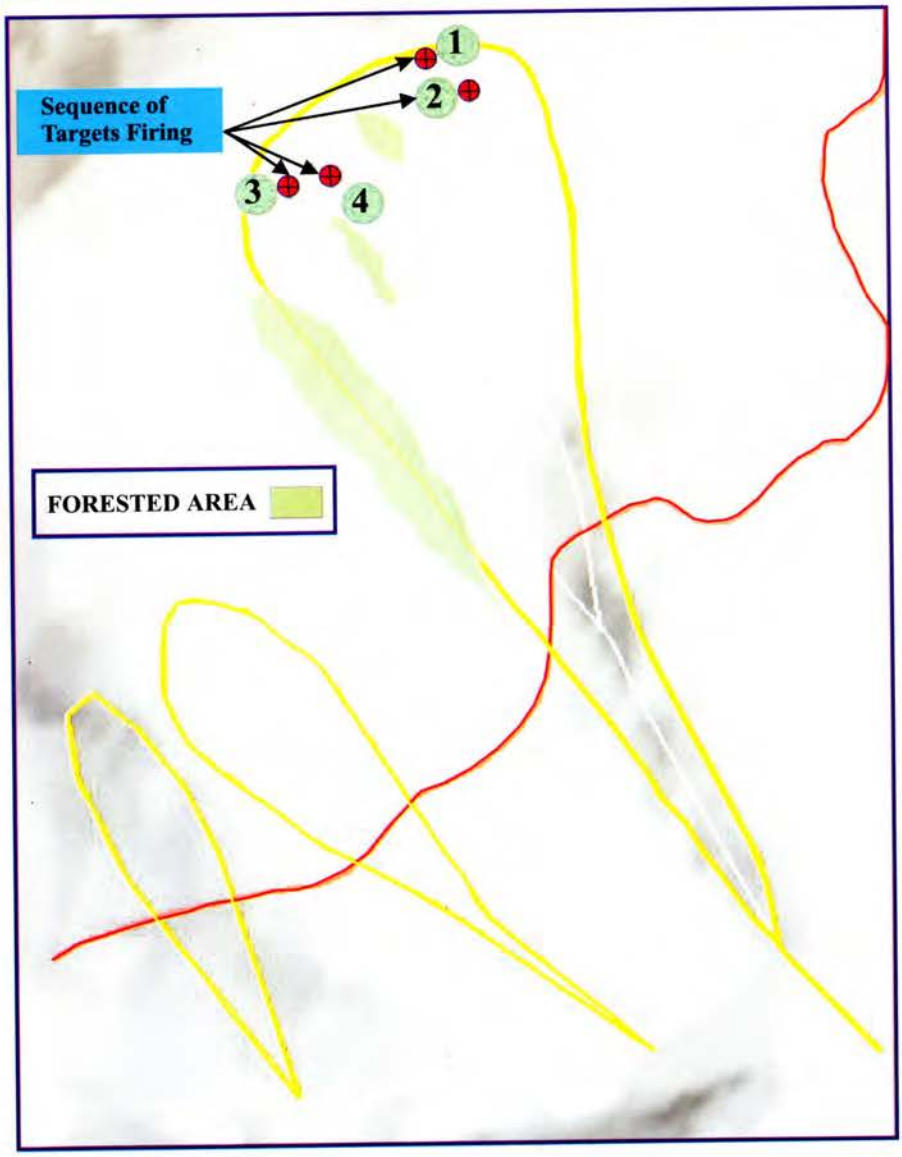


(iii) L- Section of an Avalanche Site Using DEM

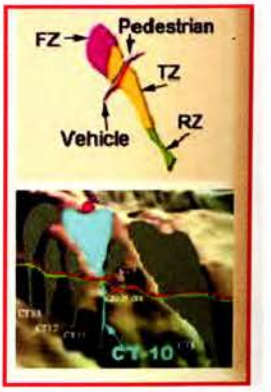
(iii) Select and Reconfirm the Targets
(iv) Eliminate Those Targets Which Lies in Forested Area



(vi) Final Selection of Targets for firing after Draping Winter Imagery on DEM



(vii) Select Targets for final Shoot on Summer, Winter Photographs of an Avalanche Site



CONCLUSION

26. Avalanche mitigation through structural control methods is a cost proposition, more so, considering the most rugged and inhospitable terrai of Himalaya.

27. While avalanche forecasting provides temporary solution, the science is y in infancy and there is always some uncertainty associated with tl technique. The awareness of the cause of release of avalanches and tl safety measures that need to be taken while traversing through tl avalanche terrain have immensely helped in reducing the casualties.

28. Extending this awareness programme, an attempt has been made to educa people in controlled release of avalanches. By understanding the pros ar cons of artificial release of avalanches and releasing them at appropria time, people can make their area safe from the avalanche menace. Prop knowledge of the selection of target locations and instructions that need be followed at the time of release of avalanches will go a long way reducing avalanche casualties.

29. Irrespective of the results of any firing operation, proper documentatior specified by SASE, should be maintained and all records should be sen SASE for their further analysis.

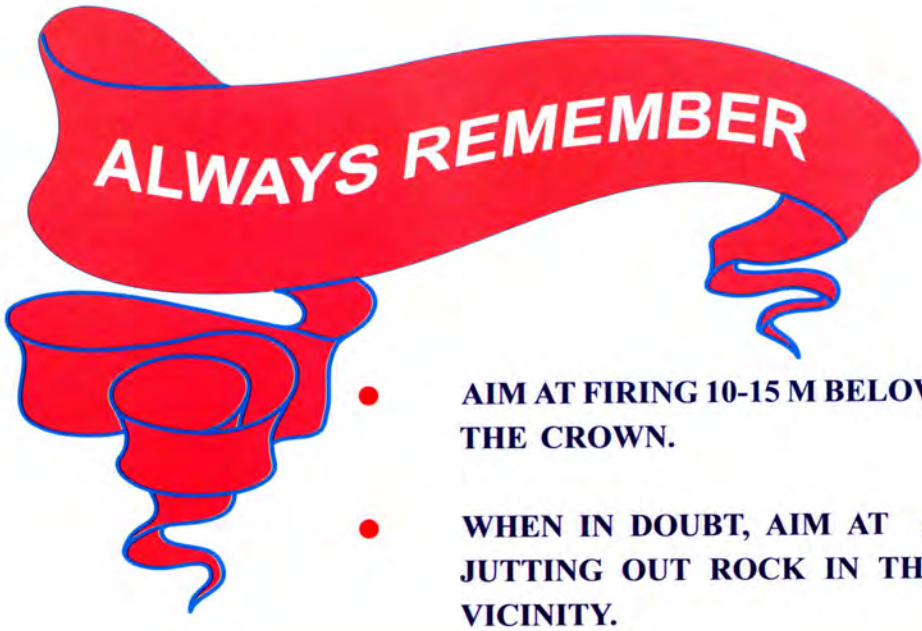
DO'S AND DONT'S

DO's

1. Select safe location for positioning the weapons and crew members. During artificial triggering adjoining avalanche slopes may trigger as ground avalanches or as airborne avalanches and can hit your selected weapon position or crew. Avoid such locations.
2. Check SNOWPACK STABILITY, if possible.
   (a) Snow pack stability will be rated 'POOR' if with little additional stress/ load, fracture propagates.
   (b) Cohesive snow pack fails above a weak layer.
   (c) Instability exists near surface.
3. Choose appropriate 'Timing for Artificial Triggering'.
   (a) Too early when there is very less snow on slopes.
      (i) No avalanche triggers.
      (ii) Only negligible snow mass may trigger.
   (b) Too Late. Larger than desired avalanche may trigger.
   (c) If there is 'Rapid rise in Temperature' immediately after snowfall the snow loses fracture propagation potential. Artificial triggering under such condition is not advisable.
4. Always fire 10-15 m below the Crown of a slab avalanche.
5. Always take 1st shoot 10-15 m below the centre of the rupture line, 2nd & 3rd shoots 25 m left and right of the first shoot. This will also be an acid test to check the snow pack stability as it will ensure release of weak snow cover and compaction of snow cover left on the slope.
6. Use high detonation velocity explosives - 5000 to 7000 m/s - for remote delivery weapons.
7. Use slow detonation velocity explosives - 3000 to 4000 m/s - for inside snow or cornice removal.

DONT's

1. Do not take shoots randomly.
2. Do not take more than three shoots for an avalanche on three respective zones (Compression, Tension & Shear zones)
3. If an avalanche triggers from the place of selected zones of targets, then do not repeat shoot at the same place. In that case select another target 50-60 m away i.e. at nearby crown location from where the avalanche has not yet triggered.



- AIM AT FIRING 10-15 M BELOW THE CROWN.
- WHEN IN DOUBT, AIM AT A JUTTING OUT ROCK IN THE VICINITY.
- ONE (01) TARGET POINT FOR EVERY 50-75 M WIDTH.
- SELECT SHOOT 10-15 M BELOW THE CORNICE, IF CORNICE IS PRESENT.
- WHEN IN DOUBT FIRE THREE ROUNDS IN THE CLOSE VICINITY OF THE AVALANCHE FORMATION ZONE SLOPE.
- MAINTAIN A PROPER RECORD OF EACH SHOOT AND ALSO OF THE ENTIRE OPERATION AS PER THE FORMAT ATTACHED WITH THIS BOOKLET, AND SEND IT TO SASE FOR THEIR RECORD AND STUDY.
- PROPER DOCUMENTATION CAN BRING OUT IMPORTANT LESSON FOR FUTURE, WHICH CAN ECONOMISE FIRING EFFORTS AND ALSO HELP IN SAVING LIVES.

REPORTING PROCEDURE

1. MSG FORM OF CONTROLLED RELEASE OF AVALANCHE (ARTIFICIAL TRIGGERING)

PRECEDENCE	DATE TIME GROUP	SECURITY CLASS

From : Location (Army Unit / Village/Town)

To : RDC SASE, Sector 37-A, Chandigarh (Through Mail/ Wireless set)

SITREP NO. (.)
FIRSTLY (.) Details of Controlled release of Avalanche (.)

ALFA (.) Year, Date & Time of Triggering (.)
BRAVO (.) Area/ Axes/ Location of Avalanche Site (.)
CHARLIE (.) Grid Reference (.)
DELTA (.) Aspect / Direction of Avalanche (.)
ECHO (.) Slope Angle (.)

SECONDLY (.)
ALFA (.) Type of Weapons used (.)
BRAVO (.) Type of Explosive used (.)
CHARLIE (.) No of Rounds used for triggering (.)

THIRDLY (.)
ALFA (.) Whether Avalanche Triggered or Not (.)
BRAVO (.) Type of Avalanche (Loose/ Slab) (.)
CHARLIE (.) Dimensions of Avalanche (Length x Width x Depth) (.)

FOURTHLY (.)
ALFA (.) Visibility (.)
BRAVO (.) Whether AWB was in force (Y/N) (.)
CHARLIE (.) Casualty if any (.)

FIFTHLY (.)
Any other information (.)

NAME OF THE PERSON SENDING THE MSG DESIGNATION

CASE NO.:-
DATED :

2. FORMAT
CONTROLLED RELEASE AVALANCHE
(ARTIFICIAL TRIGGERING)

From : Location (Army Unit / Village/Town)

To : RDC SASE, Sector 37-A, Chandigarh (Through Mail/ Wireless set)

1. **General Information**
   - (a) Year, date & time of triggering.
   - (b) Area/ axes/ location of avalanche site :
   - (c) Grid reference :
   - (d) Aspect / direction of avalanche :
   - (e) Slope angle :

2. **Explosives**
   - (a) Type of weapons used :
   - (b) Type of explosive used :
   - (c) No of rounds used for triggering :

3. **Avalanche details**
   - (a) Whether avalanche triggered or not :
   - (b) Type of avalanche (Loose / Slab) :
   - (c) Dimensions of avalanche :
     - Length :
     - Width :
     - Depth :
   - (d) Visibility

4. Whether avalanche warning bulletin was in force (Y / N) :

5. Casuality if any :

6. Other Information :

Date :

Signature
Unit/ Formation
Address

OTHER USER- RELATED SASE PUBLICATIONS AND VIDEO/ MULTIMEDIA PRESENTATIONS AVAILABLE ON DEMAND

1. Avalanche : 'A User Guide' in Hindi and English.
2. 'Avdhav Alok Chitra Pustika Surksha tatha Bachav' on avalanche safety and rescue in Hindi.
3. Avalanche forecasting our 'Successes and Failures' for the years 1997 to 2001.
4. Multimedia presentation on 'SASE user's guide' in Hindi and English.
5. Multimedia presentation on 'Artificial Triggering of Avalanches' in Hindi and English.
6. Video and Multimedia presentation on 'Artificial Triggering of avalanches along Chowkibal-Tangdhar road axis ' in Hindi and English.
7. Annual reports describing snow and met data and avalanche activity related information for various areas in India (1969-2001).
8. 30 years of SASE.
9. SASE news line.
10. Multimedia presentation on 'Actual Avalanche Accidents

CONTACT FOR DETAILED INFORMATION AND SUGGESTION

1. **RDCSASE, HIMPARISAR, Sector37-A, Chandigarh, India.**

Tele No.	:	0172-699804,699805 & 699806
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vsat	:	40410000098100
		40410001098100
e-mail	:	root@sasehq.ernet.in

2. **AFC SASE, Manali, HP**

Tele No.	:	01902-53459
Fax No.	:	01902-52406
Vsat	:	40410000088500
e-mail	:	root@drsase.ren.nic.in

3. **AFC SASE, Srinagar, J&K**

Tele No.	:	0194-466013,856288 & 856289
	:	6288 & 6289 (Army)
Fax Nos.	:	0194-466013
Vsat	:	40410000098200
		40410001098200

4. **SASE WEB SITE**
   www.drdo.org.com

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