ANCHORING EMERGENCY LIGHTWEIGHT SHELTERS. RECOMMENDATIONS, COMMENTS AND ALTERNATIVE APPROACHES

Field tests on anchors suited to emergency shelters have been conducted at the Shelter Research Unit of the International Federation of Red Cross and Red Crescent Societies. As a result, the following recommendations, comments and alternative approaches have been identified.

1 Don’t take any risks if shelters cannot be strengthened. The consequences of dismounting for a few days are much smaller than the ones of unusable or blown away shelters.

2 Forces applying to the shelter are highly dependent on the exact situation and shelter.

3 Wind speed is different from wind pressure, one of the forces impacting buildings.

4 Even after completion, weather conditions need to be monitored. If those ones become higher than the one structures are designed for, measures need to be taken.

5 The differences between the types of anchors are fairly big and need to be taken into account.

6 Instructions about how to use the anchors should always be distributed with the products.

7 If percussion-driven anchors are chosen, special attention should be paid to the arming process.

8 If the force is pulling in a different direction than the axis of resistance, the anchor might loosen the guy rope by moving. This is a risk to be considered beforehand.

9 Pegs use compression to transfer horizontal forces and friction to transfer vertical ones.

10 Screws and percussion driven anchors use both friction and compression in the same axis.

11 Always attach the rope as close as possible to the ground as this reduces the force applying to the anchor.

12 An anchor which is difficult to insert into the ground indicates a ground which is more difficult to compact and finally, a bigger resistance.

13 Anchors which do not reach their intended implementation depth are considerably weaker.

14 Check regularly anchors after installation and correct them if necessary. If an anchor cannot be fully inserted, attach the rope at the bottom, close to the soil.

15 Two types of soil are never 100% identical: different contexts = different soils = different anchor performances.

16 Don’t trust previous experiences when using pegs. A peg which worked in the same location a few years ago will not necessarily work in that location again.
17 When identifying a location, cross-checking at different depths and at different points is necessary. A few meters are sufficient to change the type of soil.

18 Even once identified, the performance of an anchor can change as it is impacted by external influences (i.e. humidity variations).

19 Screw anchors are better suited for vertical than for diagonal pull.

20 Pegs were observed working best when implemented vertically into the soil. However, a guy rope pulling in the axis of the peg should always be avoided. Therefore, if the angle between the guy rope and the soil is smaller than 45°, the angle should always be installed vertically. Correct installation increases the performance by approximately 20%.

21 V and T-sections showed best performances when used with the sharp side pointing in the direction of the tent/guy rope. Correct usage increases the performance by approximately 20%. Together with the correct inclination, approximately 45% more resistance can be obtained.

22 The climatic context has a major impact on the anchor performances. Depending on the day, the performances of an anchor in a given soil can be different.

23 Depending on the type of anchors and soils, displacements bigger than 5 cm (+/- 1) might be required before reaching the full potential of the anchor (the maximum resistance). This is especially the case for percussion-driven anchors.

24 The best test performances are reached by percussion-driven anchors, followed by screw ones and pegs.

25 Pegs were found compatible with all tested soils and show best results in ‘clay sand’ and ‘rock sand’.

26 All tested screw anchors and some big percussion-driven anchors cannot be installed with human force in ‘silt’ and ‘rocky sand’ soils.

27 All tested screw anchors loose resistance in sand soils.

28 Tested percussion-driven anchors which can be implemented with human force in ‘Silt’ and ‘Rocky sand’ show best performances in this type of soil.

29 Percussion-driven are the most complicated to install. Especially the arming process which takes place invisibly requires trained people.

30 Percussion-driven anchors are generally of single use as removal is very time-intensive if not impossible (need to dig). Therefore, an implemented anchor cannot be corrected (i.e. moved).

31 Pegs and screw anchors are easier to set up and to reuse. Also, displacements which should warn people are easier to perceive.

32 Hazard risk for beneficiaries (i.e. playing children) should be minimized by avoiding sharp ends.
33 The price of an anchor is not a reliable indicator. Performance is clearly influenced by other factors.

34 Depth is a reliable indicator: independently of the type of anchor, performance will increase with increasing depth.

35 Pegs perform better if combined as active ones rather than as x-crossing.

36 Combining percussion-driven anchors is also an option to increase resistance.

37 When choosing an anchor, one should not only bear the soil and weather conditions but also the installation procedure in mind. Who is going to install the anchors in the soil? If the answer to this question is unsure, choose an anchor which is easy to install. Otherwise, the risk of wrong installation increases.

38 Furthermore, it was noticed that one can increase the performance of anchors by either combining them or using longer models. However, simply buying a more expensive anchor is not recommended.

39 Many other alternative approaches exist. The ones discussed in this part are only examples to illustrate possible strategies.

40 Sometimes, alternatives require extensive research before becoming applicable. Examples are the durability of buried wood and textiles. The lifetime of anchors should in fact exceed the one of the building itself.

41 Inspiration can often be gathered from related fields. For instance, sheet piling within earth engineering can give ideas for combinable anchors.

Alternative approaches

1 Appropriate tools of other uses. This first approach was tested during the test sets. It is a screw tool (hand auger) used by gardeners to make holes. This one was inserted into the soil and reached a considerable maximum value of 512 kg for a displacement of 5cm(+/-1) and an absolute maximum resistance of 1500kg. This shows that product being designed for a different purpose can very effectively be used as anchors, sometimes even showing better results than specifically designed anchors themselves.

2 Local practices. Vernacular architecture. Nomad populations exist or existed in many regions of the world. As their buildings are lightweight and temporary, they have been confronted to similar challenges. In fact, some groups use interesting alternatives. Bedouins for instance use local bush vegetation which they dig into the sand before attaching the guy rope. This shows that knowledge of local and nomad populations can be of major interest. Means to identify those practices include not only members of the practicing groups but also local populations, publications, archives, etc.

3 Use local resources. Textile earth bags, rocks, refilled oil barrels, cars, trucks, car tires, wheels, etc. Before using this method, further studies concerning its influence on the soil and the environment are needed (influence on vegetation, humidity and textiles). Also, the durability of several types of textile should be explored to choose the most appropriate one.