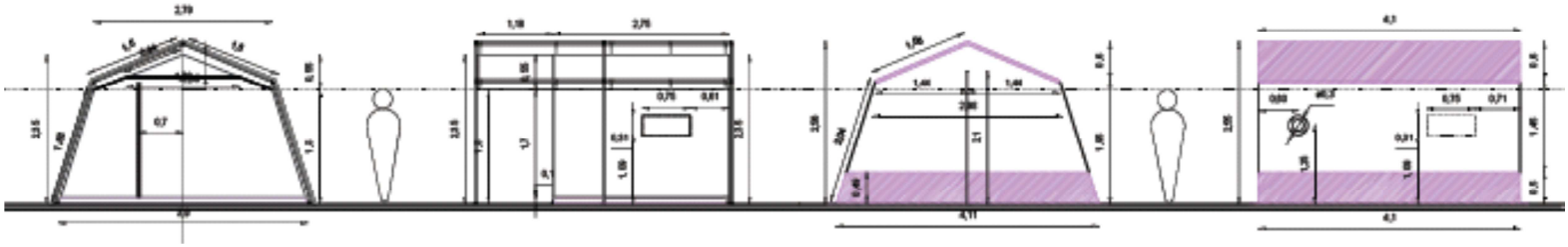
International Federation
of Red Cross and Red Crescent Societies

Shelter Research Unit
an initiative of the Benelux Red Cross Societies

Winterization room for "Kizilay tent"
Test, evaluation and recommendations



Turkey/Luxembourg
2014

NEW WINTERIZATION ROOM FOR "KIZILAY TENT"

INDEX

1. *Introduction*
2. *Test methodology*
3. *General conditions for the testing process*
4. *Test description and classification*
5. *Individual test setup*
6. *Tent description and configurations*
7. *Basic analysis of observations and beneficiaries feedback*
   - *7.1 General weather data from the Ankara test site*
   - *7.2 Detailed temperature data for the tested tent types*
   - *7.3 Observations on the Influence of winter room*
   - *7.4 Thermal performance and energetic consumption and of the winter room with an electric heater.*
8. *Basic Analysis of observations and qualitative data obtained during the testing process*
9. *Recommendations to improve the actual winter room solution for Kizilay 16m2tent*
   - *9.1 Winter room and buffer area*
   - *9.2 Winter room and volume*
   - *9.3 Winter room and floor insulation*
   - *9.4 Winter room and hanging system*
   - *9.5 Winter room doors and infiltrations*
   - *9.6 Winter room and minimum ventilation*
   - *9.7 Winter room and interior accessories*
   - *9.8 winter room and vector control*

Index of tables

1. *Table 01. Basic description of the tested tents*
2. *Table 02: Different test to indicate performance and perceived quality of the tents*
3. *Table 03.: Different tested Kizilay tent configurations*
4. *Table 04: Average weather data recorded durign testing period*
5. *Table 05.: Position and height of the Logtag inside the tent*
6. *Table 06 and 07.: The minimum and maximum temperature measured inside the tent during the testing period, in comparison to the outside max and min temperatures.*
7. *Table 08.: The minimum and maximum temperature measured inside the tent Kizilay tent with winter room and the Family tent with winter kit during the testing period, in comparison to the outside max and min temperatures.*
8. *Table 09.: Winter room influence in interior temperature and stratification in comparison with the exterior recorded temperature in the hottest day during the testing period.*
9. *Table 10.: Winter room influence on interior temperature and stratification in comparison with the exterior recorded temperature in the coldest day during the testing period*
10. *Table 11.: Influence on indoor temperatures in function of the different position of the heater in the Kizilay tent.*
11. *Table 12.: Influence on indoor temperatures in function of the different position of the heater in the Family tent.*
12. *Table 13.: Total electric consumption in 24 hrs. and electric consumption per m^2 and tent type.*
13. *Table 14 and 15.: Kizilay tent with winter room and Family tent with winter kit under "Sphere Project Guidance"*
14. *Table 16 and 17: Kizilay tent with winter room and Family tent with winter kit under* "Transitional shelter standards" (Shelter Centre)

NEW WINTERIZATION ROOM FOR "KIZILAY TENT"

1. Introduction

The degradation of humanitarian situation in Syria has caused over 2.1 million people fleeing into neighboring countries. The number of registered Syrian citizens who have found temporary shelter in Turkey has surpassed half a million people. Of these, there are over 200,000 living in camps under temporary protection of the Turkish Government. The Turkish Red Crescent (TRC) has been providing assistance to the Syrian citizens with a multi-pronged relief operation, which has consisted of food aid, relief distribution and provision of shelter, among others

The Turkish Red Crescent is one of the main humanitarian suppliers in the country. Its tent factory produces reinforced tents and other shelter products, such as rub-halls of various sizes. The National Society has distributed 6,068 tarpaulins aiming to provide tents a better insulation during winter season. Also, the total number of tents distributed is 65.602 and total number of tarpaulins distributed in camps is 25.956. By early November, with international support, the NS has distributed some 33,240 tents (including replacements for damaged ones that are not double counted): these tents have been designed to endure harsh winter and weather conditions in camps.

The IFRC-SRU on behalf of LRC-AI shall deliver technical consultancy services to TRC in order to jointly design a winterisation room fit for different tent types used in the Syrian crisis response, based on the winterisation solution already in use in TRC tents. Furthermore conduct technical testing of the kit, to establish technical performance criteria. This program aims to improve the thermal behavior of light shelters distributed therefore provide a better quality of life while significantly reducing fuel consumption per heating putting these tents.

2. Test methodology

The main objective of this field testing will be to design an improved "Winterization room" that can be used for the Kizilay tent as well as for the IFRC standard family tent and other common tent models. The design will be based on the results of comparative testing of the thermal performance of the existing "Kizilay Tent" with the "Standard Family tent" and the respective "winter-rooms"

As thermal comfort is clearly the principal factor to assure the health and well-being of beneficiaries in cold climates, it is of critical importance to establish the thermal performance of the proposed solution as well as existing solutions for comparison. The IFRC-SRU will testing and compare the Kizilay tent and the standard Family tent in two different plot site, one in Ankara (Turkey) and the other in Bertrange (Luxembourg)
To establish the thermal performance, the same methodology will be followed for the different tents and winter-rooms in order to collect clear quantitative and qualitative data. Quantitative data will be collected by measuring different performance criteria, as the inside temperature, humidity, and air quality of the different Tent models and configurations. A weather station installed on the Ankara test-site (provided by IFRC-SRU) will record the wind speed, rainfall, humidity and exterior temperature.

Table 01. Basic description of the tested tents

Kizilay 	*16m² Rectangular based double fly tent. Frame made of 6 poles and 6 roof pipes with horizontal branches with plastic connectors. Inner tent nonwoven fabric in one piece including walls, doors, windows and PVC groundsheet. Outer Tent includes PVC roof, doors and side window*	
Family Tent 	*16m² Rectangular based double fly tent with two covered polygonal entrance-spaces. The outer tent must be supported by 3 poles, 1 ridge pipe Inner, the side walls must be supported by 6 metallic poles. Inner tent canvas in one piece including walls, doors, windows and groundsheet. Outer Tent includes roof, doors, side windows and optional accessories.*	

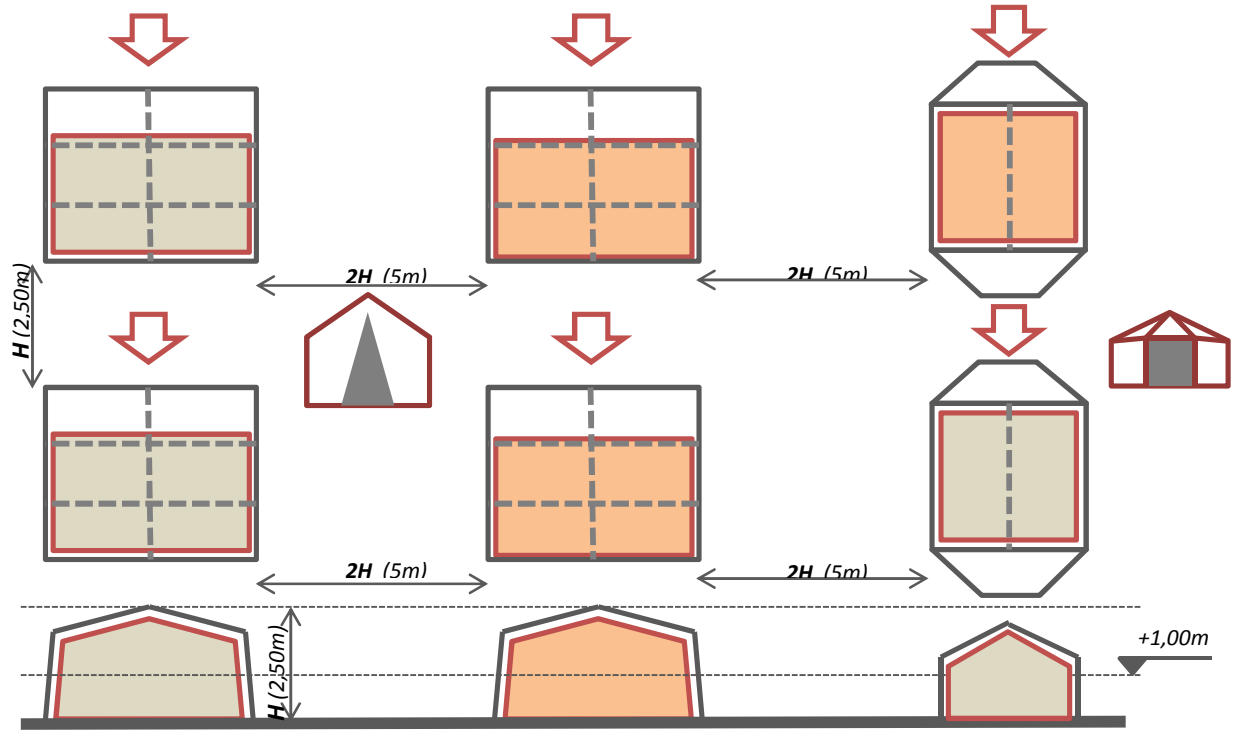
3. General conditions for the testing process

- *The entire testing (Ankara and Luxembourg fields) will be conducted on the Standard Family tent and Kizilay tent. To have reliable comparative data, different tents type and configurations shall be used for each setup.*

  For the first set-up (Ankara):
  - *2 Kizilay tents with the standard inner tent*
  - *1 Family tents with the standard inner tent*
  - *2 Kizilay tents with the new winterization room*
  - *1 Family tents with new winterization kit*

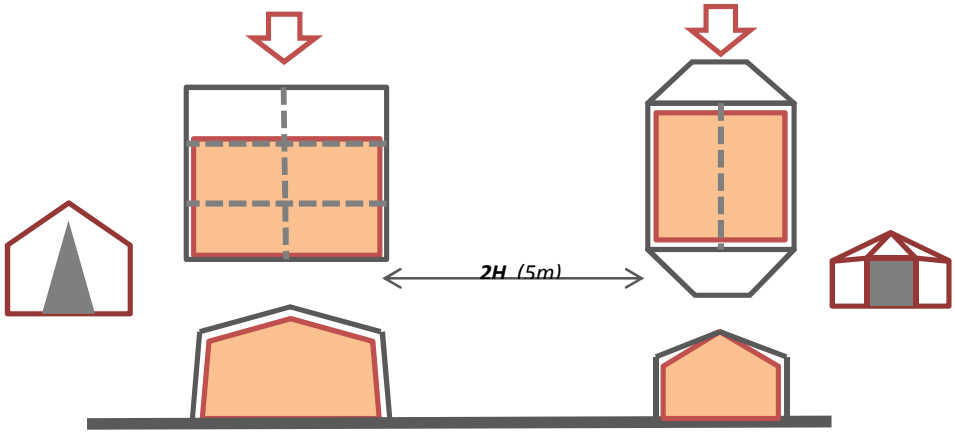
  For the Second set-up (Luxembourg):
  - *1 Kizilay tents with the new winterization room*
  - *1 Family tents with "old" winter-kit*

- *Tent disposition for the first set-up, Ankara test site*



Kizilayi Tent without winterization kit ***Kizilayi Tent with winterization kit*** ***Family Tent with winterization kit***
Family tent without "winterization kit"

- *Tent disposition for the second set-up, Luxembourg test site*



Kizilayi Tent with winterization kit ***Family Tent with winterization kit***
Family tent without "winterization kit"

- *All the tents must be assembled on the same day. Set-up will be documented by the IFRC-SRU Research officer and the TRC technical focal point*

4. *Test description and classification*

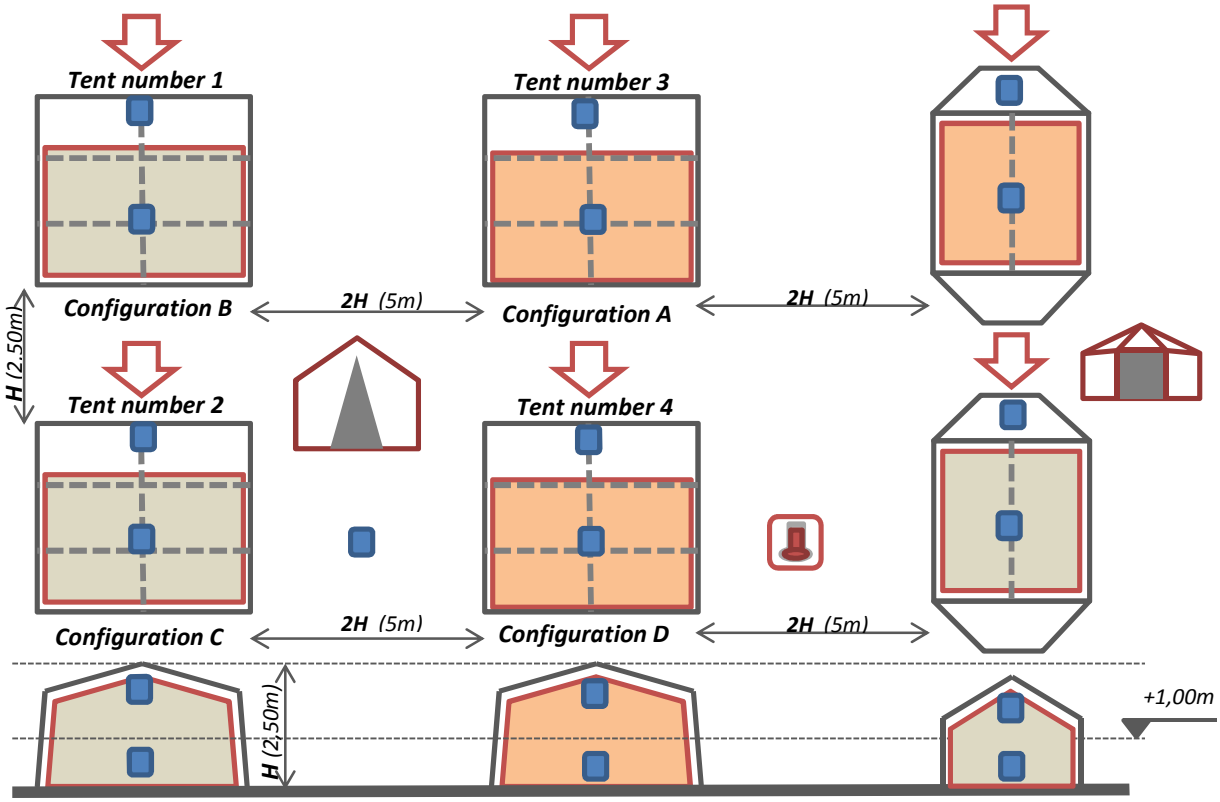
Table 02: Different test to indicate performance and perceived quality of the tents

Field test – Quantitative data			
Test/ site	***Measured criteria***	***Description***	***Tool***
1 Ankara	*Weather influence (wind and rain) on the interior temperature for the different tent configurations*	*Recorded periodic data (6 measures per day) from the weather station and comparison with interior temperatures recorded by the Logtags*	*weather station Logtag Predefined tables technical staff*
2 Ankara	*Monitoring of the Humidity inside the winterization room.*	*Recorded periodic data (6 measures per day) from the interior base of the weather station and comparison with the exterior humidity %*	*weather station Humidity data-logger Predefined tables technical staff*
3 Ankara	*Monitoring of the temperature and stratification inside the tent configurations without heater system.*	*Continue data recording temperature by Logtags on the different positions inside the tent and outside. Comparison of the data and conclusions*	*weather station Humidity data-logger Predefined tables technical staff*
	Specific one day field test		
3 Luxembourg	*Level of CO2 (inside and outside) Humidity % (inside and outside) Other gases. .*	*Continue data recording On the different positions inside the tent and outside. Comparison of the data and conclusions (minimum 3 examples of each configuration tested during 3 weeks)*	*Gas, temp, humidity Data logger Dust data logger Research Officer*
4 Luxembourg	*Insulation capacity and heat loss of the Winterization room and needed energy to heat the tent at 18°c.*	*Specific recording on temperature, energy consumption, timing and temperature. Three tests of one day 2 tent models.*	*Heater system, energy and Logtag, infrared lens. Predefined tables, IFRC-SRU Research officer*
	Field test - qualitative data		
5 Luxembourg	*Objective evaluation of different relevant parameters: Linen weight, surface and weight of winter room, number of doors and windows, interior partition, stove place, etc.*	*Evaluation of the winterization room by the Research Officer under international recommendations (Sphere Project, Transitional shelter standards….).*	*Predefined tables and values. Research Officer*

Lab test		
Objective	***Test***	***Tool***
Fabric characteristics (chemical and physics)	*Weight, tensile resistance, water proofing, water repellent, thermic transmission , etc.*	*Lab facilities*

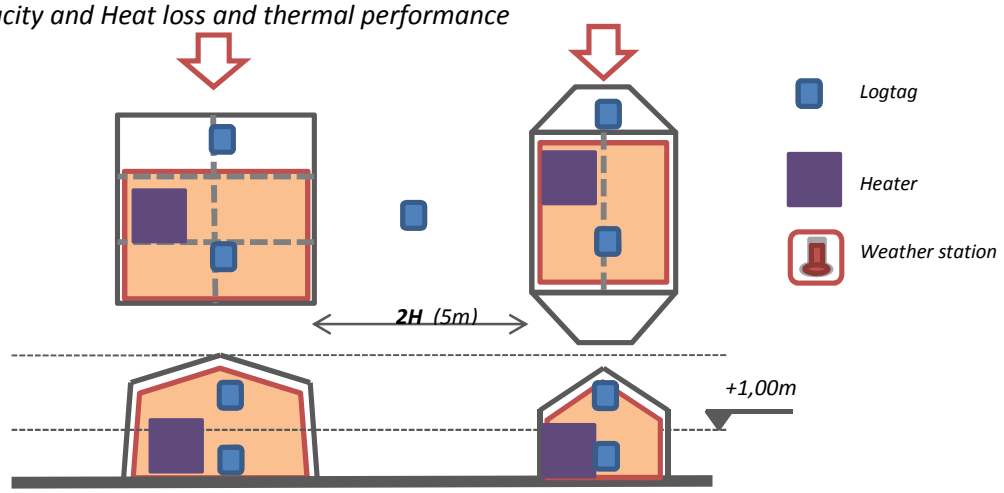
5. Individual test setup

Insulation capacity on different tent configurations
Weather influence on the interior temperature



Kizilayi Tent without winter room ***Kizilayi Tent with winter room*** ***Family Tent with winterization kit***

Insulation capacity and Heat loss and thermal performance



Kizilayi Tent with winterization kit ***Family Tent with actual winterization kit***

6. Tent description and configurations

Table 03.: Different tested Kizilay tent configurations

Tent number 3 - Basic description of 16m² Kizilay tent, configuration A			
Outer-tent			
Dimensions Outer-tent	*Width*		***4,10m***
	Length		***4,05m***
	Center height		***2,55m***
	Side height		***1,95m***
Surface outer-tent	***16,60m²***		
Weight	***30 kg***		
Openings	*2 Doors*		***2m height***
	Doors fasteners		***2m long Zip***
	2 windows		***0,31x0,75m*** *(0,23m² each)*
	Windows fasteners		***2 ropes***
Materials	*Roof*		***Cotton*** *(500 g/m²)*
	Halls		***Cotton*** *(500 g/m²)* ***PVC flaps*** *(435g/m²)*
	Ground		***NO ground***
Winterization room			
Dimensions Winterization room	*Width*		***3,90m***
	Length		***2,75m***
	Center height		***2,35m***
	Side height		***1,80m***
Surface winterization room	***10,72m²***		
Weight	***17kg***		
Openings	*1 Door*		***2m height***
	Doors fasteners		***2m long Zip***
	2 windows		***0,31x0,75m*** *(0,23m² each)*
	Windows fasteners		***3 sides Velcro***
Materials	*Roof*		***Nonwoven textile*** *(220 g/m²)*
	Halls		***Nonwoven textile*** *(220 g/m²)*
	Ground		***PVC*** *(435 g/m²)*
Structure			
Dimensions	*Width*		***4,10m***
	Length		***4,05m***
	Center height		***2,55m***
	Side height		***1,95m***
Weight	***34,8 kg***		
Materials	*Carrier system and purlins*		***Eloxal coated aluminium pipes*** *(ϕ42/2mm)*
	Pipe and food fasteners		***Plastic***
	Foots (tensioning pieces)		***Galvanized iron steel***
	Stakes		***10 nail-pile*** ***4 T-pile***
Packaging			
Dimensions	*Wight*	*Length*	*Height*
	0,47m	***2,10m***	***0,47m***
Total weight	***85,4kg***		

Tent number 1 - Basic description of 16m² Kizilay tent, configuration B			
Outer-tent			
Dimensions Outer-tent	Width		**4,10m**
	Length		**4,05m**
	Center height		**2,55m**
	Side height		**1,95m**
Surface outer-tent	**16,60m²**		
Weight	**30 kg**		
Openings	2 Doors		**2m height**
	Doors fasteners		**2m long Zip**
	2 windows		**0,31x0,75m** (0,23m² each)
	Windows fasteners		**2 ropes**
Materials	Roof		**PVC** (435 g/m²)
	Halls		**Cotton** (500 g/m²) **PVC flaps** (435g/m²)
	Ground		**NO ground**
Inner tent			
Dimensions Inner tent	Width		**3,90m**
	Length		**2,75m**
	Center height		**2,35m**
	Side height		**1,80m**
Surface Inner tent	**10,72m²**		
Weight	**18kg**		
Openings	1 Door		**2m height**
	Doors fasteners		**2m long Zip**
	2 windows		**0,31x0,75m** (0,23m² each)
	Windows fasteners		**3 sides Velcro**
Materials	Roof		**Cotton** (350 g/m²)
	Halls		**Cotton** (350 g/m²)
	Ground		**PVC** (435 g/m²)
Structure			
Dimensions	Width		**4,10m**
	Length		**4,05m**
	Center height		**2,55m**
	Side height		**1,95m**
Weight	**34,8kg**		
Materials	Carrier system and purlins		**Eloxal coated aluminium pipes** (ϕ42/2mm)
	Pipe and food fasteners		**Plastic**
	Foots (tensioning pieces)		**Galvanized iron steel**
	Stakes		**10 nail-pile** **4 T-pile**
Packaging			
Dimensions	Wight	Length	Height
	0,45m	**2,10m**	**0,45m**
Total weight	**86,4 kg**		

Tent number 2 - Basic description of 16m² Kizilay tent, configuration C			
Outer-tent			
Dimensions Outer-tent	Width		**4,10m**
	Length		**4,05m**
	Center height		**2,55m**
	Side height		**1,95m**
Surface outer-tent	**16,60m²**		
Weight	**30kg**		
Openings	2 Doors		**2m height**
	Doors fasteners		**2m long Zip**
	2 windows		**0,31x0,75m** (0,23m² each)
	Windows fasteners		**2 ropes**
Materials	Roof		**Cotton** (500 g/m²)
	Halls		**Cotton** (500 g/m²) **PVC flaps** (435g/m²)
	Ground		**NO ground**
Inner tent			
Dimensions Winterization room	Width		**3,90m**
	Length		**2,75m**
	Center height		**2,35m**
	Side height		**1,80m**
Surface winterization room	**10,72m²**		
Weight	**18kg**		
Openings	1 Door		**2m height**
	Doors fasteners		**2m long Zip**
	2 windows		**0,31x0,75m** (0,23m² each)
	Windows fasteners		**3 sides Velcro**
Materials	Roof		**Cotton** (350 g/m²)
	Halls		**Cotton** (350 g/m²)
	Ground		**PVC** (435 g/m²)
Structure			
Dimensions	Width		**4,10m**
	Length		**4,05m**
	Center height		**2,55m**
	Side height		**1,80m**
Weight	**34,8 kg**		
Materials	Carrier system and purlins		**Eloxal coated aluminium pipes** (ϕ42/2mm)
	Pipe and food fasteners		**Plastic**
	Foots (tensioning pieces)		**Galvanized iron steel**
	Stakes		**10 nail-pile** **4 T-pile**
Packaging			
Dimensions	Wight	Length	Height
	0,47m	**2,10m**	**0,47m**
Total weight	**86,4kg**		

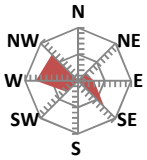
Tent number 4 - Basic description of 16m² Kizilay tent, configuration D			
Outer-tent			
Dimensions Outer-tent	Width		**4,10m**
	Length		**4,05m**
	Center height		**2,55m**
	Side height		**1,95m**
Surface outer-tent	**16,60m²**		
Weight	**30kg**		
Openings	2 Doors		**2m height**
	Doors fasteners		**2m long Zip**
	2 windows		**0,31x0,75m** (0,23m² each)
	Windows fasteners		**2 ropes**
Materials	Roof		**Cotton** (500 g/m²)
	Halls		**Cotton** (500 g/m²) **PVC flaps** (435g/m²)
	Ground		**NO ground**
Winterization room			
Dimensions Winterization room	Width		**3,90m**
	Length		**2,75m**
	Center height		**2,35m**
	Side height		**1,80m**
Surface winterization room	**10,72m²**		
Weight	**18,8kg**		
Openings	1 Door		**2m height**
	Doors fasteners		**2m long Zip**
	2 windows		**0,31x0,75m** (0,23m² each)
	Windows fasteners		**3 sides Velcro**
Materials	Roof		**Nonwoven + film lamination** (250 g/m²)
	Halls		**Nonwoven + film lamination** (250 g/m²)
	Ground		**PVC** (435 g/m²)
Structure			
Dimensions	Width		**4,10m**
	Length		**4,05m**
	Center height		**2,55m**
	Side height		**1,95m**
Weight	**34,8 kg**		
Materials	Carrier system and purlins		**Eloxal coated aluminium pipes** (ϕ42/2mm)
	Pipe and food fasteners		**Plastic**
	Foots (tensioning pieces)		**Galvanized iron steel**
	Stakes		**10 nail-pile** **4 T-pile**
Packaging			
Dimensions	Wight	Length	Height
	0,47m	**2,10m**	**0,47m**
Total weight	**87,2kg**		

7. Basic Analysis of obtained data

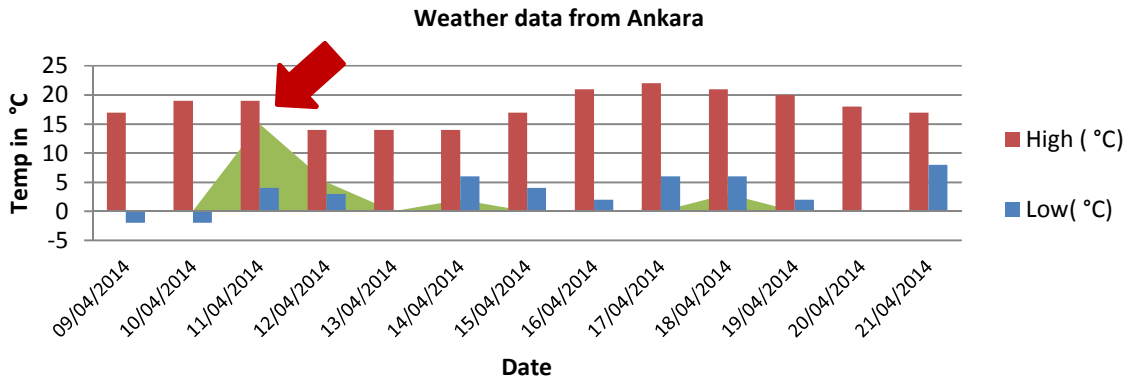
7.1. General weather data from the Ankara test site

A weather station was installed on the test site to record windspeeds, humidity, rainfall and temparature. The data was recorded every day by local team of Kizilay. To have more exact data on the temperature one Logtag was attached to the weather station to automatically record every 15min the outside temperature.

Table 04: Average weather data recorded durign testing period

Weather in Ankara			
Weather station	*Registered data*		*Average*
	*MAX 23 km/h* *MIN 1 km/h*	*Main wind direction:* *W/NW*	
	*One important precipitation during testing period*	*April 4th = 15mm^3*	*0,85mm^3*
	*MAX 33,3°C* *MIN -6,7°C*		*MAX 17,9°C* *MIN -0,5°C*

The testing period in Ankara was at the beginning of the spring season. In this time of the year, the differences between day and night temperatures are the most significant characteristic with differences around 30°C.
The recorded wind-speeds were between 1 and 23km/h which in the Beauford scale is defined as “moderate breeze” (Dust and loose paper raised. Small Branches begin to move). In this case, the wind effect on the temperature inside the tents could be a key factor in terms of air renovation, especially at night time.

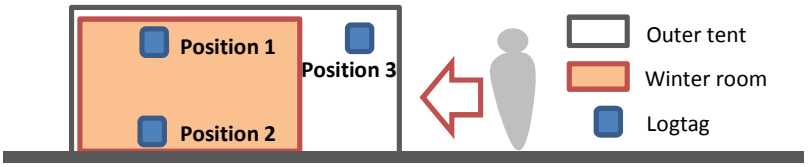


Only some minor rainfalls were recorded during the testing period with maximum precipitations of 15mm^3. These precipitations have been causing a decrease of outside temperature of around 5°C The humidity was around 20-80% throughout the testing period with atmospheric pressure between 923 to 935 hpa.

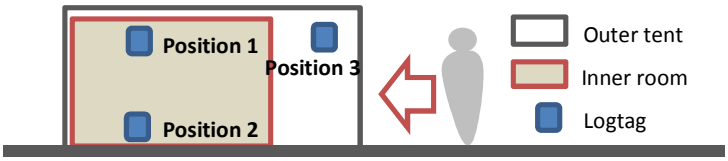
7.2. Detailed temperature data for the tested tent types

20 Logtag TRIX-8 were installed to record exact temperature data in all the tents. Three Logtag installed in each tent in different heights and positions, and one additional Logtag on the weather station that were installed in the Ankara testing site.

Table 05.: The next scheme shows position and height of the Logtag inside the tent



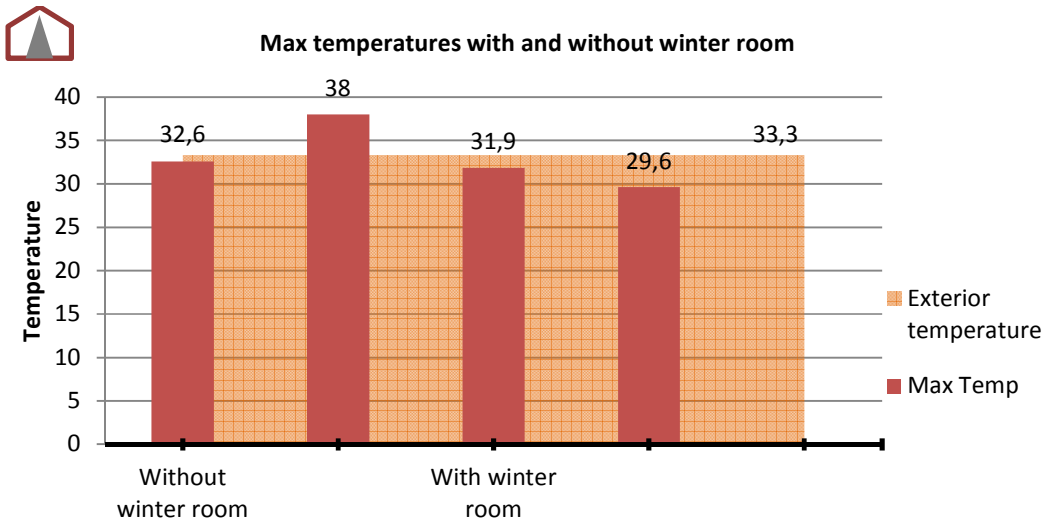
Log tag position in tent with winter room



Logtag position in tent without winter room

The Logtag automatically register the temperature every 15 min during the whole testing period in total registering 2880 measures for each Logtag (in total 57600 lectures). The Logtag data was recuperated by the IFRC-SRU Research Officer at the end of the testing period and processed for analysis.

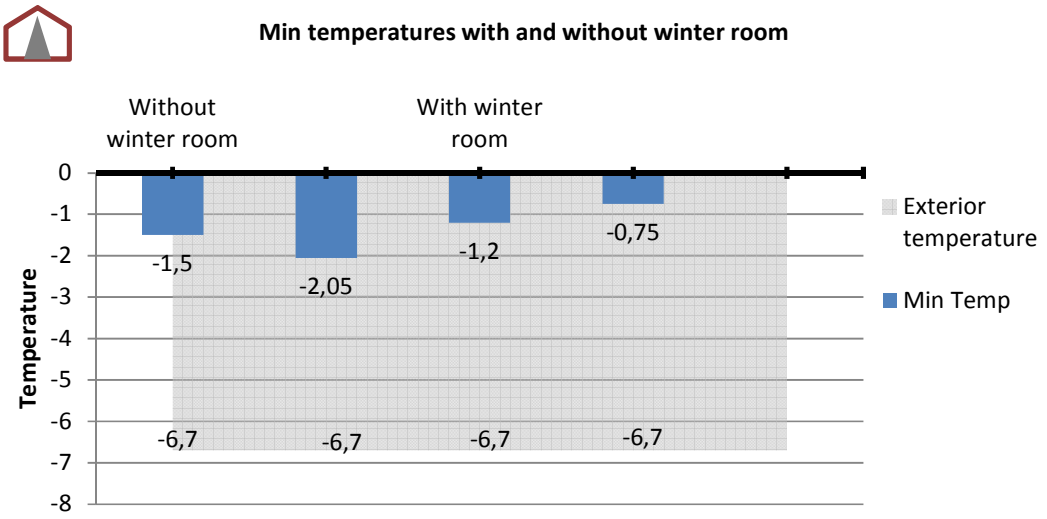
Table 06 and 07.: The minimum and maximum temperature measured inside the tent during the testing period, in comparison to the outside max and min temperatures.



Compared with exterior maximum recorded temperature, the winter room provides a positive reduction of around 4°C.
The Kizilay tent without winter room does not provide a significant reduction on the maximum recorded temperatures, furthermore the greenhouse effect in one of the tents provides an increase of the max temperatures in 4,7°C.

Preliminary conclusions

The winter room has an insulation capacity more effective than the Kizilay tent without winter room on the max recorded temperatures.

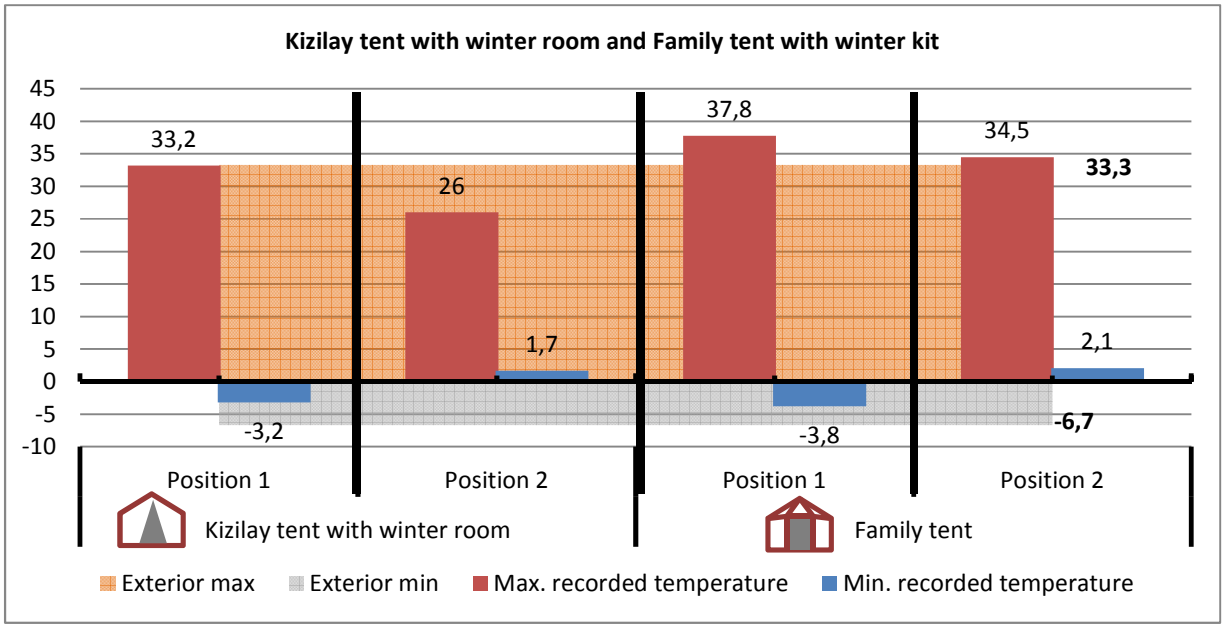


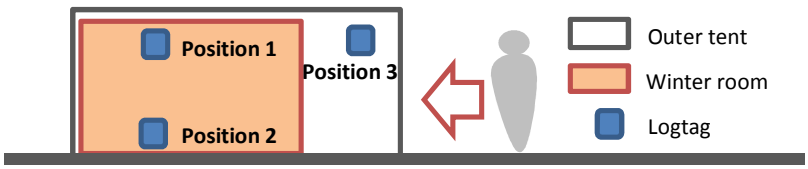
Compared with exterior minimum recorded temperature, the winter room provides a reduction of 5,5°C.
The Kizilay tent without winter room provides a reduction of 4,6°C. (1,3°C colder than the tent with winter room)

Preliminary conclusions

The winter room has an insulation capacity more effective than the Kizilay tent without winter room on the min recorded temp.

Table 08.: The minimum and maximum temperature measured inside the tent Kizilay tent with winter room and the Family tent with winter kit during the testing period, in comparison to the outside max and min temperatures.





The recorded data in table 08 clearly shows that the minimum inside temperature of both, the family tent and the Kizilay tent is very similar in *position 1* (next to the roof).
The minimum recorded temperatures in position 1 are higher in the Family tent than in the Kizilay tent in the same position. The recorded min temperatures in position 1 do not provide a significant variation between tents (just 0,6° C better reduction in the Kizilay tent with winter room).

The maximum recorded temperatures in position 1 are lower inside the Kizilay tent with winter room in comparison with the Family tent in the same position. The Kizilay winter room provides 4,6° C of reduction on the maximum temperatures in comparison with the Family tent in the same position.

However, the maximum recorded temperatures in position 2 (bottom part of the tent) are lower inside the Kizilay tent with winter room than in the Family tent in the same position. The Kizilay winter room provides 8,5°C of reduction on the maximum temperatures in comparison with the Family tent.
The minimum recorded temperatures in position 2 are higher in the Family tent than in the Kizilay tent in the same position. The recorded temperatures in position 2 do not provide a significant variation between tents (just 0,4°C better reduction in the Family tent with winter kit).

Preliminary conclusions

As all tents were installed in basically the same exposure situation, the reason for these differences clearly lies in the insulation tent capacities not in outside conditions like a shaded or particularly breezy site.

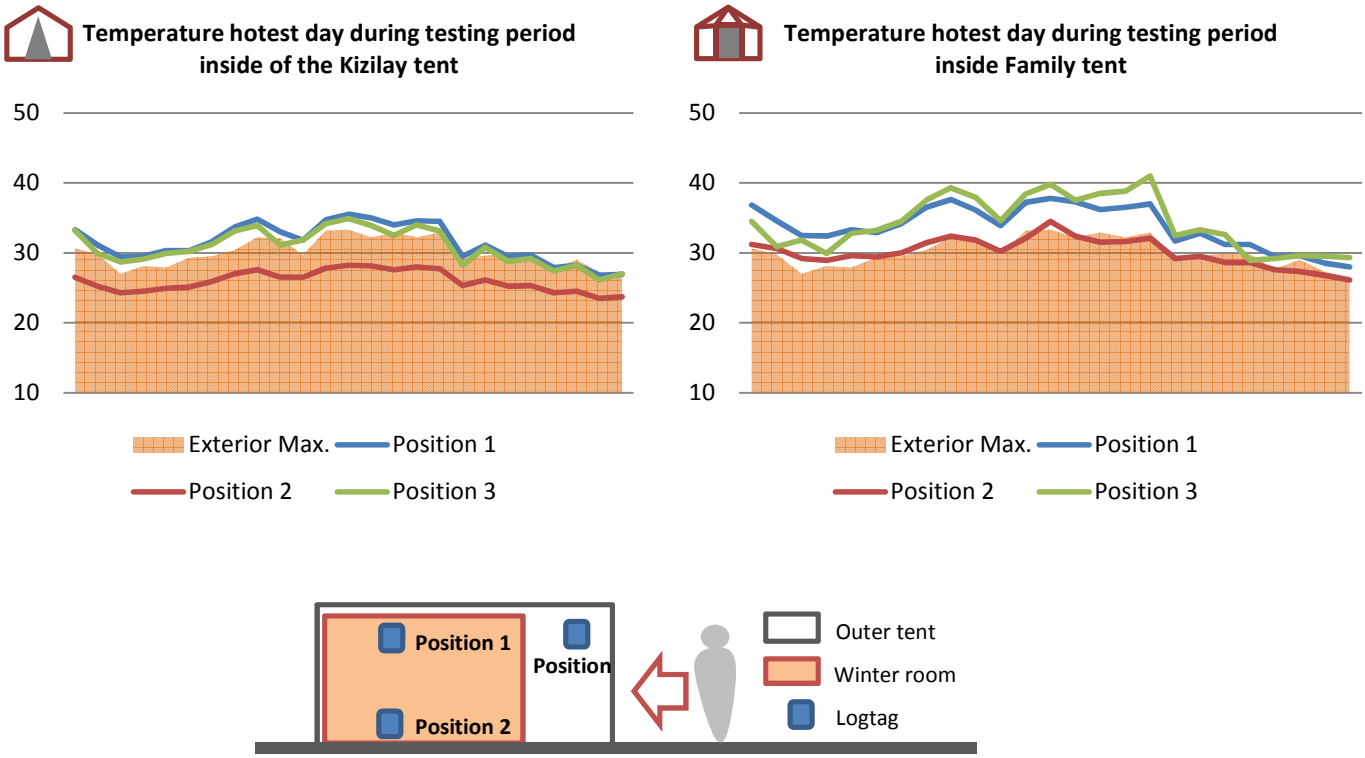
The temperatures in the bottom part of the winter room/kit are very similar.

Improving the insulation in the floor of the Kizilay winter room can provide a better performance in terms of temperature inside the winter room.

7.3. *Observations on the Influence of winter room*

All tent types were tested with and with out winter room to recover data of the influence on the climatic comfort.

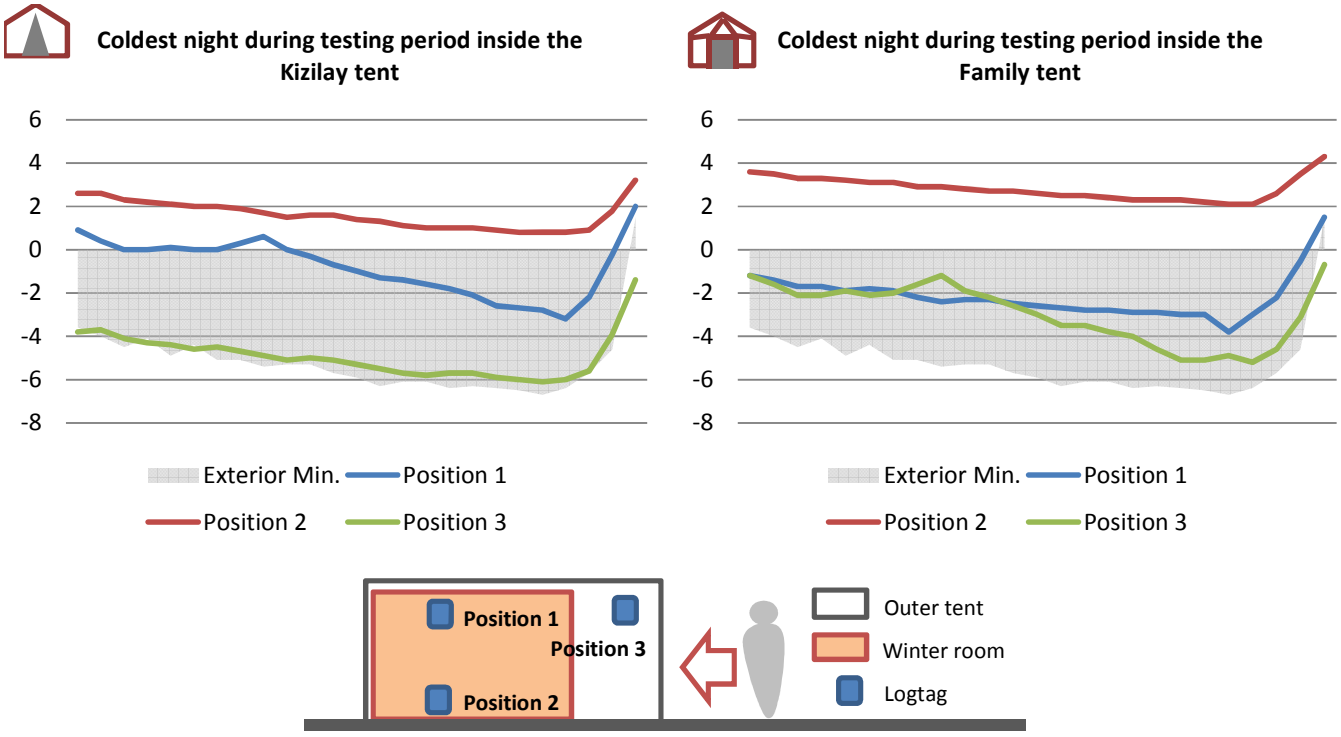
Table 09.: Winter room influence in interior temperature and stratification in comparison with the exterior recorded temperature on the hottest day during the testing period.



The graphs in table 09 show that the effect of the winter room on the inside temperature are different in the Kizilay tent and the Family tent.

The temperatures in position 2 (bottom part of the tent) are 5°C lower than the exterior temperature in the Kizilay tent with winter room, but the temperatures in the Family tent with winter kit in the same position are very close to the outside temperature.
However the maximum recorded temperature in the Family tent (Positions 1 and 3) was 41°C, 8 °C more than the outside temperature of 33°C recorded that day.

Table 10.: Winter room influence on interior temperature and stratification in comparison with the exterior recorded temperature in the coldest day during the testing period.



The Logtag in position 3 (outside the winter room) has the lowest temperature inside the Kizilay tent, with similar temperatures than the exterior Logtag.
The Logtag in position 1 provides the lowest temperature inside the winter room but with a positive reduction of 2°C in the coldest moment in comparison with the Logtag in position 3.
The Logtag in position 2 has recorded the better temperature reduction inside the winter room, around 5,9°C in comparison with the log tag in position 3.

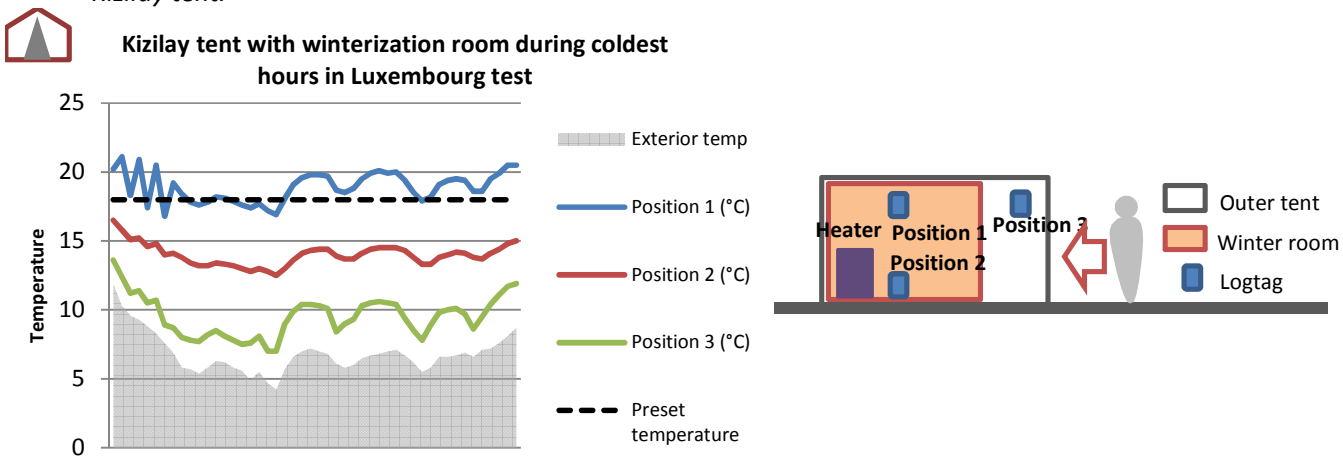
Preliminary conclusions

The winter room provides a difference in the interior temperature of 6 to 8°C higher than the exterior temperature in Position 2 where the people sleep during night time. Improving the insulation of the floor of the Kizilay winter room can provide a better performance in terms of temperature inside the winter room.

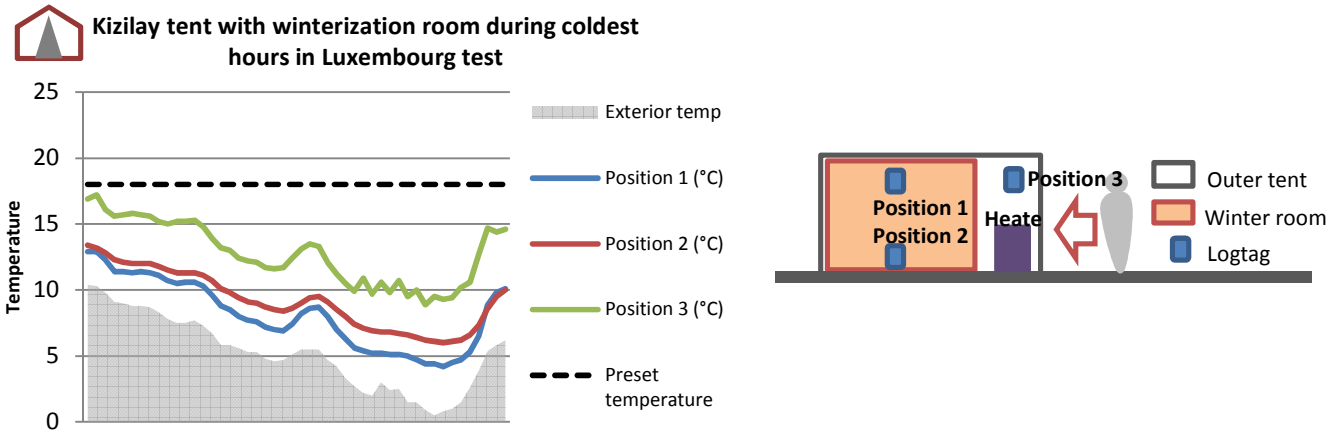
7.4. *Thermal performance and energetic consumption and of the winter room with an electric heater.*

The tested tent types with winter room was also tested in Luxembourg with an "electric oil radiator" (Model HOR9E20-10/ 2000w) installed inside the tent in different positions, to recover data of the influence on the climatic comfort as well as the energetic consumption of the heater inside or outside the winter room.

Table 11.: Influence on indoor temperatures in function of the different position of the heater in the Kizilay tent.

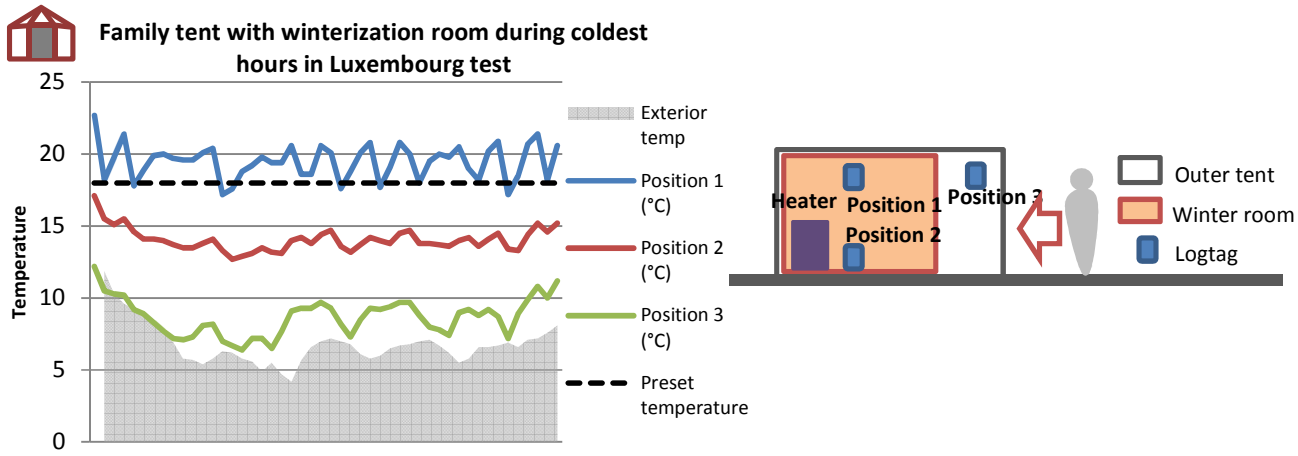


The graphs show that the effect of the heater inside the winter room produces a significant increase of the recorded temperatures in positions 1 and 2, between 10 to 15°C in relation to the exterior temperature. The temperatures in position 3 outside the winter room increase only around 3°C. However looking at the stratification of the recorded data, the highest recorded temperature is in position 1 (on the roof of the winter room) with a difference of 5 to 8°C with position 2 (in the floor where the people sleep). The log tag in position 1 is the only one who has recorded temperatures above 18°C.

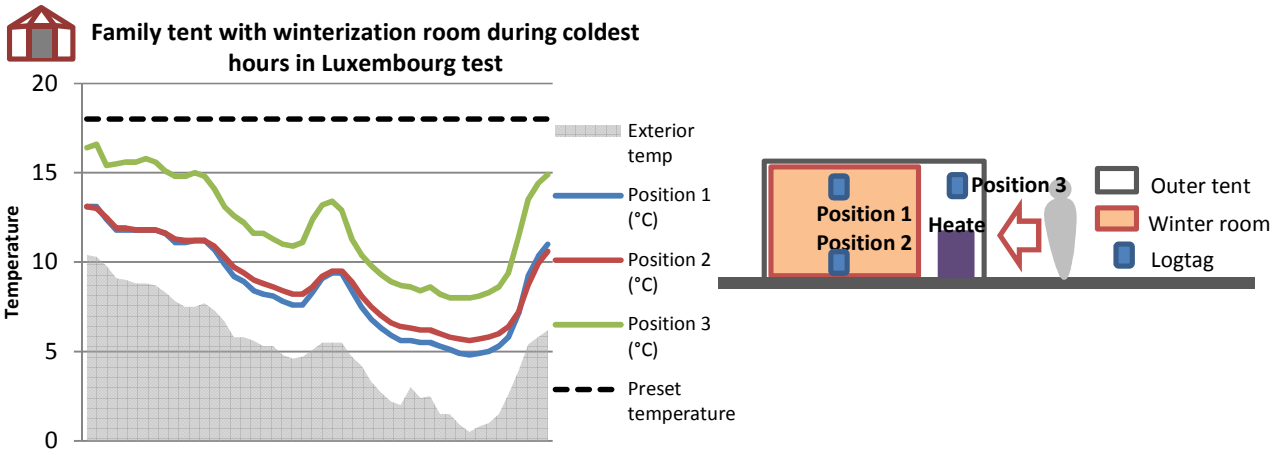


The heater outside the winter room does not produce an important increase on the recorded temperatures in positions 1 and 2 (inside the winter room). In this case none of the Logtag have registered temperatures over 18°C.

Table 12.: Influence on indoor temperatures in function of the different position of the heater in the Family tent.

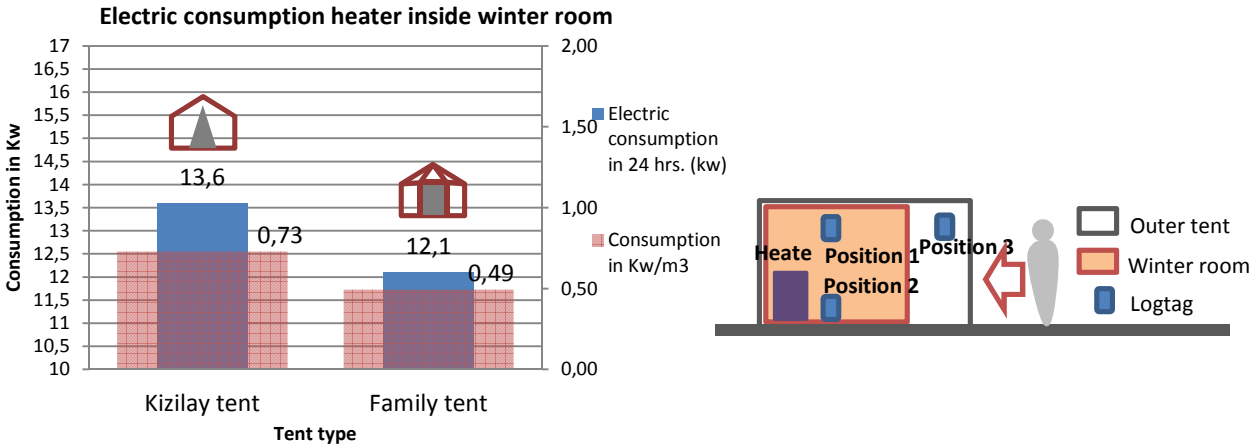


The same can be concluded for the Family tent with the heater inside the winter room, which has produced a significant increase of the recorded temperatures in positions 1 and 2. Also in this case the log tag in position 1 is the only one who has recorded temperatures above 18°C.

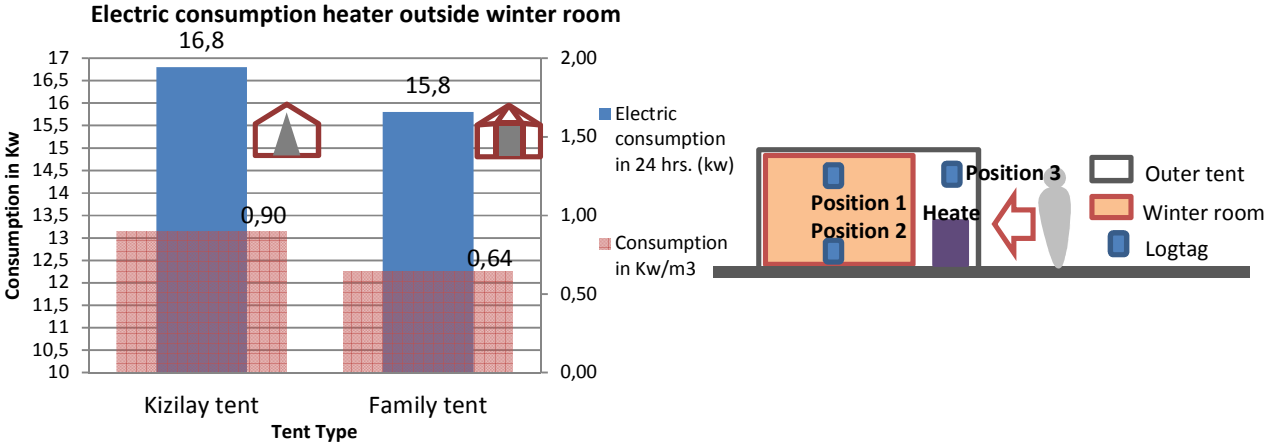


The heater outside the winter room does not produce an important increase on the recorded temperatures (inside the winter room). Furthermore, there are no significant differences on the recorded temperatures in positions 1 and 2; both remain lower than the temperature outside the winter room.

Table 13.: Total electric consumption in 24 hrs. and electric consumption per m^2 and tent type.



The heaters inside the winter room have been programed with a predefined temperature of 18°C. The test was executed with a minimum exterior temperature of 4°C. In these conditions, the electric consumption of the heater inside the Family tent was 12,1Kw in comparison with the Kizilay tent (13,6Kw = 11% extra consumption).



The heaters outside the winter room have been programed with the same parameters. During this 24hrs test the minimum recorded temperature was 0,4°C and the recorded electric consumption 16,8kw for the Kizilay tent and 15,8kw for the Family tent (23% extra consumption for the Kizilay tent and 30% for the Family tent).

Preliminary conclusions

The heater inside the winter room performs better than the heater outside the winter room in terms of energetic consumption and interior temperature. The electric consumption for the heater inside the Kizilay tent is higher than the electric consumption in the Family tent.

The maximum temperature has been recorded in position 1 inside the winter room that proves the convection inside the tent as a relevant influence in the thermal comfort. The temperatures in

position 2, where the people sleep, never reach the predefined 18°C. The floor insulation is a critical factor to ensure a minimum comfort inside the tent.

8. Basic Analysis of observations and qualitative data obtained during the testing process

The qualitative information and observations of the tested solutions provide decisive information to well understand and evaluate them. Especially if this information comes from beneficiaries or/and experts in the area.
The IFRC-SRU Research Officer collected related information from the Kizilay tent with winter room during all the testing process in the different plots and also collected information from the manufacturer.
With the aim of analysing this information in a scientific and impartial way, has been used different matrix based on the "The Sphere Project" and "Transitional shelter standards" (Shelter Centre) to evaluate and compare the Kizilay tent and the Family tent with the same basic criteria.

Table 14.: Kizilay tent with winter room and Family tent with winter kit under "Sphere Project Guidance"

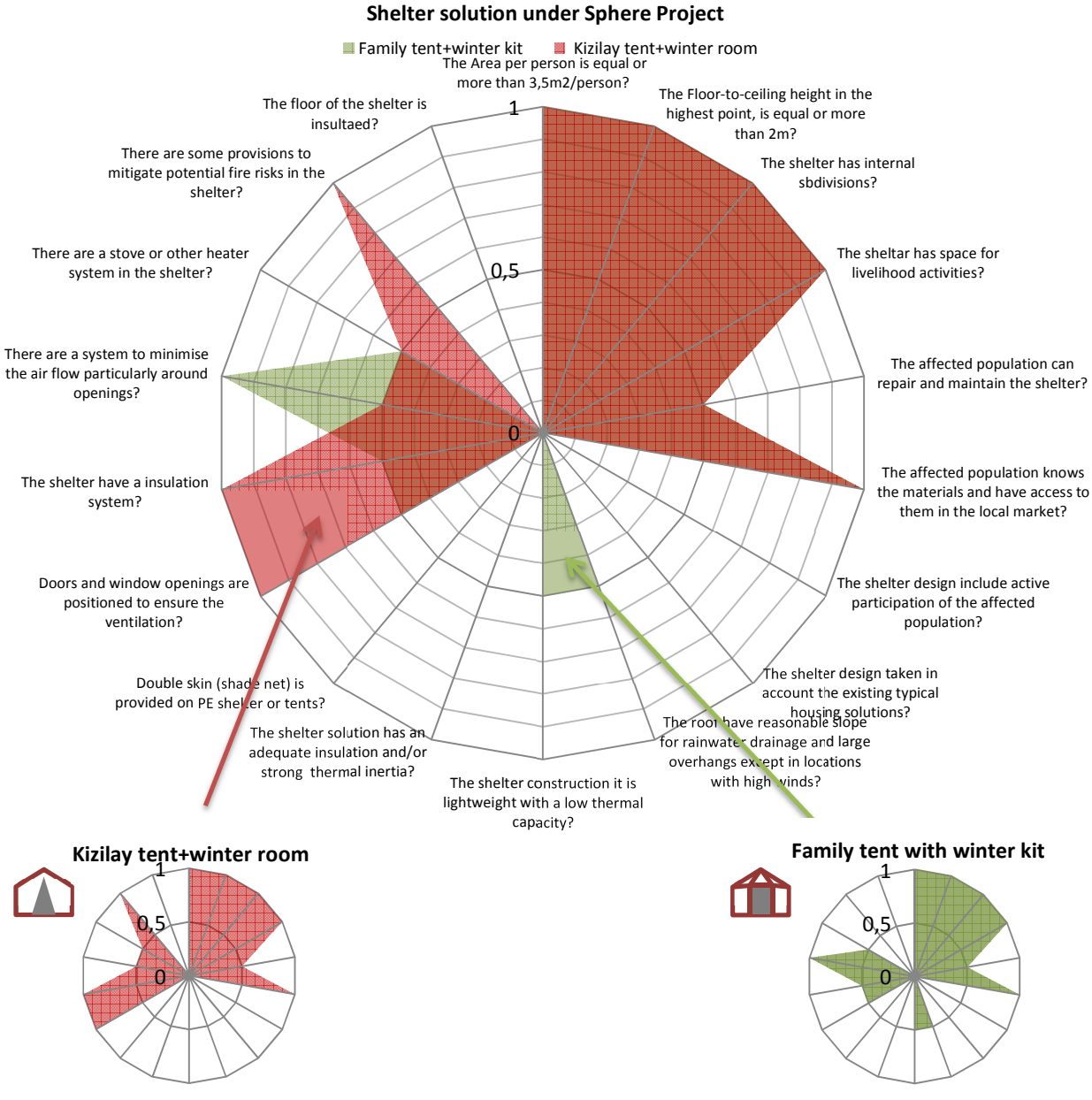
The Sphere Project			
Shelter and settlement standard 3- Covered living space "People have sufficient covered living space providing thermal comfort, fresh air and protection from the climate ensuring their privacy, safety and health and enabling essential household and livelihood activities to be undertaken."			
Key actions	**Criteria (yes=1; no=0; N/A=0,5)**	***Family tent + winter kit***	***Kizilay tent + winter room***
Ensure that each affected household has adequate covered living space. Guidance notes 0,5: A covered floor area in excess of 3,5m2 per person… The floor-to-ceiling height should be a minimum of two miters at the highest point.	The Area per person is equal or more than 3,5m2/person?	1	1
	The Floor-to-ceiling height in the highest point, is equal or more than 2m?	1	1
Guidance notes 3: *Opportunities for internal subdivision within individual household shelters should be provided*	The shelter has internal subdivisions?	1	1
Guidance notes 4: *The covered area should provide space for the following activities: sleep, dressing, care of infants, storage, and the common gathering of the household members*	The shelter has space for livelihood activities?	1	1

Guidance notes 5: *Defined shelter solutions such as family tents, shelter kits, packages of materials or prefabricated buildings should be provided where local post-disaster shelter options are not readily available, inadequate or cannot be sustainably supported by the local natural environment. The technical and financial ability of the affected population to maintain and repair their shelter should also inform the specification of materials and technologies.*	The affected population can repair and maintain the shelter?	**0,5**	**0,5**
	The affected population knows the materials and has access to them in the local market?	**1**	**1**
Guidance notes 6: *All members of each affected household should be involved to the maximum extent possible in determining the type of shelter assistance to be provided. The shelter design should be informed by assessments of existing typical housing solutions.*	The shelter design includes active participation of the affected population?	**0**	**0**
	The shelter design taken in account the existing typical housing solutions?	**0**	**0**
Guidance notes 7: *In warm, humid climates: Shelters should be designed to maximize ventilation and minimize entry of direct sunlight. The roof should have reasonable slope for rainwater drainage with (locations with high winds are one exception) The construction of the shelter should be lightweight, as low thermal capacity is required.*	The roof have reasonable slope for rainwater drainage and large overhangs except in locations with high winds?	**0,5**	**0,5**
	The shelter construction it is lightweight with a low thermal capacity?	**0,5**	**0**
Guidance note 8: *In hot, dry climates: Construction should be ensuring high thermal capacity, allowing changes in night and day temperatures to alternately cool and heat the interior. If only plastic sheet or tents are available, a double-skinned roof should be*	The shelter solution has an adequate insulation and/or strong thermal inertia?	**0**	**0**

provided with ventilation between the layers to reduce the radiant heat gain. Doors and window openings should be positioned to ensure correct ventilation.	Double skin (shade net) is provided on PE shelter or tents?	0	0
	Doors and window openings are positioned to ensure the ventilation?	0,5	1
Guidance note 9: *In cold climates: Substantial insulation is required. Minimize air flow to ensure personal comfort while also provide adequate ventilation. Stove or other forms of space heaters are essential and must be appropriate to the shelter. Assess and mitigate potential fire risk are required. The loss of body heat through the floor should be minimized.*	The shelter has a insulation system?	0,5	1
	There is a system to minimize the air flow particularly around openings?	1	0,5
	There is a stove or other heater system in the shelter?	0,5	0,5
	There are some provisions to mitigate potential fire risks in the shelter?	0	1
	The floor of the shelter is insulated?	0	0
Overall assessment under "Sphere project"		***52,8%***	***55,5%***

The previous matrix shows that none of the tested tent models reach 100% the "Sphere Project Guidance". Between the two tent models there is no big difference (52,8% for Family tent and 55,5% for Kizilay tent) but none of them reach the ¾ (75%) of the Sphere Project recommendations.
The performance on the first guidance (1 to 4) is the 100% on both tent models. This guidance is related to specific criteria about surface, or physical characteristics as interior partition or extra space for livelihood activities. On guidance 3 to 9 the result is not uniform for the two tents, but in general the results remain in the line of the 50% of the criteria.
The guidance 6 (active participation of the affected population) and 8 (in hot and dry climate) the valorised parameter reach less than the 50%, between 0 and 45%.

Table 15.: The next graph shows graphically the results on the previous matrix with Kizilay tent with winter room and Family tent with winter kit under "Sphere Project Guidance"



The graph shows the assessment of the two tent models under the Sphere Project, none of the tent models reach 100% of the recommendations but each of them has a different performance and an important range of superposition on the selected criteria. Please notice that some of the criteria are related to specific projects and have to be evaluated under these particular conditions.

Table 16.: Kizilay tent with winter room and Family tent with winter kit under "Transitional shelter standards" (Shelter Centre)

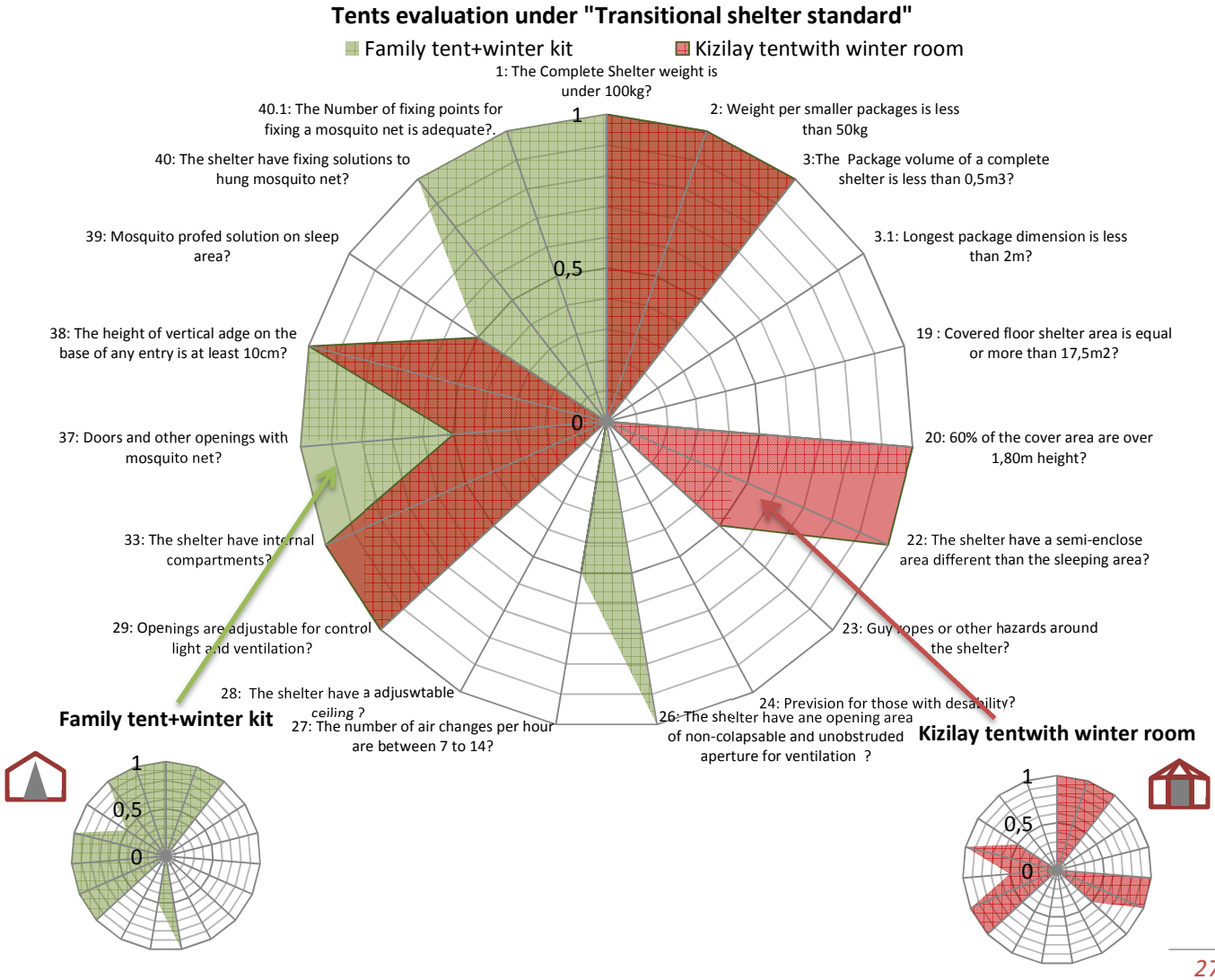
Transitional shelter Standards			
The transitional shelter standards will provide manufactures with a manufacturing standard from which their individual designs can be derived. … the Standards do not constitute any obligation of Project members to procure, designs meeting these Standards may be suitable for deployment in an emergency or post-disaster context.			
Requirements	**Criteria (yes=1; no=0; N/A=0,5)**	***Family tent + winter kit***	***Kizilay tent + winter room***
1: The mass of a complete packed shelter shall be no more than 100 kg. 2: A complete packed shelter shall consist of one package that can be broken down into smaller packages of weights suitable for transport by two people. The mass of each smaller package should be no more than 50kg. 3: The volume of a complete packed shelter shall be no more than 0,5m3 The longest dimension of a packed shelter shall be no more than 2m	1: The Complete Shelter weight is under 100kg?	**1**	**1**
	2: Weight per smaller packages is less than 50kg	**1**	**1**
	3:The Package volume of a complete shelter is less than 0,5m3?	**1**	**1**
	3.1: Longest package dimension is less than 2m?	**0**	**0**
19: Covered floor area of the shelter shall be at least 17,5m2 20: The standing height for the covered space shall be a minimum of 1,8m over at least 60% of the covered floor area. 22: Provision will be made for shaded cooking areas, such as by designing the outer liner to be larger than the inner liner, which would provide a sheltered semi-enclosed space. 23: There shall be no guy ropes, or other trip hazards around the shelter. 24: Provision shall be made to facilitate use by those with a disability, Entry and exit should have a minimum access width of 90cm to a maximum height of 2cm to provide for wheelchair user.	19 : Covered floor shelter area is equal or more than 17,5m2?	**0**	**0**
	20: 60% of the cover area are over 1,80m height?	**0**	**1**
	22: The shelter have a semi-enclose area different than the sleeping area?	**1**	**1**
	23: Guy ropes or other hazards around the shelter?	**0**	**0,5**

	24: Prevision for those with disability?	**0**	**0**
26: Minimum ventilation shall be achieved through an un-obtruded, non-closable aperture with a total area of at least 0,01m2. The aperture should be at high level. 27: the number of air changes should be from 7 to 14 per hour. 28: Shelter shall have a ceiling to provide an adjustable air gap for insulation and ventilation 29:All doors and openings shall be adjustable to control light and heat. 33: in cold climates, the shelter shall have internal compartments in order to minimize heat loss though infiltration....	26: The shelter have an opening area of non-collapsible and un-obtruded aperture for ventilation ?	**1**	**0**
	27: The number of air changes per hour is between 7 to 14?	**0,5**	**0,5**
	28: The shelter have a adjustable ceiling ?	**0**	**0**
	29: Openings are adjustable for control light and ventilation?	**1**	**1**
	33: The shelter has internal compartments?	**1**	**1**
37: All doors and openings shall be protected against mosquitoes, flies and other disease vectors 38: The shelter shall impede the entry of crawing insects. This impedance may be a 10cm vertical edge around the base of all entry points or an equivalent alternate. 39: The shelter must be mosquito proofed in an area long and brad enough for the intended occupancy to sleep in. 40: There shall be fixings for additional or replacement mosquito nets to be hung. It shall be possible to hang mosquito nets with both a single fixing or multiple fixings.	37: Doors and other openings with mosquito net?	**1**	**0,5**
	38: The height of vertical edge on the base of any entry is at least 10cm?	**1**	**1**
	39: Mosquito proofed solution on sleep area?	**0,5**	**0,5**
	40: The shelter have fixing solutions to hung mosquito net?	**1**	**0**
	40.1: The Number of fixing points for fixing a mosquito net is adequate?.	**1**	**0**
Overall assessment under "Transitional Shelter standards"		***63,2%***	***52,6%***

The matrix shows that none of the tested tent models reach 100% of the "Transitional Shelter Standard". Between the two tent models there is no big difference (63,2% for Family tent and 52,6% for Kizilay tent). In general the two tents reach the ½ (50%) of the Transitional Shelter Standard recommendations.

The performance of the Logistics Requirements (1 to 3), is reaching the 75% except on the packaging dimensions where the long packaging side is more than 2m in the two tents. On the Physical requirements (19 to 24) the performance of the two tents are very different. The Family tent just reaches the 20% of the evaluated parameter but the Kizilay reaches 50%. The tent under the ventilation requirements (26 to 33) reaches the 90% which is the highest value. The analysis of the vector control requirements (37 to 40) is very different between two tents. The family tent reaches the 90% of the requirements but the Kizilay tent just the 50%. The incidence of the mosquito net is determinant as a vector control solution. Finally the evaluation under the environmental and toxicity requirements (41 to 43) provides a similar value around 50%. Here it is important to highlight that controls on the environmental impact during the shelter construction process will be a relevant aspect.

Table 17.: The next graph shows graphically the results on the previous matrix with Kizilay tent with winter room and Family tent with winter kit under "Transitional shelter standard"



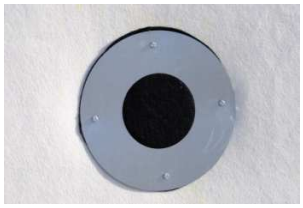
The graph shows the assessment of the two tent models under the "Transitional Shelter standard", none of the tent models reach 100% of the recommendations but each of them has a different performance and an important range of superposition on the selected criteria. It has to be noticed that some of the criteria are related to specific projects and have to be evaluated under these particular conditions.

9. Recommendations to improve the actual winter room solution for Kizilay 16m^2 tent.

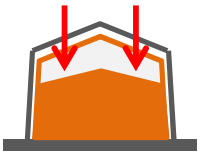
This study has been conducted in Ankara, Turkey and Luxembourg during two months of the early spring season. Statements on technical performance, based on quantitative data and the comparisons with the selected international criteria, can be generalized. However, other qualitative aspects, in particular beneficiaries' satisfaction and specific geographic conditions are only valid in a particular context.
The aim of the next chapter is to provide ideas and recommendations to improve the Kizilay winter room in order to have a suitable solution for winter conditions that can be easily deployed especially to help the victims of the Syrian conflict.

9.1 Buffer winter room

The actual winter room (inner tent) of the Kizilay model does not cover the total inner space. The tested solution just provides an additional protection on the "entrance hall" roof with nonwoven material.
In order to provide an intermediate protected space between the exterior and interior room in the tent, it could be useful to extend the winter room to this space but maintaining the actual configuration of the winter room. This extension can provide an extra protected (insulated) space and also a "buffer" area between the exterior and interior part of the tent, reducing infiltrations and improving the quality of life for the beneficiaries.
The floor in this "buffer area" should be designed with a protected space to place the heater (60x100cm approx.) and also providing for a stack hole in coordination and with the same characteristics than the one in the exterior tent.



9.2 Volume of the winter room



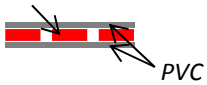
The current height of the winter room starts from 1,80m on the side, up to 2,35m on the bridge, providing a comfortable space inside the winter room. But from the thermic point of view, and according to the results obtained during the tests, the performance was reduced.
Including an adjustable ceiling fixed to the interior part of the winter room can reduce the height and the total volume for heating in cold conditions. This new adjustable ceiling should be an insulated material. Could be the nonwoven fabric with aluminum laminated that, placed to the bottom part of the ceiling, providing an extra insulation effect. Fixed with longitudinal Velcro on the roof of the winter room, the new adjustable ceiling will have a polygonal shape in order to generate a triangular volume under the bridge. Finally the new height of the winter room will start from 1,8m up to 2m.

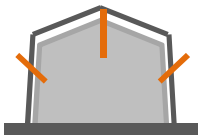
9.3 Winter room and floor insulation.

Inside the tent the normal activities take place on the floor. Common daily routines as sleeping, eating, reading or other livelihood activities are in direct contact with the floor of the tent. Good floor insulation is critical to ensure a minimum comfort level in cold climates, especially during the nighttime when the people sleep in direct contact with the floor. The current floor of the Kizilay winter room does not have any insulation material which is however necessary. A proposed solution could be a multilayered floor in order to provide thermic insulation, protection from water

from the outside and hygienic features (washable) from inside. The new solution could consist of one superior layer in PVC with a non-skid surface, one interior layer with high-density nonwoven textile with a recommended 5mm thickness and anti-bacterial and anti-fungus treatment, and finally a bottom PVC layer in contact with the ground (same as the actual).

Insulation





9.4 Winter room and Hanging systems

The current winter room is hung to the tent structure by metallic hooks. This is a very efficient system in terms of setup timing and flexibility. In order to improve these capacities, the union between the hooks and the winter room could be adjustable to provide the possibility to hang the inner room in different types of structures like a 45m^2 tent.
Copying the same solution that exists in the bottom part of the winter room could be an effective tool. Furthermore replacing the metallic hooks for plastic ones could reduce the total weight and price.

9.5 Winter room Doors and infiltrations

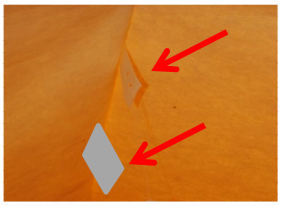
Through the proposed “buffer area” the infiltrations and loss of temperature from the interior will be reduced. In the objective to complement this solution it could be necessary to change the door positions and reduce the doors height. The total height of the new door will be around 1,90m and the door will have to be displaced by 0,70 m, one on the right and the other on the left, to avoid direct infiltration in to the winter room. Moreover the bottom part of the doors must have a fixing system to avoid air infiltration. This is a critical point because the cold air infiltration will produce a temperature drop in the bottom part of the winter room, where the people sleep. The inclusion of Velcro lines in the bottom part of the doors could provide an effective solution.

9.6 Winter room and minimum ventilation

Based on the proposal to reduce the inner volume (see 9.2), the winter room could have two triangular vents in each gable top (150x30cm) made of mosquito net. The netted triangle window must fill the space from the ridge to the top of the adjustable ceiling. The flaps, made of the same material as the inner tent, must open downwards and be fixed around the triangle with a Velcro system.

9.7 Winter room and interior accessories

It is necessary to add a minimum quantity of hanging points and pockets inside the winter room. There should be at least 6 hangings - loops of 30mm made in a flexible material such as fabric - to suspend light-weight items. In addition, two pockets of 200x300mm could be placed on the opposite walls of the winter room.



9.8 Winter room vector control and doors

There is no mosquito net in the doors of the current winter room for the Kizilay tent. All doors and openings should be protected against mosquitoes, flies and other disease vectors. A second interior and independent door made in mosquito-net material can be placed on each door of the winter room. In order to ensure the effectiveness of this second door, the closing system could be completed with a vertical zip and Velcro in the bottom part.
The inclusion of a lock to close the tent to prevent unwanted intruders like animals, playing children or thieves from entering could also be necessary. The inclusion and design of a basic lock/security system for doors and windows presents only a minor adaptation and would be an added value highly appreciated.

Contributors and publishers

Contributors

Study founded by:

Luxembourg Red Cross

With the support of:

Turkish Red Crescent (Kizilay)

In collaboration with:

Marmara University – Prof. Dr. Mehmet Akalin
Hassan Group – Chemical Engineer Burak Dalbudak

Publishers

Lead of the R&D project and editor of this document:

Ledesma, Daniel (IFRC-SRU Research Officer)

IFRC-Shelter research unit team :

Braedt, Cecilia (Coordinator)
Virgo, Vincent (Research Officer)
Ledesma, Daniel (Research Officer)

IFRC-SRU related contacts:

IFRC-SRU, 10 Cité Henri Dunant, L-8095 Bertrange, Luxembourg
T.: +352.27.55.89.03 – M.: daniel.ledesma@croix-rouge.lu