Civil Protection

International Federation of Red Cross and Red Crescent Societies

Shelter Research Unit

an initiative of the Benelux Red Cross Societies

CLADDING AND FIXING CONFERENCE

Luxembourg, 3rd & 4th of September 2014

Insulation needs

Vincent Virgo, IFRC-SRU
**Definition**

Thermal insulation is the reduction of heat transfer (the transfer of thermal energy between objects of differing temperature) between objects in thermal contact or in range of radiative influence.

Heat flow is an inevitable consequence of contact between objects of differing temperature.

Thermal insulation provides a region of insulation in which thermal conduction is reduced or thermal radiation is reflected rather than absorbed by the lower-temperature body.

The insulating capability of a material is measured with thermal conductivity ($k$). Low thermal conductivity is equivalent to high insulating capability (R-value). In thermal engineering, other important properties of insulating materials are product density ($\rho$) and specific heat capacity ($c$).

Heat loss

Complexity and costs implications

Insulation needs according to external exposures

Hot & Dry
Hot & Humid
Temperate
Cold
Altitude

Attitudes against wind, rain and cold:

Source: www.ademe.fr

Pertes thermiques d’une habitation à rénover

Source: Component parts of shelter heat loss with no wind
Heat loss split for tested shelter, p. 77
Emergency shelter for humanitarian relief in cold climates, policy and praxis, P. Manfield (1999)

Source: Heat loss split for tested shelter even after normalization to Kosovan ground temperature conditions.
Simulation for winter ground conditions, p. 25
Modeling of a cold climate emergency shelter prototype and a comparison with the UN winter tent, P. Manfield (2000)
Thermal comfort

depends from 6 parameters:

- The metabolism
- The Cloths
- The ambient air temperature $T_a$.
- The average temperature walls $T_p$.
- The relative humidity (RH).
- The air velocity (air velocities generally do not exceed 0.2 m/s)

An ambient temperature of 15-19°C is desirable, but lower temperatures can be tolerated with warm clothing.

More the climatic exposure is rigorous and harsh, more occupant health may be affected.
### Contexts

#### Global
- Nepal
- Afghanistan
- Kyrgyzstan
- Tajikistan
- Kazakhstan
- Turkmenistan
- Uzbekistan
- Mongolia
- China
- Iran
- Lebanon
- Pakistan
- Syria
- Turkey

#### Climate Data
- **Cold**
  - T (max)
  - T (°C)
  - Préc. (l/m²)

- **Wind**
  - T (max)
  - T (°C)
  - Préc. (l/m²)

- **Altitude**
  - T (max)
  - T (°C)
  - Préc. (l/m²)

#### Impacts
- Cold
- Wind
- Prot. & Isol. / Prot. & Insul.
Global

Contexts

Mongolia
China
Iran
Lebanon
Pakistan
Syria
Turkey

<table>
<thead>
<tr>
<th>Name</th>
<th>lat N</th>
<th>long E</th>
<th>Alt (m)</th>
<th>Heating</th>
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= heating period or 9 months
**Tent characteristics**

→ **Standard Family Tent Specifications – Description Sheet**

- **OUTER**
  - Roof, polyester and cotton blended fibers yarns, 350 g/m² ± 15%
  - Wall, polyester and cotton blended fibers yarns, 200 g/m² ± 10%
  - Mud flap, HDPE laminated both sides with polyethylene, 180 g/m² ± 5%

- **INNER**
  - Room, polyester and cotton blended fibers yarns, 130 g/m² ± 10%
  - Floor, HDPE laminated both sides with polyethylene, 180 g/m² ± 5%

→ **Winter kit**

- FLOOR PROTECTION, heat resistant, for tent heater, 0.5x1m
- SLEEVE, heat resistant, for tent heater fume pipe, 0.7x0.35m
- INSULATING FLOOR MAT, aluminized, fleece covered, 0.9x1.8m
- PARTITION, winterization for the standard Family Tent
- LINER, winterization for the standard Family Tent, polycotton 130gr

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Ind. price</th>
<th>Ship. weight</th>
<th>Ship. vol.</th>
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<tbody>
<tr>
<td>HSHETENTF10C</td>
<td>TENT, FAMILY, 16 m² double fly with groundsheet</td>
<td>CHF 310.00</td>
<td>55 kg</td>
<td>0.28176 m³</td>
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310 CHF = 354 USD

On request

- **Winterisation kit, for the Family Tent**

<table>
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<tr>
<th>Code</th>
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<th>Ind. price</th>
<th>Ship. weight</th>
<th>Ship. vol.</th>
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<td>WINTERISATION KIT, for the Family Tent</td>
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425 USD

325 USD

750 USD
Winter kit

Specifications

WINTERISATION KIT
for the standard
Family Tent

Packing list:
- 5 x LINER
- 5 x PARTITION
- 5 x FLOOR PROTECTION
- 5 x SLEEVE
- 5 x INSULATING FLOOR MAT
  - aluminized
  - fleece covered
  - 0.9 x 1.8 m

Straw

1 x LINER

1 x PARTITION

1 x FLOOR PROTECTION
- heat resistant, for tent heater
- 0.5 x 1 m = 4 x (0.5 x 0.25 m)

1 x SLEEVE
- heat resistant, for tent heater fume pipe,
- 0.7 x 0.35 m

Family Tent + winter kit

Sdt Family Tent
Statement

Thermal infra-red camera

Sdt Family Tent

Sdt Family Tent + Winterkit
Thermal infra-red camera

Sdt
Tent

With Winter kit

[Images of thermal images with temperatures and FLIR logos]
### Fuel Consumption Cost

<table>
<thead>
<tr>
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<th>Sdt Family Tent</th>
<th>Winterkit</th>
<th>Prefab</th>
<th>Montana</th>
<th>Montana+Kit</th>
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<tr>
<td>Conso (KWh)</td>
<td>17341.25</td>
<td>13837.56</td>
<td>4642.06</td>
<td>38150.76</td>
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<td>Kerosene (liters)</td>
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<tr>
<td>Charcoal (kg)</td>
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<td>1779</td>
<td>597</td>
<td>4904</td>
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#### Graph

**conso (KWh)**

- **Sdt Tent**: 17341.25 KWh
- **Winterkit**: 13837.56 KWh
- **Prefab**: 4642.06 KWh
- **Montana**: 38150.76 KWh
- **Montana+Kit**: 23523.85 KWh
### Results

<table>
<thead>
<tr>
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<th>Sdt Family Tent</th>
<th>Prefab</th>
<th>Collective Tent</th>
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<table>
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<td>1 year:</td>
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Results

- **Sdt Family Tent**
- **Prefab**
- **Collective Tent**

### Stove Costs
- **8KW**: 125 USD
- **7.5KW**: 100 USD
- **2.5KW**: 35 USD
- **20KW**: 175 USD
- **12KW**: 155 USD

### Fuel Cost

- **Winter Option**:
  - **8KW**: 125 USD
  - **7.5KW**: 100 USD
  - **2.5KW**: 35 USD
  - **20KW**: 175 USD
  - **12KW**: 155 USD

- **Structure**:
  - **8KW**: 125 USD
  - **7.5KW**: 100 USD
  - **2.5KW**: 35 USD
  - **20KW**: 175 USD
  - **12KW**: 155 USD
World Vision decided to focus on unregistered refugees for the stove distributions because they are amongst the most vulnerable and cannot access formal assistance. Each stove costs about $100 and each family requires about $100 per month in fuel coupons.

Bekaa Valley
Alt = 850m
Winter = 4 months
(Dec-Mar) with T below 15 °C
Average T = 6°C

Feb. 2013 = 3,17 USD / 1 Gallon = 0,84 USD / 1 liter
100 USD = 119 liters = month cons.
119 liters / 30 days = 3,96 liters / day = 3,4 USD / day / shelter
3,96 liters / day = 0,165 liters / h
Heat of combustion Kerosene = 9,78 Kw/ litr.
0,165 liter/h * 9,78 Kw / litr. = 1,61 Kwh
Kerosene Heater 8500 BTU = 2,5 Kwh

Source: http://www.dec.org.uk/blog/syria-crisis-refugees-lebanon-1
Needs of:
additional specifications + items
requested and missing information for thermal modeling

<table>
<thead>
<tr>
<th>Ref.</th>
<th>Parameters</th>
<th>Measurement tool</th>
<th>Test Description</th>
<th>Units</th>
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<td>Scale</td>
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<td>Kg/m³ gr/sqm</td>
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<td>02</td>
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<td>W/m.K</td>
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<td></td>
<td>Thermal Resistance</td>
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<td>03</td>
<td>Surface propriety:</td>
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<td></td>
<td>- Reflection (solar and visible)</td>
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<td>% (0,00)</td>
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<td></td>
<td>- Transmission (solar, visible and IR)</td>
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<td>% (0,00)</td>
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<tr>
<td></td>
<td>- Absorption</td>
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<td></td>
<td>% (0,00)</td>
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<td>- Emissivity</td>
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<td>Specific Heat = Heat capacity</td>
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<td>Wh/kg.K J/kg.K</td>
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<tr>
<td>05</td>
<td>Air permeability</td>
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</table>

new material investigation and studies

new investigation on stoves + temperature requirements
Ongoing & Further developments

Synergies

www.speedkits.eu
Sun protection – Field tests
Shade net testing in Burkina Faso – temperature observed

1/ Refugee camp
Lat: 12°32'23.22'' N
Long: 01°27'40.61'' W
Alt: 287m

02/ IFRC-SRU test site
Burkina Faso

01st Nov until 10th Nov. 2014

Note: all the tents were completely closed and the loggers were fixed at the same height (1m) in each tent

SFT Model following the EIC specifications

Prototype Shade net option:
- HDPE monofilament
- Weight = 185 gr/sm
- Shade factor = 70 to 80 %
- Color = Black

Shade net supplier option:
- HDPE flat filament
- Weight = 85 gr/sm
- Shade factor = 80 %
- Color = strong green
Sun protection – Field tests
Shade net testing in Burkina Faso – temperature observed

Prototype Shade net option:
- HDPE monofilament
- Weight = 185 gr/sm
- Shade factor = 70 to 80%
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Supplier Shade net option:
- HDPE flat filament
- Weight = 85 gr/sm
- Shade factor = 80%
- Color = strong green

Comments:
- Max. temp. = 24 Nov. at 12am with 46,8 °C
- External loggers
  * daytime: non protected logtag is always higher
  * nighttime: protected logtag always lower
- The highest temp from a tent record is corresponding to the highest temp in SFT
- The SFT without shade net is cooling faster than the tents with shade nets at mid night a difference of ± 3,5°C
- Shade nets are really effective with a better impact for the field made option (higher and more ventilated)
Ongoing & Further developments

Synergies

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Shelter Research Unit
an initiative of the Benelux Red Cross Societies

ARCHITECTURE ET CLIMAT
UCL
Université catholique de Louvain

International Federation of Red Cross and Red Crescent Societies

www.speedkits.eu
Cecilia Braedt, Coordinator / cecilia.braedt@croix-rouge.lu
T.: +352.27.55.89.02

Vincent Virgo, Research Officer / vincent.virgo@croix-rouge.lu
Daniel Ledesma, Research Officer / daniel.ledesma@croix-rouge.lu
T.: +352.27.55.89.03

IFRC-SRU, 10 Cité Henri Dunant, L-8095 Bertrange, Luxembourg