CLADDING AND FIXING CONFERENCE
Luxembourg, 3 & 4 of September 2014

Shelter Fixings for Flexible Fabrics 2/2 – Fixings TO FRAMEWORK

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Shelter (non structural) fixings for flexible fabrics

True?

Plastic Sheeting
Fixings to framework tested
Test methodology

EP: EXTERNAL POINT
CP: CENTRAL POINT
CPS: COMPONENT PULLING STRENGTH
PS: PULLING STRENGTH
DTS: DIAGONAL TEARING STRENGTH
Test methodology

DOUBLE SPOT TEST SET-UP

PULLING SPOT TEST SET-UP
Analyzed data

**Fixing Execution:**
- Double Spot Test / Pulling Test
- I-Shape / Simple Edge

**Simple Nail 3.1x65**

### Loading Capacity of the Fixing-Fabric Unions (kg)**

<table>
<thead>
<tr>
<th>Types of Fabrics Tested with the Fixing</th>
<th>PC 200</th>
<th>PC 350</th>
<th>PE IFRC</th>
<th>PE IFRC + Band</th>
<th>PE IHR + Band</th>
<th>SN Type 1</th>
<th>SN Type 2</th>
<th>PVC 240</th>
<th>PVC 450</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average of max. load. cap. (kg)</td>
<td>30.7</td>
<td>14.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard deviation*</td>
<td>0.66</td>
<td>2.26</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average of max. load. cap. (kg)</td>
<td>24.3</td>
<td>19.6</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>Standard deviation*</td>
<td>7.00</td>
<td>3.72</td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Average of max. load. cap. (kg) in diagonal tearing strength (DTS)</td>
<td>17.08</td>
<td></td>
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</tbody>
</table>

Average of max. resistance (k) of a 50x10 cm fabric stripe:

- 299.5
- 150.9
- 261.6
- 174.3
- 352.5

### Displacement of the Fixing-Fabric Union (mm)

<table>
<thead>
<tr>
<th>Types of Fabrics Tested with the Fixing</th>
<th>PC 200</th>
<th>PC 350</th>
<th>PE IFRC</th>
<th>PE IFRC + Band</th>
<th>PE IHR + Band</th>
<th>SN Type 1</th>
<th>SN Type 2</th>
<th>PVC 240</th>
<th>PVC 450</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average of max. displacement (mm) of the fabric-fixing union (CPS)</td>
<td>8</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard deviation* from a data set of three test (CPS)</td>
<td>3.21</td>
<td>3.21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average of max. displacement (mm) of the fabric-fixing union (PS)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard deviation* from a data set of three test (PS)</td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

* Standard deviation of a data set is the square root of its variance. The bigger the worse, as it shows how much variation or dispersion exists from the average of the tests. Variance measures how far a set of numbers is spread out.

** The results of the graphic are not reduced by a safety factor. It must be considered for any structural calculation. The loading capacity of the fixing-fabric is reached in a punctual moment; not under a sustained load.

### Usability data

<table>
<thead>
<tr>
<th>Types of Fabrics Tested with the Fixing</th>
<th>Fabric</th>
</tr>
</thead>
<tbody>
<tr>
<td>Failure (a)</td>
<td>3</td>
</tr>
<tr>
<td>Reusability (b)</td>
<td>2</td>
</tr>
<tr>
<td>Easy to fix (c)</td>
<td>1</td>
</tr>
<tr>
<td>Easy to remove (c)</td>
<td></td>
</tr>
<tr>
<td>Understandability (c)</td>
<td>3</td>
</tr>
<tr>
<td>Fixed without tools (d)</td>
<td>2</td>
</tr>
<tr>
<td>(a) Fixing failure, fabric failure, both (if fixing and fabric fail), Sliding failure</td>
<td></td>
</tr>
<tr>
<td>(b) 1= no, 2= yes if the fixing were not used in maximum capacity, 3= yes</td>
<td></td>
</tr>
<tr>
<td>(c) Usability level from 1 to 3 (1: difficult, 3: easy)</td>
<td></td>
</tr>
<tr>
<td>(d) 1: specific tools needed, 2: common tools needed, 3: no tool needed</td>
<td></td>
</tr>
</tbody>
</table>

### Observations:

- Fixed without tools (d) = 2
- Easy to fix (c) = 1
- Understandability (c) = 3
- Reusability (b) = 2

### Logistic data

#### Price
- Fixing Value
- Ratio max. loading capacity / price
- Unit price (€)
- Ratio max. loading capacity / weight
- Unit weight (g)
- Ratio max. loading capacity / dimension (cm²)
- Unit dimension (cm²)

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International Federation of Red Cross and Red Crescent Societies
Shelter Research Unit

[Image: Simple Nail 3.1x65]
Analyzed data
Fixings to framework COMPARATIVE

Double spot & pulling test / Simple edge / Fabric: PE IFRC
Best fixings

2
1
3
Best fixings
End shape variants

- I-SHAPE
- L-SHAPE
- U-SHAPE
- @-SHAPE
End shape variants

U-SHAPE is 2,5 times stronger
Edge types tested

- Simple edge
- Edge hem
- Double hem
- Multiple hem
- Tape reinforcement
- Rope reinforcement
- Bar reinforcement
- Eyelet and rope reinforcement (UNHCR)
Edge types tested

Double hem is almost 2 times stronger
Edge types tested

Reinforcing the edge with a bar increases 50% the resistance
Nail position comparative

An inclined nail does not increase the resistance.

Bending the back of the nail (when possible) provides 3 times more resistance in the pulling test.
Recomended fixings

Try allways to nail the edge in U-SHAPE position

Whenever possible use a stripe of wood over the fabric when nailing it

If there is no strips of wood available, the BIGHEAD NAIL is a good and balanced option

If only SIMPLE NAILS are available use a metallic (no plastic) bottle cap as washer
Plastic sheeting revision

True?
Woven fabric asymmetric resistance

Pulling position of the 0° Test

Pulling position of the 0° Test
Woven fabric asymmetric resistance

Pulling position of the 90° Test

Pulling position of the 90° Test
Woven fabric asymmetric resistance

0° position pulling test of the woven PE IFRC is 30% stronger than 90° position
Best fixings
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