▶ **Functionality**: Does the design meet the primary requirements?

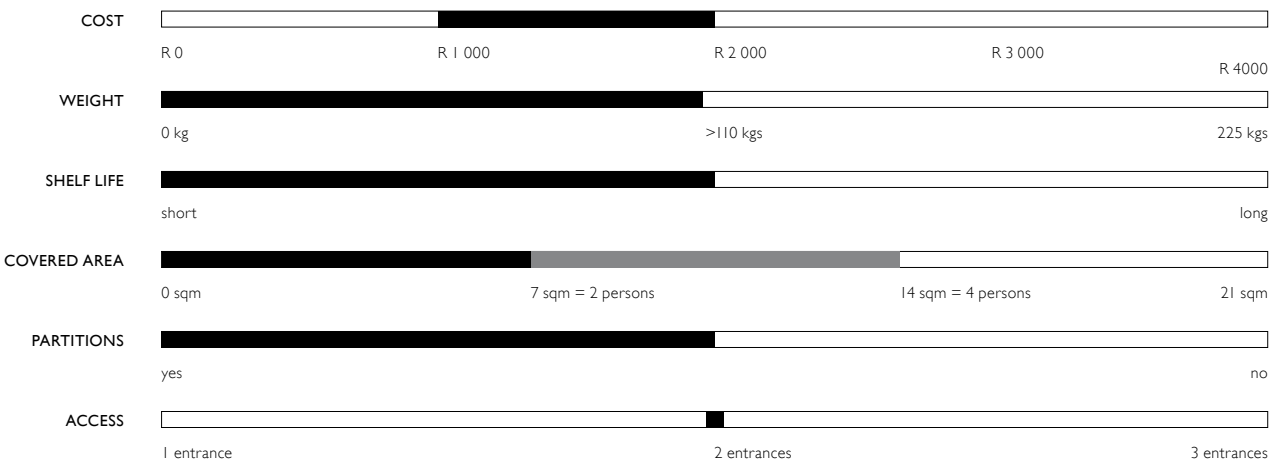
Reliability: Does the design behave in a stable and consistent way?

Usability: Is the design simple and forgiving to use?

Proficiency: Does the design enable the user to do things better?

Creativity: Does the design encourage interaction in innovative ways? Was the design used to explore and create areas that extend both the design and the person using it?

Table 12 Basic requirements



09|DESIGN DEVELOPMENT

The concept development process relied on a series of sketches, paper models, computer generated images and scaled prototypes to investigate the subject matter in terms of Maslow's hierarchy of design needs. Starting with the most basic functional design requirements the following chapter summarizes the main decisions made during the development of the design, addressing needs such as functionality, reliability, usability, proficiency and creativity.

The material chapter has already established a variety of feasible coatings and films to enable cardboard to withstand the prescribed fire resistance, vector control as well as ideas on how to improve water resistance.

So far research has provided the design with the following constraints [Table 12].

The project proposes a shelter unit that is small enough to fit into a room of damaged property or attach onto it. In the event that displacement is necessary the design should be flexible enough to be used as an extension to host families, be set up inside a collective centre, or in worst case scenario clustered to form part of a rural/ planned camp.

9.1 DEFINING A MODULE

9.1.1 3.5sqm ANALYSIS

DESCRIPTION:

In the event of emergency guidelines require 3.5sqm covered space per person. This concept was challenged through evaluation of 3.5sqm in plan, volume and surface area to see:

(a) variations of modular system

(b) most efficient use of material

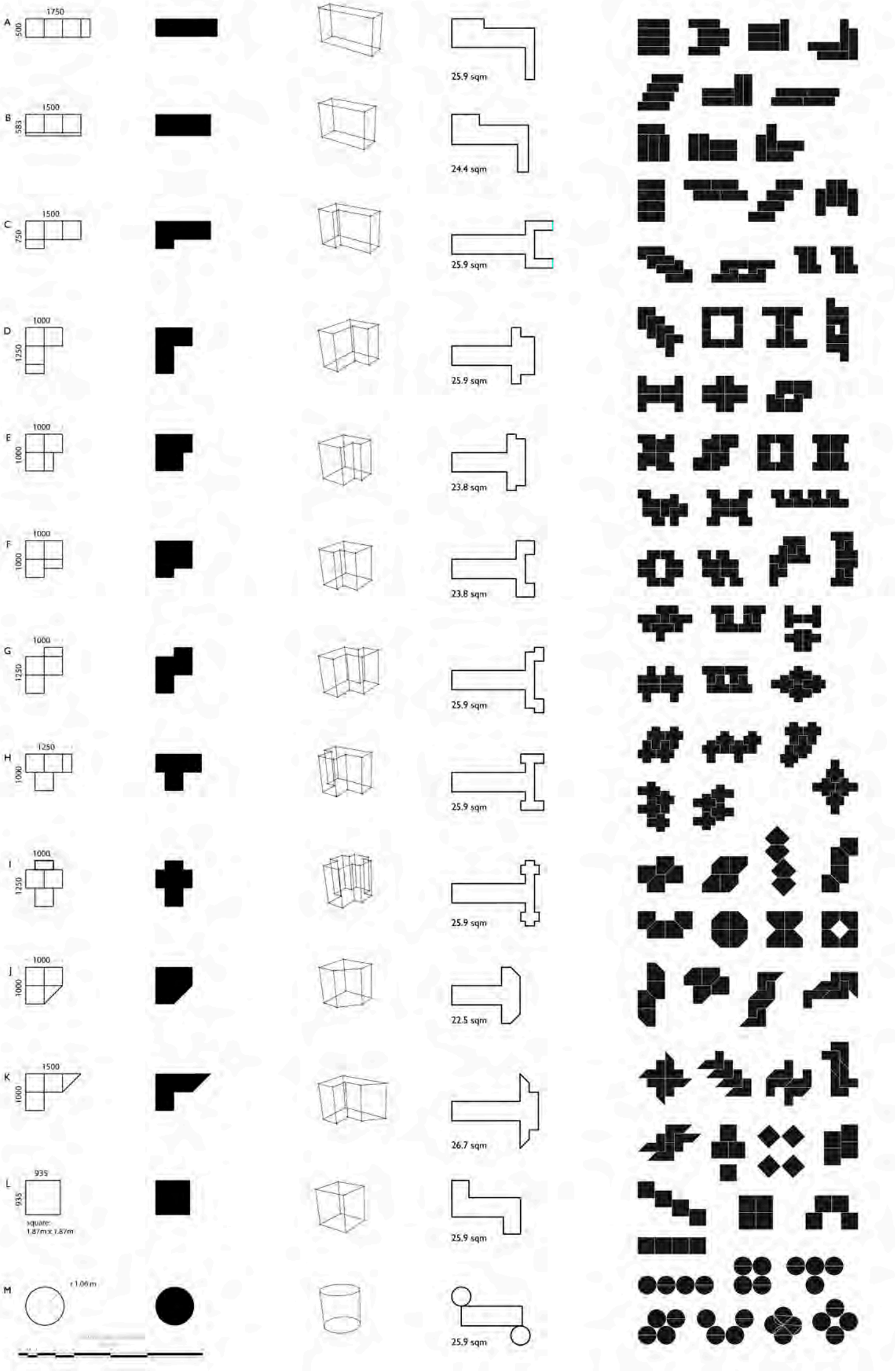
(c) most configuration potential

CONCLUSION:

Option J proved to be the most efficient use of material as well as having the most potential in terms of flexible and practical configurations.

However it was found that single shelter units would be more tedious and expensive to design and further development is focussed on developing 2 person units.

Table 13 3.5sqm Analysis ▶



DIMENSIONS | AREA | VOLUME | SURFACE | CONCEPTUAL COMBINATIONS

Functionality: Does the design meet the primary requirements?

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9.2 CONCEPT A

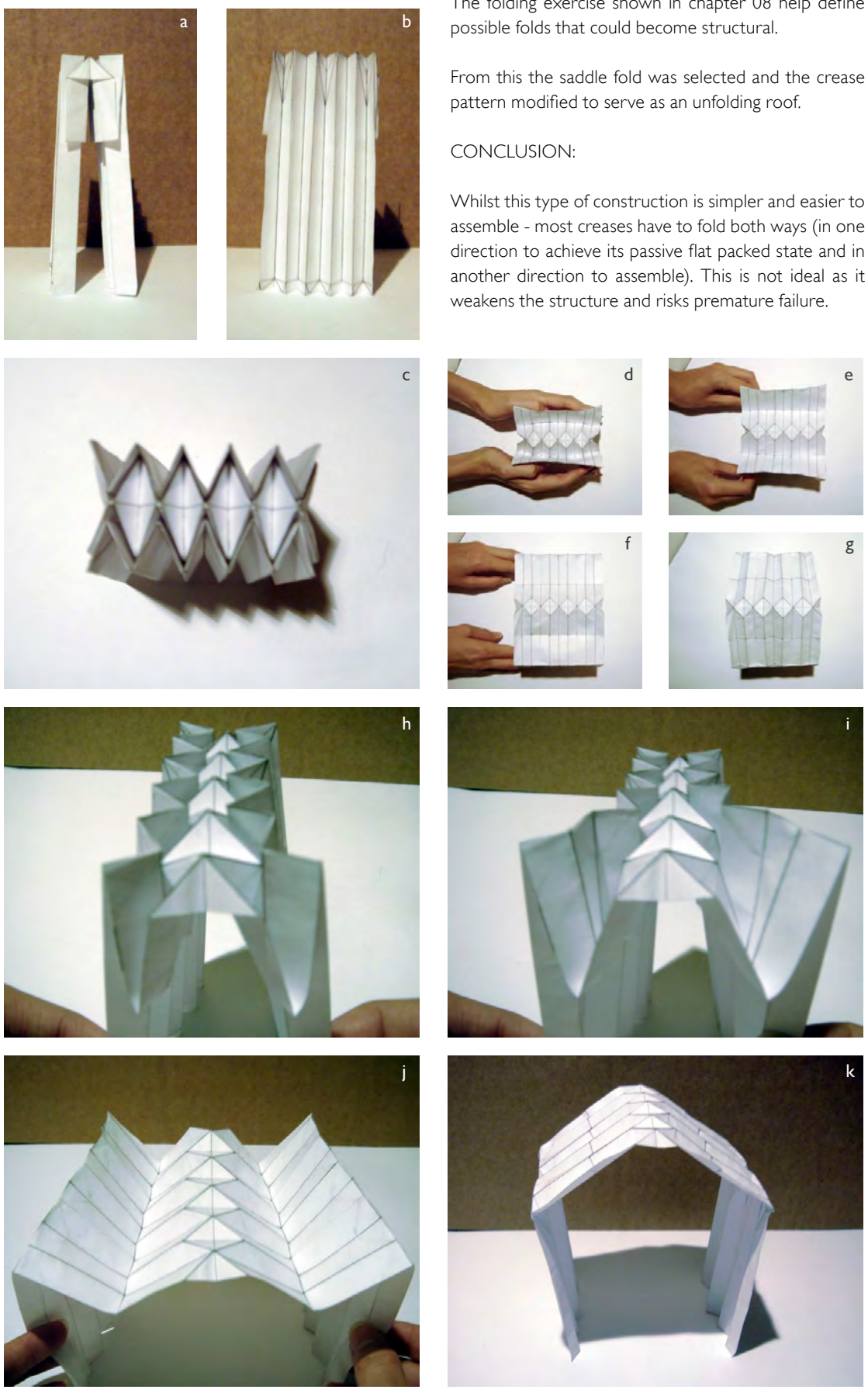
PROCESS:

The folding exercise shown in chapter 08 help define possible folds that could become structural.

From this the saddle fold was selected and the crease pattern modified to serve as an unfolding roof.

CONCLUSION:

Whilst this type of construction is simpler and easier to assemble - most creases have to fold both ways (in one direction to achieve its passive flat packed state and in another direction to assemble). This is not ideal as it weakens the structure and risks premature failure.



◀ Figure 192 (a-k) Assembly of paper model

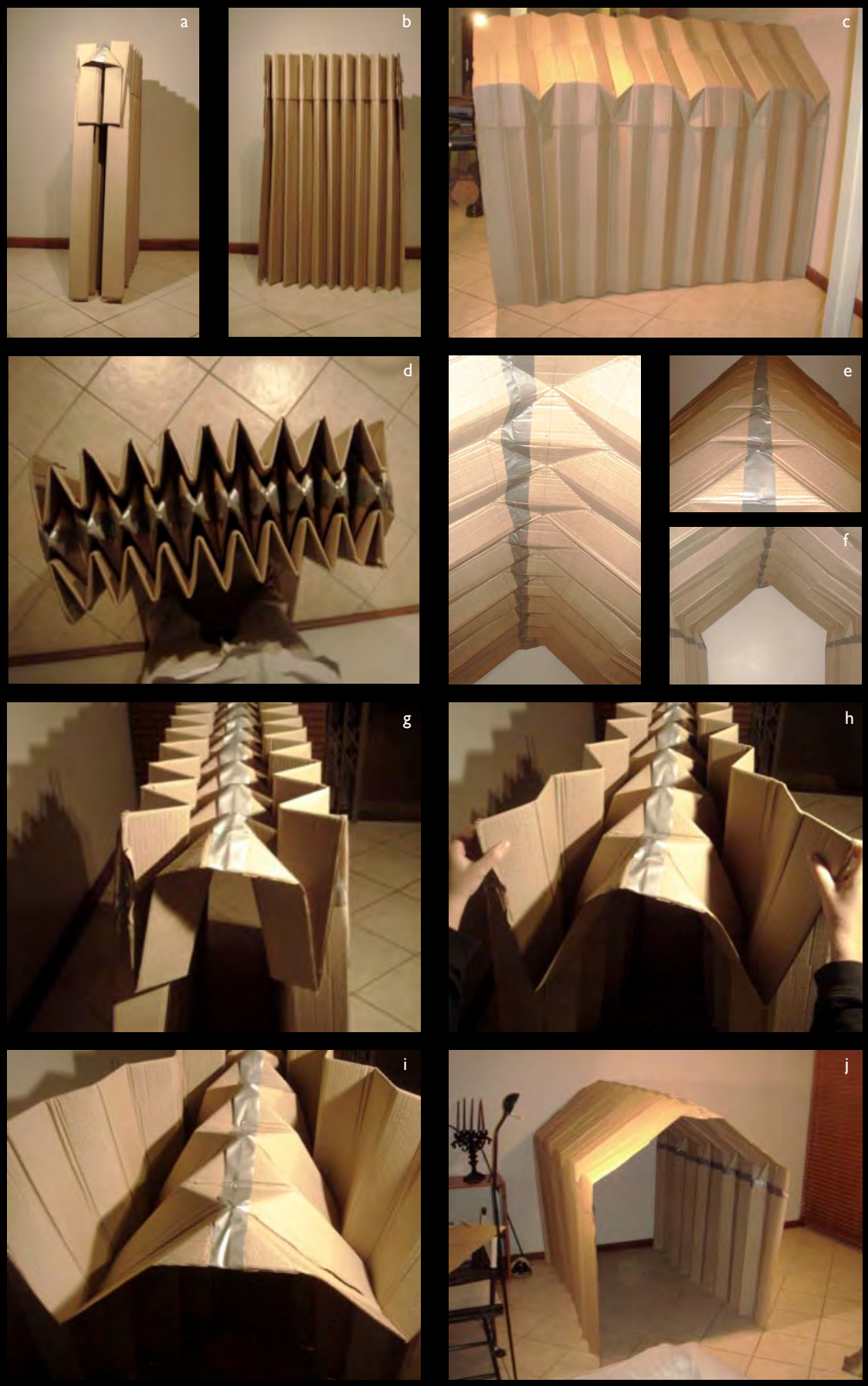


Figure 193 (a-j) Assembly of scaled prototype ▶

Functionality: Does the design meet the primary requirements?

▶ **Reliability:** Does the design behave in a stable and consistent way?

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9.3 CONCEPT B

PROCESS:

A flat roof structural enclosure was developed to evaluate whether it would be more stable than concept A.

The initial concept entailed a structure made of 3 skins (a waterproof skin, a fire resistant skin and an interior skin). The notion was to have the structure pre-assembled in 3-4 sections that can be unfolded joined together on site.

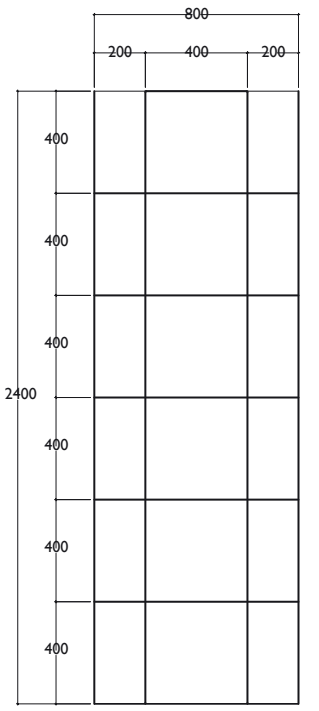

Figure 194 Conceptual module

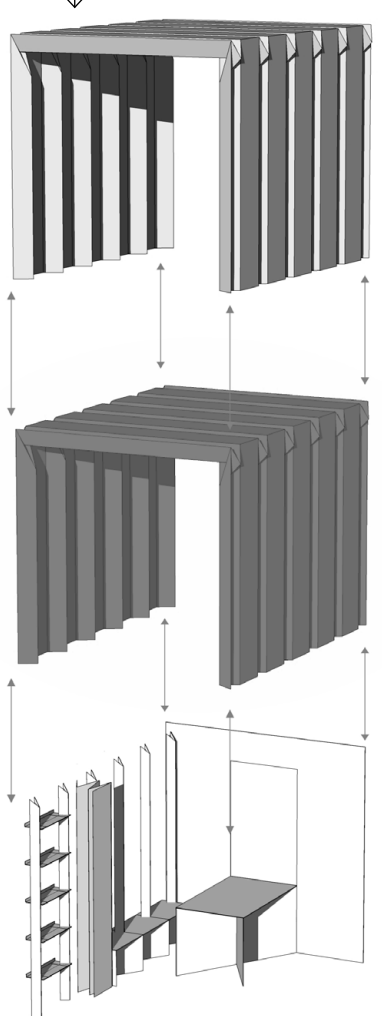

Figure 195 Conceptual diagram showing skins

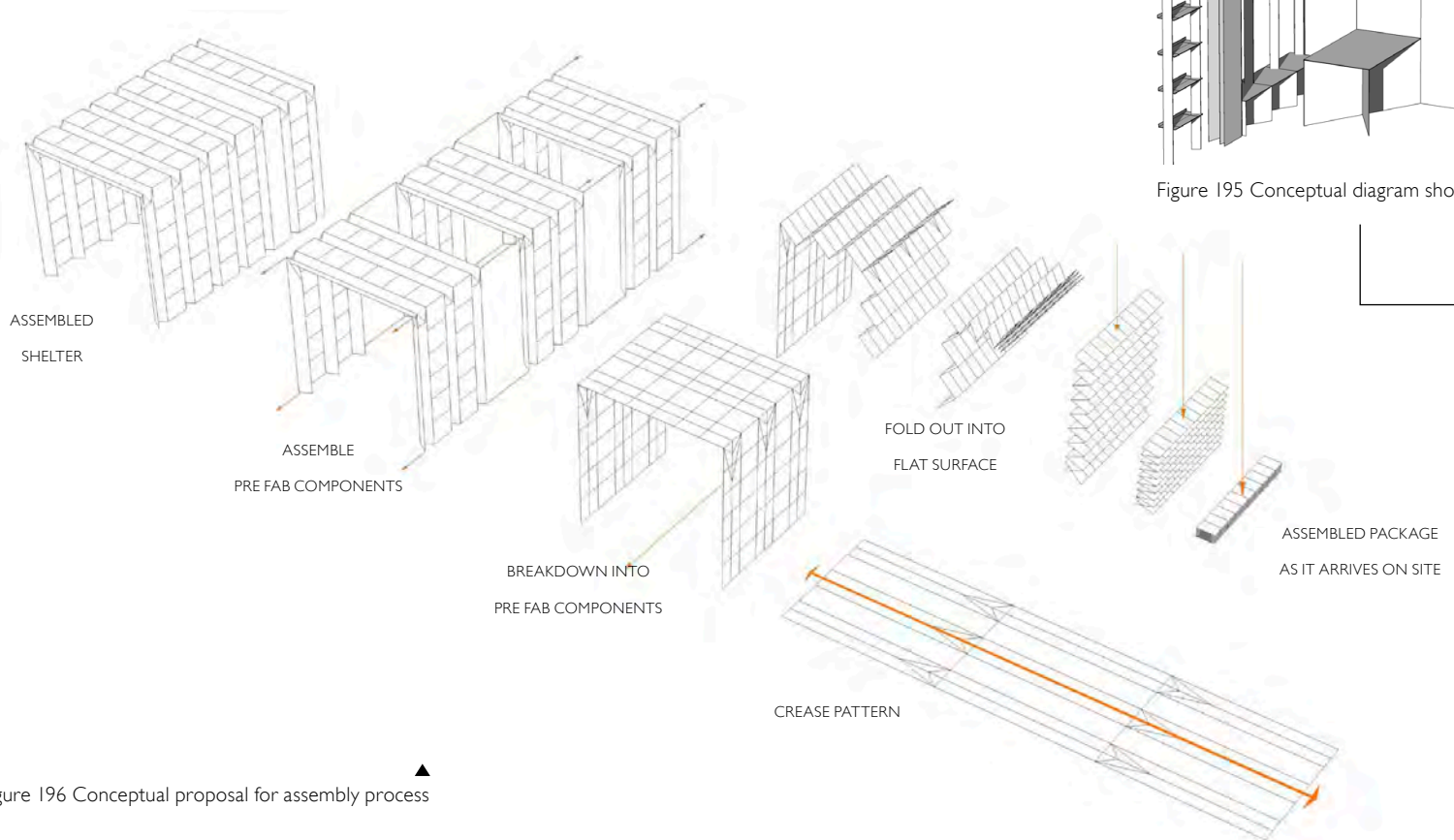

Figure 196 Conceptual proposal for assembly process

9.3.1 SHELVING CONCEPT

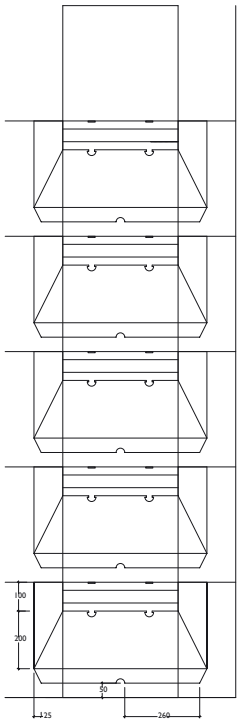

Figure 197 Shelving type A

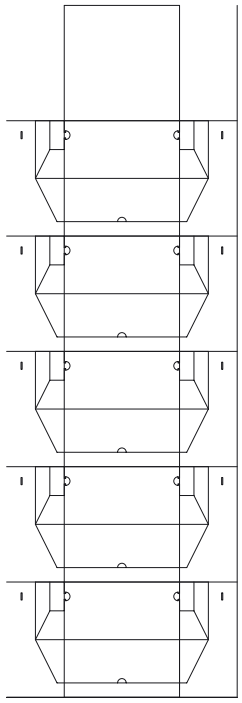

Figure 198 Shelving type B

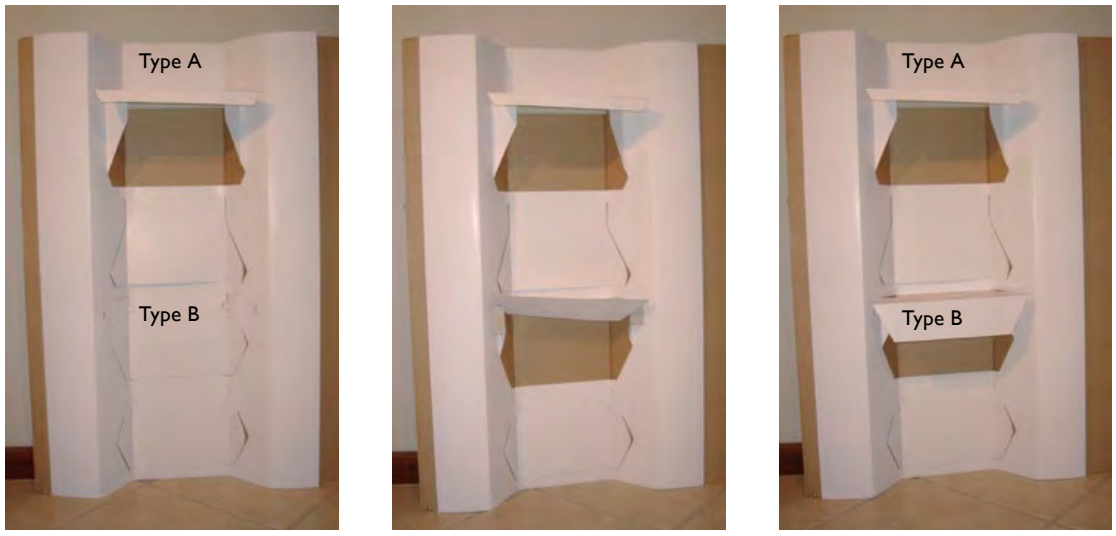

Figure 199 Half scale prototype of shelving component

9.3.2 PAPER MODEL 01

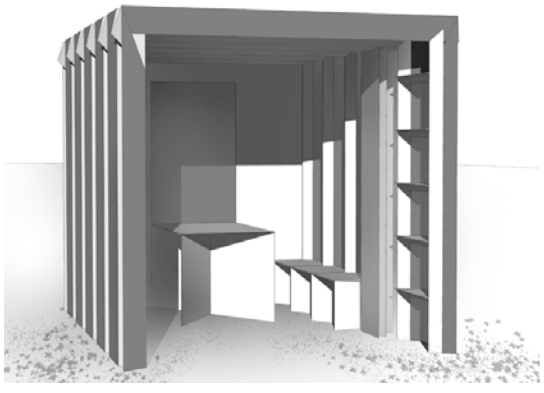

Figure 200 Concept section

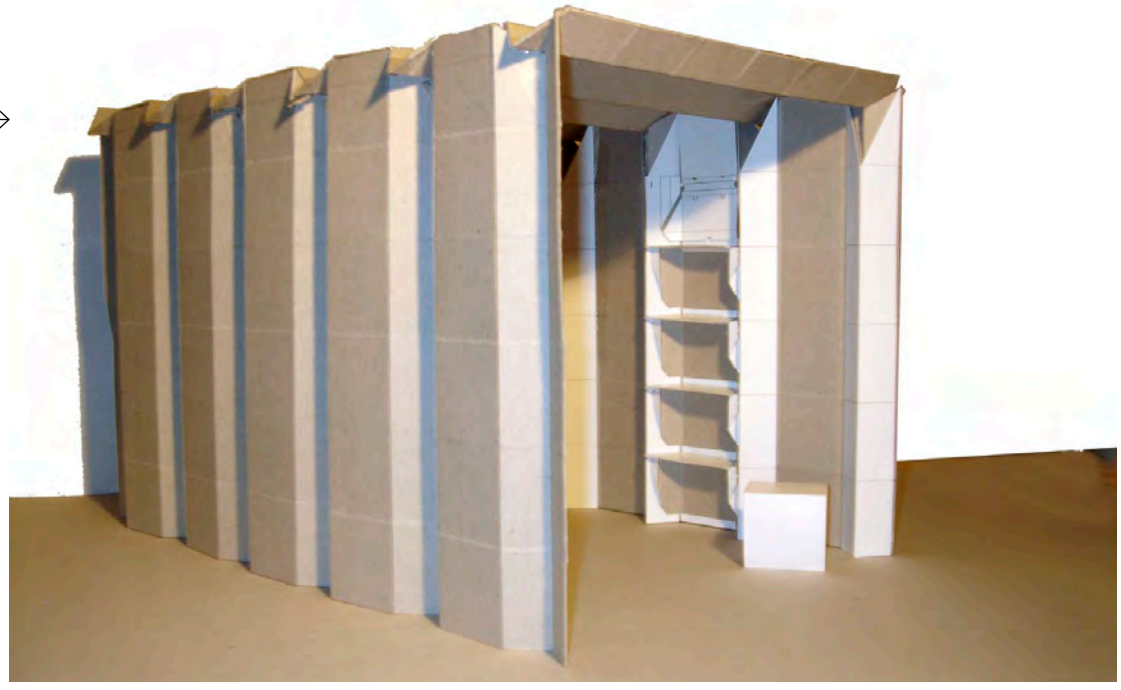

Figure 201 Cardboard model section

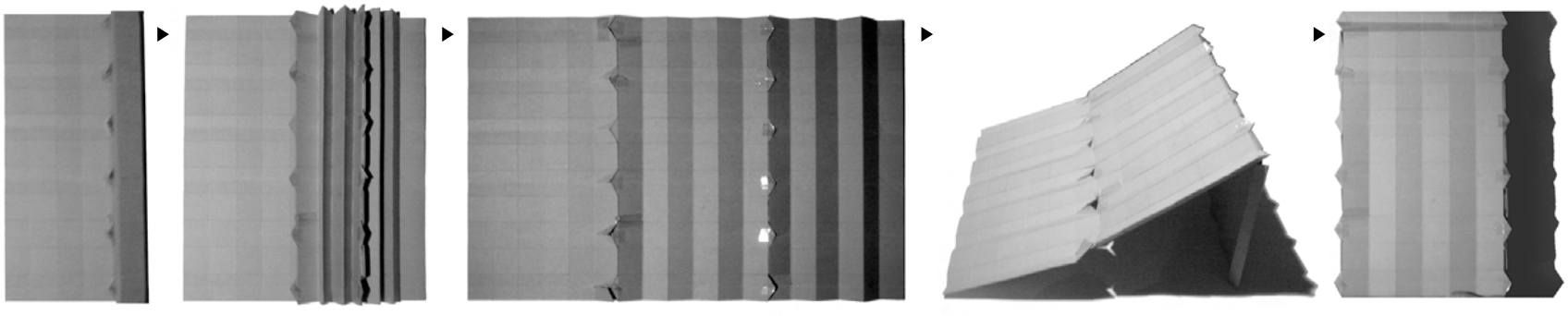

Figure 202 Folding sequence of shelter model: from flat pack to 3D

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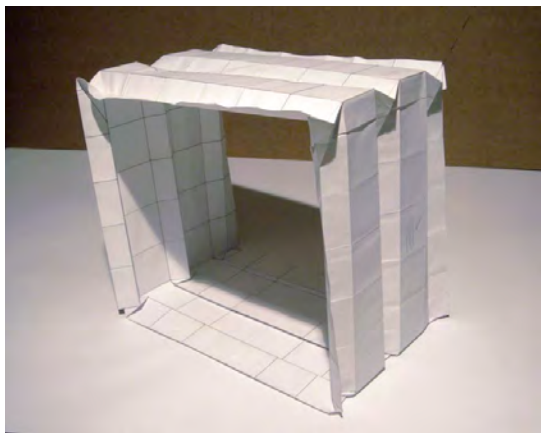
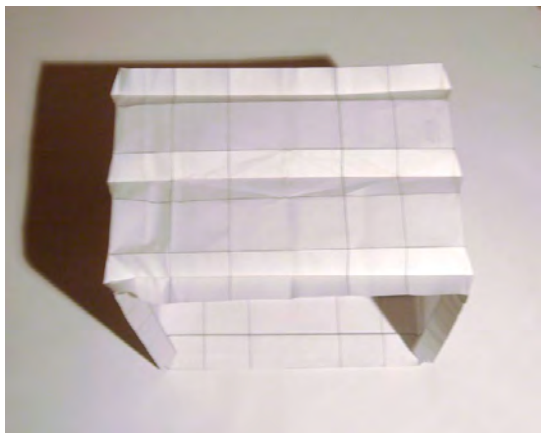
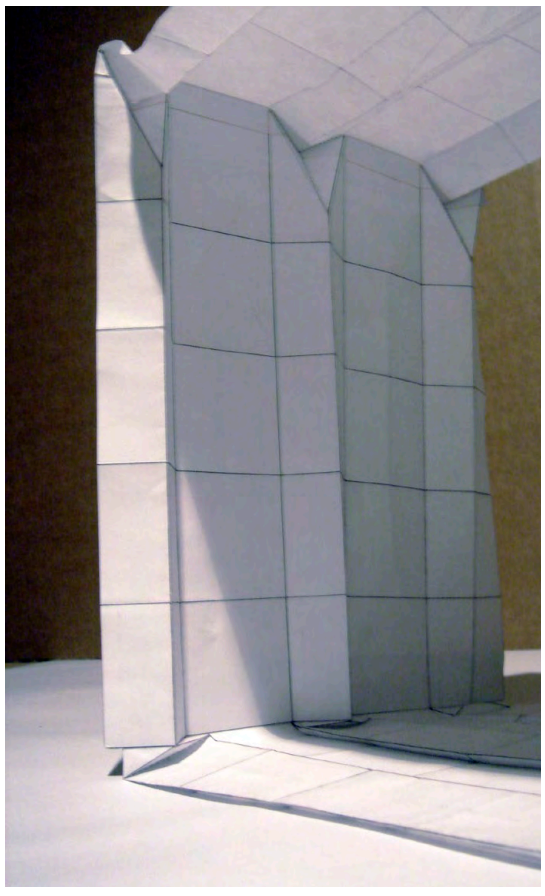
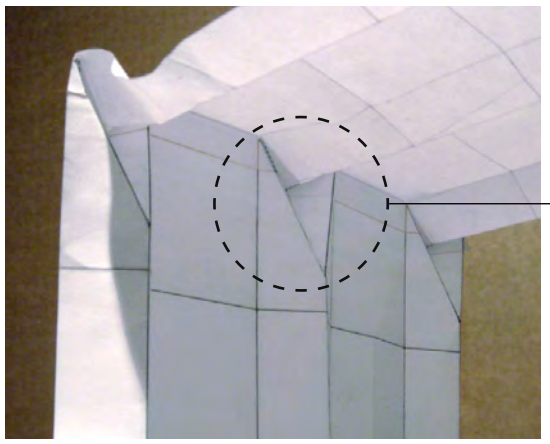
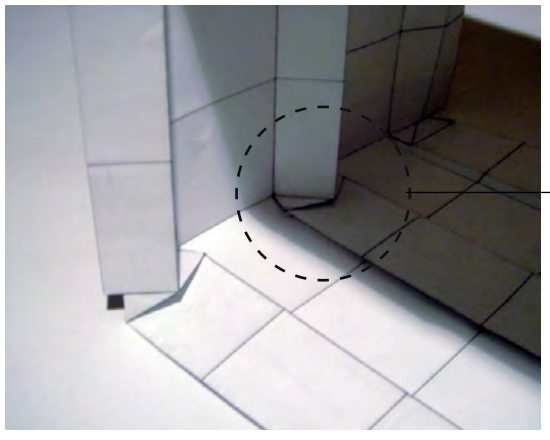
9.3.3 PAPER MODEL 02

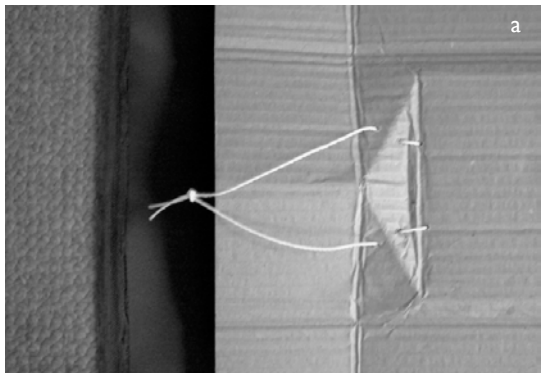


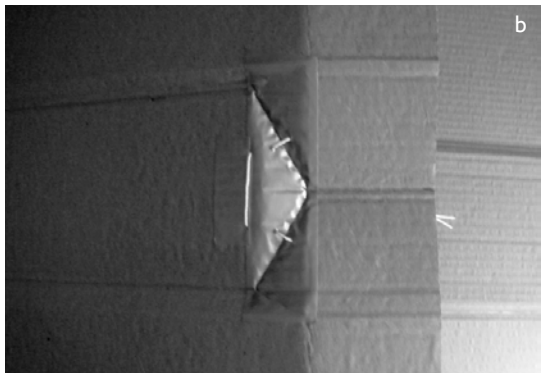












◀ Figure 206 The triangular ribs give the shelter its structural strength by exposing the anisotropic properties of the material.

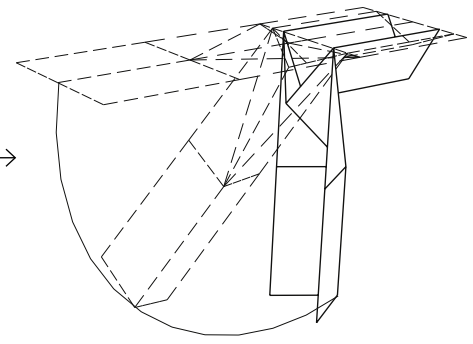


Figure 203 Detail of roof/wall connection fold

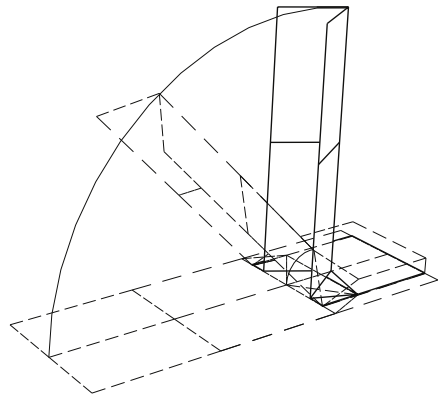


Figure 204 Detail of floor/wall connection fold

Figure 205 Details a + b show the floor/wall fold. Prototyping was a valuable exercise as the fold does not work as effectively in corrugated cardboard as with paper.

9.3.4 PROTOTYPE B

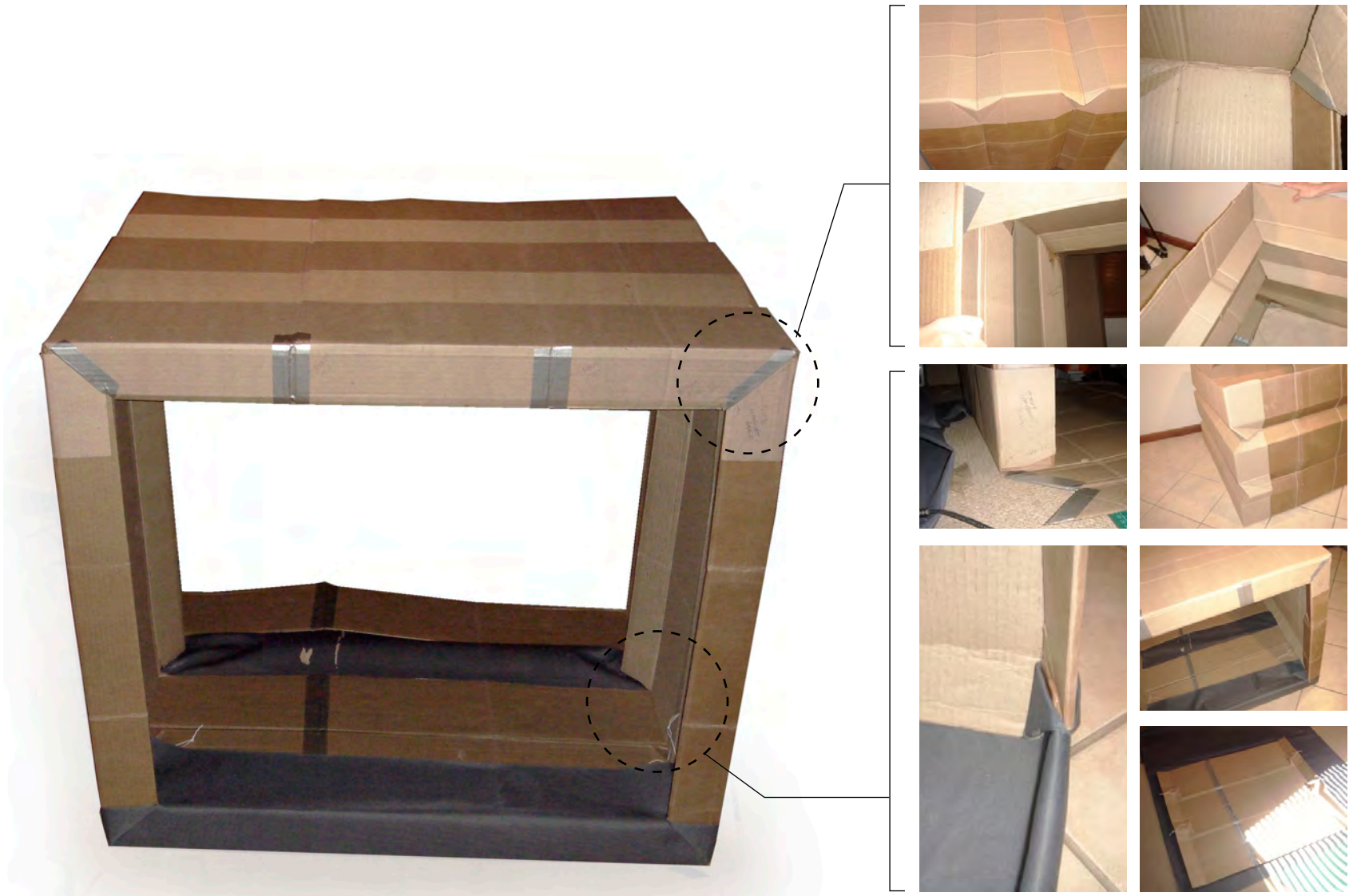


Figure 210 Half scale prototype of concept B

9.3.5 DEVELOPMENT OF PARTI FOLD

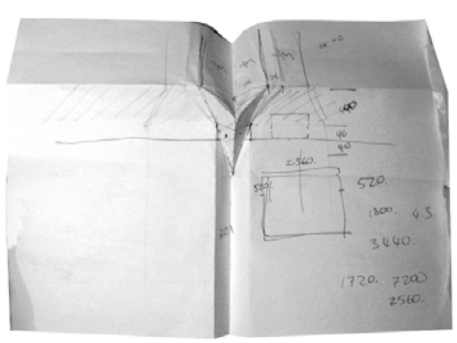


Figure 207 Fold Parti

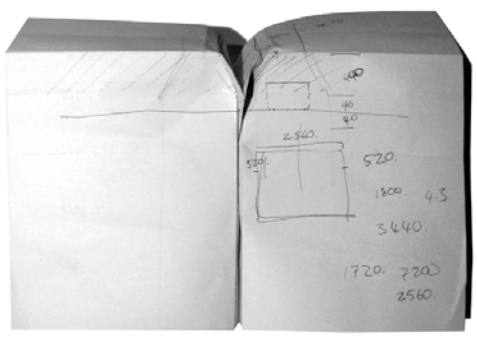


Figure 208 Paper model of parti

Figure 209 Prototype of parti

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10.1.1 ASSEMBLY

CONCLUSION:

The concept requires both primary (parallel to the corrugations) and secondary folds (perpendicular to the corrugations) which is not ideal. The assembly, which seemed simple to do with paper models, proved much more difficult in real life.

Figure 211 (a-l) Assembly of flat roof prototype