STATES (TX)

MS 7859

FLEXIBLE

ROLL UP SIGN

FIELD EVALUATION

FIELD EVALUATION OF FLEXIBLE ROLL-UP SIGN

by

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DISTRICT 12
STATE DEPARTMENT OF HIGHWAYS
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HOUSTON, TEXAS

NOVEMBER 1986

ACKNOWLEDGEMENTS

The authors wish to thank Mr. Larry Galloway (District 12) and Mr. Lewis Rhodes (D-18T) for their constructive comments and suggestions during the course of the research documented herein. Special contributions of Mr. Jerry Lofland (District 12) and his Alvin maintenance personnel, whose members are listed below, are gratefully acknowledged:

Willie Cross, Maintenance Assistant Foreman
C. I. Bell, Crew Leader
Mr. Cannon, Crew Member
Mr. Wusterhaussen, Crew Member
Mr. Raby, Crew Member

DISCLAIMER

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ABSTRACT

This report documents a comparison of the effectiveness between the flexible roll-up sign and the plywood sign. Factors considered in this comparison are materials, construction, visibility, windload, set-up time, and storage space.

Considering all these factors, the result indicates that the plywood sign is more effective than the flexible roll-up sign. Because the materials and construction of the flexible roll-up sign present more defects. Flexible materials of this new sign produce different types of distortions that affect the legibility of the sign. The cross braces, as needed to spread open the flexible sign, is made of hazardous material. And most important of all, the fragility of materials and poor construction of sign lead to failure to resist chemicals. This means that life span of flexible roll-up sign can be extremely short.

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INTRODUCTION

I. Preface

The flexible roll-up sign is primarily designed to suit incident-response operation. The objectives of this design are as follows:

- To minimize the time required for set-up/disassembly
- To minimize the effort required for relocation during a moving operation
- To minimize storage space requirement
- To maximize worker safety during set-up/disassembly

The characteristics and performance of this new sign have not yet been examined closely against those of plywood sign. Broader range of applications of this new sign has not yet been established, either. Other areas in which application of this new sign may be more desirable than plywood sign are:

- (Moving) Maintenance Operations
- Moving Construction Operations

Considering material and construction factors, flexible roll-up sign differs significantly from plywood sign. Unlike simple plywood sign, roll-up sign consists of different types of materials. And its construction is more complex.

II. Flexible Roll-Up Sign Design

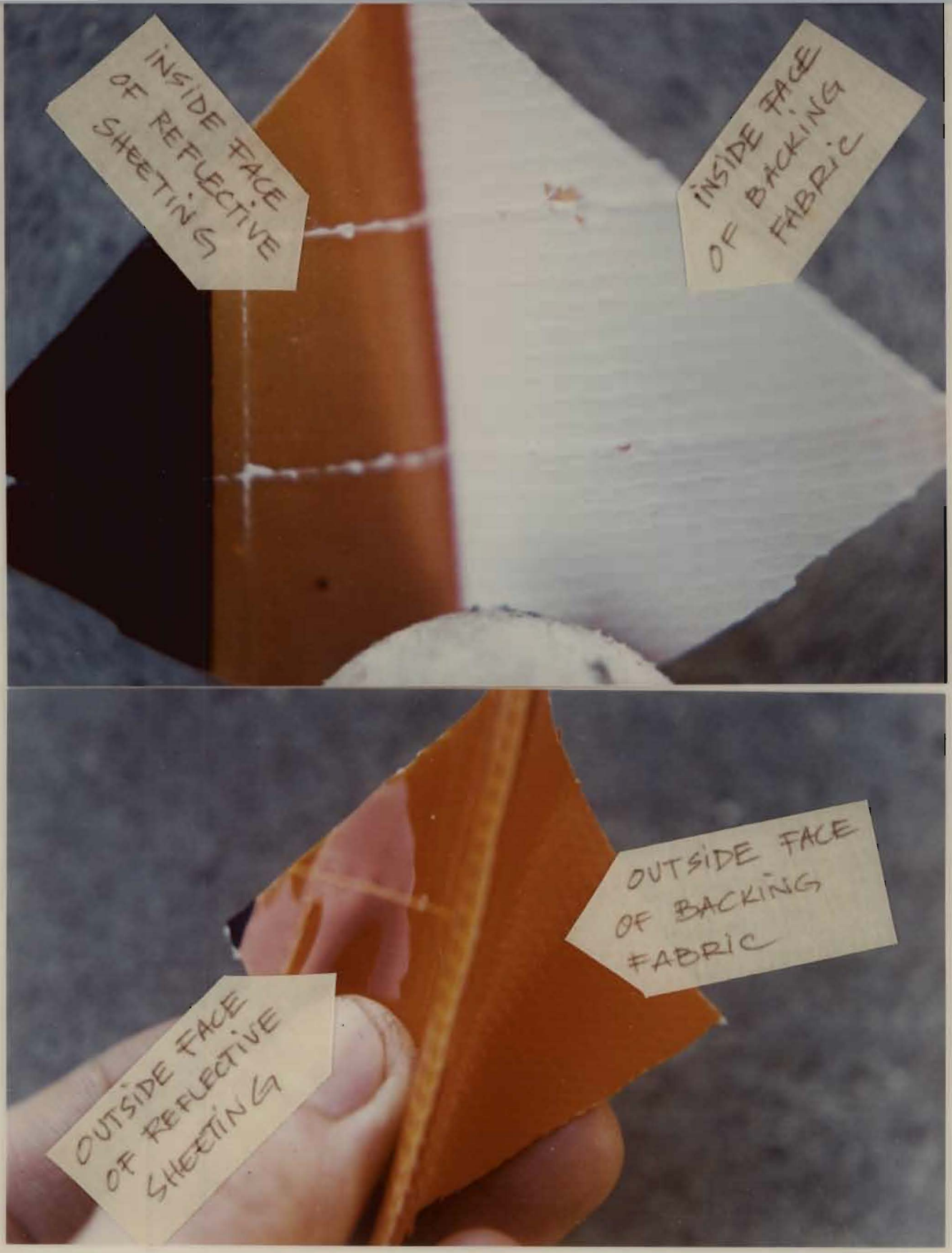
The flexible roll-up sign consists of two basic elements: the sign itself and the cross braces.

The sign itself consists of

1. The face and backing layers
2. Four corner pockets for cross braces
3. Four vinyl tie straps
4. Overlay panels for only lane closure signs

The face and backing layers make up the main structure of the sign itself. The face layer is a vinyl microprism retroreflective sheeting. This layer is heat sealed in a pattern not to exceed one and one quarter inches to the backing layer. The backing layer is made of fabric. This fabric is coated on both sides with polyvinyl chloride. The reflective face and backing both are UV light stabilized and of the same color(see Picture 1 on page 2).

The four corner pockets are means of attachment of the face and backing layers (the sign) to the cross braces. The corner reinforcements are vital for the formations of these pockets. Each corner reinforcement is attached to the back side of the sign at each corner. Each reinforcement is made of three



Picture 1 - Retroreflective sheeting and backing fabric of flexible roll-up sign

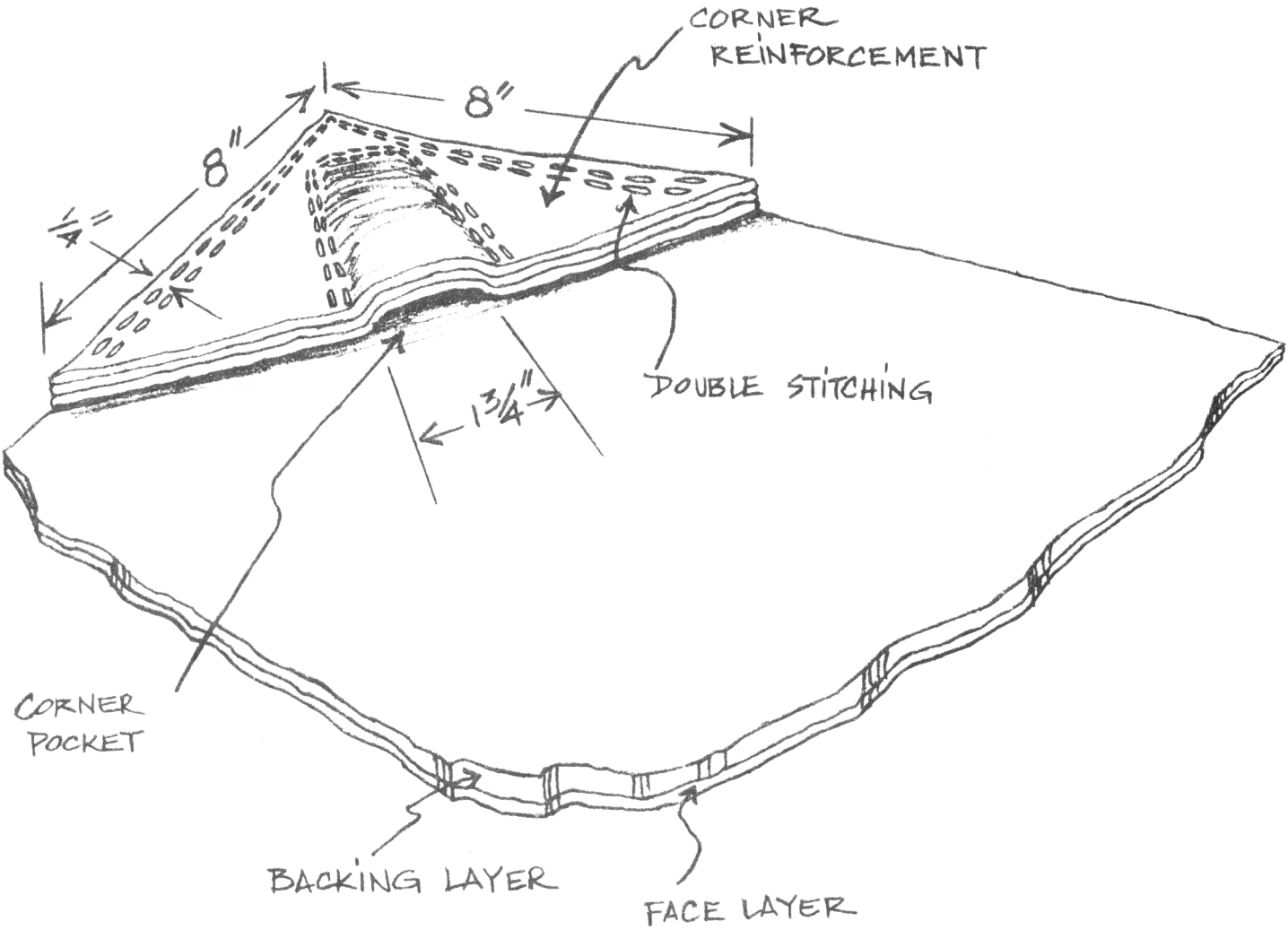


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Figure 1 - Corner reinforcements of flexible roll-up sign

8" x 8" x 11" pieces of 18 ounce nylon reinforced vinyl. These triangular vinyl pieces are double stitched to both face and backing layers. The stitching is one quarter inch from the edges of the sign. Each pocket is then formed in each corner reinforcement by double stitching. The stitchings are 1 to 1-1/8 inches along both sides of and parallel to the sign diagonals. They cut a slot of 1¼ inches long into the outer layers of the reinforcement (see Figure 1, page 3).

The four vinyl tie straps supplement the four corner pockets as well as the attachment hardware on the sign support. When the complete assembly of the sign (sign and cross braces) is set on the sign support, two out of four reinforced vinyl tie straps fasten the sign (face and backing layers) to the horizontal cross brace. The other two fasten the sign to both the vertical cross brace and the sign support pole. These four tie straps or hook and loop fasteners are attached to the back side of the sign. Attachment is on the sign diagonals and 12 to 14 inches from the sign center. The method used to attach the tie straps to the roll-up sign materials is by sewing with a non-wicking, high tensile strength, mildew resistant thread. Attachment is within one half inch of the center of tie strap, and is a 1" x 3/8" rectangular with diagonal stitching. Hook side and loop side of fastener is a minimum of 5½ inches x 1 inch each. Hook side of fastener faces away from the back of the sign (see Figure 2, page 5).

Note that signs carrying lane closure messages have overlay panels. These panels provide convenience for changing lane closure messages: left to right, vice versa. Overlay panels are attached to the face of the sign by means of hook and loop fastener system. Hook fastener component is attached to the sign by means of sewing. A non-wicking, high tensile strength, mildew resistant thread is used. Loop fastener component is attached to back of overlay panels.

The cross braces are the back bones of the sign. They stretch open the sign and are means of attachment of the sign to the sign support. Cross braces are constructed of glass reinforced resin. This material allows the cross braces to withstand 40 mph winds without causing sign material to distort enough to affect the legibility of sign. Cross braces are fastened together at centers with a pop rivet (see Figure 3, page 6).

See Figure 4, page 7 for complete assembly of flexible roll-up sign.

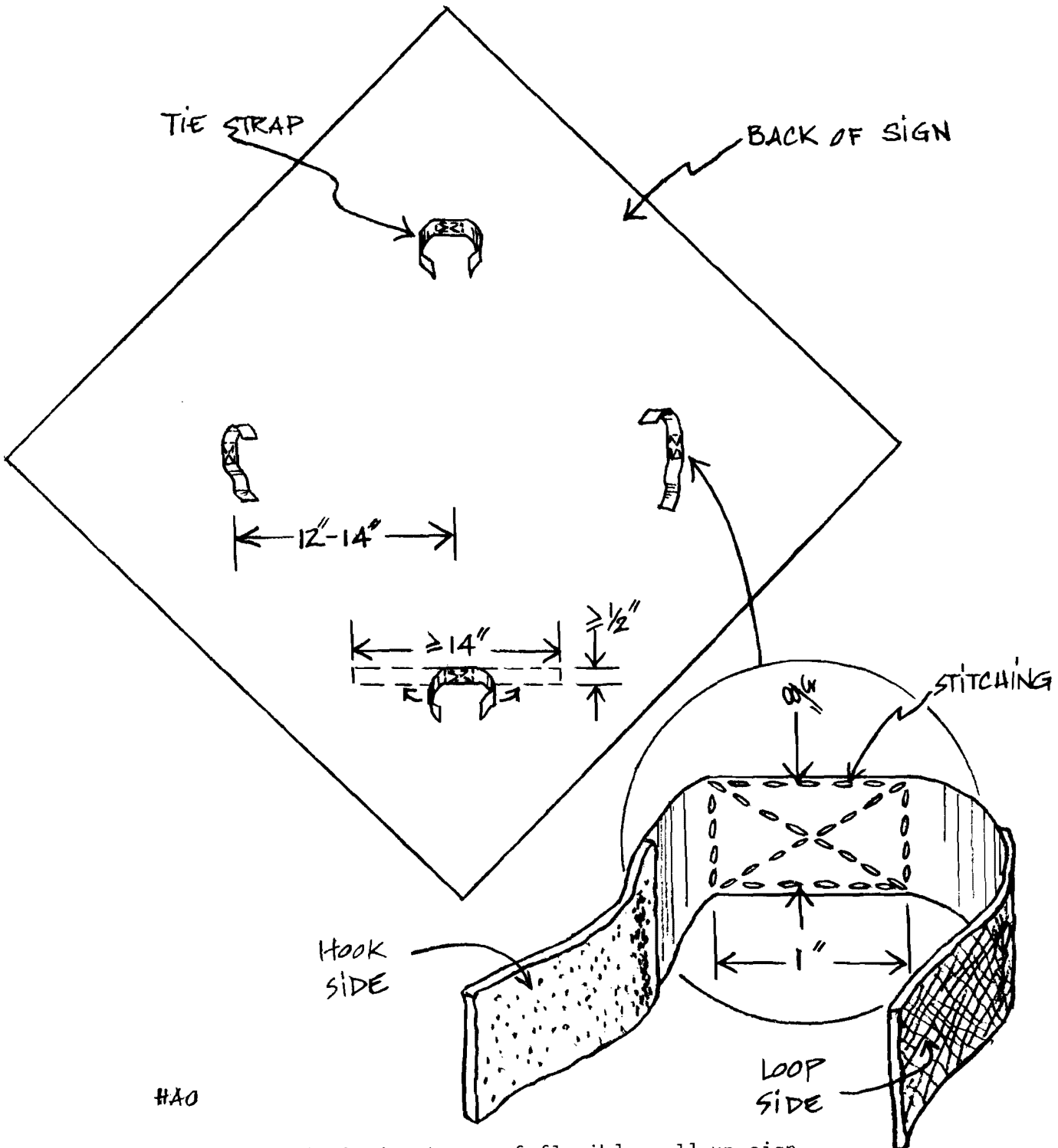


Figure 2 - Vinyl tie straps of flexible roll-up sign

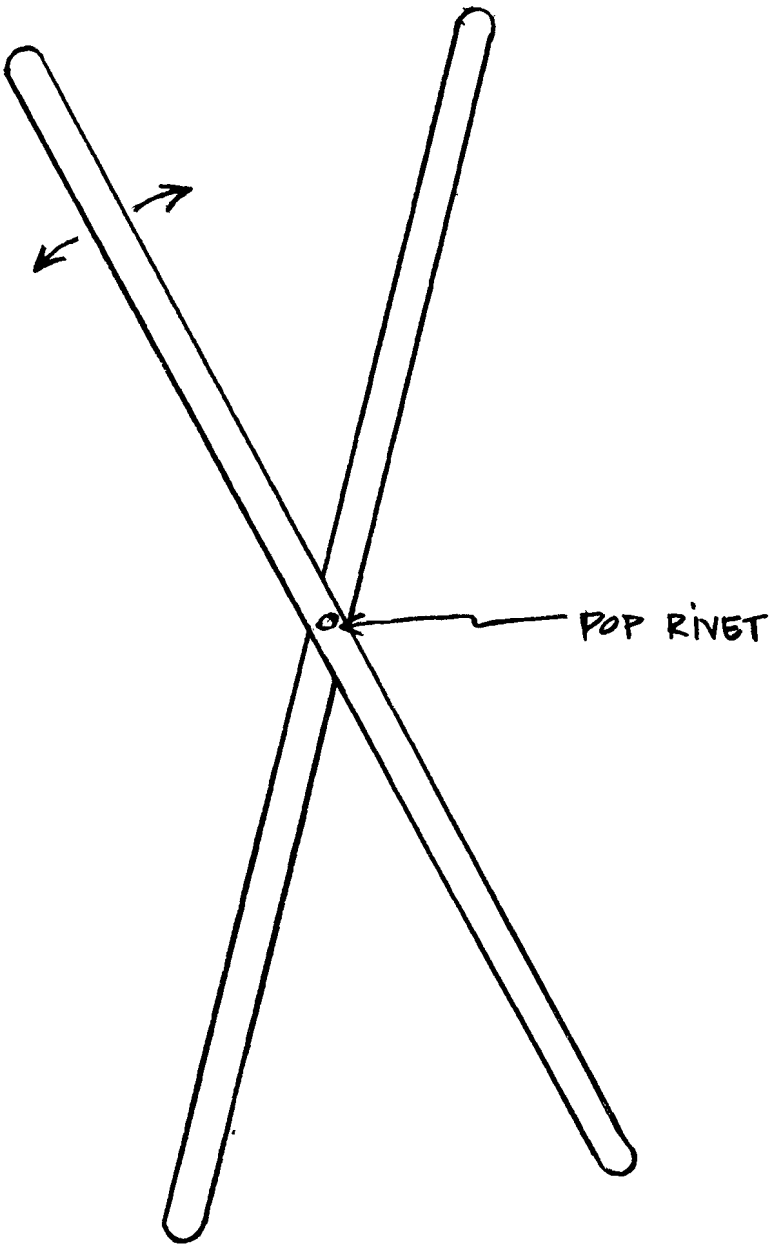


Figure 3 - The cross braces of flexible roll-up sign

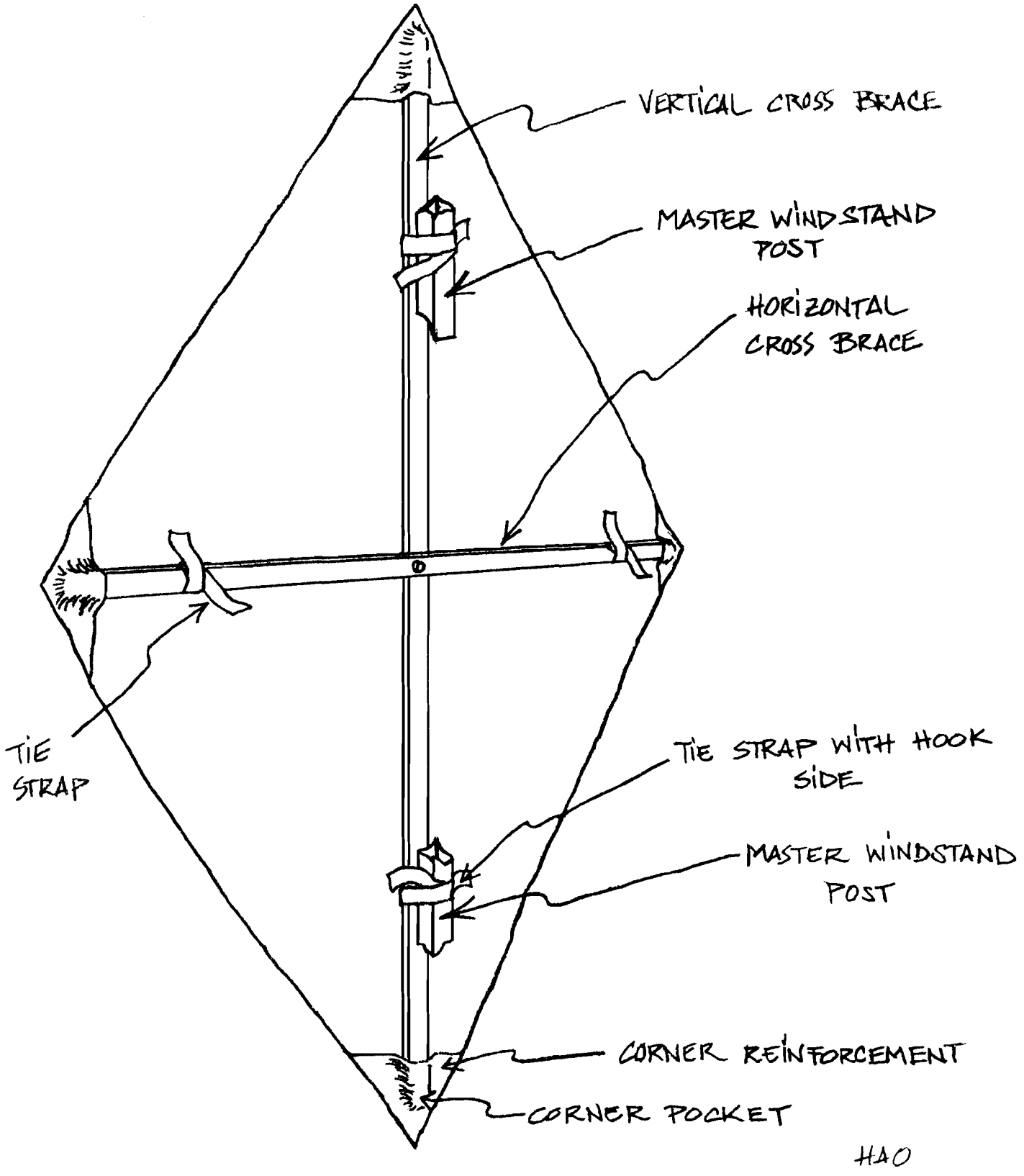


Figure 4 - Complete assembly of flexible roll-up sign

SUMMARY

I. Background

High density, outdoor grade plywood layers provide a durable and rigid sign. Of course, these layers do not distort, and thus do not affect the legibility of sign.

To the contrary, fragile reflective sheeting and vinyl coated backing fabric of the flexible roll-up sign are subject to severe tears and cuts. A small puncture through either layer can expose a square gap (results from heat sealing in pattern) between these layers. During the process of cleaning RC2 off the sign having such puncture, kerosene or solvent or deisel mixed with RC2 enter this pocket. The mixture of liquids does not leave the pocket (see Picture 2, page 9). The backing fabric of sign is therefore damaged. More astoundingly, attachments (by sewing) of corner reinforcements and hook fastener component of overlay panel to the sign already result the same effect. The stitches provide the same type of access into the square pockets -- within the areas of stitching (see Picture 3, page 10). Unlike hard layers of plywood, flexibility of the new sign (the sign itself) can cause distortions on the face of sign under both high wind and truck wind. And flexible horizontal cross brace (when complete sign is set on windstand) can easily bend backward along the vertical sign diagonal. Such bending property can severely distort the sign due to the truck wind on the Freeway. These distortions are severe especially at night, under strong truck wind and high wind, on a freeway having no artificial lighting. In addition to these defects, the break-away tiny pieces of glass reinforced resin (material of the cross braces) puncture the hands of users. These light and tiny particles cling on everything.

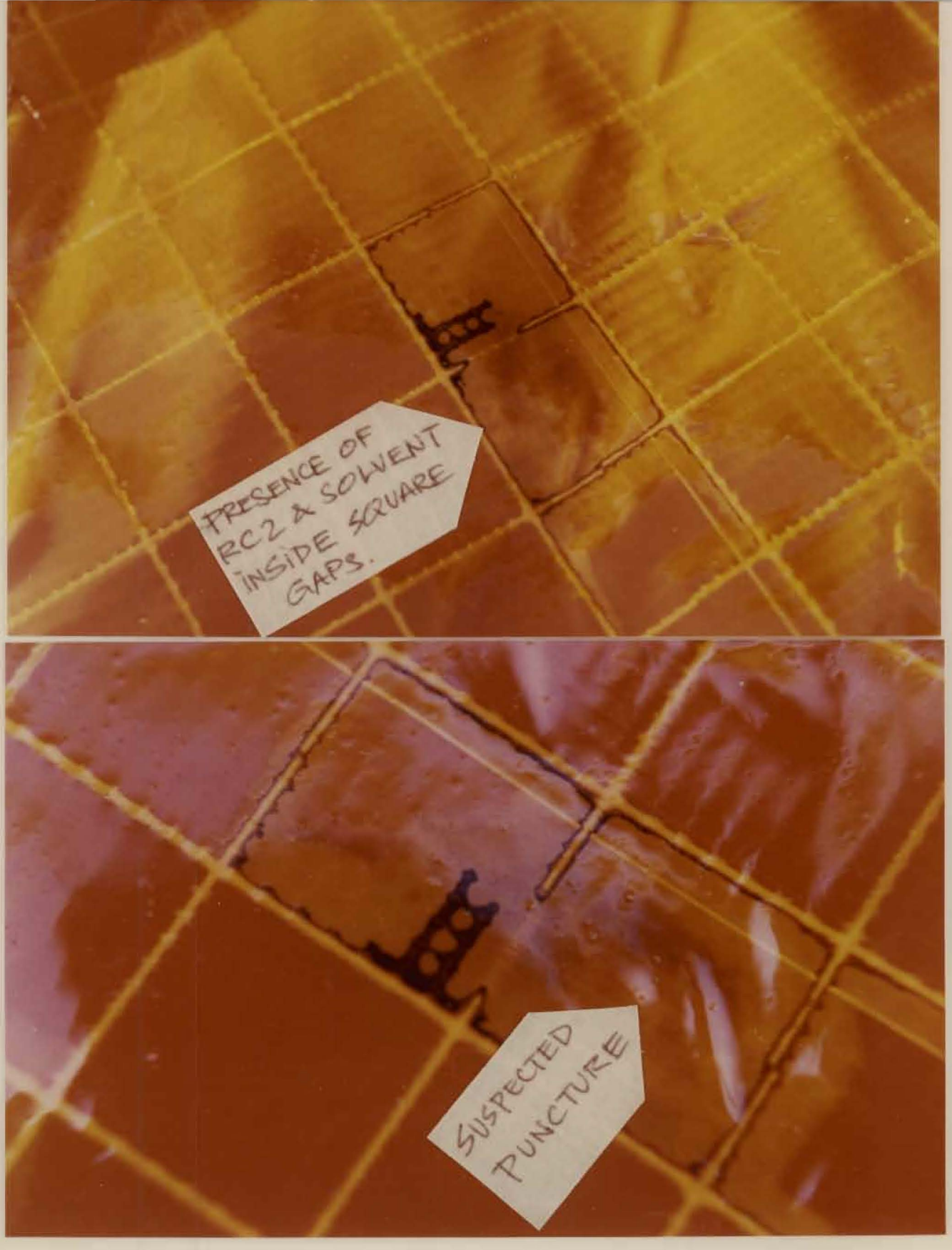
Bearing such defects above, flexibility and light weight of this new sign provide convenience. The flexible roll-up sign weighs much less than the plywood sign. It can be rolled up while being carried by user. When being rolled up, this sign takes up volume of a round tube--maximum diameter of 10 inches and maximum length of 67 inches. This size takes less space than the size of the plywood sign.

II. Suggestions

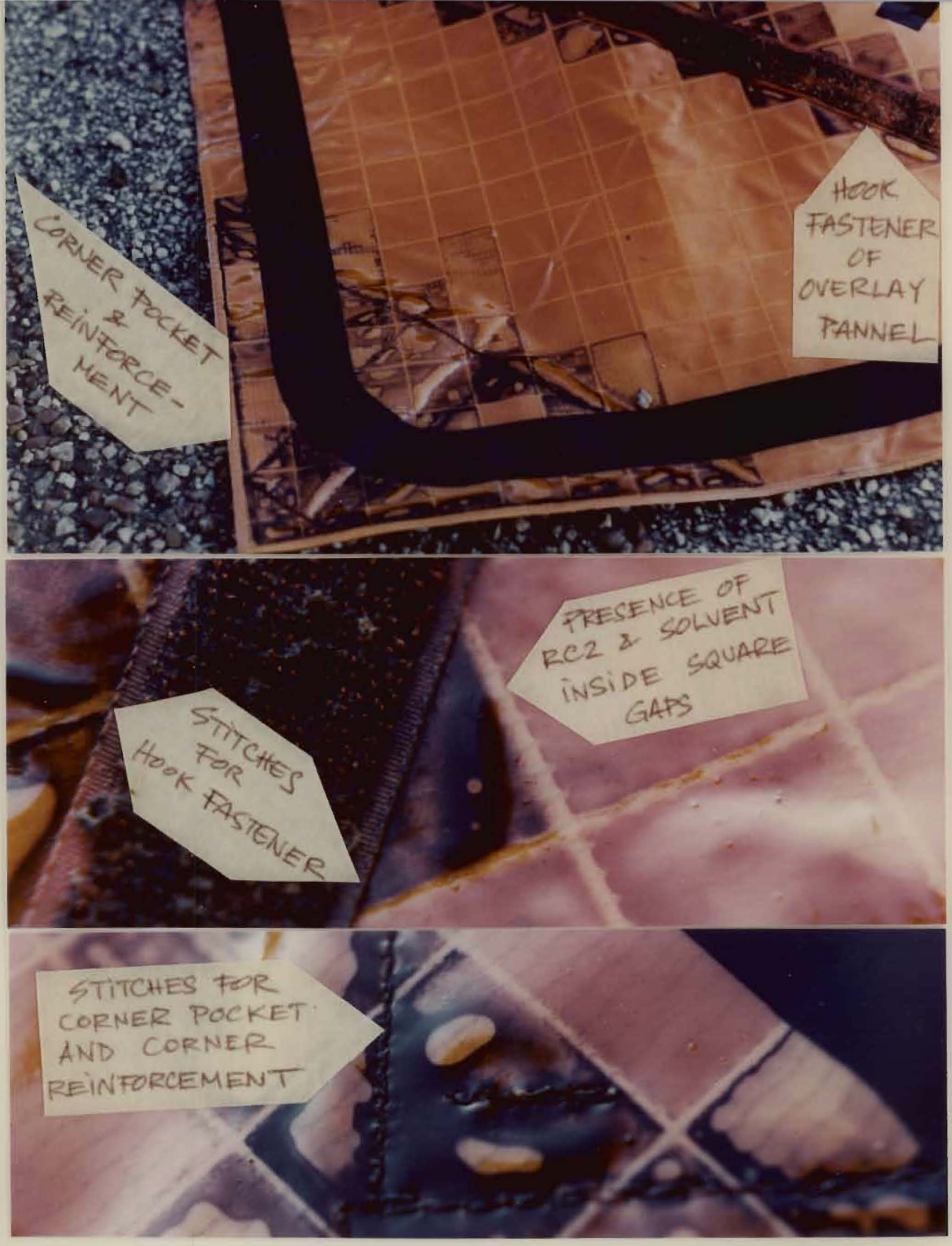
The above defects of flexible roll-up sign may be eliminated or reduced as follows:

Although more weight is added, thicker reflective sheeting and backing fabric will perhaps prevent most distortions and severity of damages. Also, a storage tube for each sign can isolate the sign from sharp and heavy objects, which can tear or cut sign.

Along the lines of stitching, reflective sheeting can be heat sealed to backing fabric prior to sewing process. This will eliminate gaps between these layers where the stitches are located.



Picture 2 - Result of torn reflective sheeting
of flexible roll-up sign



Picture 3 - Exposure of square gaps by stitches along the lines of stitching

Mica reinforced plastic can perhaps replace the hazardous glass reinforced resin.

EVALUATION APPROACHES AND RESULTS

I. Test of Materials

This Test concerns:

1. Effects of any hazardous chemistry
2. Durability

Procedure

The flexible roll-up signs are used by the Alvin maintenance crew (D12) for a period of two weeks. Signs are rolled up after each maintenance operation. Both plywood and flexible roll-up signs are stored in the back of a pick-up truck along with the spring-loaded sign supports--master windstands.

Results

Plywood Sign:

1. Plywood sign does not have a hazardous chemistry.

2. Throughout the testing period of two weeks, the plywood sign is dropped several times. It shows no damage

Flexible Sign:

1. Tiny particles of glass reinforced resin in the cross braces of flexible roll-up sign puncture the hands of crew members severely. The crew members are therefore forced to use gloves. These punctures can be extremely painful.

2. The reflective sheeting of the flexible roll-up sign has a small puncture. This puncture is so small that it can only be recognized after the mixture of solvent and RC2 had entered the square gap behind the reflective sheeting. The cause of this puncture is not known.

II. Effectiveness of Construction of Sign

Procedure

The RC2 is splashed on the faces of flexible roll-up and plywood signs. A week later, these signs are washed with deisel and solvent. The maintenance personnel follows the normal procedure for this situation. He heavily wets two pieces of cloth with the above two liquids separately. Half of each sign is then cleaned with one of the two solutions. The other half of the sign is cleaned with the second solution. The signs are wiped with dry cloth right after RC2 is removed. The cleaning process takes from ten to fifteen minutes for each sign.

Results

Plywood Sign:

The plywood sign has no damage.

Flexible Sign:

A puncture in the reflective sheeting of the flexible roll-up sign allows the mixture of either solution and RC2 to enter a square gap between reflective sheeting and backing fabric. The mixture of liquid does not leave this pocket even three days later (see Picture 2, page 9). The stitches on the sign also open up the square gaps along the lines of stitching (see Picture 3, page 10). As soon as these liquids enter the gaps, the backing fabric absorbs the RC2 and turns black (original color of the front of the backing fabric is white).

III. Field Performance

1. Legibility

a. Day

Procedure

Both plywood and flexible roll-up signs are set-up on the shoulders of a freeway on a sunny day. There is light wind.

Results

Plywood Sign:

Uniformity due to the hard surface of the plywood sign makes this sign clearly visible.

Flexible Sign:

Flexibility of the flexible roll-up sign causes the sign to constantly flap due to natural wind and truck wind. This flapping action creates slight glares throughout the face area of the sign due to strong sun light.

b. Night

Procedures

Both plywood and flexible roll-up signs are set-up on the shoulder of a freeway having no artificial lighting on a clear night. Then they are set-up on a different freeway having artificial lighting on the same night. There is light wind at both locations. In both situations, water is also splashed constantly on to the face of the sign to create rain effect. The same procedures are followed on a windy night.

Results

Plywood Sign:

Plywood sign is clearly visible under any of the situations described above.

Flexible Sign:

Visibility/legibility of flexible roll-up sign is reduced significantly on the windy night on the freeway having no artificial lighting. As the flexible sign flaps violently due to high wind, strong glares cover the complete face of the sign. These glares are created by headlights on vehicles.

2. Windload

a. Truck Wind

Procedure

See procedures for the evaluation of visibility/legibility. Note that spring-loaded sign support is used.

Results

Plywood Sign:

Plywood sign falls backward to the extreme that it makes an angle of approximately 40 to 50 degrees with the ground. Such extreme results from heavy weight of the high density plywood layers. Slow rebound is another heavy-weight effect.

Flexible Sign:

The flexible roll-up sign also falls backward to almost the same extreme. It makes an angle of approximately 50 to 60 degrees with the ground level (see Picture 4, page 16). But due to its light weight, this new sign rebounds more quickly than plywood sign. In addition, flexibilibility of the horizon cross brace allows the sign to bend backward along the vertical sign diagonal, or windstand pole (see Figure 5, page 17).

b. High Wind

Procedure

See procedures for the evaluation of visibility/legibility.

Results

Plywood Sign:

When high wind hits the face of the sign directly, the plywood sign falls backward as caused by truck wind. Otherwise, high wind has no other effect on plywood sign.

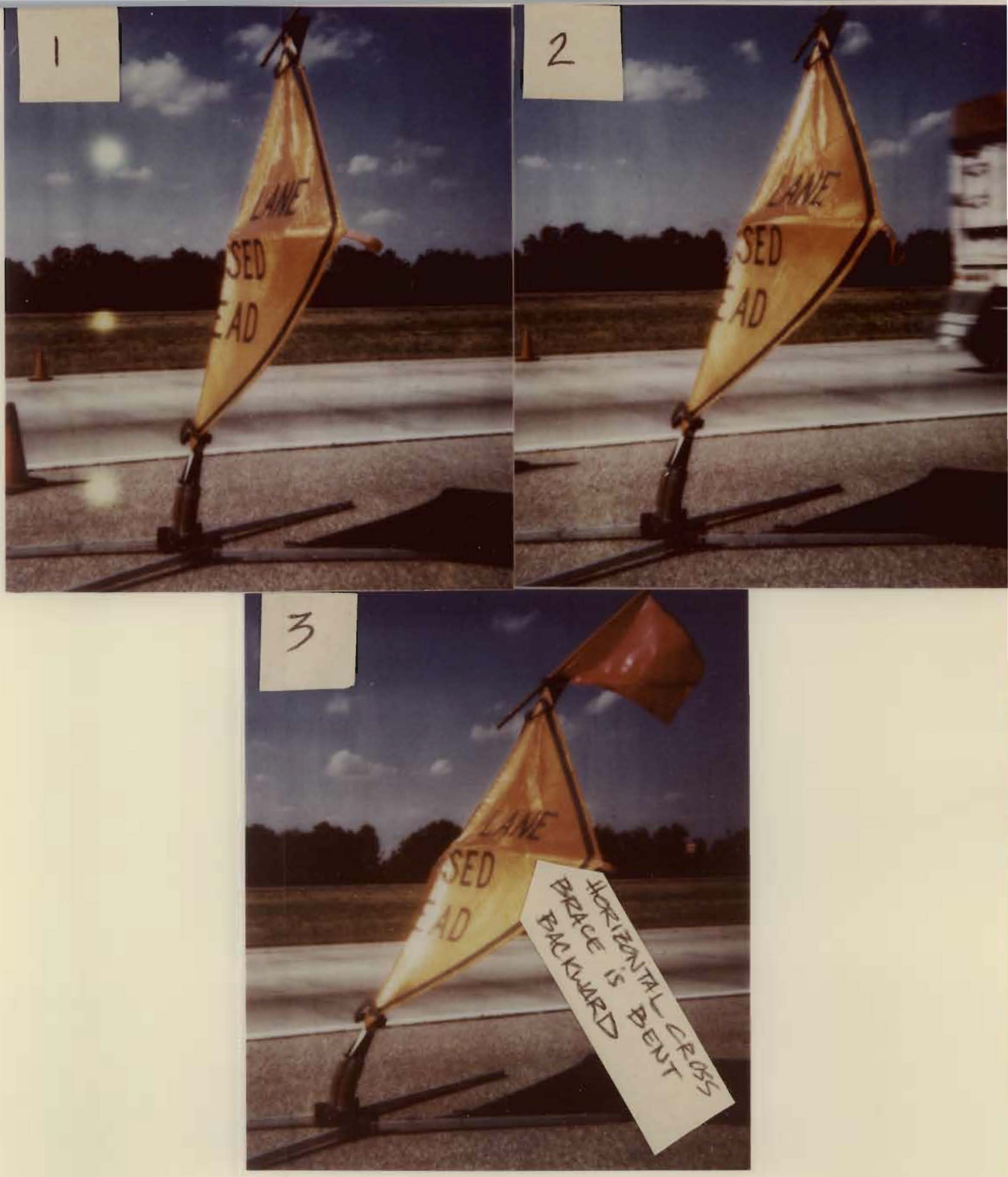
Flexible Sign:

High wind causes flexible roll-up sign to flap violently. It also twists this sign horizontally (side-ways) due to light weight and flexibility of the sign.

IV. Views of Users

According to the Alvin maintenance crew, the time required to assemble and set-up a flexible roll-up sign is not as long as it seems. The same amount of time is required for set-up of plywood sign. Carrying a light, roll-up sign out of the back of a pick-up truck requires less effort than carrying a plywood sign.

The flexible roll-up sign is quickly rolled open. One cross brace is still kept assembled. The other has been disassembled and set parallel to assembled one. This disassembled cross brace is then tucked into its two corresponding corner pockets. The sign is then ready to be put on the windstand. The same fact holds true for time of disassembling and storing the signs. As of storage space requirement, flexible roll-up sign is definitely compact.



Picture 4 - Truck wind effect on flexible roll-up sign

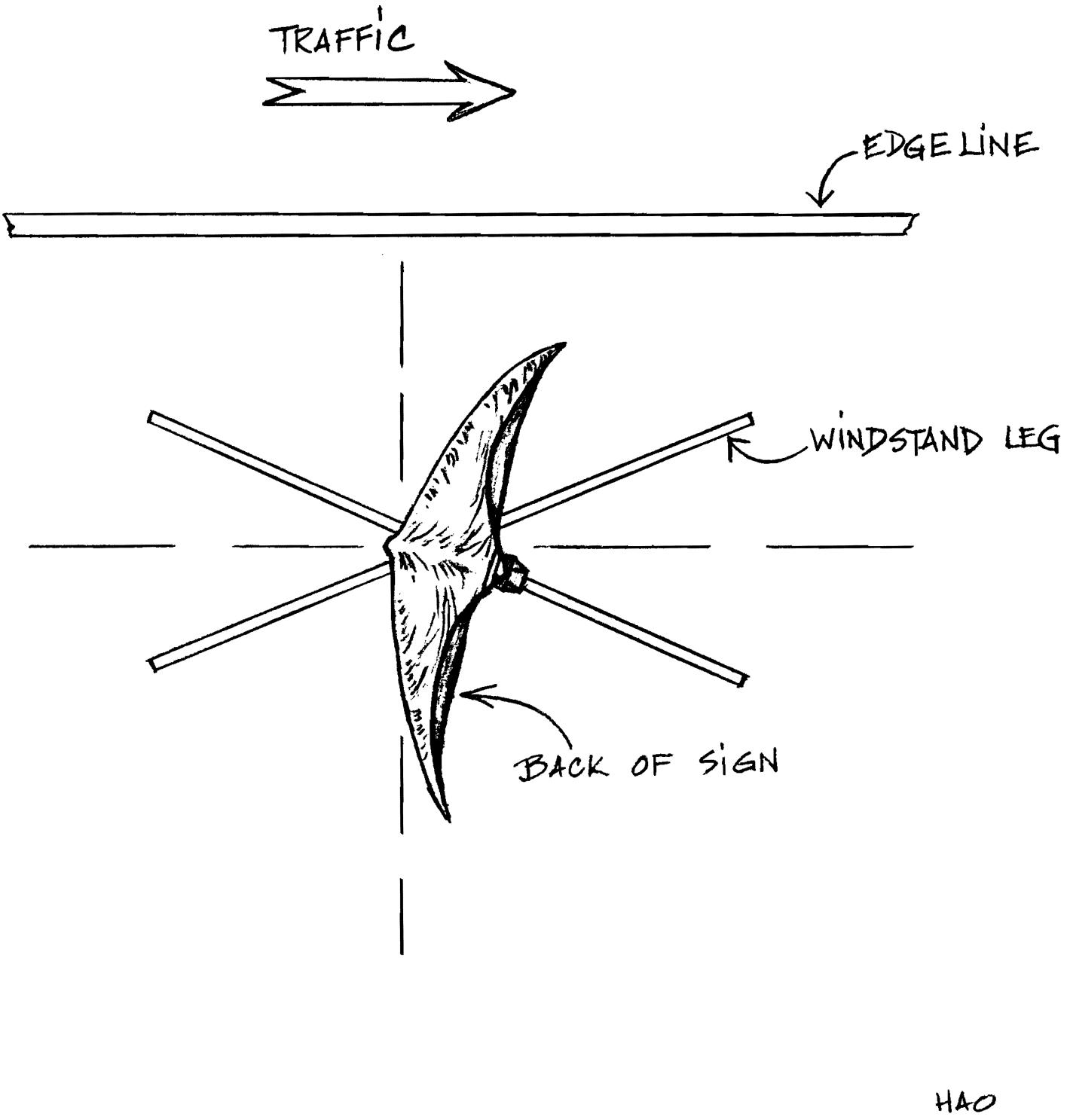


Figure 5 - Bending characteristic of the cross braces