

# **Estruturas de Alinhamento para CMS em Materiais Compósitos**

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## Presentation

### **INEGI** - INSTITUTE OF MECHANICAL ENGINEERING AND INDUSTRIAL MANAGEMENT

Is an Institute of Innovation and Technology Transfer, providing the interface between the Department of Mechanical Engineering and Industrial Management of the University of Porto (DEMEGI) and Industry.



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Within INEGI, the unit responsible to carry out this research will be **CEMACOM** - the Composite Materials Unit.

As associated members CEMACOM has companies that are leaders in their sectors of activity, such as manufacturers, raw materials and National Defence companies. The association with several R&D European Centres for many years provides a larger widening of activity.



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The activities of CEMACOM in the field of composite materials include the following:

- **Structural design** with composite materials through numerical methods;
- **Prototype and/or pre-series** development in association with industrial companies in the areas of filament winding, pultrusion, RTM, and bag/autoclave moulding;
- **Mechanical** (tensile, bending, compression, shear) static, fatigue or creep testing of polymeric materials, metallic or polymeric composite materials, wood and other materials;
- **Fire and smoke testing** in polymeric, wood, cork or other composites. • **Non-destructive testing** (ultra-sonic, acoustic emission and laser interferometry) for composite materials.

## Recent projects with CERN

- Creep behaviour of advanced composites under LHC environment  
Project CERN/P/FAE/1055/95
- Development of a new PAPS - Portable Auxiliary Positioning System
- Development of the Alignment Wheel for CMS  
Project CERN/P/FIS/1192/98

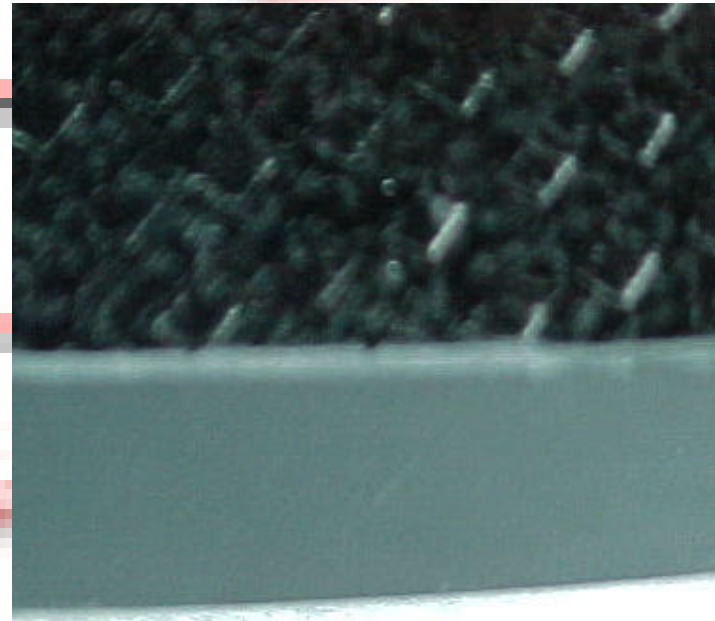
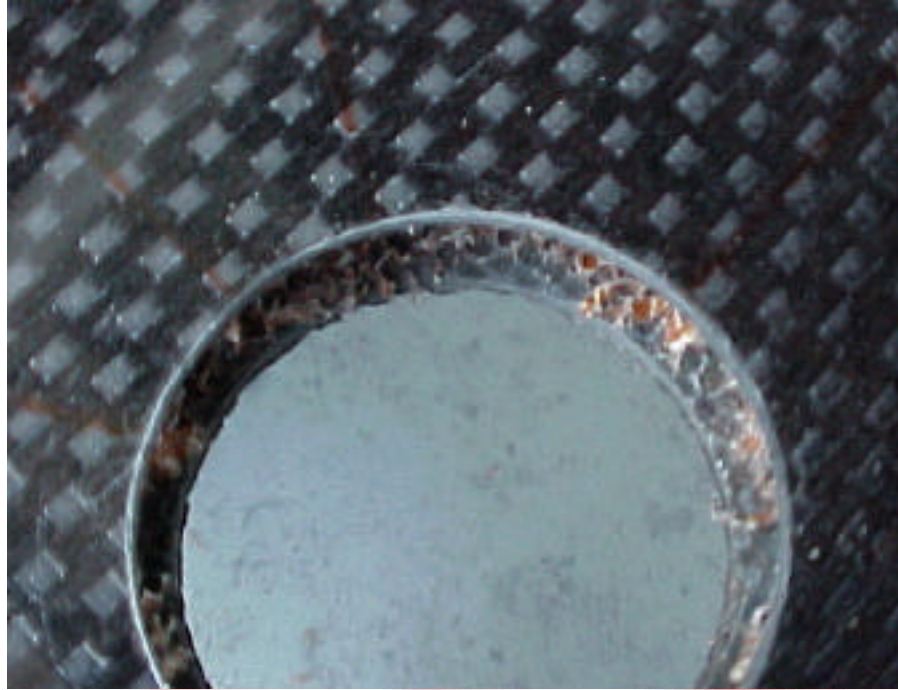
# CMS alignment structures

- Alignment wheel
- MABs

## Development of CMS Alignment Wheel

- Sandwich structure
  - Carbon fibre/epoxy resin/honeycomb nomex
  - Aluminium inserts
- General dimensions :  $t = 20\text{mm}$   
 $d = 2450\text{ mm}$   
 $m = 35\text{ kg}$

# CMS Alignment Wheel





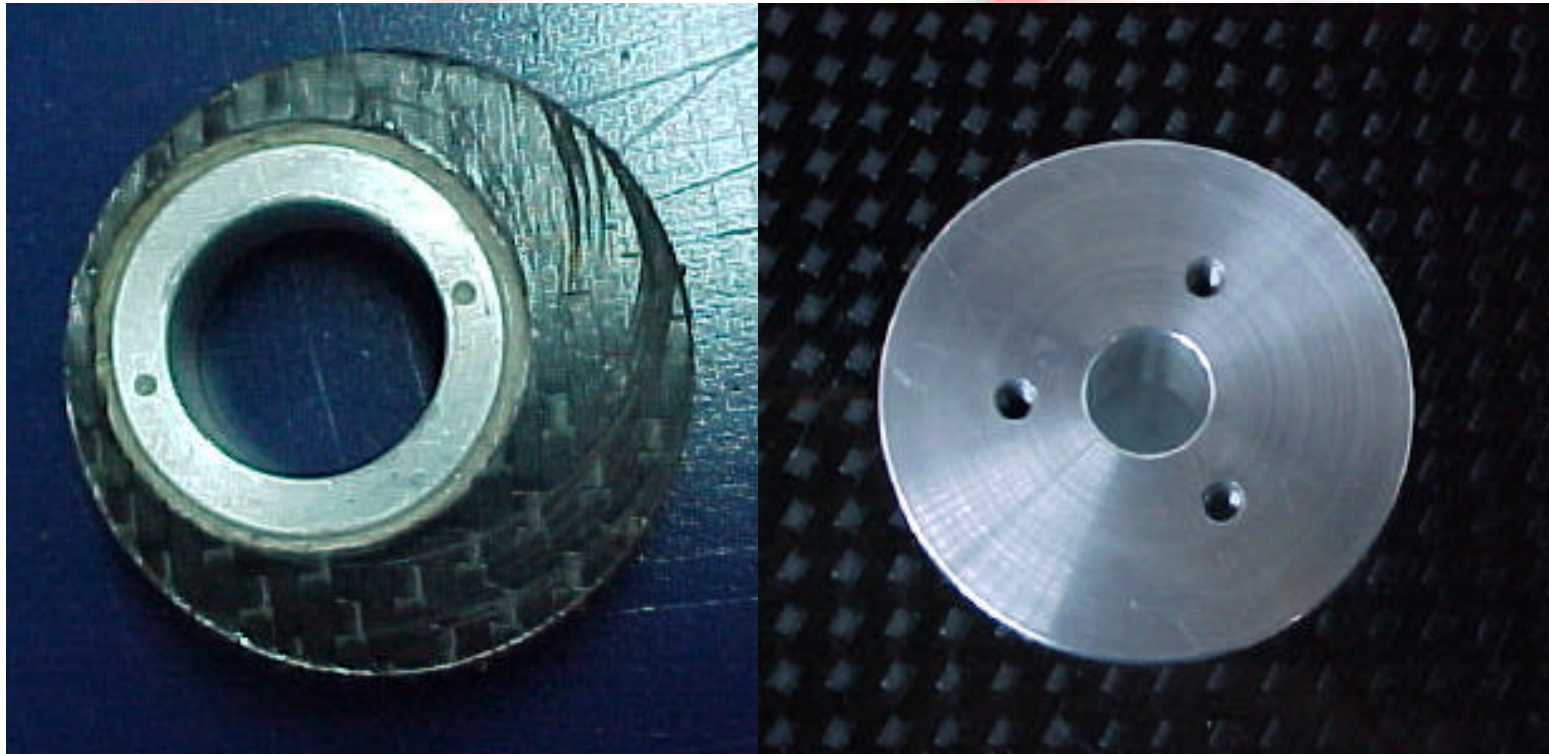
## CMS Alignment Wheel

### Inserts



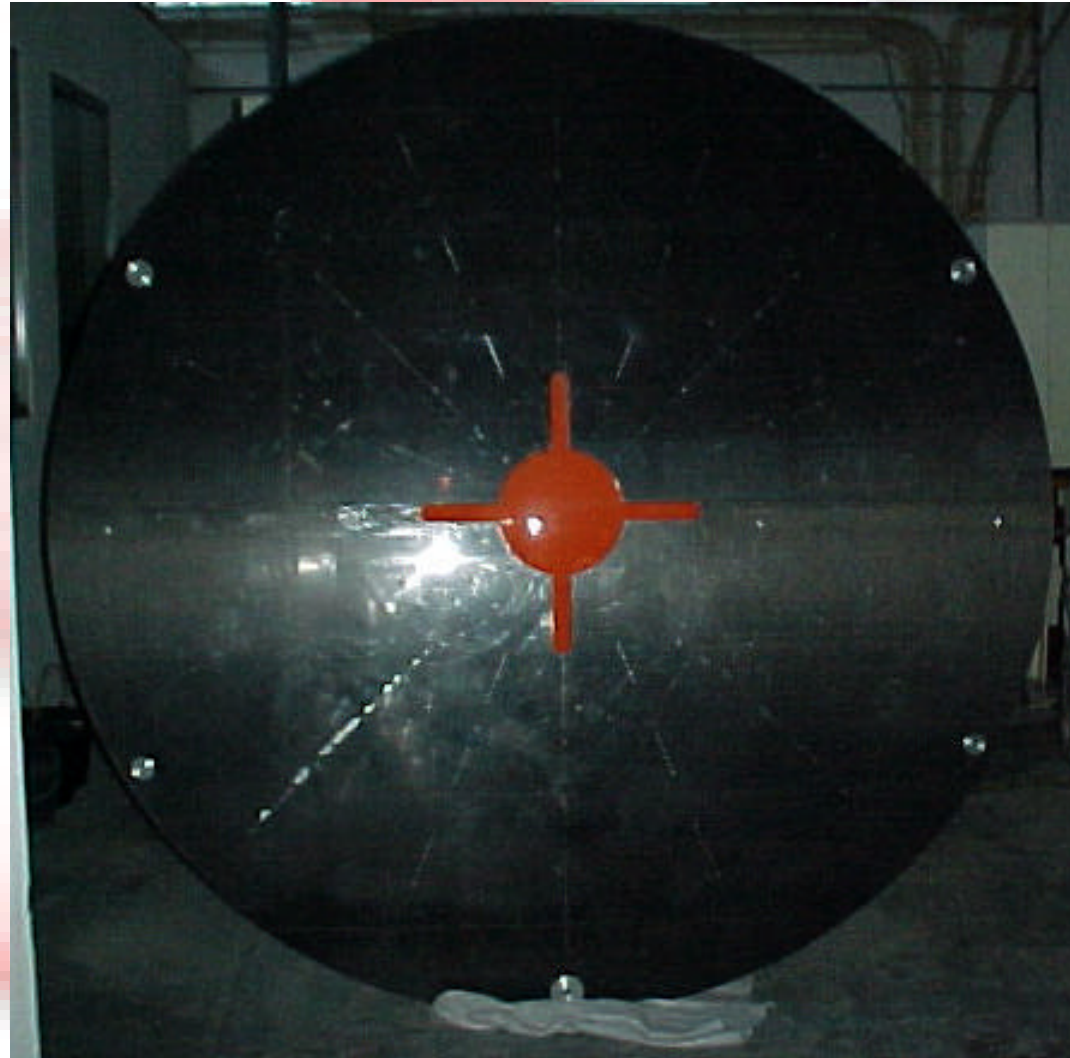
# CMS Alignment Wheel

## Inserts



# CMS Alignment Wheel

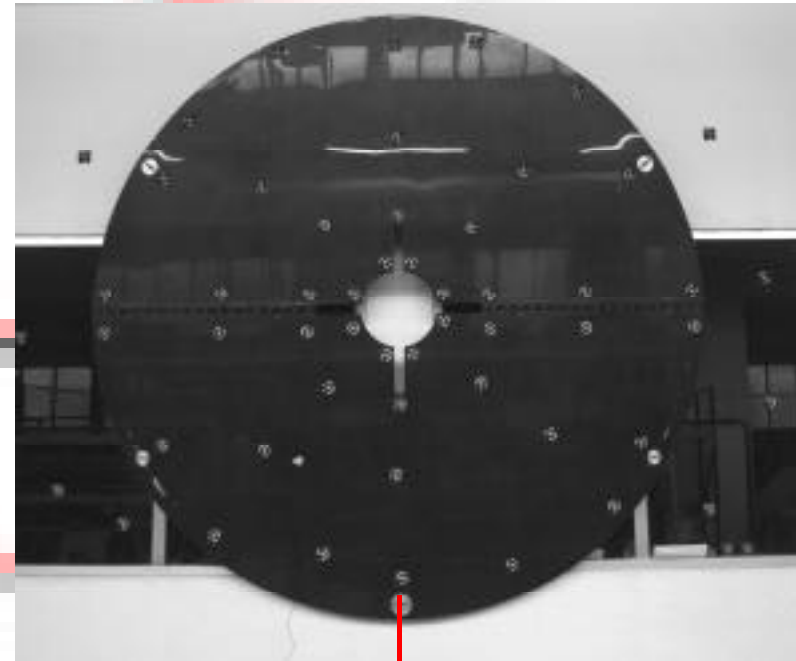
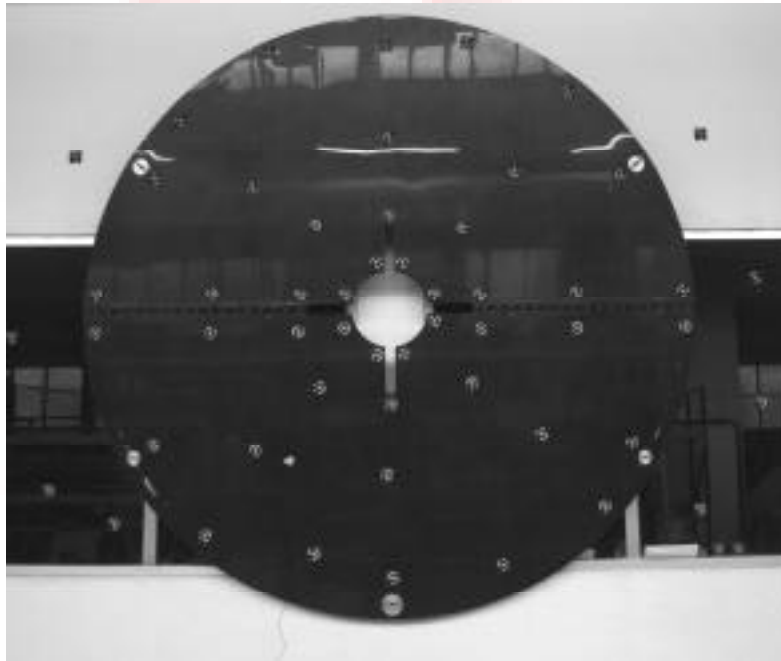
Full-scale wheel



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# CMS Alignment Wheel

## Measurements by digital photogrammetry



10 Kg

## !! PRELIMINARY RESULTS !!

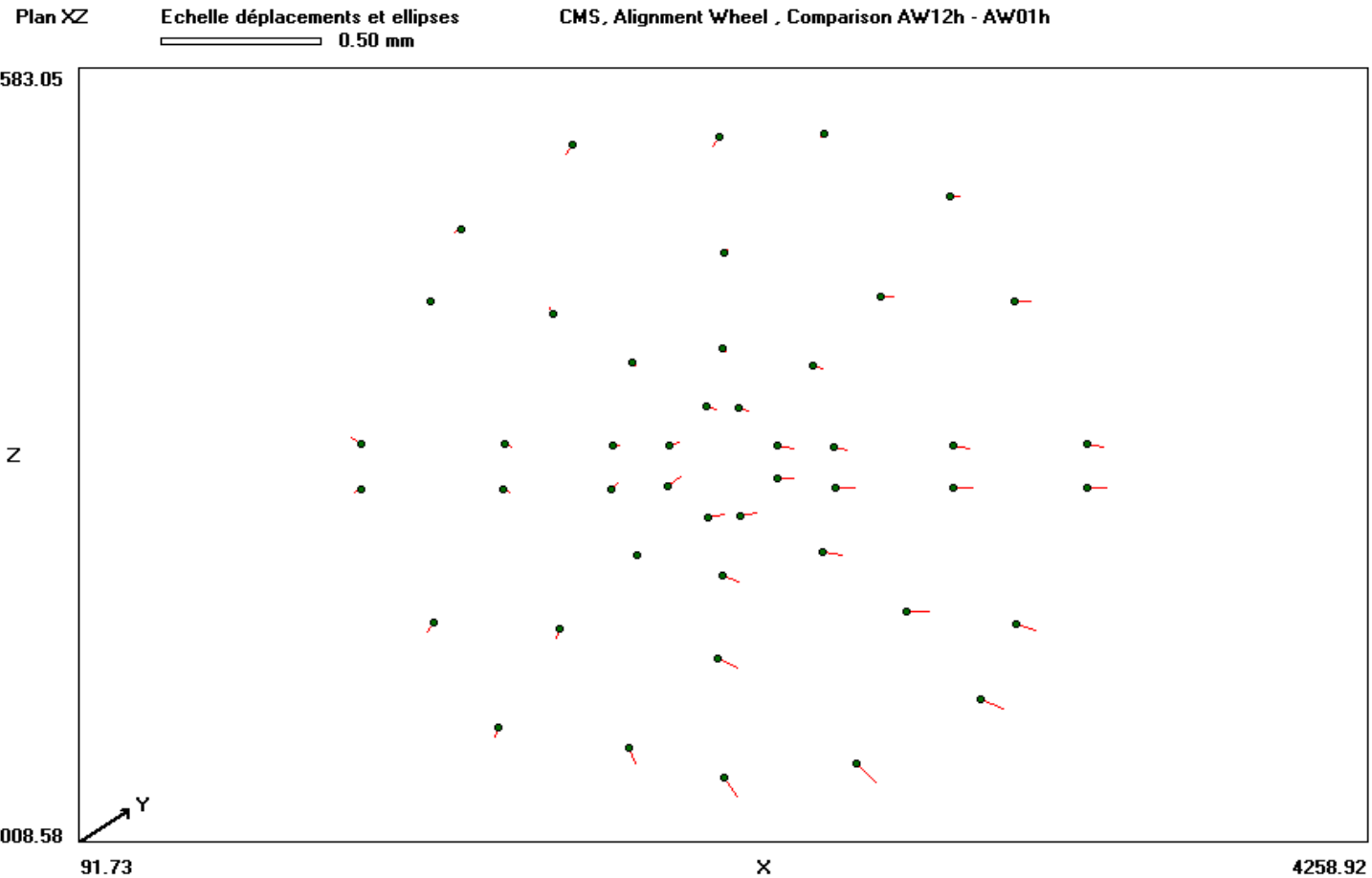
- Deformation test
- Accuracy of the calculated 3D coordinates :  
$$\text{RMS / XYZ} = 0.05 \text{ mm}$$
- Preliminary results for one comparison :  
project AW\_12h (one 10kg load) vs AW\_01h (no load)

→ no significant deformations...



# CMS Alignment Wheel

## !! PRELIMINARY RESULTS !!

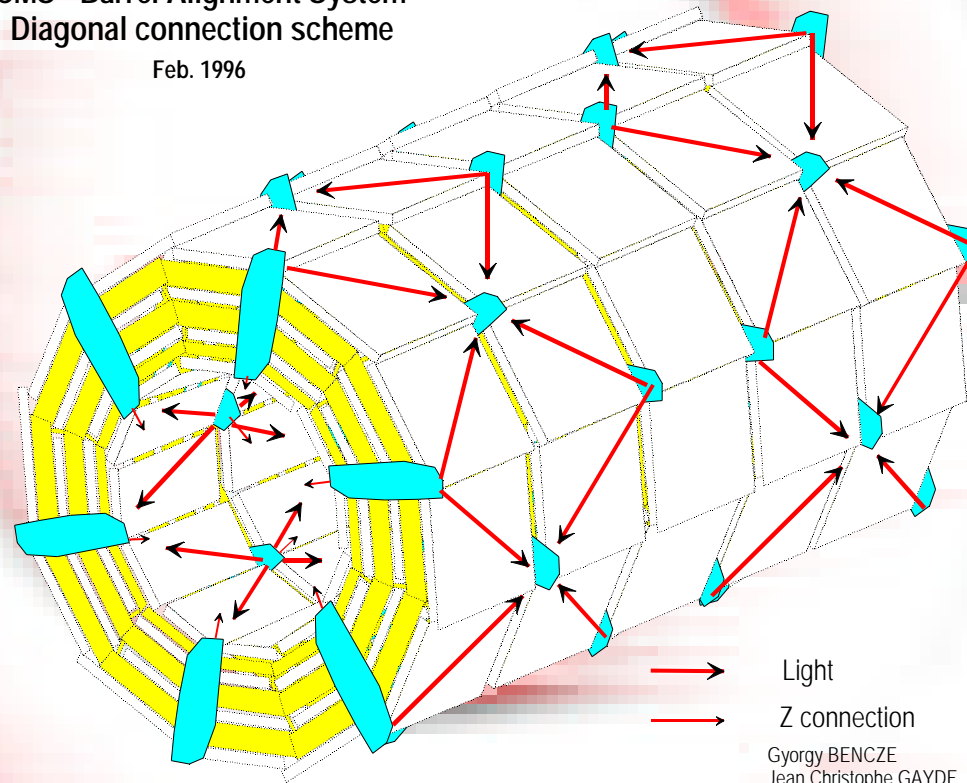


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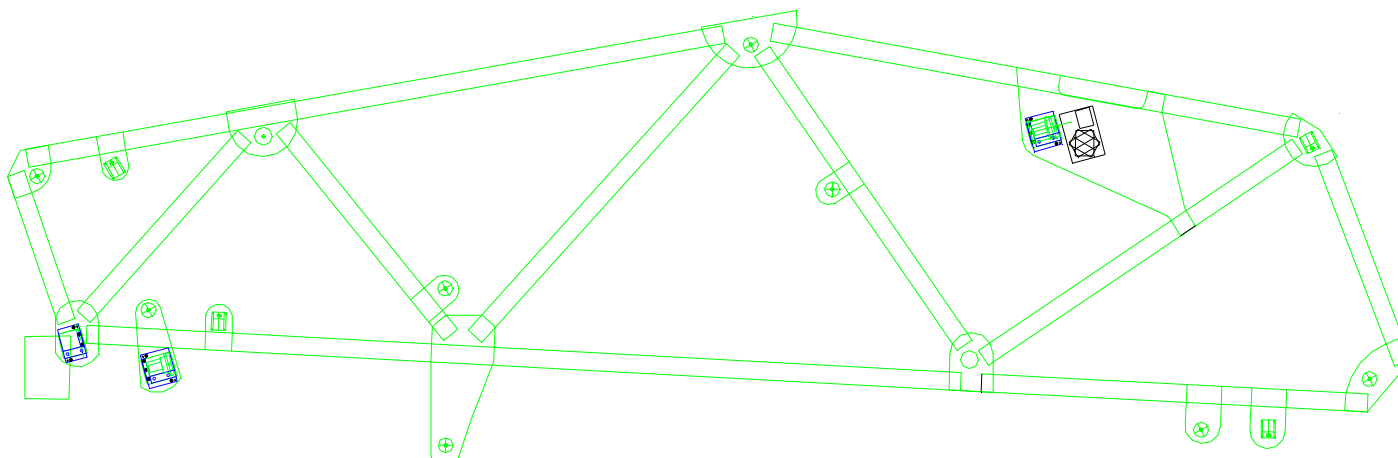
# Development of Composite Structure for MABs

CMS - Barrel Alignment System  
Diagonal connection scheme

Feb. 1996



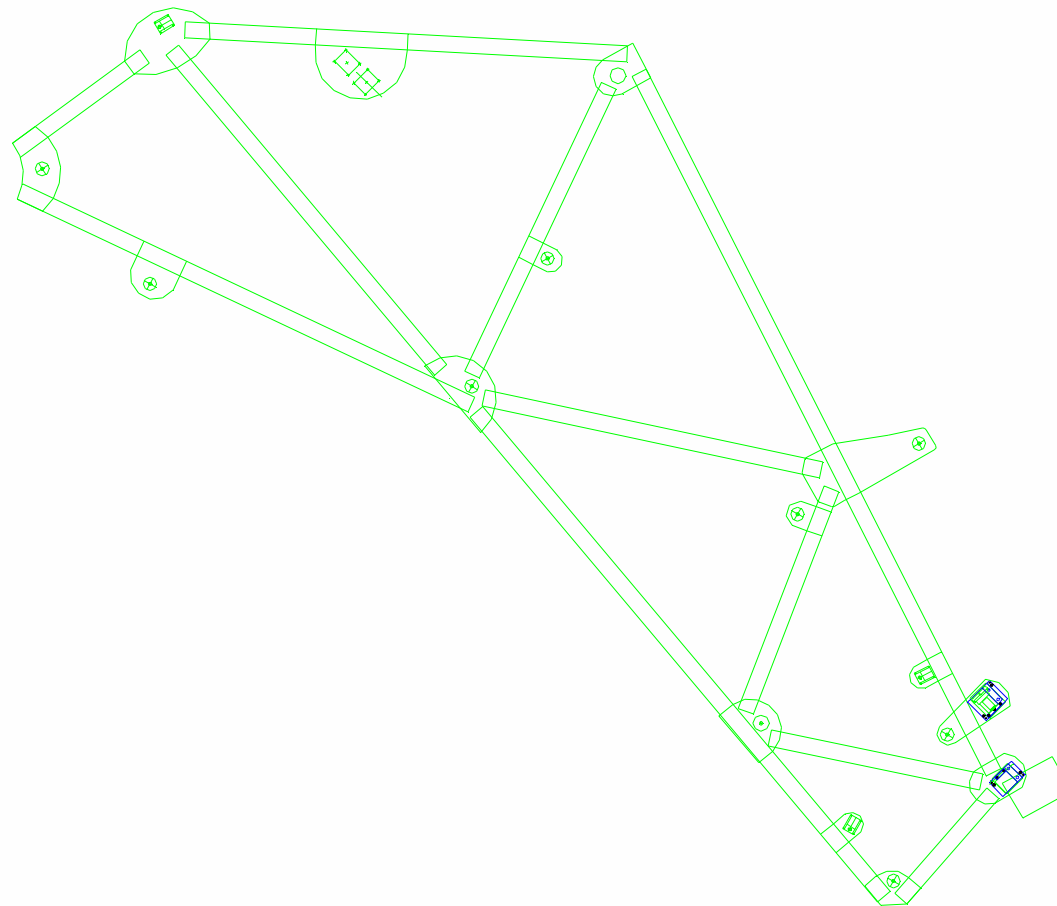
MABs



**MAB type 1 (24 MAB)**

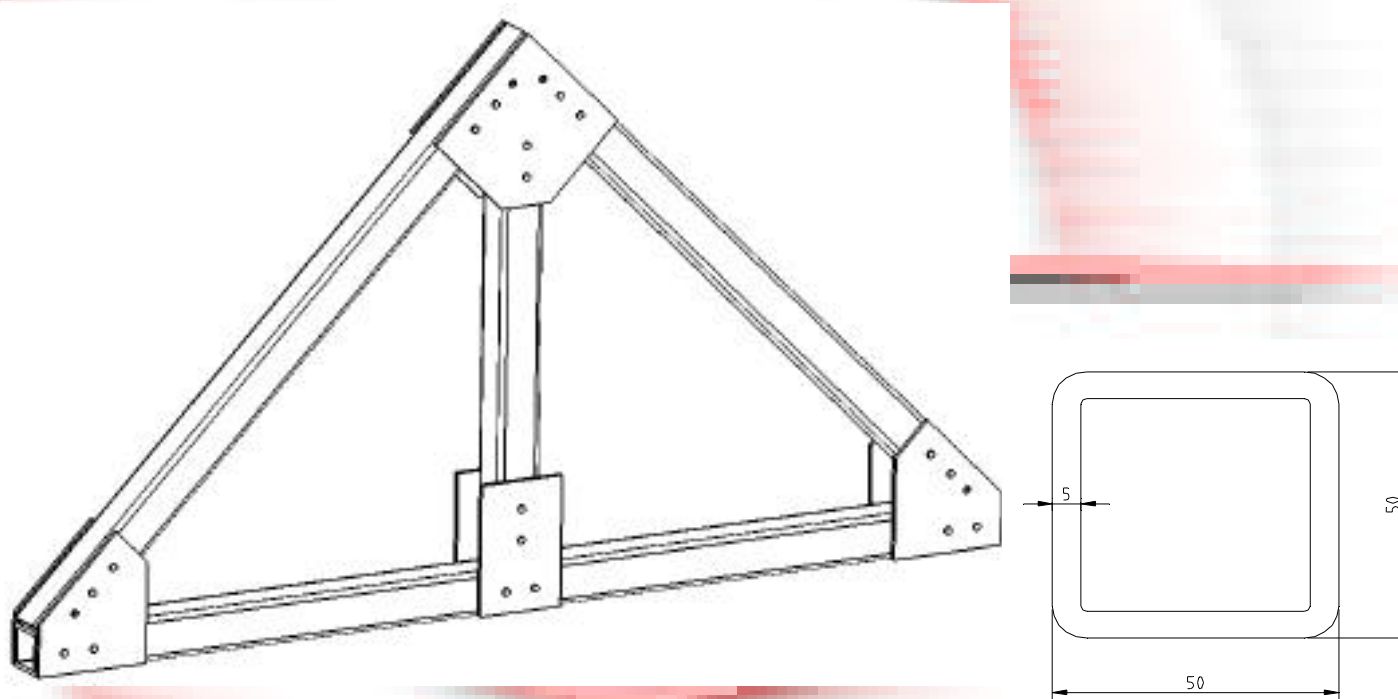


# MABs

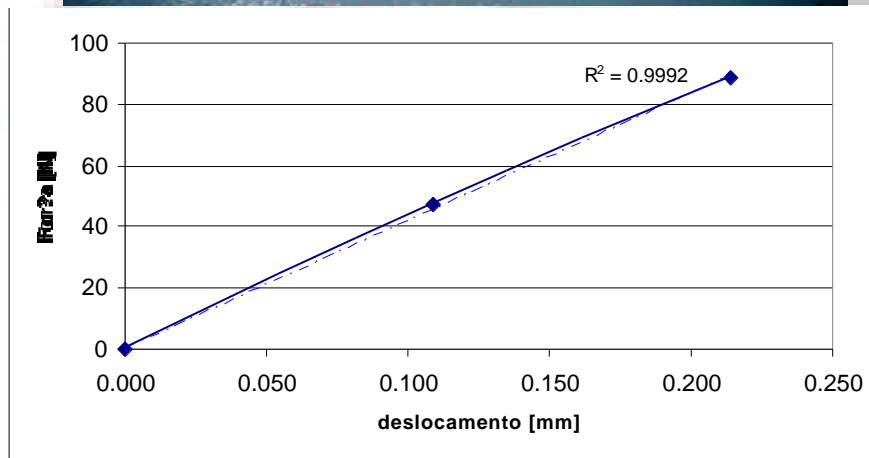
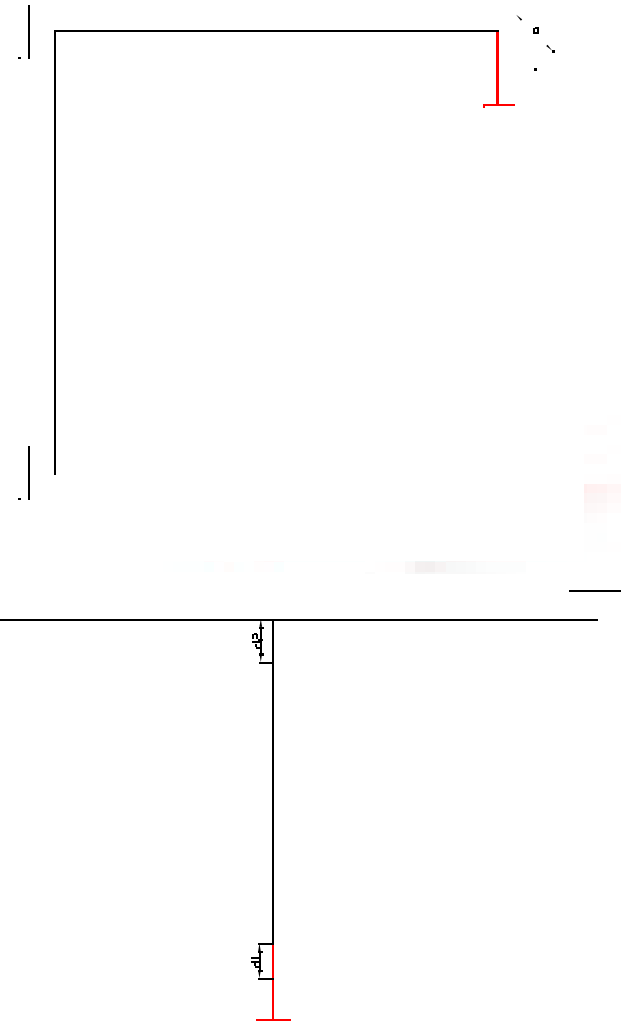
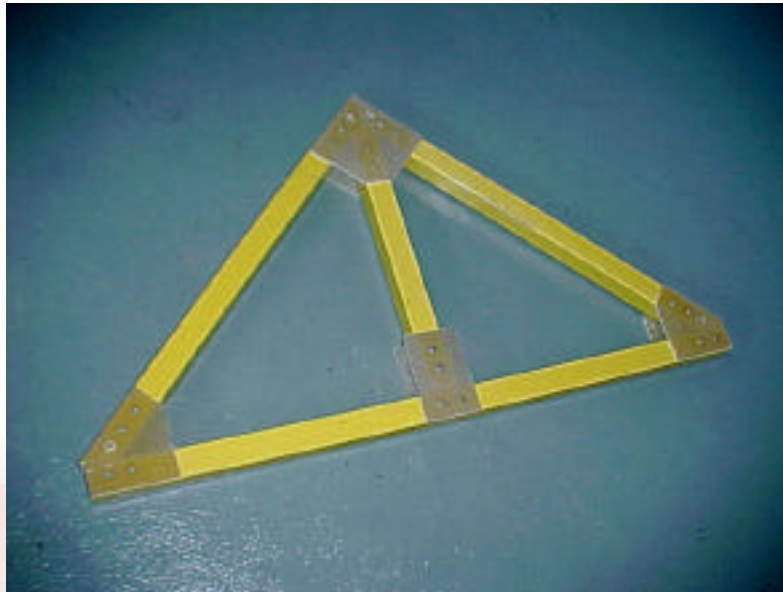


**MAB type 2 (12 MAB)**

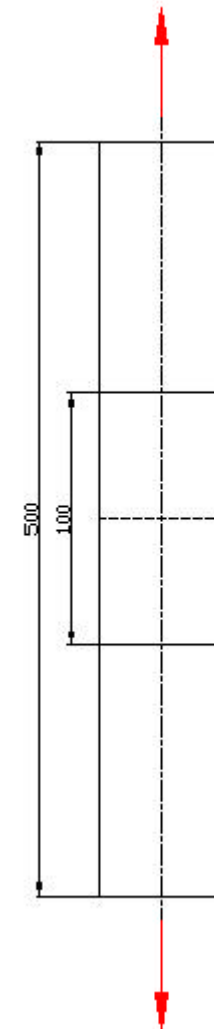
# Preliminary Work - Simplified structure



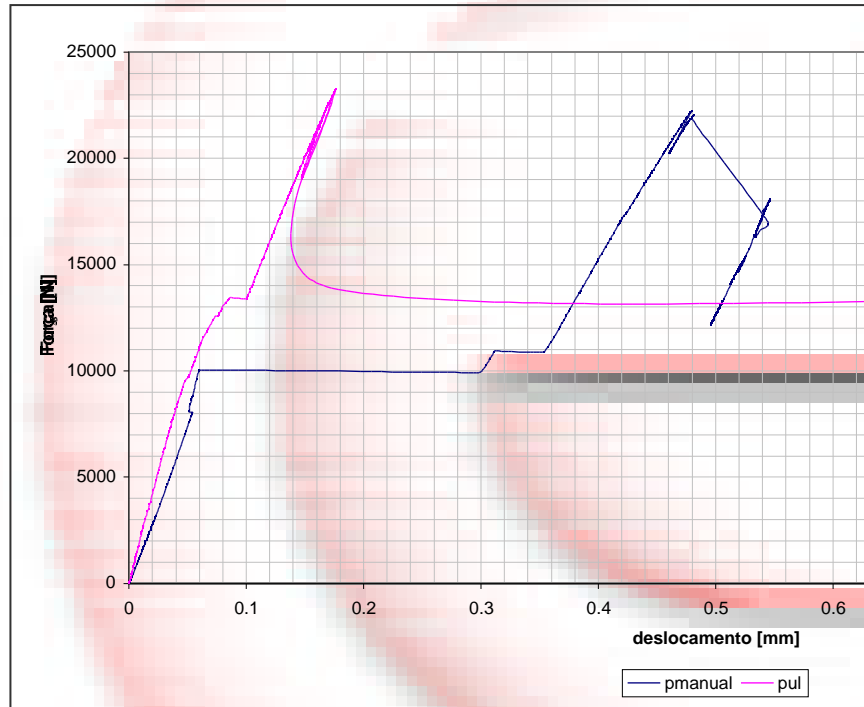
# MABs



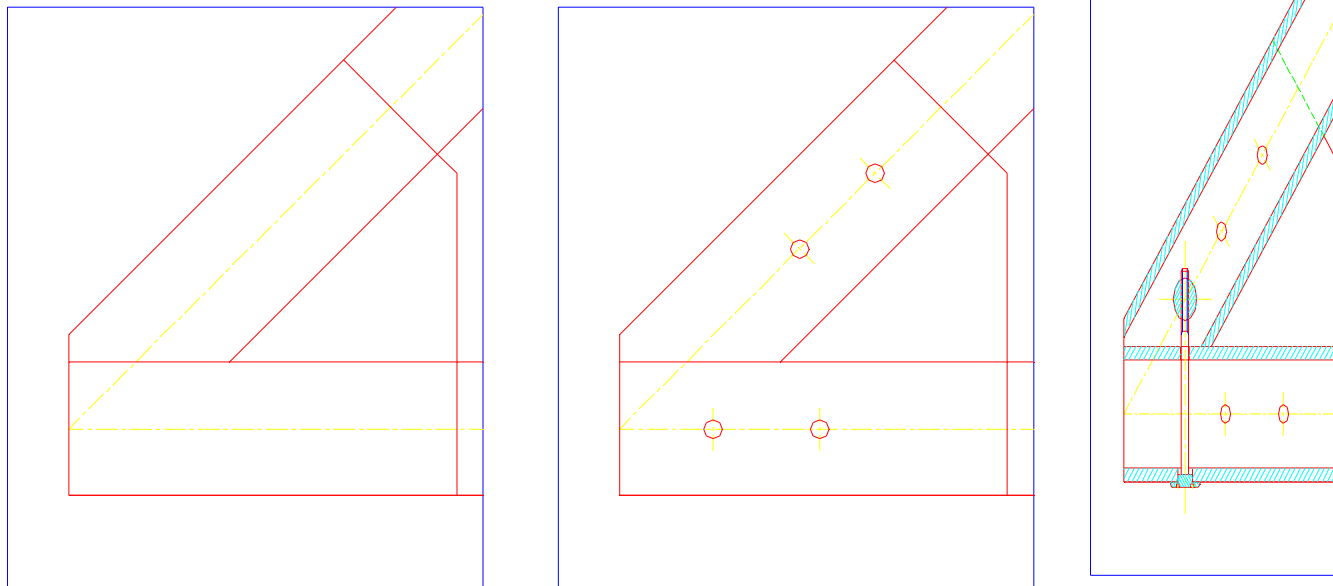
# Study of bonded connections



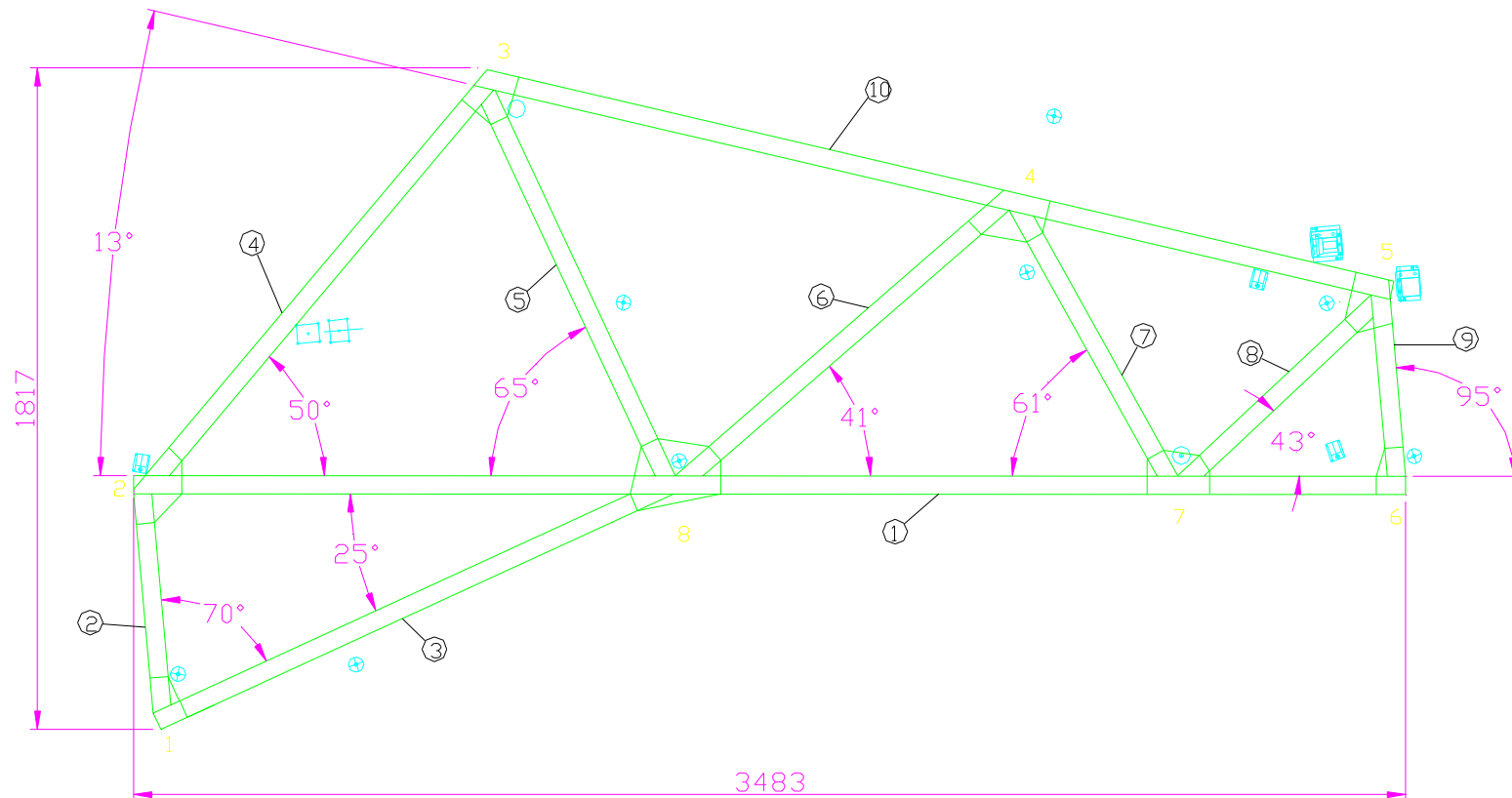
# Study of bonded connections



# Study of connections

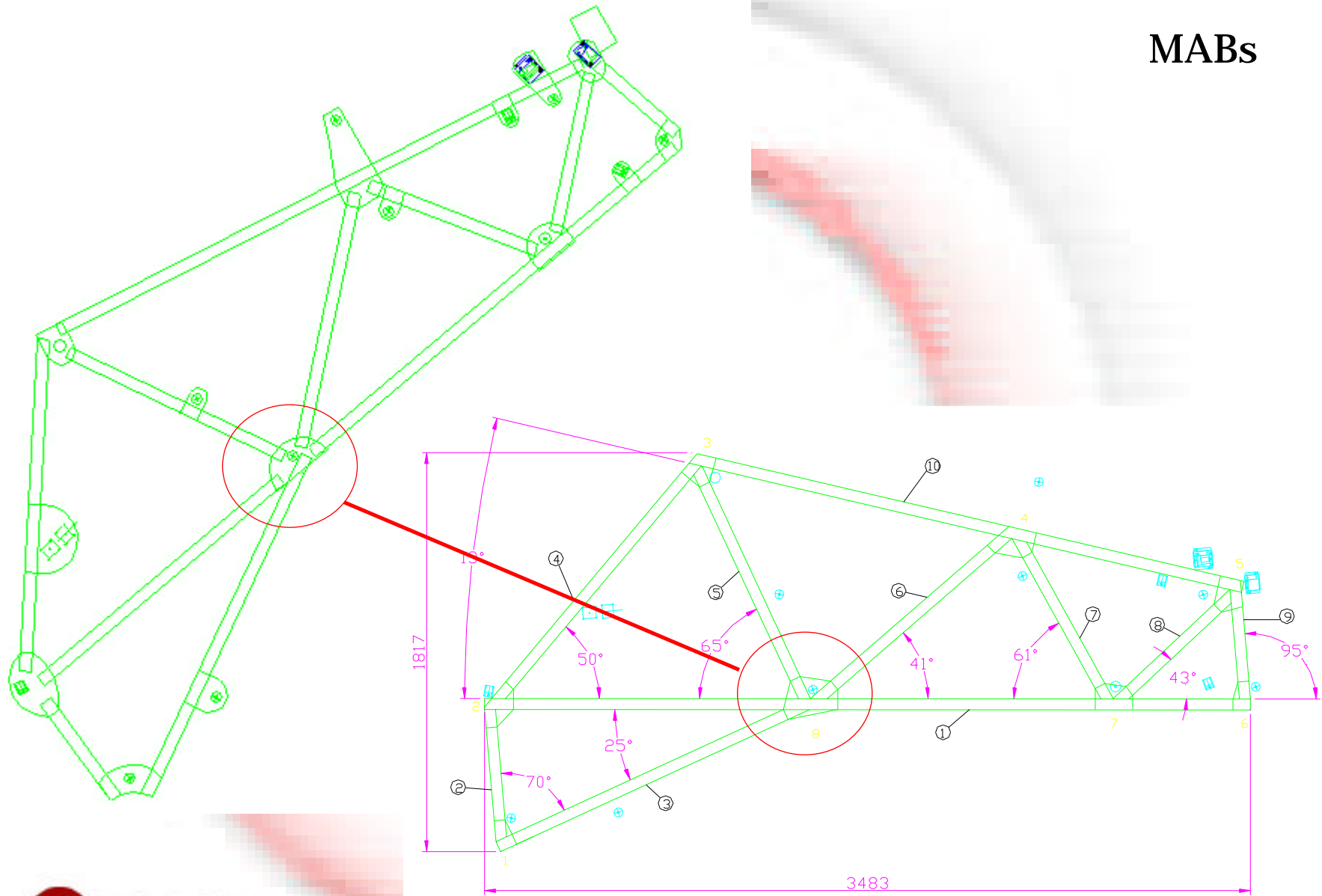


# MABs



**MAB type 2 - proposed solution**

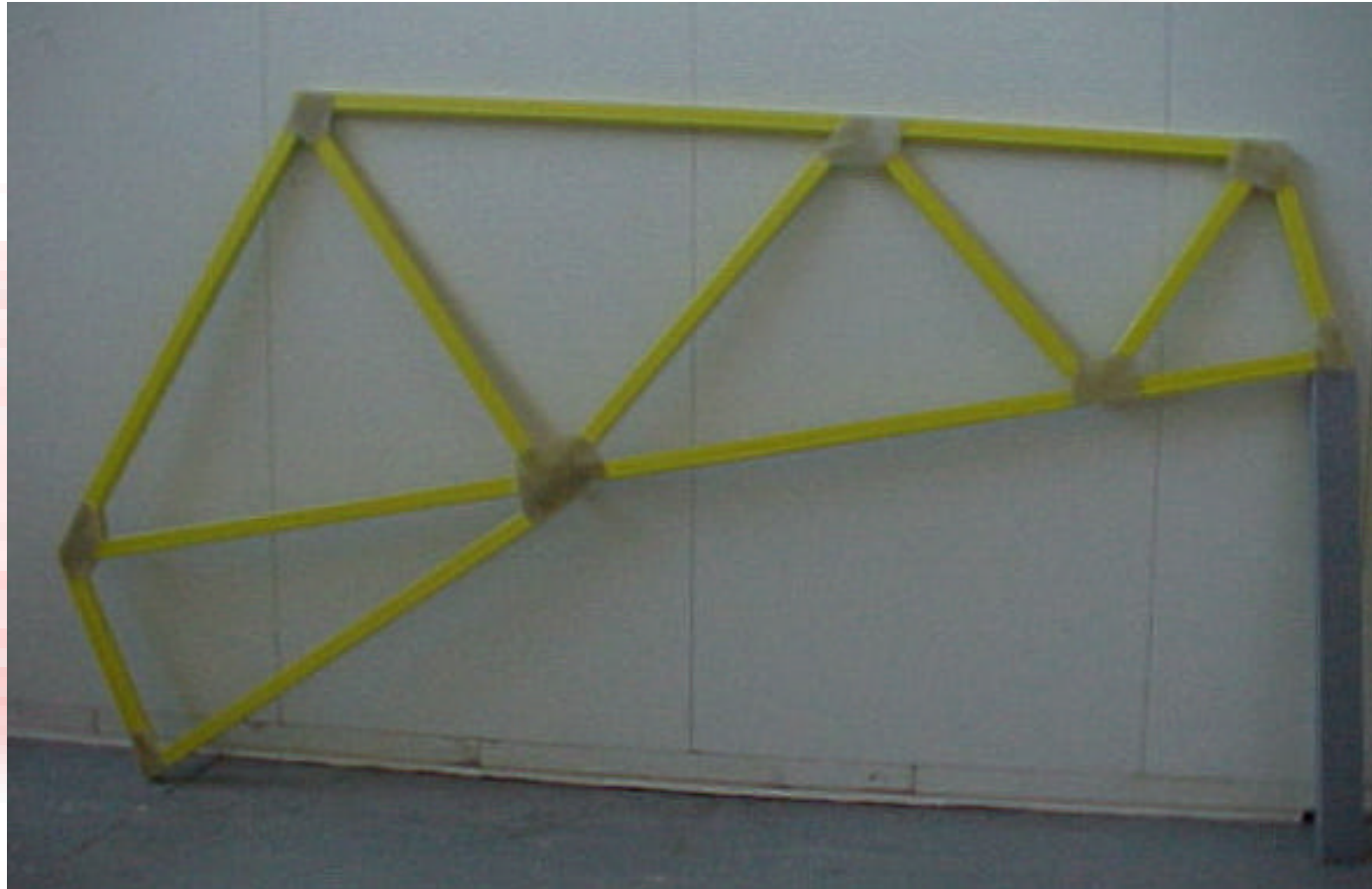
# MABs



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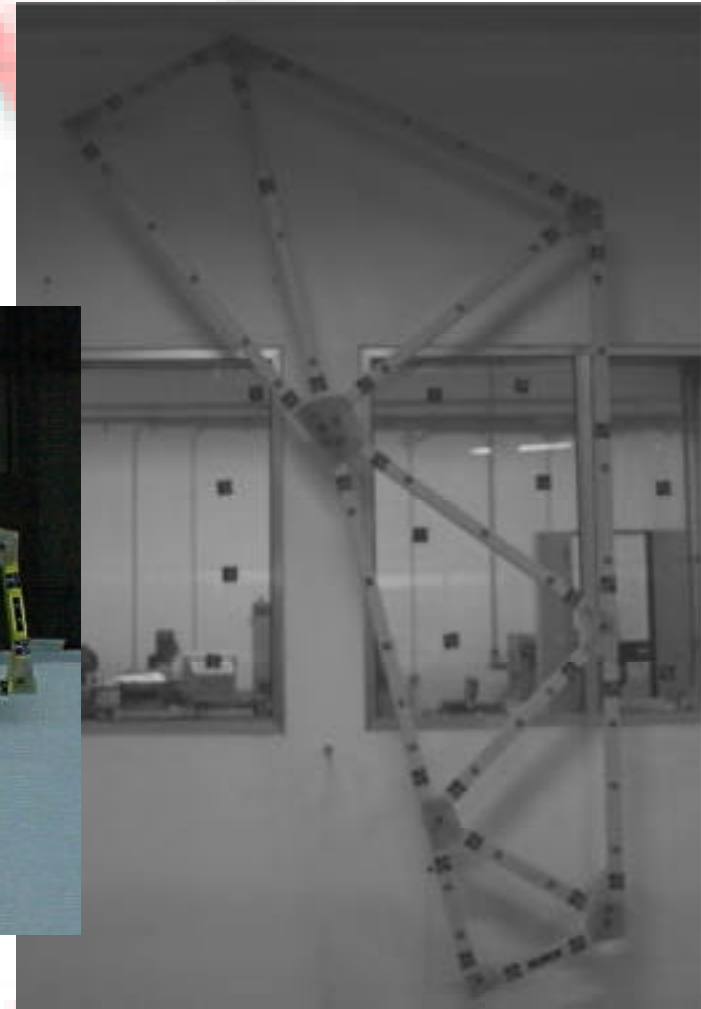
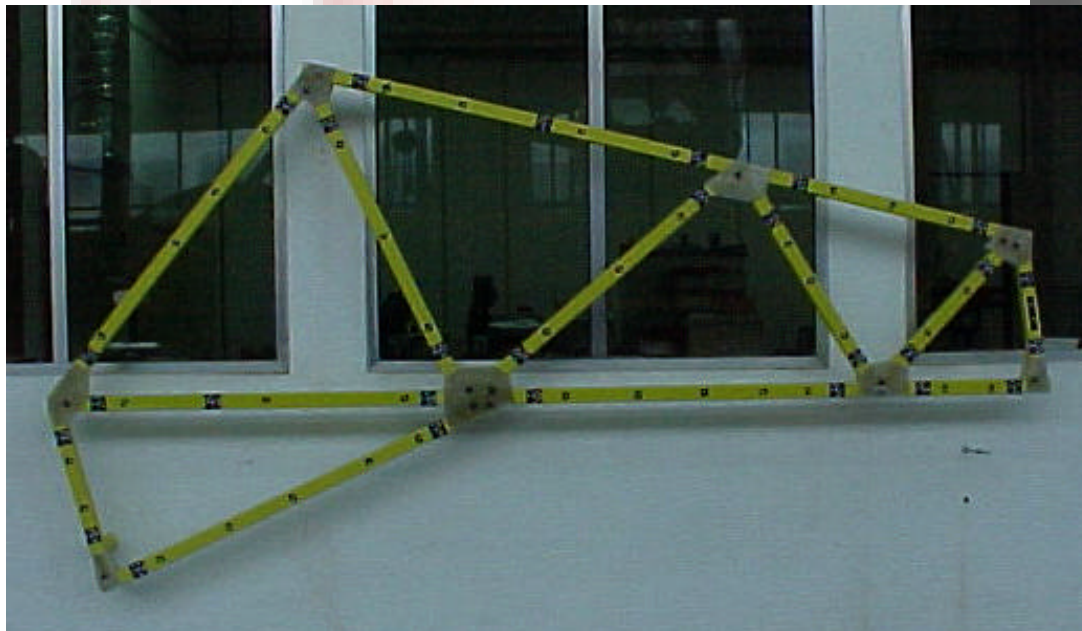
MABs



**MAB type 2 - proposed solution (1:1 scale)**

MABs

# Measurements by digital photogrammetry



## Future

Production of the final alignment wheel (  $\approx 1,2$  m)

MAB prototype by carbon fibre

Full Engineering studies