



# Progress in preparations for the BM@N STS ladder assembly .

Base workflow and equipment

- BM@N STS modules and ladders
- Ladder Assembly Device for BM@N STS ladder assembly
- Three coordinate module positioners and special tools from them
- Basic workflow for ladder assembly

V. Elsha, LHEP, 23.10.2020

# 1. The Ladder

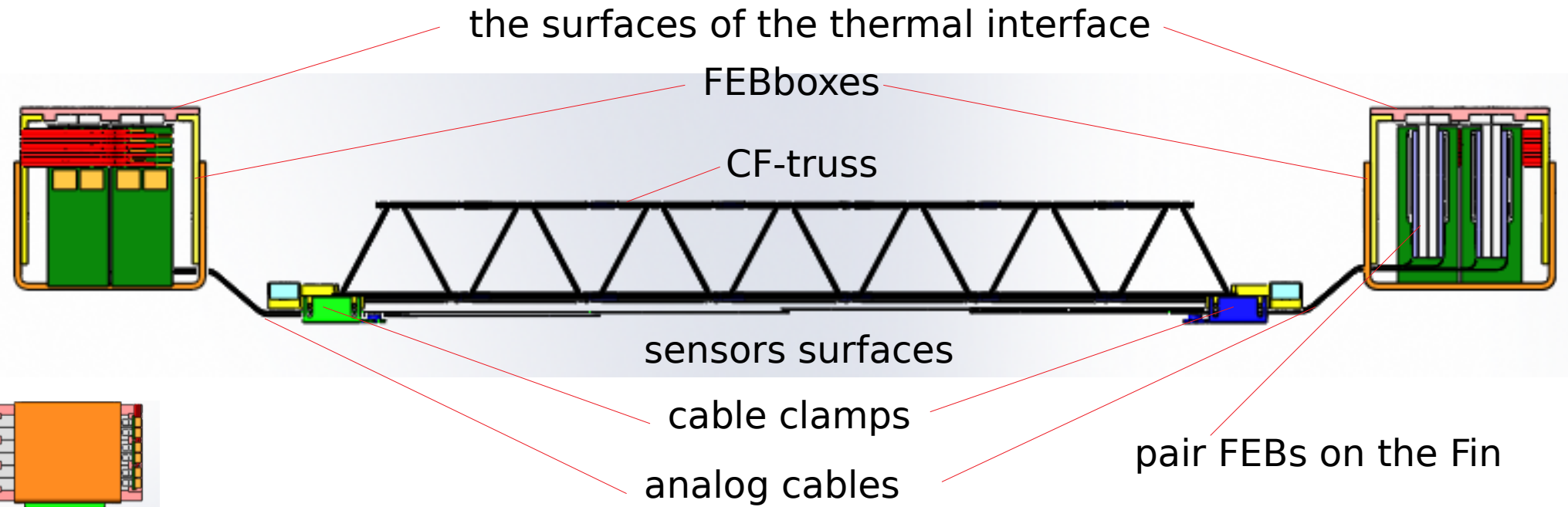


Fig. 1: The ladder components.

Different types of ladders for different stations can contain from 4 to 10 modules

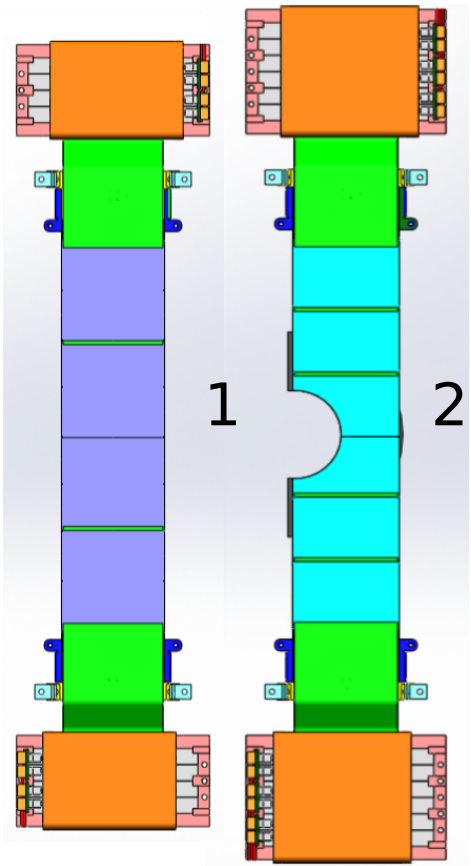


Fig. 2: Regular (1) and Central (2) type of ladders for STS1.

## 2. The Module

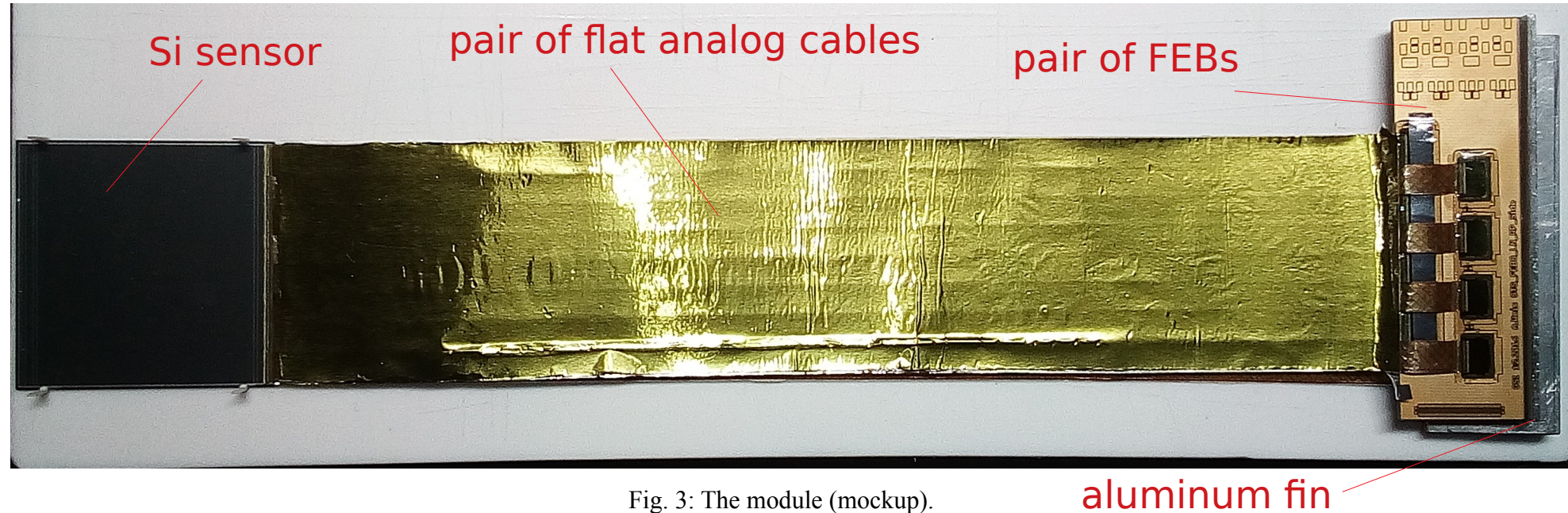


Fig. 3: The module (mockup).

In the BM@N STS modules uses sensors with dimensions of 6x6 and 6x4 cm and cables of different lengths

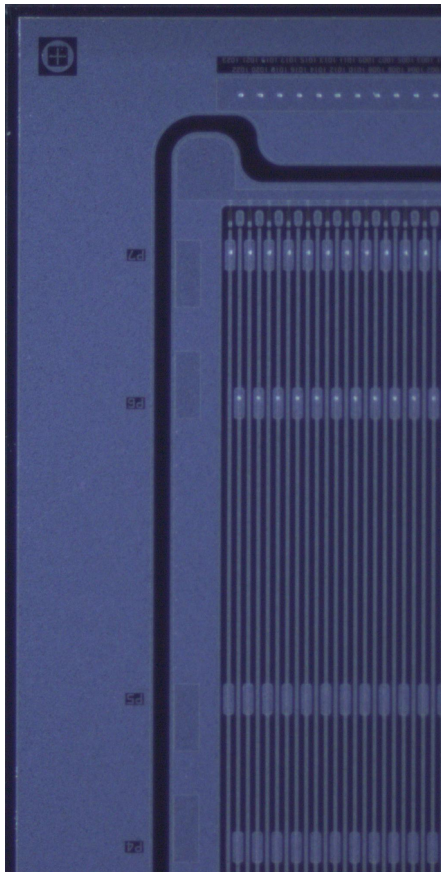


Fig. 4: Si sensor corner with fiducial cross



### 3. The Ladder Assembly Device

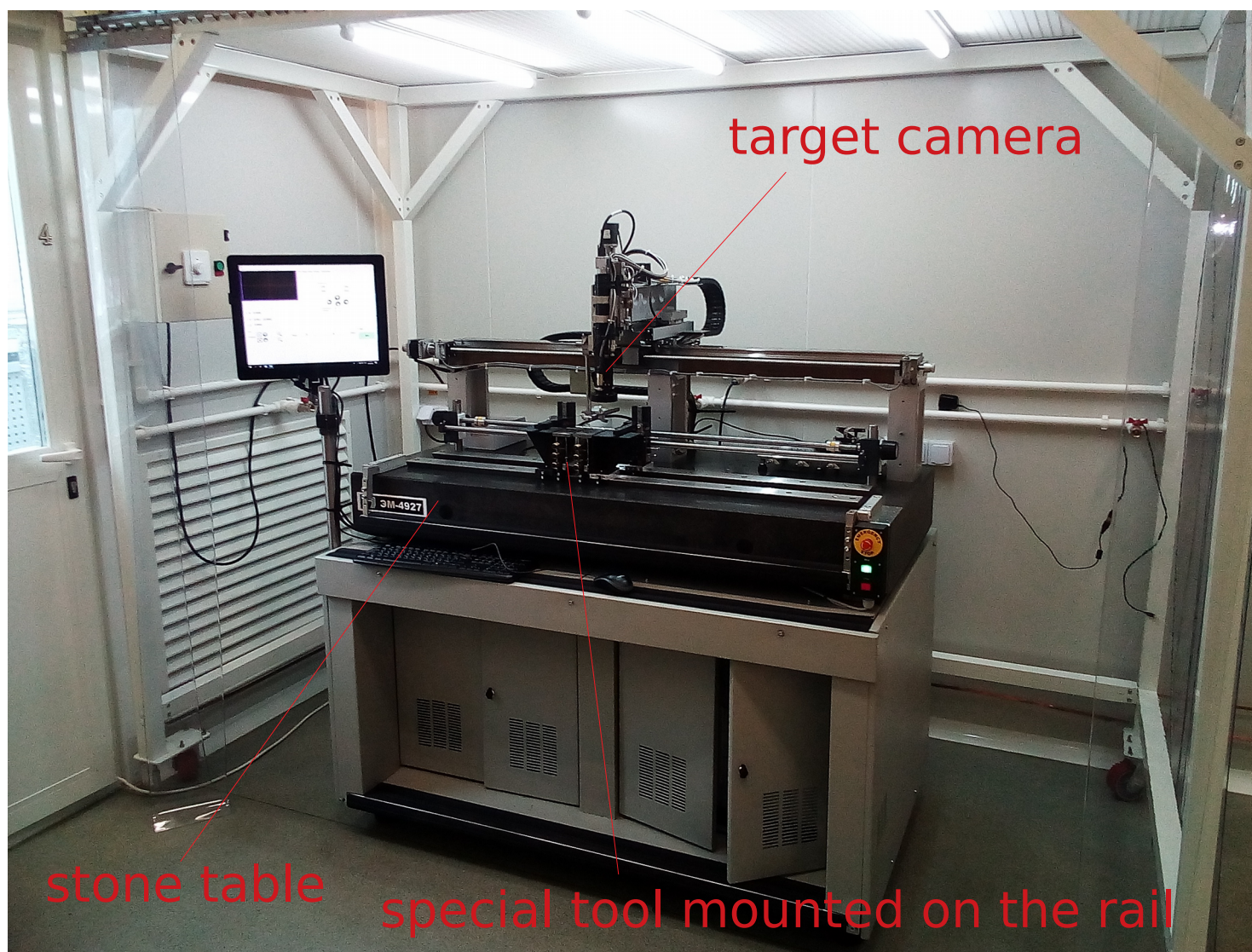


Fig. 5: The Ladder Assembly Device

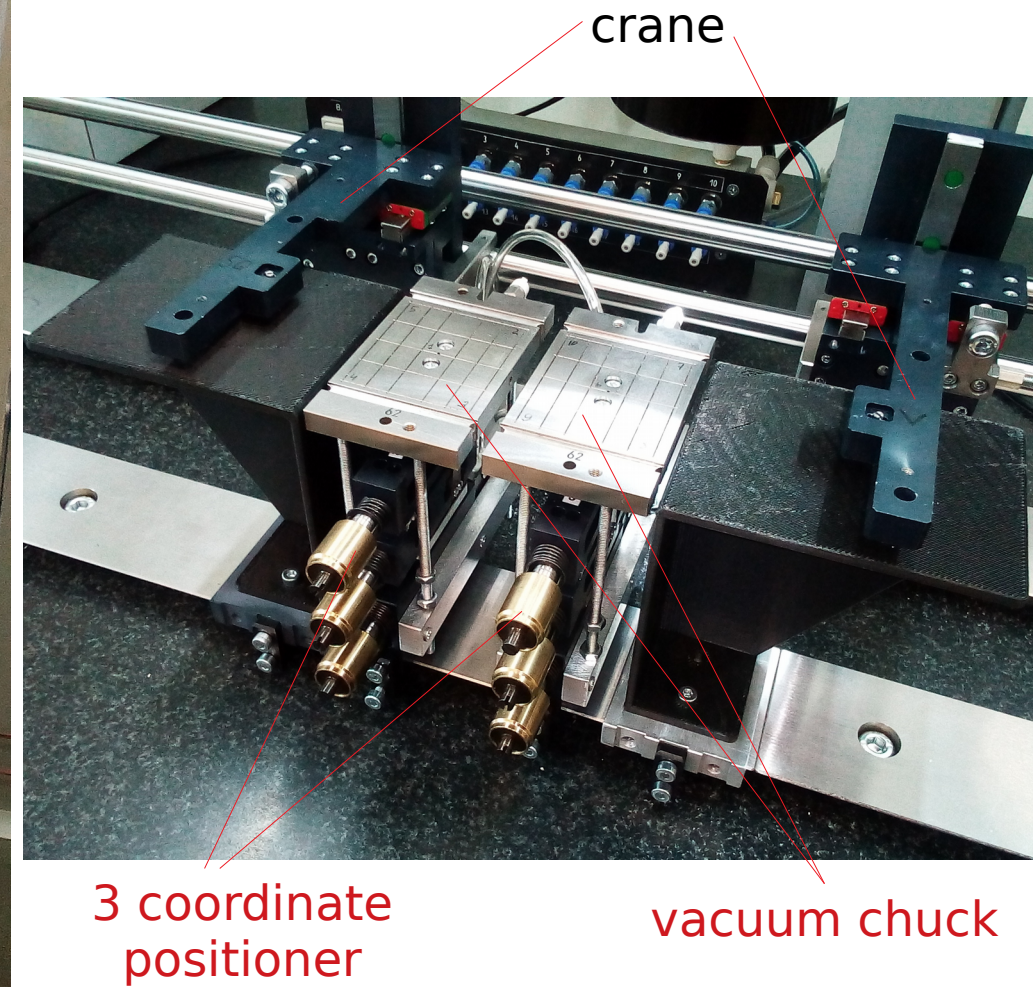


Fig. 6: The special tool for 2 sensors mockup



## 4. ladder assembly sequence

Each ladder is installed at the station using two positioning blocks supported by two precision ruby balls.

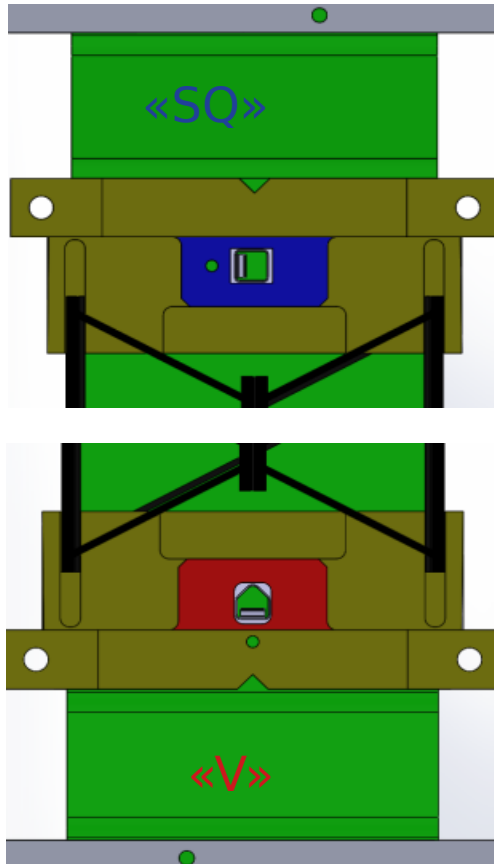


Fig. 7: SQ and V positioning blocks

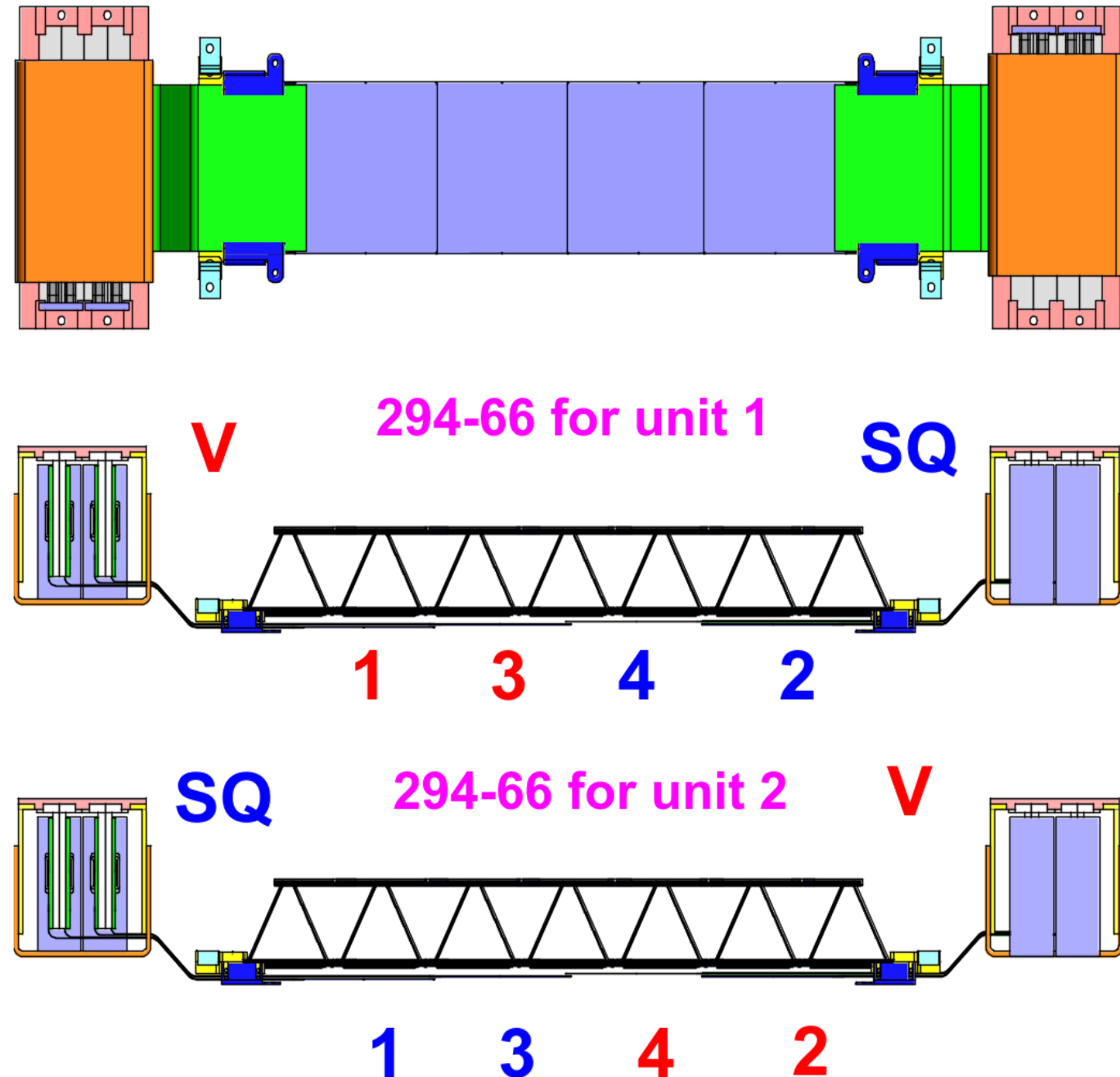


Fig. 8: The Assembly sequence of the same ladders for different units.  
Ladder 296-66 for example.

## 5. Ladder Assembly Tool configuration

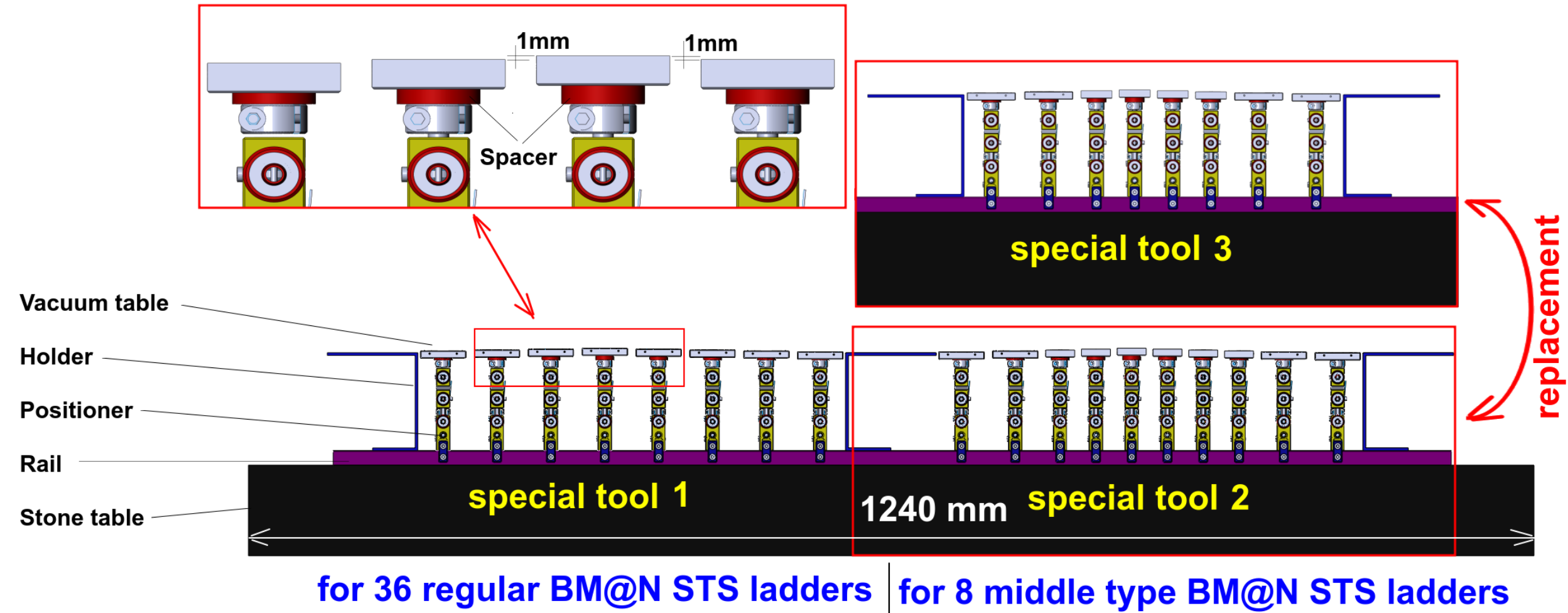


Fig. 9: Special tools for ladder assembly



## 6. Special tool and placement program

3 special tools and placement programs are needed for BM@N STS at all

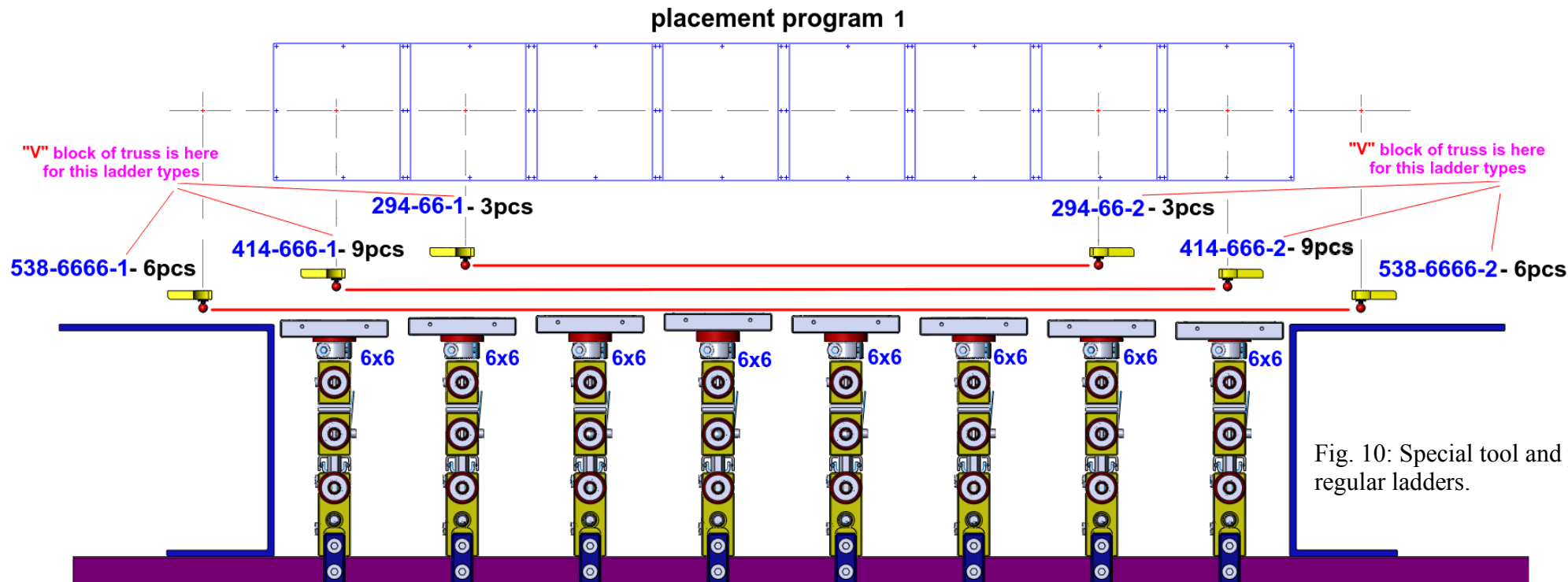


Fig. 10: Special tool and placement program 1 for 36 pcs. of regular ladders.

## 7. Basic Workflow

It is assumed that:

- **L-legs preliminary glued on sensors**
- **FEBs glued on the fin**
- **preliminary cut module shields stacked separately from module**
- **electromagnetic screen connections must be on the assembled ladder**
- **L-legs join with CF-truss in one gluing process**

## 8. Basic Workflow

### Pereliminary operation for CF-truss positioning

- 1.Lowering the CF-truss to the gluing position
- 2.Adjustment the position of ruby balls
- 3.Attaching cable clamps to the template

### Operations repeated for each pair of modules

- 4.Installing the lower shield of the module 2
- 5.Instaling of the module 2
- 6.Adjustment the position of the module 2
- 7.Installing the upper shield of the module 2 and lower shield of the module 1
- 8.Instaling of the module 1
- 9.Adjustment the position of the module 1
- 10.Installing the upper shield of the module 1

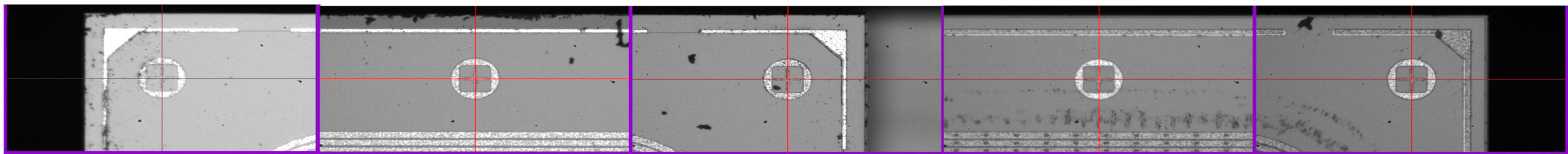


## 9. Basic Workflow

### Operations for assembly

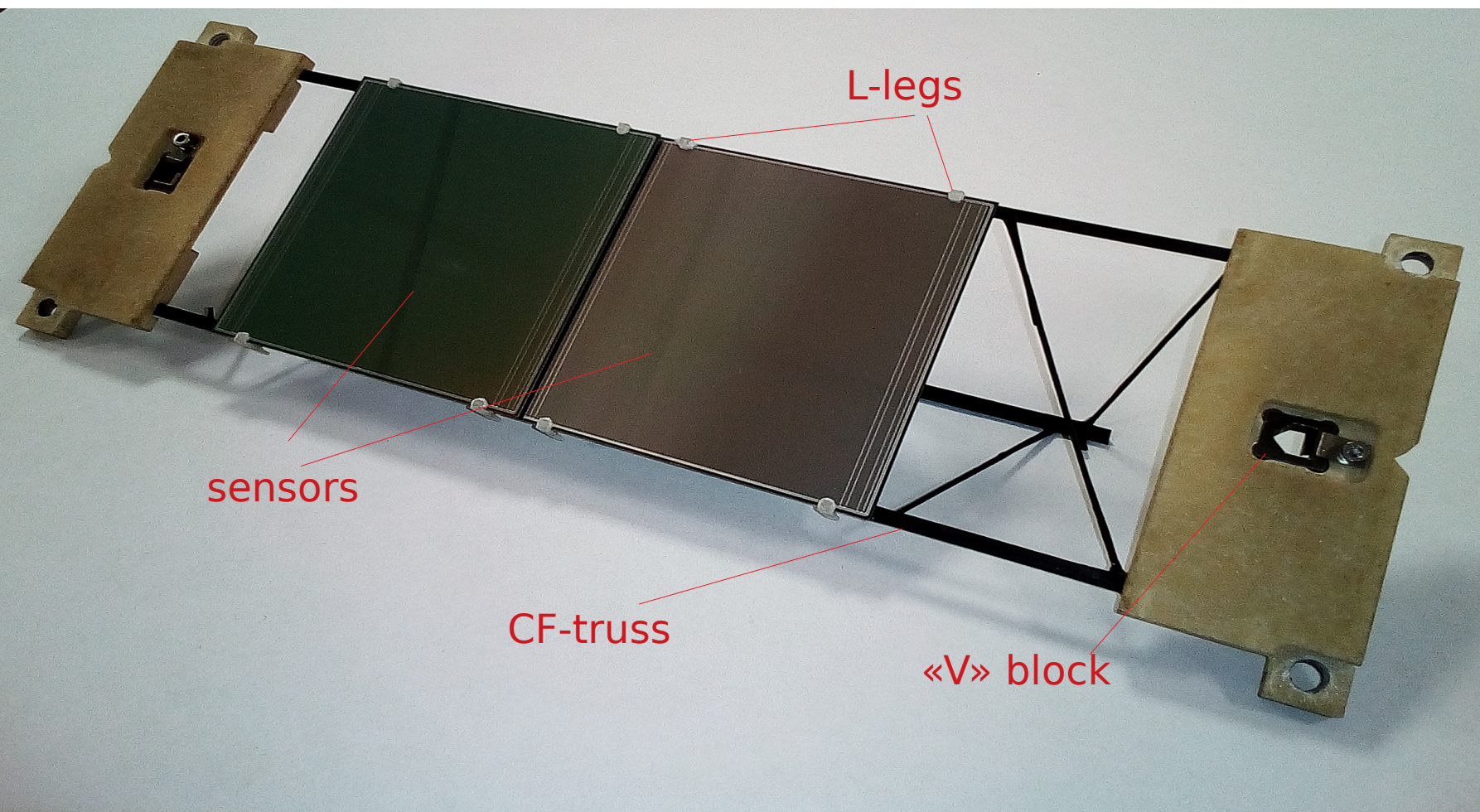
11. Test of the modules position
12. Lowering the CF-truss and L-legs gluing. Lifting of the assembly
13. Mounting FEBbox base on crane
14. Mounting FEBs to the FEBbox
15. Installing shields on FEBbox base
16. Laying bottom cable shields
17. Mounting holder and sensors shield
18. Mounting handle and release complete ladder from crane
19. Ladder boxing and storing

# 10. Test of 1st assembly



|                                                          |                                                          |                                                          |                                                          |                                                          |
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Fig. 12: Measured positions of 5 crosses on one side (120 mm length)



The accuracy of sensor positioning in the transverse direction of 10 microns by 120 mm was confirmed

Fig. 13: 2 sensors on the CF-truss assembled using the LAD

# 11. Conclusions

- As part of the work under grant 18-02-40113, a starting technology for building ladders was created.
- The first experiments were conducted and the results were obtained confirming the possibility of assembling ladders on existing equipment.
- It is necessary to continue to improve the technical process, equipment and software.
- For this purpose, it is planned to build 3 mockups of ladders this year.
- Next year, it is planned to measure the position of modules on mockups and start to the assembly of real ladders.

**Thank you for Your  
Attention!**