ATLAS Internal Note
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ATLAS
Tile Hadron Calorimeter
Installation Procedure

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1 INTRODUCTION

In this note we describe the procedure and the tools needed for the final assembly in the ATLAS experimental hall of the tile calorimeter barrel and extended barrels.

The basic idea is to join first modules in supermodules to give better rigidity during manipulation and to speed up the assembly procedure. After this, supermodules will be lifted down in the ATLAS pit using special tools.

Self supporting cylinders will be constructed starting from prefabricated supermodules.

2 Barrel and Extended Barrels assembly

The final Barrel as well as Extended Barrels assembly shall be performed directly in the ATLAS pit. Before assembly all modules should be tested and intercalibrated, some of them will be calibrated in test beams. TILECAL Barrel and Extended Barrels assembly is complicated by LAr calorimeter and SC solenoid bodies being inside. A number of cryogenic tubes as well as feedthrough for electrical cables will limit available space, see Fig. 1.

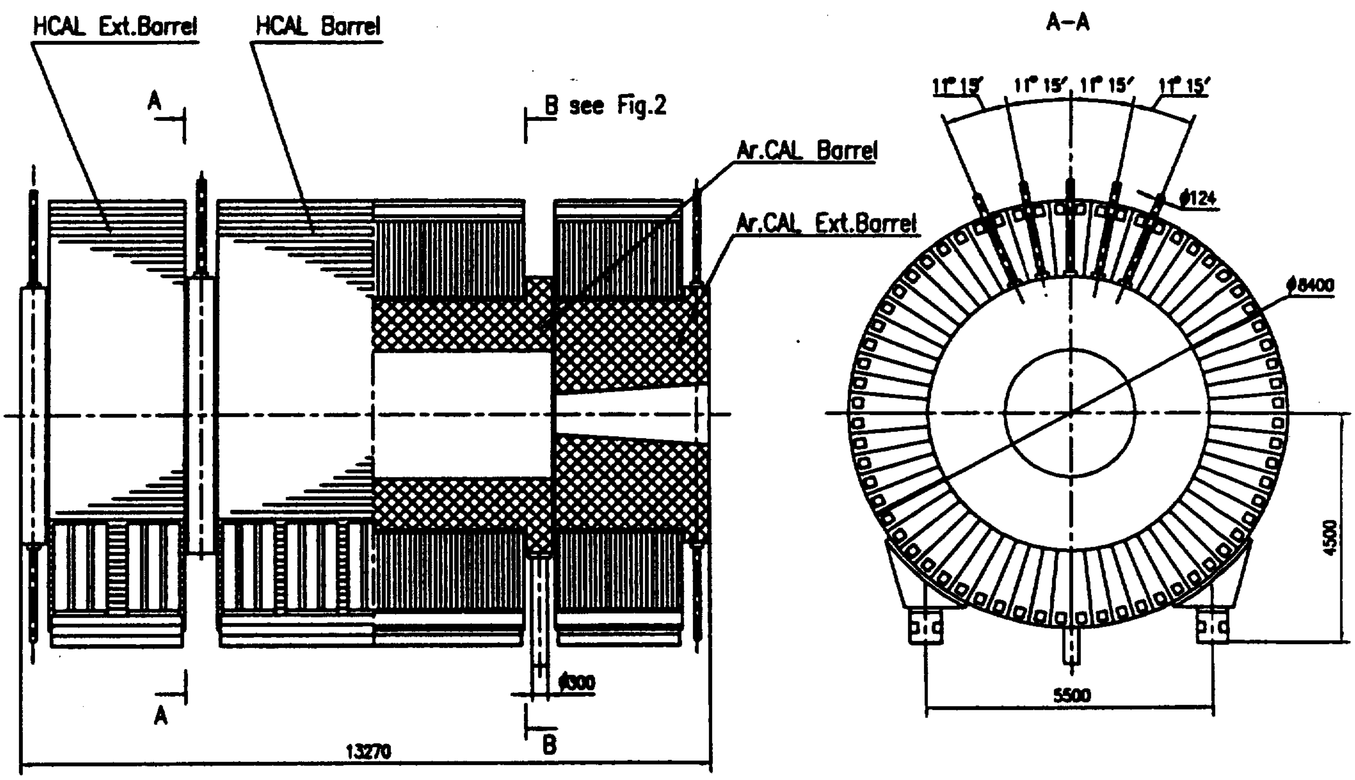


Figure 1: TILECAL and LAr calorimeter layout

Since TILECAL should provide a support for the above mentioned elements, 4/64 of it's modules should have reduced height. This reduction, of the order of 10 cm, in accordance with innermost tile width. TILECAL's support is made of Al structures reinforced by stainless steel plates throughover the whole Barrel/Extended Barrels length (Fig. 2).

During assembly of supermodules the allowed gap inbetween modules should not exceed 1 mm. The main elements which provide precise positioning of each TILECAL module are 2 cm thick endplates. The position of sandwich-like structure of a module itself may vary within allowed tolerance, but this should not be the case for the endplates in order to be able to assemble the whole device. The best way to do it is to produce each 64 endplates set from a single steel plate 8.4 m in diameter. This plate may be composed of a few pieces. After mechanical treatment all the holes for the connections to submodules and to the girder are drilled as well as 60 mm in diameter holes for the pins to be used for the precise modules positioning. Then the plate is cut for 64 endplates leaving 5 mm gap inbetween them. Each endplate should be labeled, so it's position in azimuth is fixed (Fig. 3). There is no need in very precise cutting of the plate since the precision in relative position of the modules will be determined by those pins and hole diameters. In this case there will be no tolerancies accumulation and with standard technique one can easely achieve overall non circularity not exceeding fractions of a millimeter.

An individual Barrel module is not rigid enough to provide in a safe way all kind of manipulations with it during the Barrel assembly. The minimal "unit" for the assembly is 2 or 3 modules joined together. Such pre-preassembling should be done with a special jig of Fig. 4. Unavoidable upper module deformation can be cured by hydraulic jacks with subsequent putting proper shims in place with their fastening by welding (Fig. 5). This operation should be performed at inner and outer radii of a modules over all their length in order to fix the gap, if any, between modules. Positioning pins do not serve to accept all the load of the calorimeters during and after assembling. Their role is just positioning, all the load forces are applied to the shims at inner and outer radii. Additional fixing plates put temporarily over the pins will improve modules rigidity during preassembly operations.

The joint of the modules (Fig. 6) is done at inner and outer radii. See Figs. 7-8 for the details. Two millimeter stainless steel plate glued at inner radius can withstand 158 t for tension and 23 t for compression forces which is at least 2 times more then required. Service plates will be taken out at final stages of assembling. Finally the brackets are bolted to endplates at inner and outer radii of pair or triades of modules to allow crane manipulations, Fig. 9.

To minimize underground work, the calorimeter assembly should be done from preassembled supermodules (up to 8 single modules). With the weight not exceeding 180 ton, they will be strengthened over their inner radius to allow better and safe manipulations (Fig. 10). These strengthening plates will be taken out after the whole calorimeter assembly.

This assembly phase will require special manipulation equipment like rotating tools and chassis. The rotating tool provides final orientation in azimuuth while downloading, and the chassis only a fine tunning with short range hydraulic jacks during underground assembly. The assembly sequence is depicted in Figs. 11-13.

Taking into account limited space available for the assembly, the beam is used together with brackets for chassis manipulations.

The final calorimeter assembly in the pit is a very delicate operation. For the first supermodule installation special service stop may be requied. It's aim is to provide more easy positioning of the first supermodule (Fig. 14).

Two bottom supermodules are bolted to the calorimeter suppports (Figs. 14-15).

After the calorimeter bottom part is assembled, the LAr cryostat and calorimeter are installed, including all cryogenic services and feedthroughs (Fig. 16). Finally, the second half of the tile calorimeter is put in place (Fig. 17).

During TILECAL supermodules assembly, carefull measurements of their position should be done and in the case of deviations extra shims should be put. It seems reasonable before LAr calorimeter downloading put some equivalent load on TILECAL's support and check deformations arised. After the whole calorimeter assembly will be finished, extra supporting plates of Fig. 10 will be taken away. TILECAL Cylinder is self-supporting and the links between modules are created externally on the girder. The contact between adjacent modules is made at inner and outer radii using localised bearing surfaces. The design gap between wedges is less then 1 mm. The resulting cylinder will rest on feet placed every 50 cm and sitting on rails. The Extended Barrels will be mouvable by means of a remote control for fast and easy access to the LAr calorimeter and to the inner detector. Strength calculations for the whole structure show that the maximum value of displacements is about 2 mm at the top of the barrel. Stresses are reasonably small and never reach a value of 120 Mpa, which represents 60% of the allowable value of material stresses.

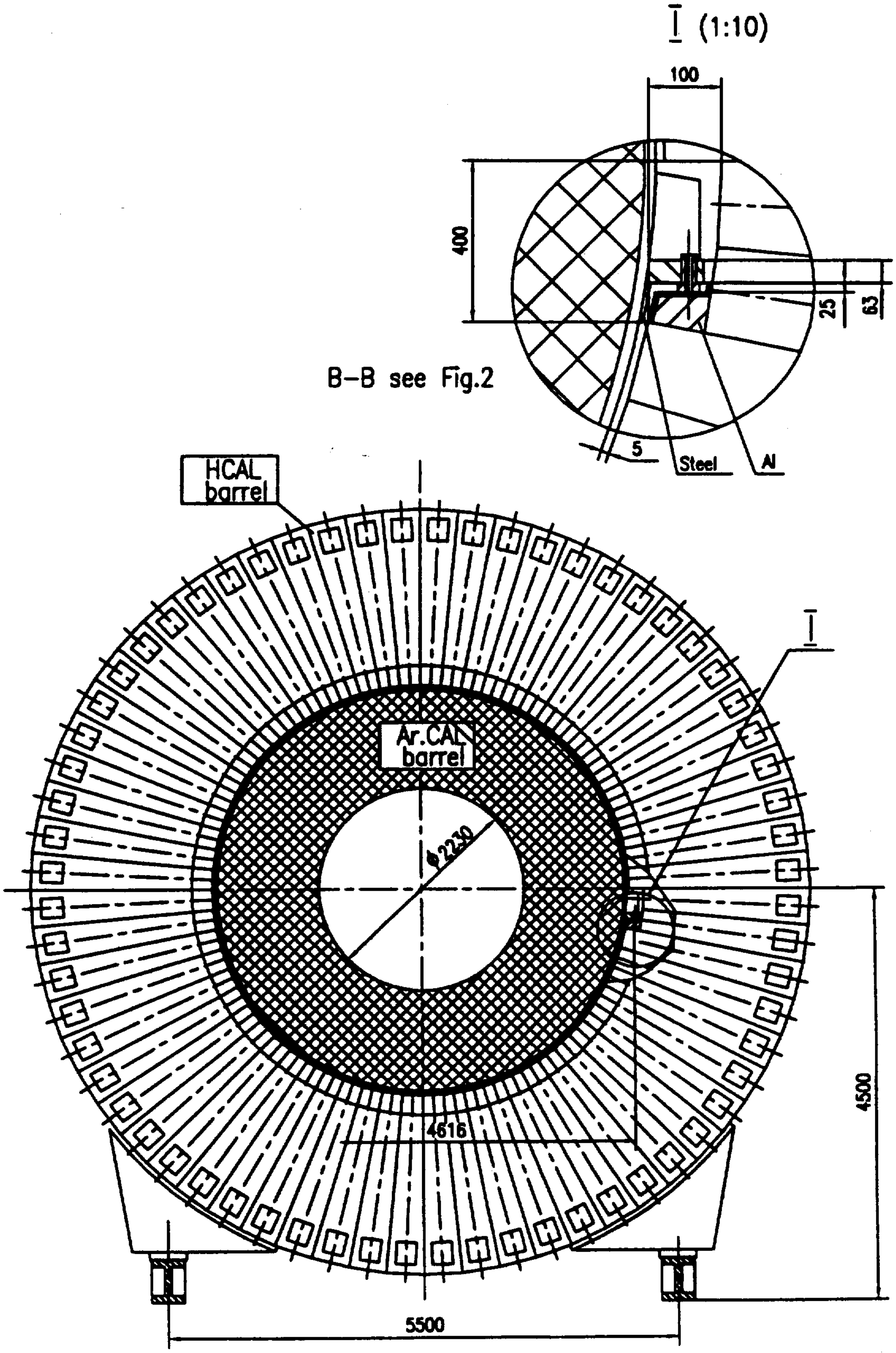


Figure 2: Support for LAr calorimeter

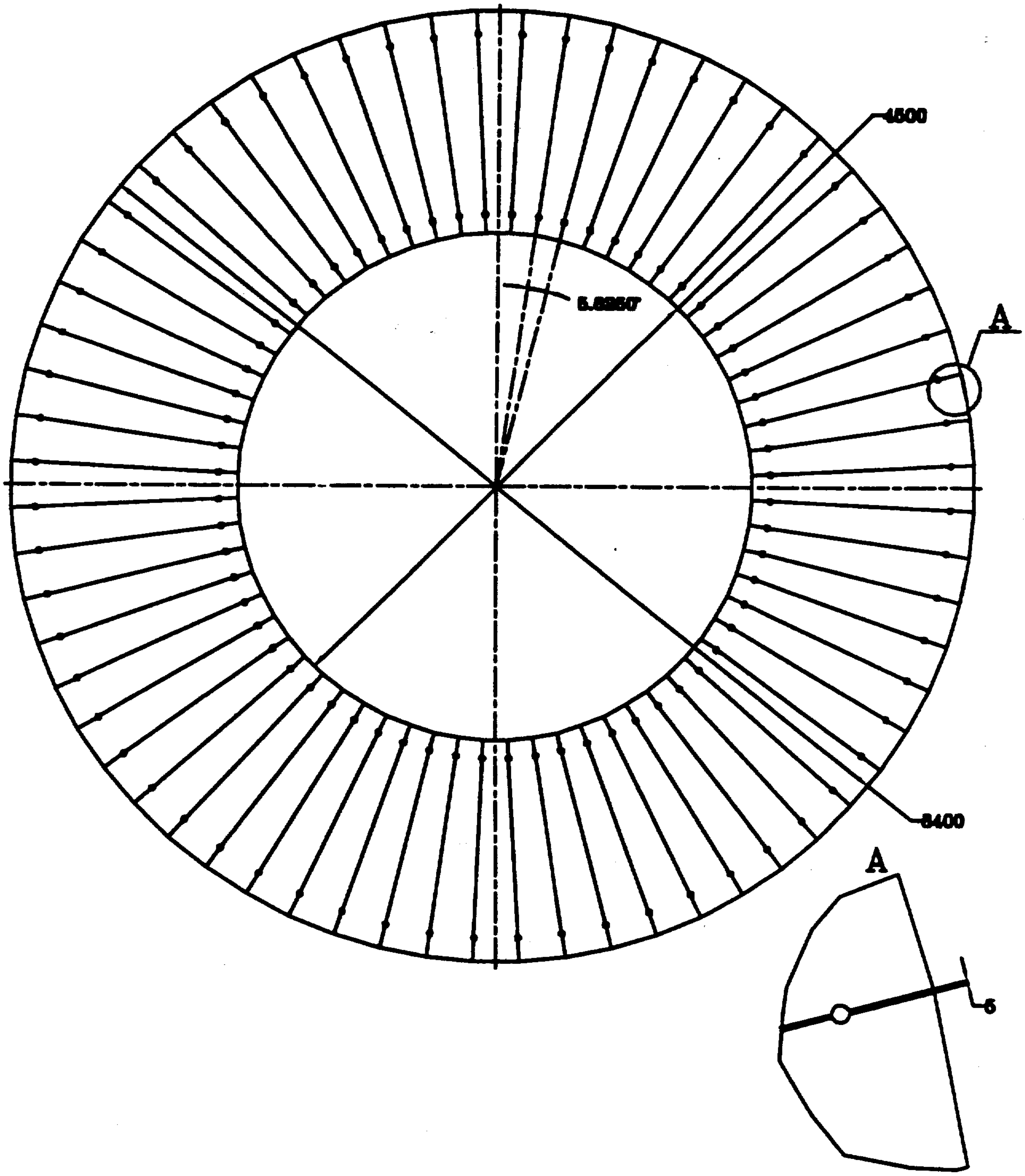


Figure 3: TILECAL endplates fabrication

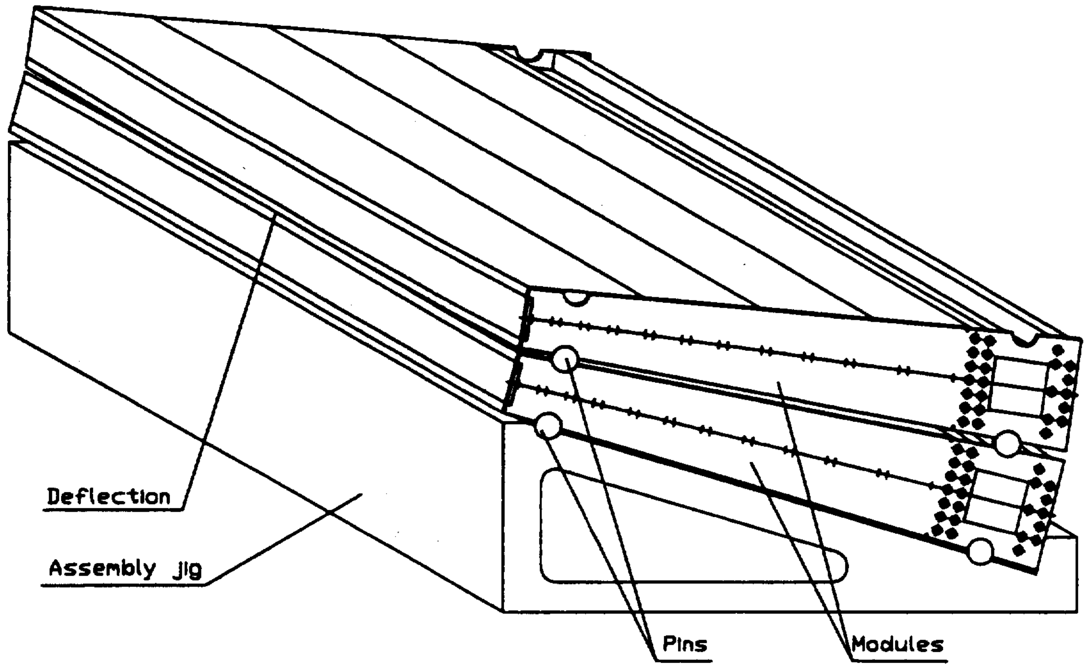


Figure 4: Two modules positioning on the jig

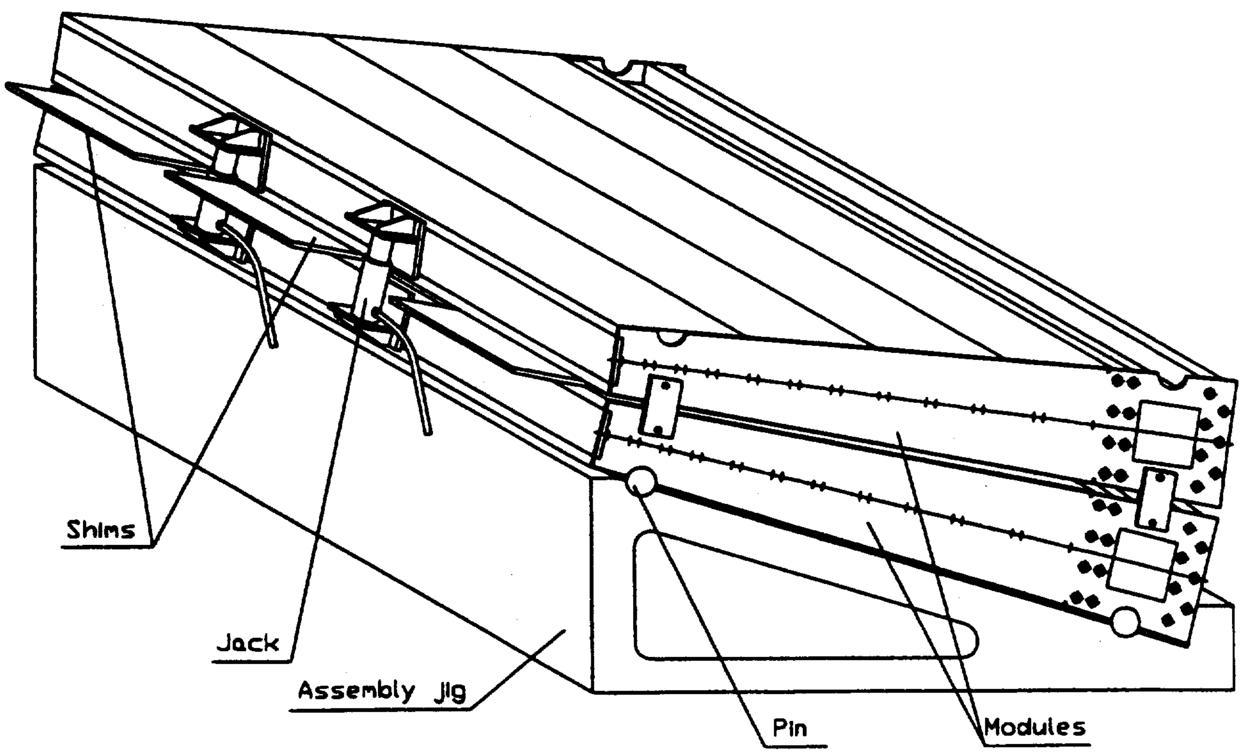


Figure 5: Correction for upper module deformation

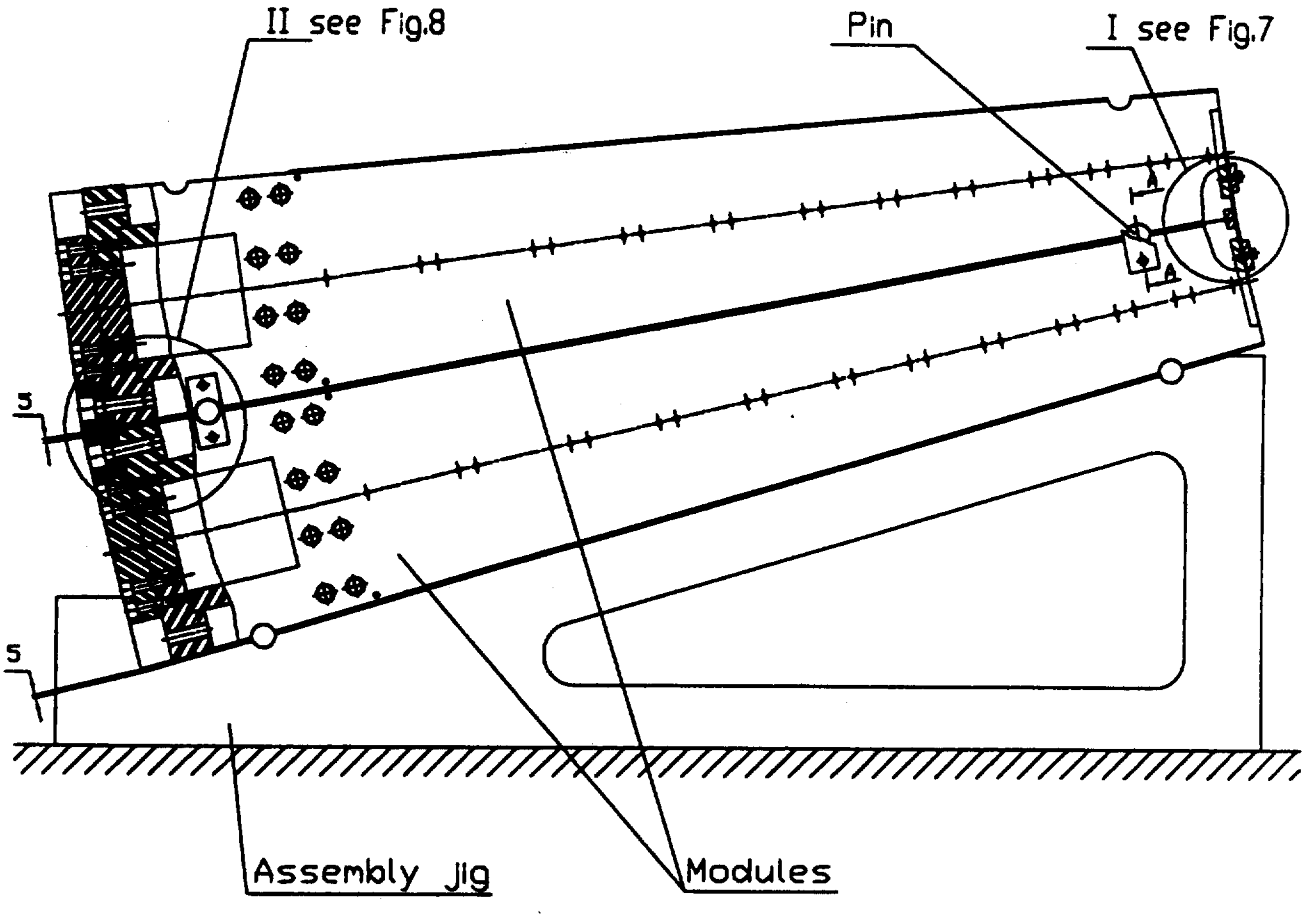


Figure 6: Two modules joint at inner and outer radii

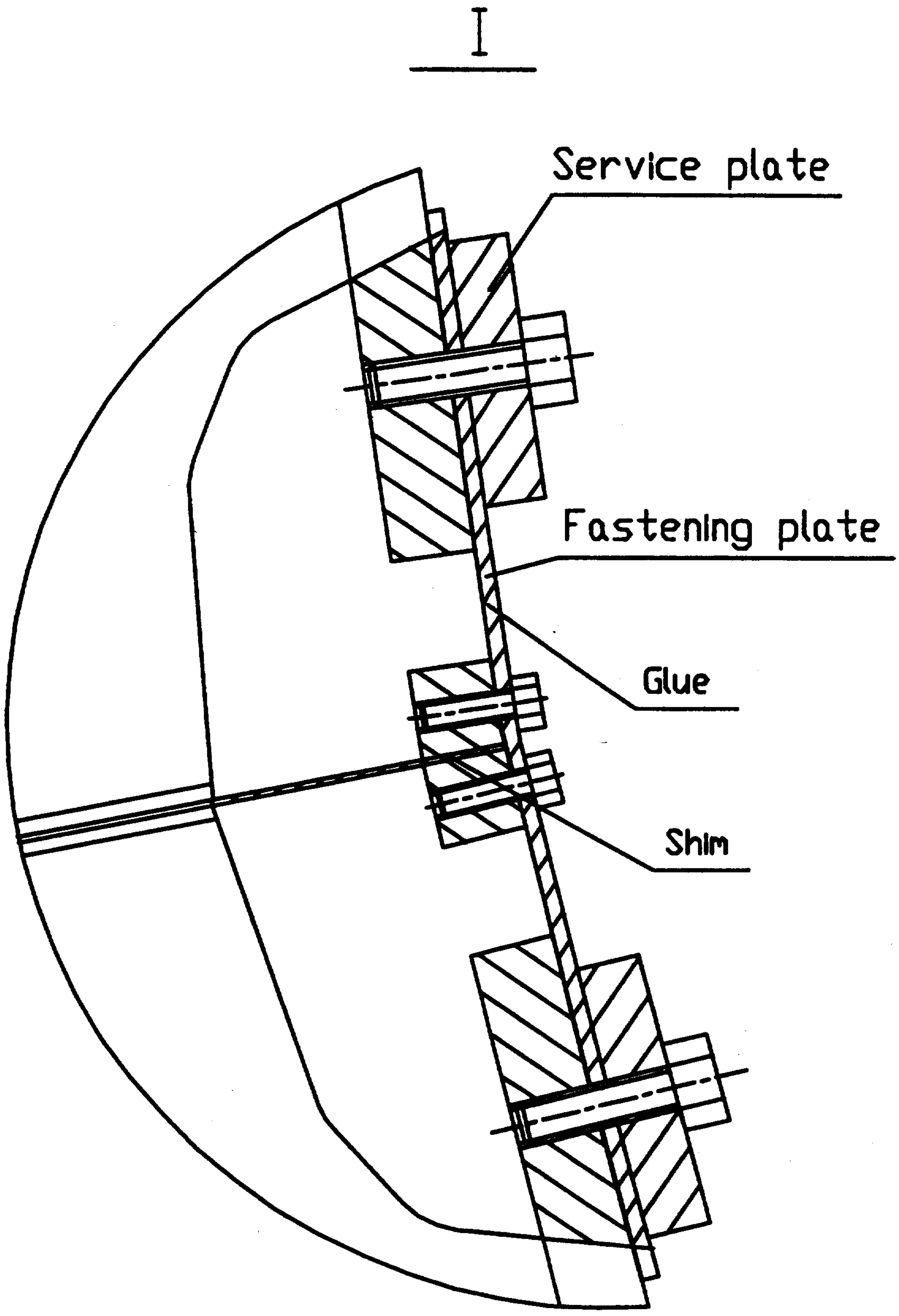


Figure 7: Detailed view at outer radius joint

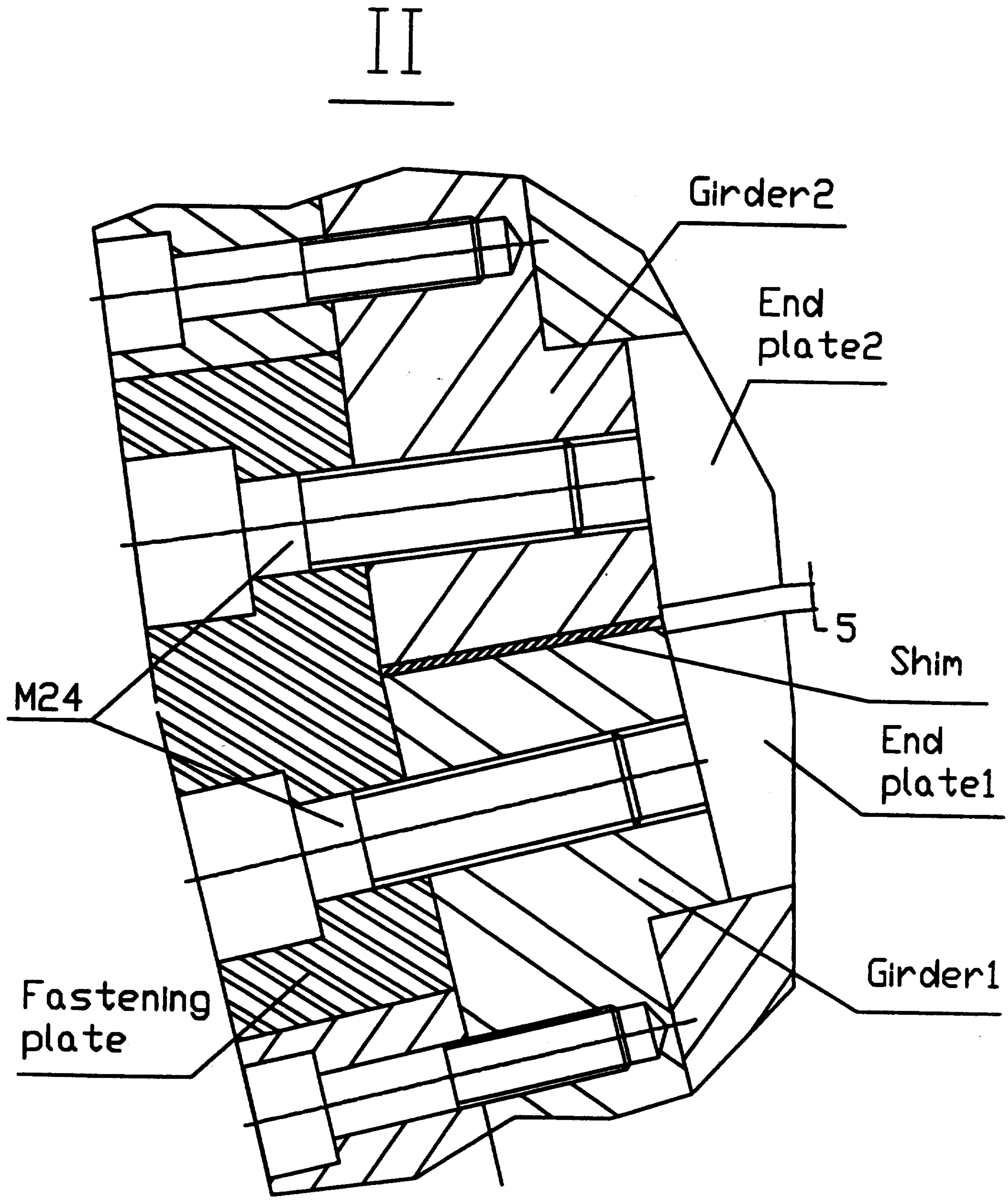


Figure 8: Detailed view at inner radius joint

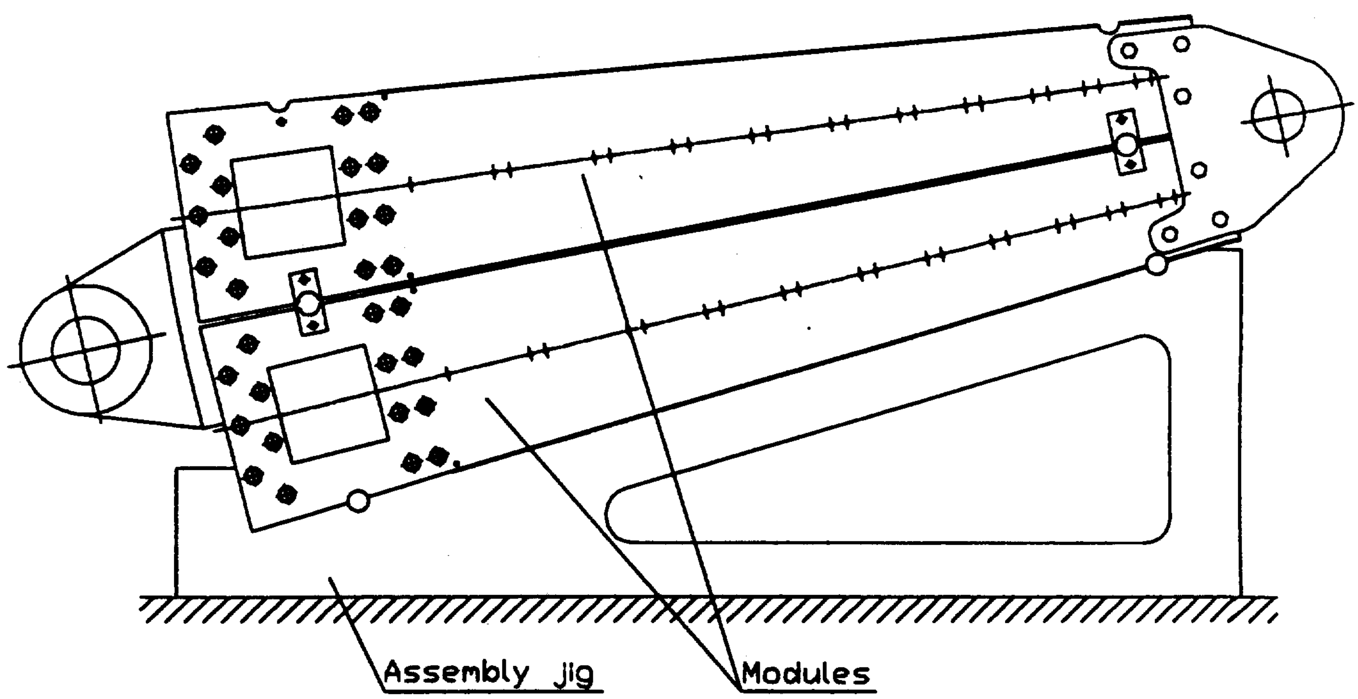


Figure 9: Brackets bolting

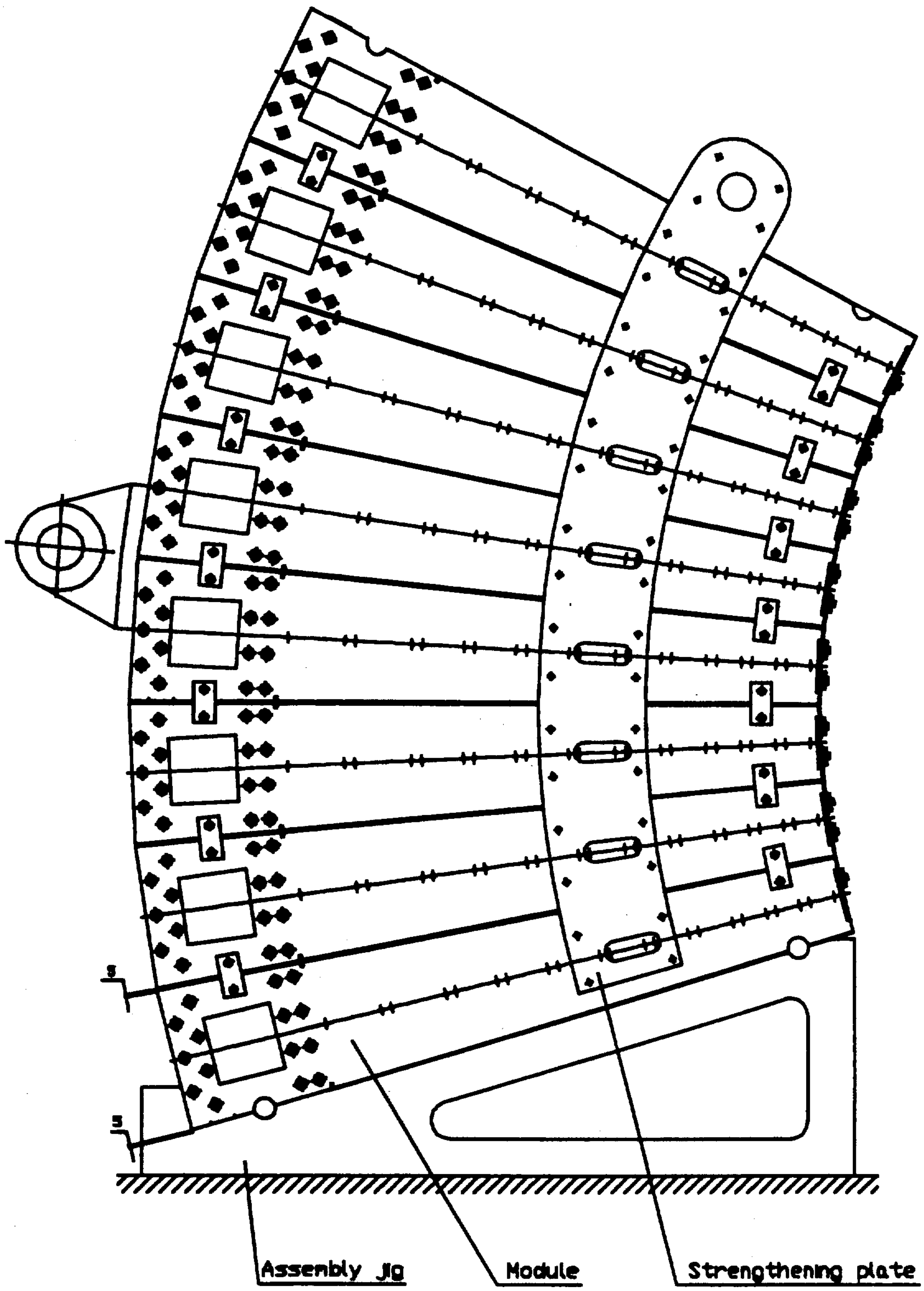


Figure 10: Supermodule on the jig

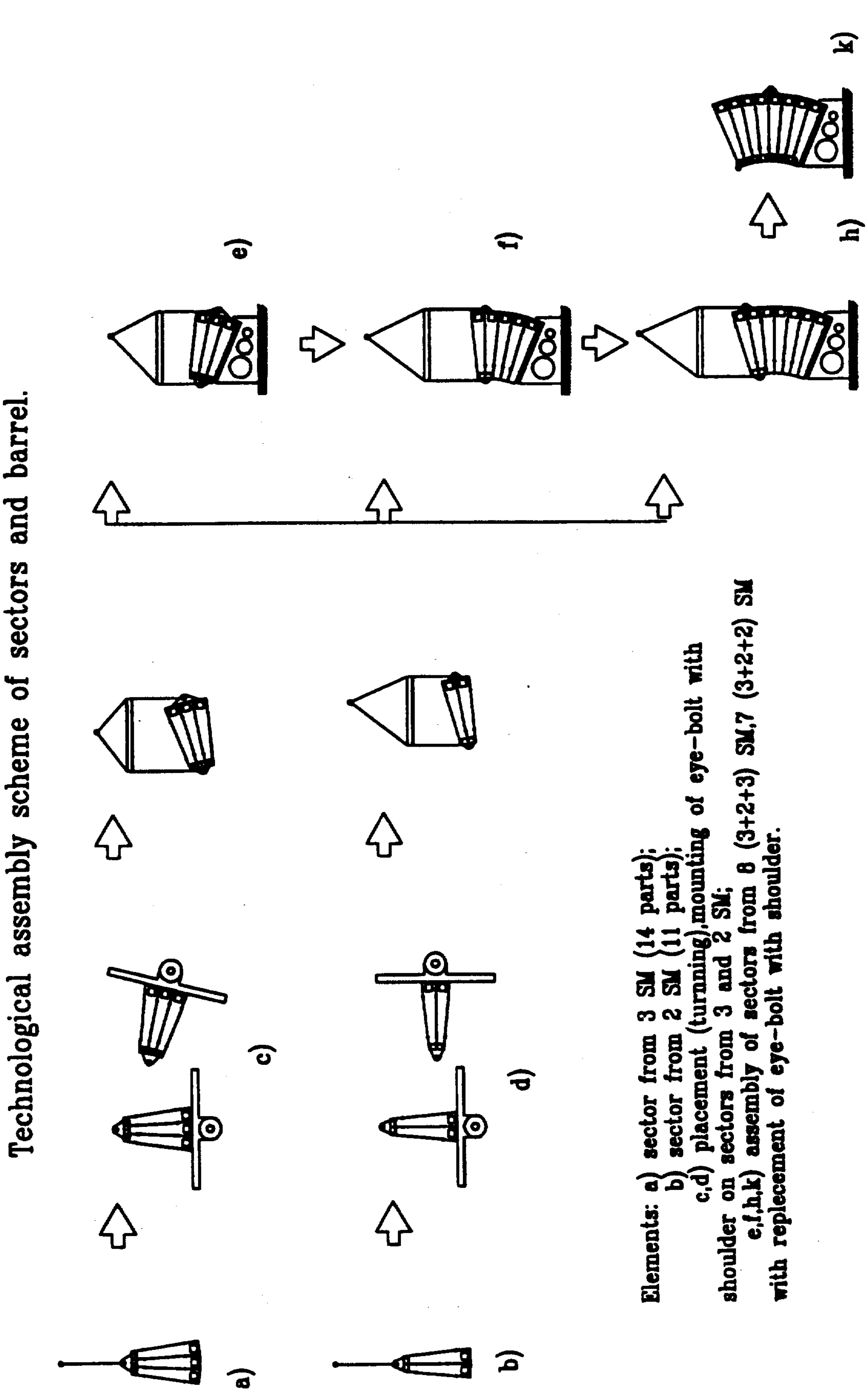
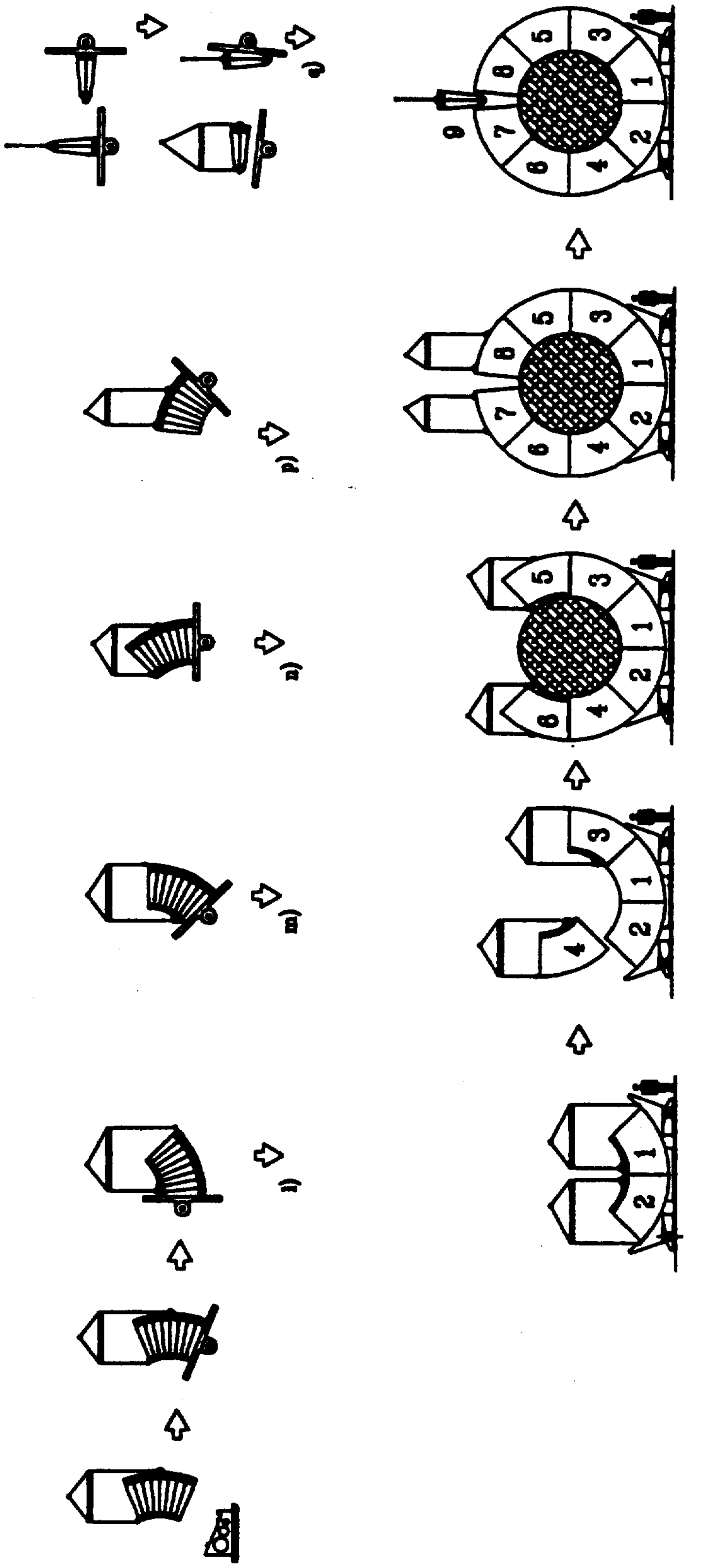


Figure 11: Supermodule assembling



l,m,n) placement (turning),replacement of eye-bolt with shoulder,
assembly of sectors from 8 SM (1,2,3,4,5,6)with mounting of Ar-calorimeter;
p,q) placement (turning),replacement of eye-bolt with shoulder,
assembly of sectors from 7 SM (7,8),from 2 SM (9).

Figure 12: Calorimeter assembly from supermodules

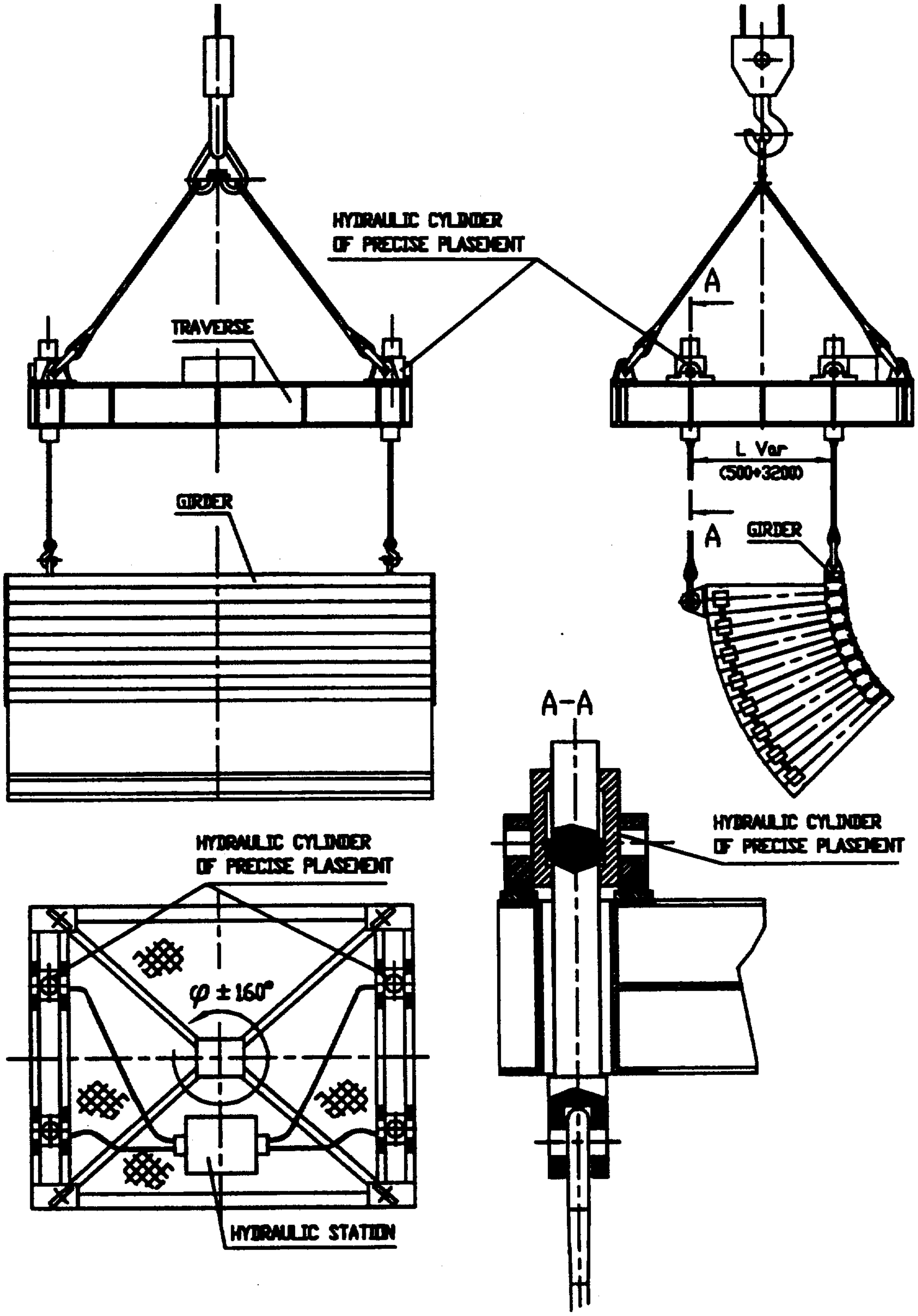


Figure 13: Traverse for assembly work

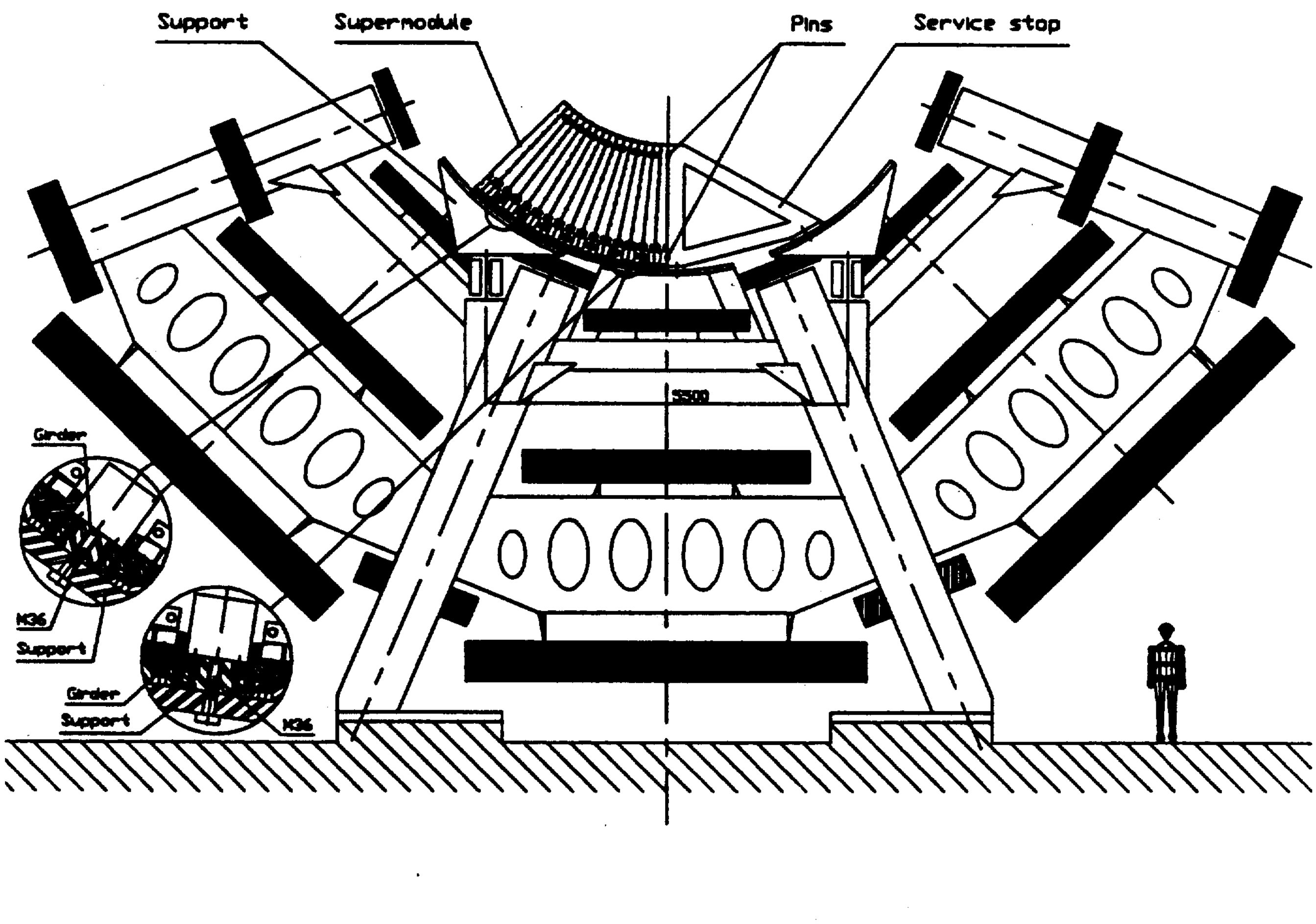


Figure 14: First TILECAL supermodule assembly in the pit

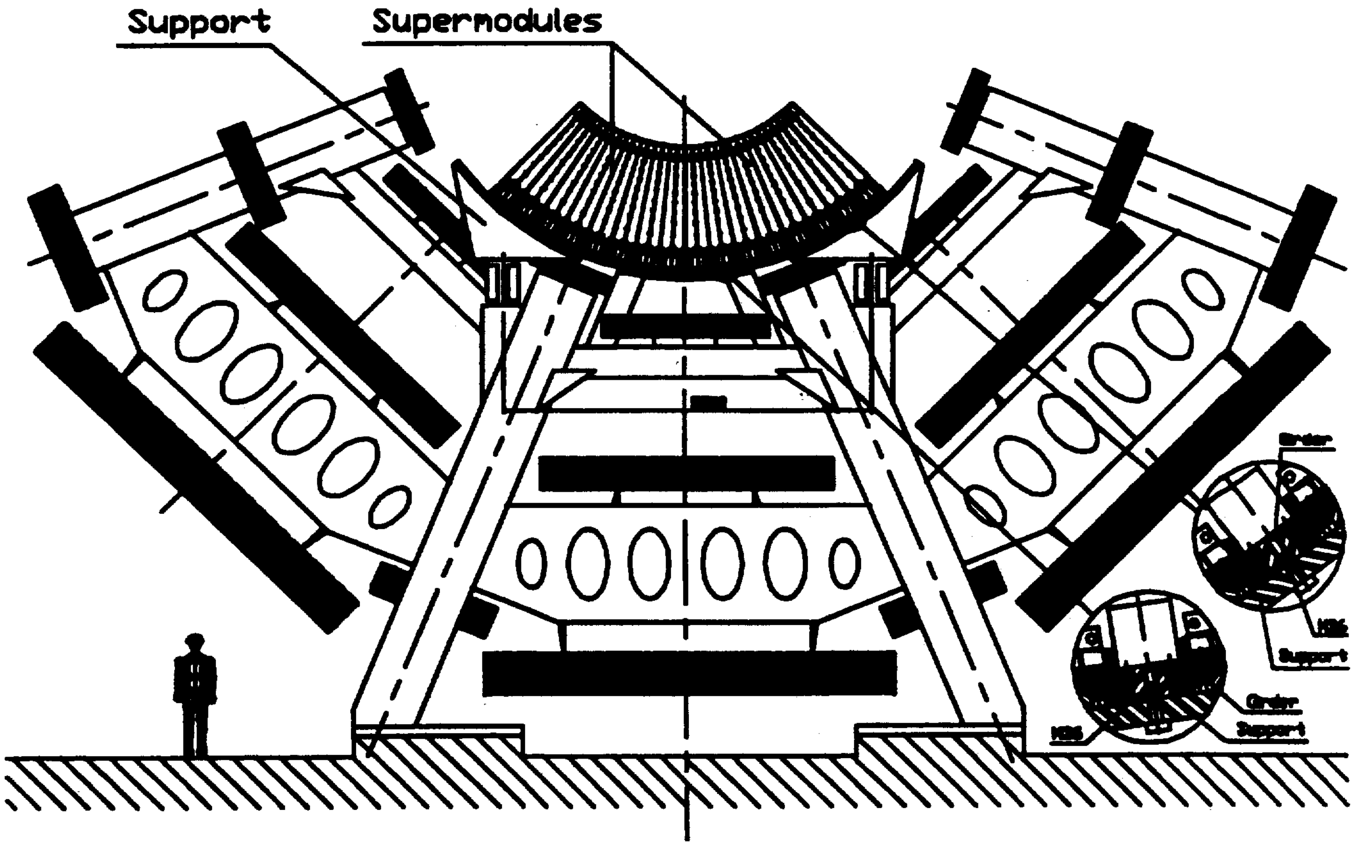


Figure 15: Two bottom supermodules fixation

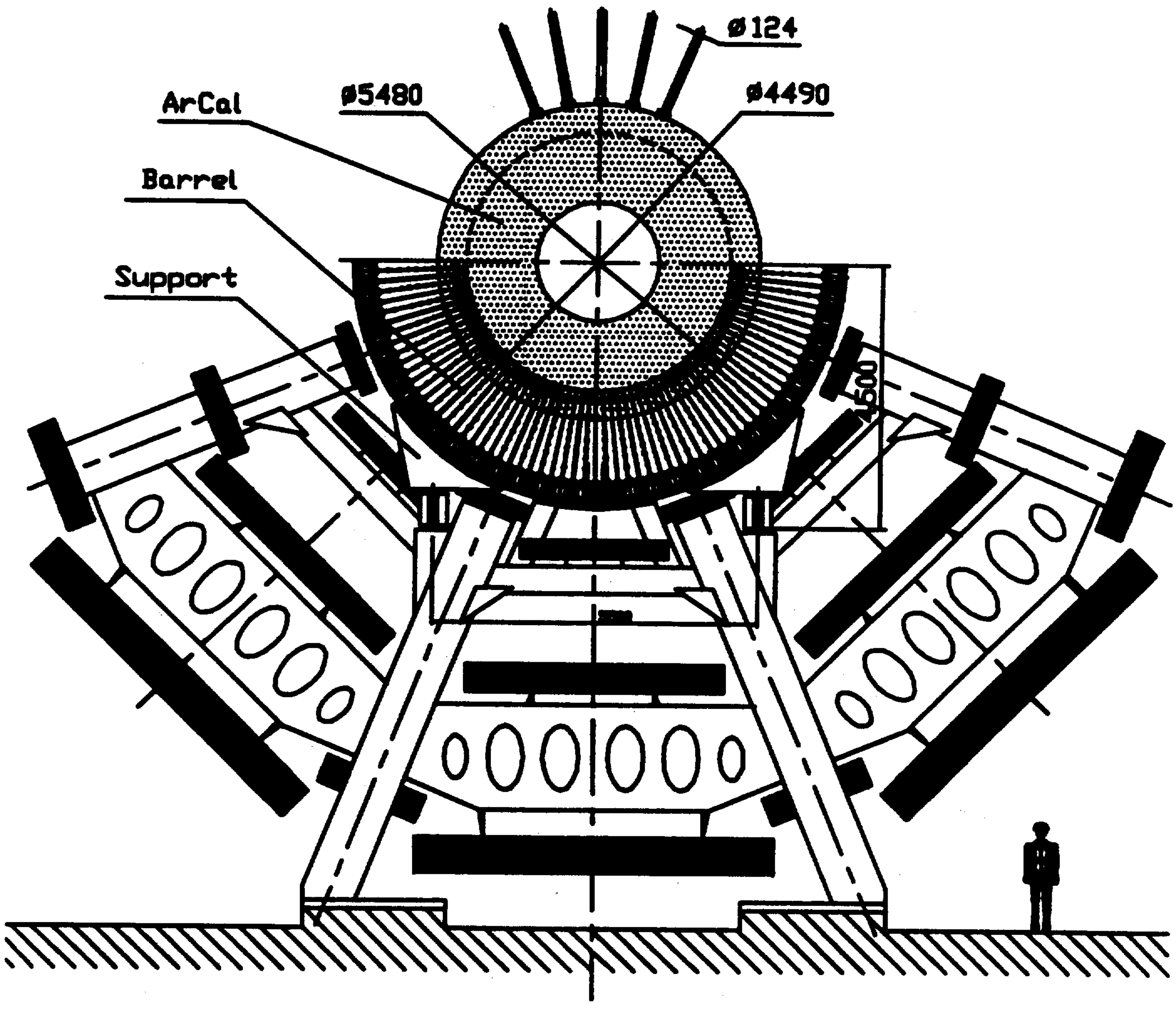


Figure 16: LAr calorimeter installation

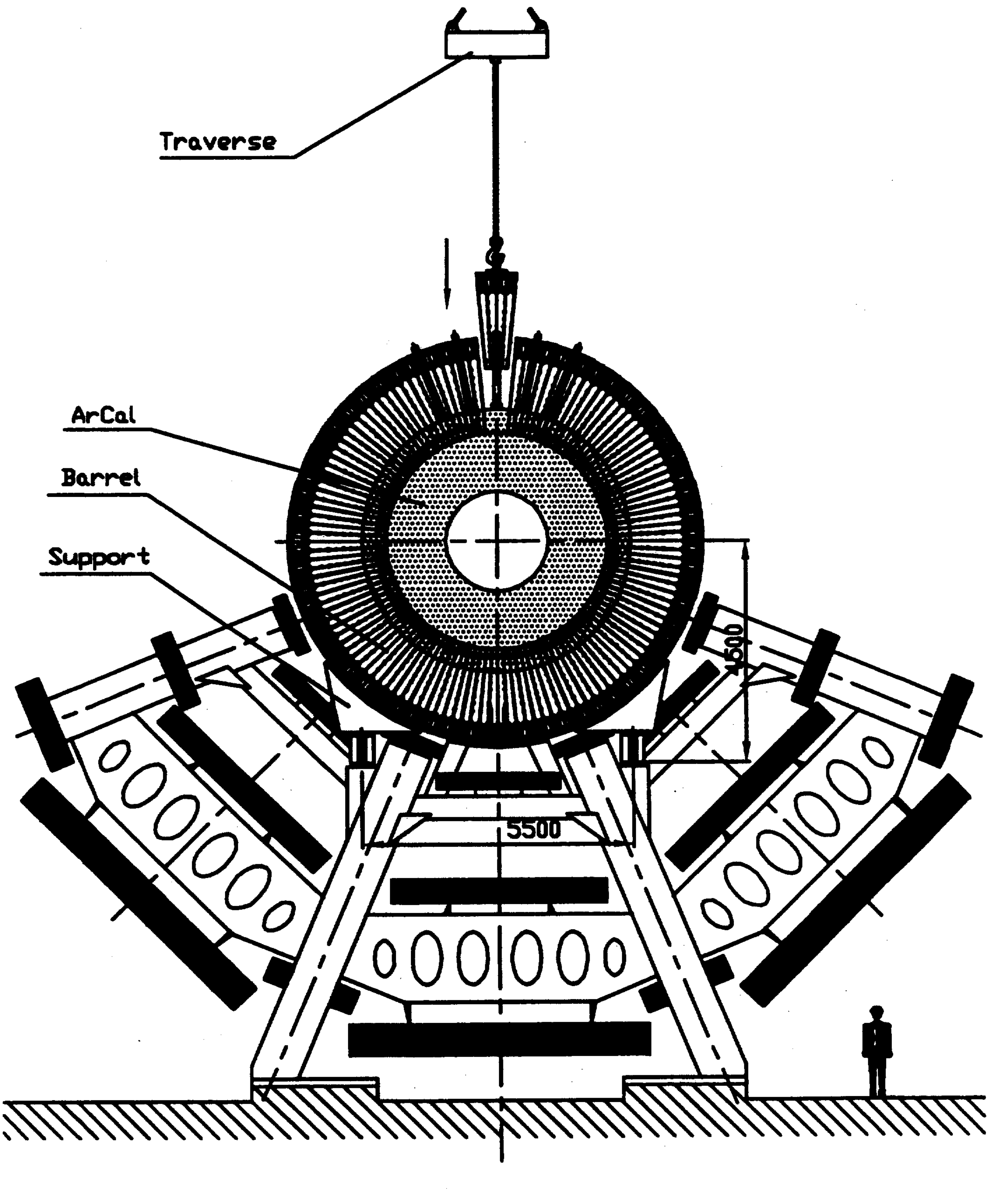


Figure 17: TILECAL final assembly