INSTITUTE OF BUILDING DESIGN

Report no. **110**

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RECENT DANISH FACADE JOINT DESIGN

Den polytekniske Læreanstalt, Danmarks tekniske Højskole
Technical University of Denmark. DK-2800 Lyngby 1975

PREFACE

This report is a reprint of a paper presented on the third meeting of the CIB Working Commission W61: "Joints in Exterior Walls" held in Copenhagen in November 1975.

SUMMARY

This report deals with joints in concrete facades in Denmark, mainly the two-stage versions, which is the result of a semiofficial typifying

RESUMÉ

Denne rapport omhandler danske fugeløsninger i betonfacader, hovedsagelig en serie 2-trinsløsninger, som er resultatet af en halvofficiel typisering.

RECENT DANISH FACADE JOINT DESIGN

By

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Concrete has become a widely used material for facades in industrialized building in Denmark.

In most cases, the joints between the facade components are designed as two-stage joints with a rain-screen at the outside, a windtightning member at the inside, and a ventilated and drained cavity in between. The two-stage joint, in a number of slightly varying versions, has proved very successful as a facade joint in a wide variety of buildings.

The BPS-Design

Under the BPS-programme, which is a plan for the development (creation, coordination and standardization) of a new industrial building practice, a project group has been working on the typifying of the many different versions of this joint, which, although they differ from each other, do so only on points that are of no significance at all to the modus operandi of the joint. Here, it was obvious that rationalization would mean a saving in design and production.

The BPS-organization has been established on the informal and voluntary initiative of sections of the Danish building industry - primarily by consulting engineers, architects and research institutes - but manufacturers, contractors and public building departments are now also participating in the programme.

"BPS" is short for "Building Planning Systematics".

An analysis of material collected on normal connections, interior wall/facade connections, roof/facade connections, foundation/facade connections, etc., indicated that three versions of the vertical joint and two locations of the horizontal joint would be able to cover the majority of the designs encountered in practice.

The result of this semiofficial typifying, which covers recognized legitimate solutions that satisfy the normal, functional requirements, is as follows:

The horizontal joint, designed as a joint that is open at the outside, where the upper component overlaps the lower component. Two heights of overlap are recommended.

the vertical joint, designed with a rain-screen (baffle) in front of a cavity, which is drained and ventilated via the open, horizontal joint, and which lies in front of a windproofing material. Three designs are recommended, all comprising an almost watertight baffle plus a means of drainage behind, viz:

a. a neoprene strip in grooves plus a "washboard" (i.e. inclined grooves leading the water down, outwards,
b. a neoprene strip in grooves plus vertical grooves for drainage,
c. an extruded neoprene profile with fins and cavities combining the baffle and the drain.

The windtightning member consists of a solid plugging of mineral wool plus mortar or concrete-grouting.

These designs give absolute watertight facade joints as proved by experiments and extensive use in practice for 15 years, provided that also the cross between horizontal and vertical joints is solved properly. (Attention is drawn to the effect of high winds, especially near corners etc., transporting water on ledges in the horizontal joint, and to the importance of the windtightness where horizontal and vertical windtightning members cross.)

Horizontal Joints

1.

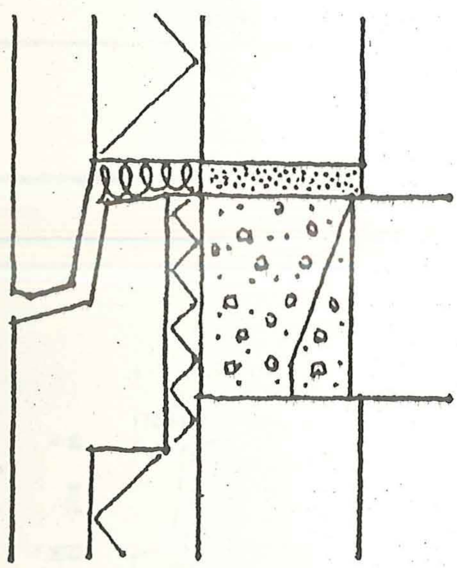


Figure 1 shows a horizontal joint with a location of the exterior joint corresponding to the minimum overlap required in the joint to make the joint watertight.

2.

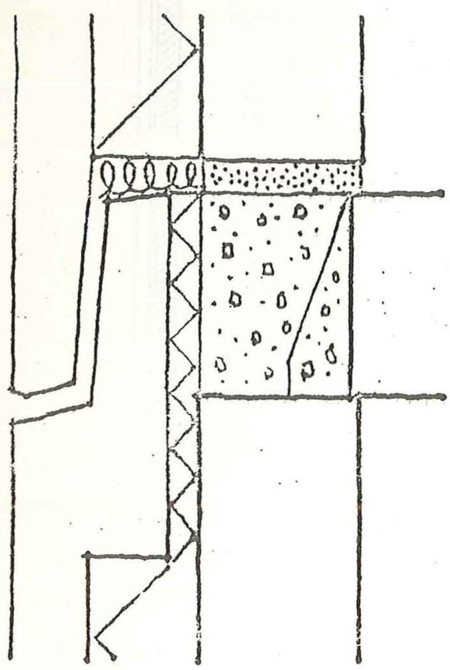
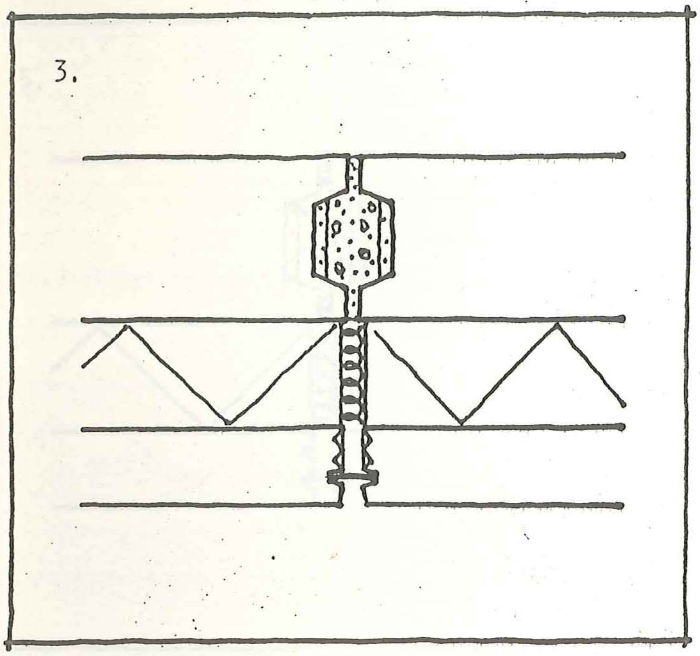


Figure 2 shows a horizontal joint with the exterior joint located at the level of the bottom of a 185 mm standard floor component.

This location is very common and corresponds to the usual location of the horizontal joint in a lightweight facade (in many cases you have concrete in the short exterior walls (gables) and lightweight exterior in the longitudinal walls (facades)). Also, this location may be decided upon from an aesthetical viewpoint, i.e. the lower edge of the facade component corresponds to the lower edge of a balcony parapet.

3.



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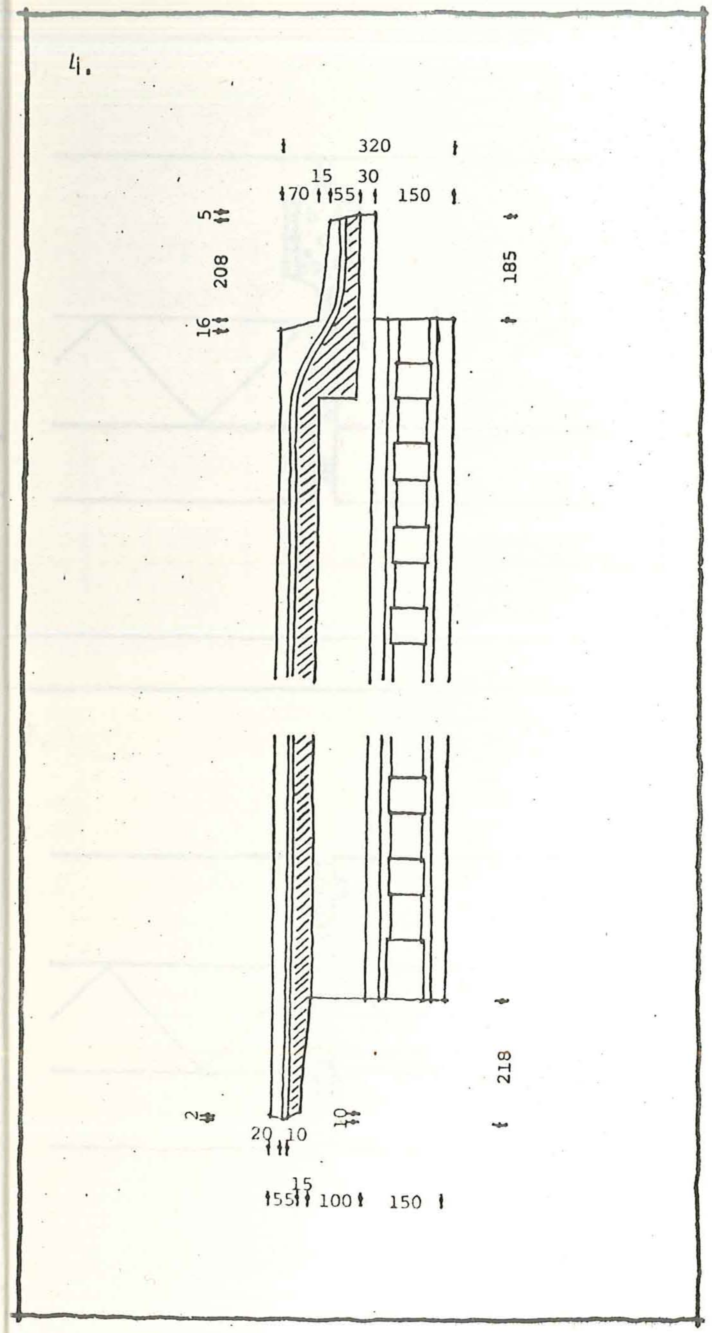


Ordinary, Vertical Joint

Figure 3 shows an ordinary, vertical joint between two facade components. Here, the joint is designed with neoprene baffle, with washboard behind to lead out any water that may pass the baffle.

The washboard offers the big advantage that its efficiency is not greatly affected by minor casting faults.

Figure 4 shows the normal component edge that corresponds to the normal, vertical joint.

5.

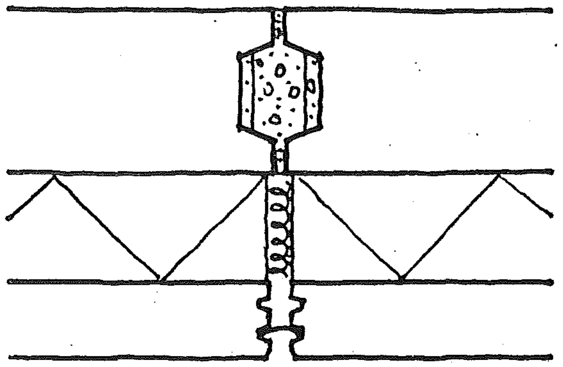


Figure 5 shows the second design of the ordinary, vertical joint; here, the washboard is replaced by an extra groove (draining groove), which stops any water seeping through the baffle.

The principle is known fron joints in lightweight wood-framed facades.

The solution is more sensitive to minor casting faults, but on the other hand, manufacturers assert that this profiling is easier to make.

6.

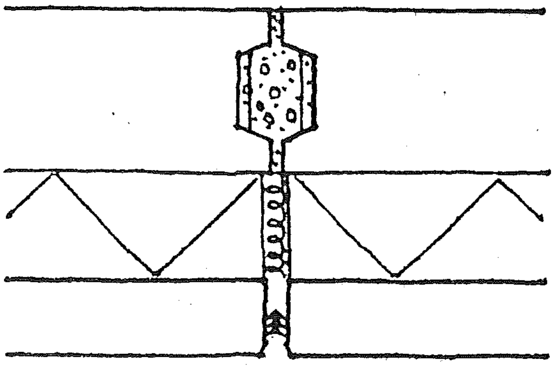


Figure 6 shows the third design of the normal vertical joint. Here, an extruded neoprene profile with fins is used, so all that is necessary is that the edge of the component is plane (smooth).

On the other hand, it is absolutely essential that it is plane so that rainwater does not seep through at points where projections in the concrete surface or casting faults prevent the fins of the special profile from sealing properly against the concrete.

7.

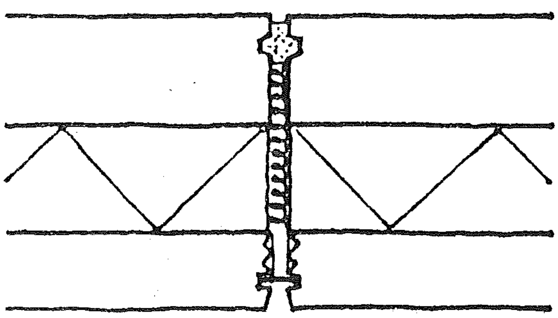


Figure 7 shows another joint solution in the interior layer, viz. grouting with mortar instead of casting.

This solution can be used when the edges of the elements in the joints do not have to transmit forces.

Corners

Corner connections are designed on the same lines as the normal connection.

8.

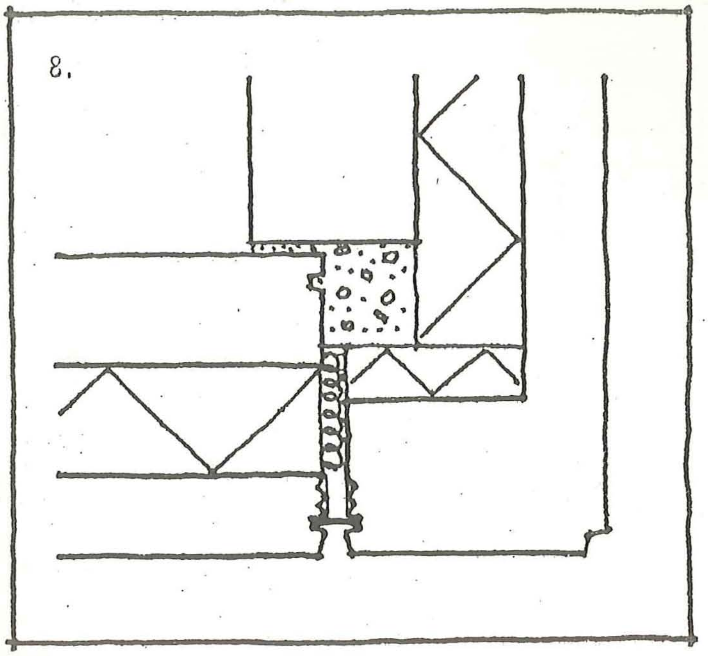


Figure 8 shows the outwards corner. Here, it is shown with a washboard. It should be noted that the joint is placed and designed in such a way that all the special details are concentrated in one component, the corner component, whereby the other component can be a normal facade component.

9.

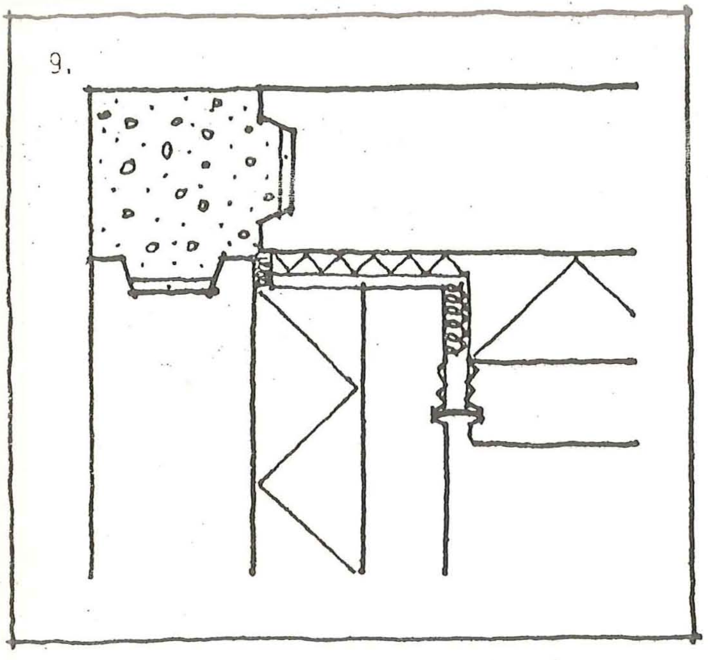


Figure 9 shows the inwards corner. Here, both components are special components.

A Special Design

Following this description of the BPS-solutions, we will take a look at an example of a special facade joint, which, although differing in design, is still a two-stage joint. We can call it the 45^{o}-solution; it comes from a recent Danish system, "Terraform", and a patent has been applied for.

The Terraform building system is a system based on columns and intermediate walls and facades. One of the advantages of the system is that it is suitable for buildings with many corners because the corner solutions are, so to speak, constructed using normal facade components.

10.

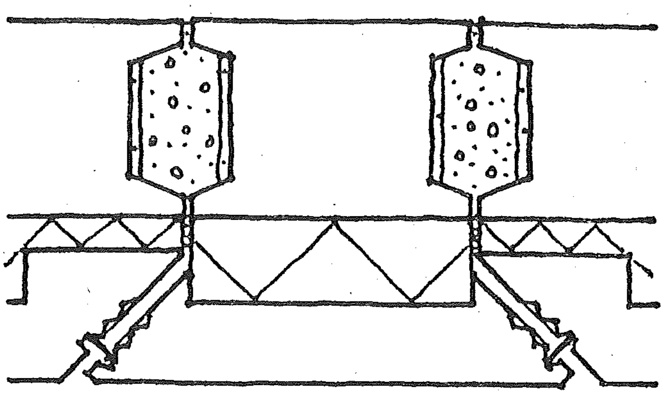


Figure 10 shows the ordinary, vertical joint between a column and two facade components.

11.

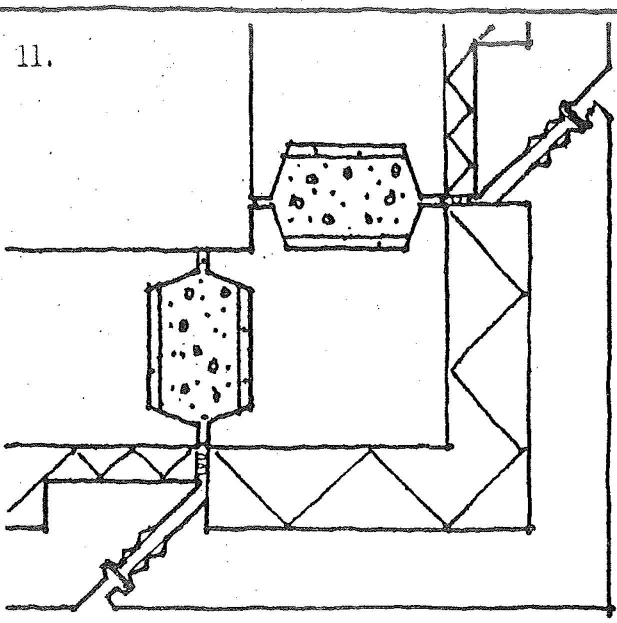


Figure 11 shows the outwards corner.

12.

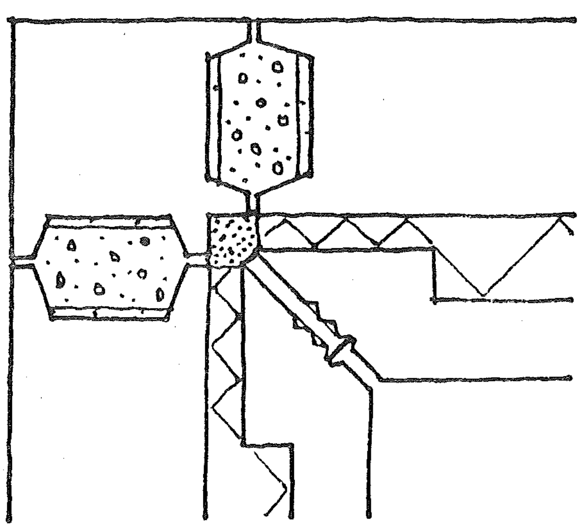


Figure 12 shows the inwards corner.

Strip Material

In the joints shown here, an artifical rubber (neoprene) is used as baffle - for the flat strip as well as for the extruded strip profile with fins.

In principle, however, any material that satisfies the functional requirements can be used, for example, sheet metal, aluminium or wood. Even some type of mortar will give a satisfactory solution under certain local conditions, as a washboard behind a somewhat leaking baffle will lead the water out.

Normal and Border Joints

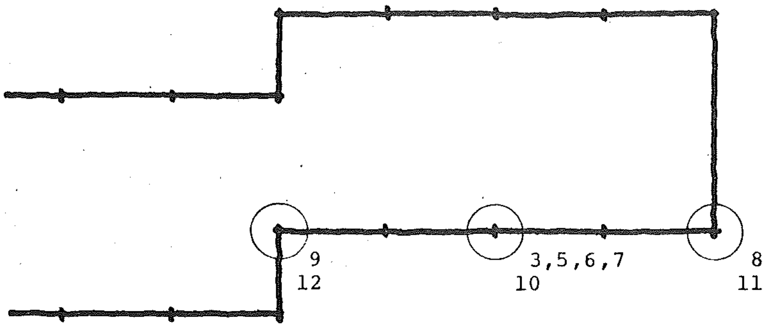
Here, only joints in a normal storey in a multistorey building have been shown, even though there are special variants at roof, basement, foundation, etc.. This has been done in order to focus attention on the principles of the joint solutions.

However, - in order to avoid unpleasant surprises at the various adjacent building components - it is important, when designing a normal joint, to bear in mind the conditions at the edge - and the cross between horizontal and vertical joints, as mentioned earlier.

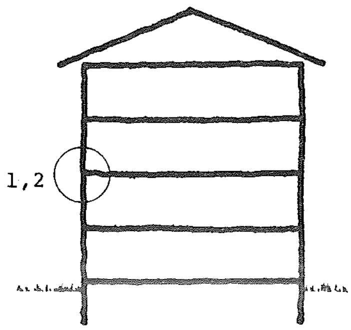
In the first instance, the BPS-typifying of joints in concrete facades covers only joints in a normal storey. During its work, the project group has been presented with various solutions at roof, basement, etc., but has found it best to publish joints for normal storeys first. Here, a very few standard designs could be achieved relatively quickly, whereas there are so many solutions for "abnormal" joints that it would not be easy to obtain a reasonable small number of standard solutions.

Furthermore, one should notice that the "abnormal" joints could be designed by using normal facade components and concentrating all the special details in the adjacent building components.

Locations of details.



Plan



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