Evidence for a logical sequence of Roof Types on Maya Buildings at Piedras Negras

The Maya Indians were the most southeasterly of several groups of great builders in what is now Mexico and Guatemala. Their unique contributions to Middle American architecture were all-masonry roofs and great ornamental towers rising from the roofs. The history of their development is an important problem for Maya archeology. Both first appear in the lowland region south of Yucatan, that is, in the ruins of the so-called "Old Empire" of the Maya.

Slide 1

The earliest lowland temples were surely roofed with thatch. Leaves or grass were laid like shingles on light wooden frames, as shown in the slide. These were given the necessary slope by wooden grusses. The latter did not rest on the walls, if walls were present, but on beams spanning the intervals between posts.

Slide 2

Late New Empire architects of northern Yucatan could choose between two other roof-types: all-masonry vaults, and masonry supported on wooden beams. In both, the upper surfaces are given very slight slopes and in general effect are flat. A thin plaster skin, polished to make it water-proof, rests on a thick sheet of masonry, usually concrete. In vaulted buildings this sheet rests on masonry corbels sloping inward and upward from the tops of masonry walls, as in Fig. 1 of the slide. In beam-roof buildings this sheet rests on closely-placed parallel poles supported by wooden beams, as in Fig. 2.

Both of these advanced roof types were entirely free from damage by wind; the beam roof was comparatively, the vault roof absolutely rot and fire-proof. The beam roof, if less permanent, possessed certain advantages. It was lighter and cheaper to build and did not exert outward pressure or thrusts on the tops of the walls, as do vaults. It could be used to span a much wider room.

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The question under consideration is whether the Maya adopted the beam roof as a substitute for thatch before they began placing corbels on the free-standing walls of buildings. The principle of corbeling may have been borrowed or invented for roofing subteranean burial chambers in very early times. In such chambers solution of the problem of meeting the outward thrusts was easily solved. Neither do we know as yet when the beam roof idea first appeared in America. It seems the logical first step in the direction of permanancy, but empirical evidence is necessary. We need to know when each type first appeared in the Old Empire region. Since most important southern buildings have collapsed, we first need all possible criteria for deducing the roof type from the resulting mound of debris; or from the wall plan of the building, which usually survives, in part at least.

The First Second and Third Eldrige R. Johnson and subsequent expeditions of the University Museum, University of Pennsylvanai, have worked on the problem at Piedras Negras, Guatemala. This is an Old Empire site in the western part of the southern lowlands. The particular district is known as "Middle Usumacinta" because of its position on a river of that name. The seventh season of excavations was prosecuted with the aid of a grant from the American Philosophical Society. It provided us with new grounds for the previously held belief that the beam roof appeared here before the vault. We are, however, presenting evidence for a hypothesis, and not claiming that it is proved.

Slide (3) The slide shows a partly standing Piedras Negras vault.

In the Usumacinta district the vault facing stones are selected for thinness, the walls stones are not. If there is a fallen vault thin slabs occur in quantity on the floor, ~~as in Fig. 1 of this slide.~~ Wall ~~stones~~ debris usually falls outside, and contains few or no thin slabs.

Slide (4) Specialized cap-stones, of the sort here shown, were used to bridge the gap between the tops of the corbels, and appear in the room debris. Slide (5) The quantity of roof debris is much more than in non-vaulted ruins. ~~Fig. 2~~ The right photograph shows a cut through the debris of the non-vaulted temple No. R-1, to which we shall refer later, ~~compared with vault debris pictured on the left.~~ It illustrates the lack of slabs and the lesser quantity of debris, as compared with vault debris pictured on the left.

For reasons which we cannot detail here the walls stumps of vaulted buildings tend to better preservation at the base, but also tend to lean outward at the top. The mounds of non-vaulted buildings show ~~xxx~~ an absence of the various characteristics enumerated, so that fallen vaults can be distinguished with assurance. On the other hand, identification of roof type as between fallen beam and fallen thatch roofs appears in theory at least impossible except in special cases.

Both beam and thatch roofs, being supported on wooden members, should usually fall before the walls. The wood will quickly rot away. For a time in a beam ruin the roof concrete will underlie wall stones as they fall, and furnish a recognizable distinction. But in time the repeated uprooting of trees, growing close to floor level, will mix wall and roof debris and destroy the distinction. Failure to find beam roofs positively reported seems to mean nothing if we allow for the action of the forest through the centuries. Positive proof can be expected only in exceptional cases.

Such a case presented itself at Piedras Negras in 1931, when Dr. J. Alden Mason, who initiated the work, excavated a steam bath known as Structure P-7, ~~shown in the slide~~. Parts of vaults remained to normal height, with level tops. But the rooms were three meters seventy five centimeters meters wide, much greater than known Old Empire vault spans. In addition the very high vault necessary to complete the span would have left much more debris than was present. Cap stones were absent. To restore a thatch roof would render the corbels meaningless and produce a very strange facade since the medial molding characteritic of vaulted buildings was present. Dr. Mason concluded that, in order to span an exceptionally wide room, beams replaced the the usual cap-stones at the surviving corbel height, and that the cross-section was as shown ~~xxxx~~ in this slide at the lower right. The resulting facade does not differ from those of vaulted buildings. Proof that his deductions were correct was supplied later. In the debris, often on or near floor level, were fragments of a thin sheet of exceptionally hard plastered concrete, the stone being river gravel instead of the soluable crushed limestone used on and in the walls and vaults. These fragments, and river gravel in quantity, were found on the tops of the corbels, showing that a special type of plastered roof concrete was the source of the floor deposits.

Slide (6)

Mr. A. Ledyard Smith, for the Carnegie Institution of washingt excavating in the central part of the Old Empire area, known as the Peten, has since reported the beam roof there. My impression is that there, as here, the example found was built after vaulting was known. The proved distribution of beam roofs has thus been extended to the southern cities.

The Piedras Negras combination of vault and beam principles to meet a special need raises a certain presumption that beam roofs had already been known for some time. There is at present no reason to limit this time to something less than the first use of vaults. The now established antiquity of Mexican highland cultures provides a possible foreign source for the beam idea in pre-vault times. Or it could have first occurred to the Maya themselves. Masonry walls and plastered concrete sheets for floors occur in the sixth and earliest level of the Piedras Negras Acropolis. Five of these strata of building remains are shown in section at the lower left of the slide. In the fill forming the fourth level burned clay fragments preserve impressions of closely placed parallel poles, the reverse sides being smooth and plastered. These establish the early use of a pole fabric to support plastic material. A mere recombination of known principles and technics could produce the beam roof at any time after this early period. The clay fragments appear below the surface everywhere at the site, showing the frequency of fires. A strong motive for the invention was also present from early times.

Slide 7 In the ceremonial center of any Maya city temples and the buildings called palaces far outnumber other functional types, ~~and they~~ the temples are given the most imposing substructures, such as here shown. ~~Fourteen~~ Thirty-one temples and palaces have been examined for roof type, including all which showed sufficient debris for fallen vaults. Only nineteen, or 61 per cent, were vaulted. We include only those in use just before the time of general abandonment, which apparently was sudden. (Further excavation will almost certainly reduce the vaulted percentage considerably.)

Several lines of evidence, taken together indicate that all the vaulted roofs were built during a single final building period; and that this began at or near the end of an early period of dated monuments. These lines of evidence include (1) stratifications of earlier structures below all vaulted palaces and below the three temples sufficiently investigated to reveal them; (2) associations of middle to late dated monuments and of late pottery types with certain vaulted buildings; (3) a peculiar distribution of all vaults on the city plan: and ~~finally~~ (4), evidence for a steady advance in vault building technique, which implies that they were built in one general period.

On the other hand the distribution of the non-vaulted temples and palaces can be accounted for only by supposing them to be survivals from a pre-vault period. General and one specific association with monuments seem to carry them back to the beginning of the early monument period. The typical vaulted palace wall plan, which is somewhat complex, occurs in a non-vaulted palace also. In 1937 the more complex typical vaulted temple plan was also found to have existed among the non-vaulted temples. The assignment of these buildings to a period immediately preceding that of the vaulted ones seems inevitable. Some of the non-vaulted buildings are so massive as to suggest they were planned

for vaults which failed and were replaced with either beam or thatch roofs. If this be so, our relative dating is confirmed, if anything, since first attempts are often unsuccessful.

We have established the presence of the beam roof in vault times and also the need for it and the possibility of its invention or introduction in pre-vault times. An admitedly tentative and rebuttable line of reasoning now seems admisible to justify the correspondingly tentative conclusion that some of the~~xx~~ pre-vault temples were in fact roofed in this manner.

Slide ⑧ The slide shows, at the right, a Piedras Negras temple which was vaulted in its final phase at least. In the drawing the roof has been cut off to show the ground plan. All elements shown were found in position. This complex plan is ~~is the~~ typical at Piedras Negras and in the central Old Empire or Peten region, from which it was doubtless borrowed. Here no temples survive to full roof height, but in the Peten many are standing, and a plan and section of one of them is shown at the left. The high massive ~~xxxx~~ tower or comb provides an obvious function for the solid mass behind the temple chamber. This is the comb foundation.

Slide ⑨ This slide shows as fig. 1 a restored plan of a non-vaulted temple, No. R-1. The rear portion had largely disappeared but the indentation in the side of the foundation platform was positively identified. In the Peten, this indentation usually occurs in the building itself, as it does on one of our vaulted temples also. It is always placed about in the center of the side facade. In the Peten as here, wherever preservation permits knowledge, the temple extends to within a foot or so of the rear of its foundation platform. Therefore we must restore this temple with a front to rear depth approximately as shown.

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We were able to make out the sill at the rear of the room, and the position of certain fallen blocks, and of the altar, indicated the niche shown in the rear wall of the chamber. There was no rear room because, apart from these, wall blocks were absent behind the sill. We must therefore fill this area with ruble as in the well preserved vaulted temple of the last slide. This in turn has no meaning unless we restore a roof comb, as in Figs. 2 to 4. Figs. 2 and 3 represent attempts to roof the chamber with the steep slopes necessary for thatch. Neither seems convincing. The large rearward overhang in Fig. 2 could be eliminated in a manner shown for the next temple ~~to be shown~~ considered. Fig. 4 shows a beam roof restoration, essentially similar to the ~~known~~ standing vaulted Peten temples.

Slide 10 The restoration of plan on this slide reflects essential features found in situ. There was here a rear room. The solid masses at the sides of the rear room are probably vestigial remains of the standard comb foundation, rendered functionless by the introduction of the rear room.

Slide 11 Figs. 1 to 5 of this slide show five schemes for thatched roofs on the foregoing ground plan. Placement of a simple pitched roof, either with gable or sloping ends, as in Figs. 1 and 3, produces unsightly and meaningless overhangs at the rear. If the gabled roof is cut to fit the wall plan, as in Fig. 2, rain would blow under the front projection thus produced. By breaking the planes of an end slope as is shown in plan in Fig. 4, a pitched roof can be made to follow the plan with unfform eaves height and not displeasing results. But the necessary gutters of perishable materials seem extremely improbable.

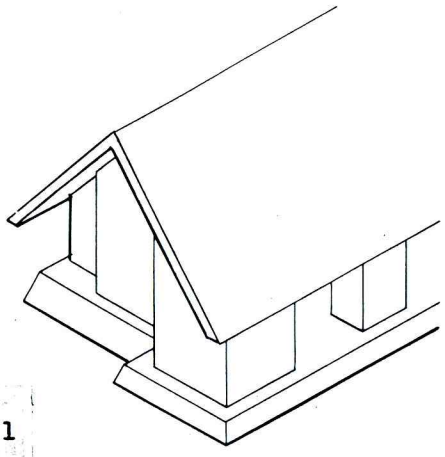
In Fig. 5 a single end slope is retained, walls being raised to meet the slope and the latter being cut to fit. A weather-tight result is achieved and a possible reason now appears for raising the base of the side walls toward the rear. I think we should conclude that it was possible to roof these buildings with thatch in a manner reasonable to us.

However, we are working backward from known late roofs and plans to earlier ones. The Maya moved in the opposite direction. Structurally the trussed thatch roof naturally takes a rectangular or circular outline, or combinations of these. Experimentation with irregular outlines would be in spite of natural roof requirements. In all of our attempts we have mutilated the natural and pleasing original form.

If, however, the nearly flat beam roof first replaced thatch for utilitarian reasons such as fire-proofing, the building outline could thereafter be modified at will without problems in solving roof design. Once this was done we should expect a decorative cornice ~~xxxxxxxxxxxx~~ to replace the line of the over-hanging eaves. The resulting effect, as in Fig. 6, differs from a vaulted one only in the absence of an upper zone, above this cornice. If this is actually a pre-vault type, with the coming of vaults the roof would be raised to accomodate the height of the corbels. Slide 12 The old cornice would remain for the same esthetic reason for which it was first adopted, but it would become a medial molding below an upper zone, (as we see here on our combined beam and vaulted steambath and new Empire) These are universal features on Usumacinta vaulted buildings.

It appears to me highly probable that thatch, beam and vaulted roofs first appeared at Piedras Negras in that order. This is still, however, a hythothesis. Even if correct it may not apply to the still older central cities. Mexican influences may ~~xxxx~~ be involved ~~and~~

and may have effected various Old Empire districts differentially; and the medial molding is not there universal. At least we have shown that beam roofs must be considered in tracing the development of Old Empire architecture. We have also raised the question whether roof combs of the Peten type may not also have been evolved before the vaulted roof.



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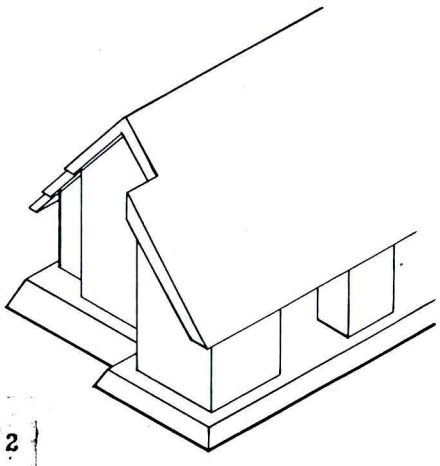

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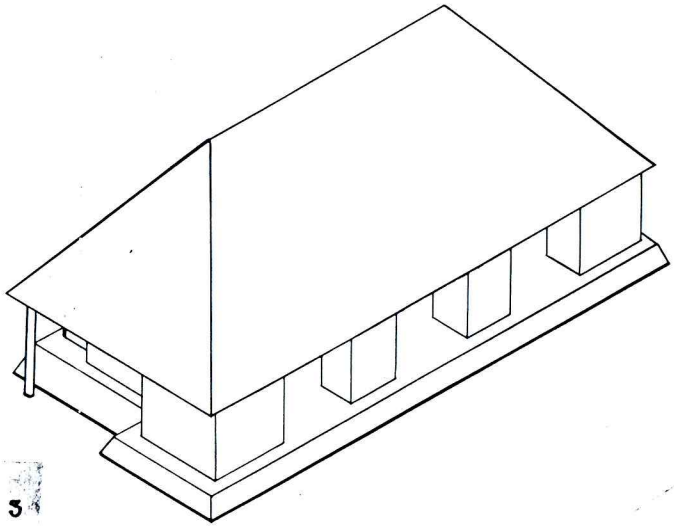

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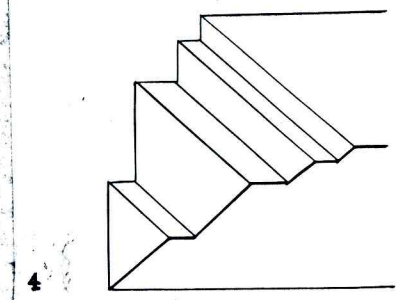

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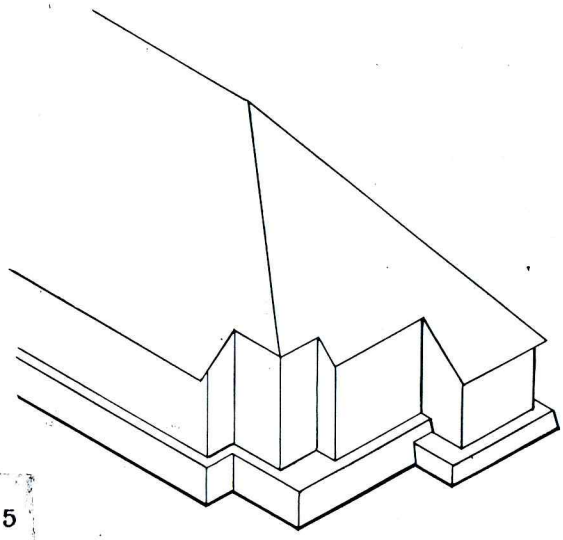

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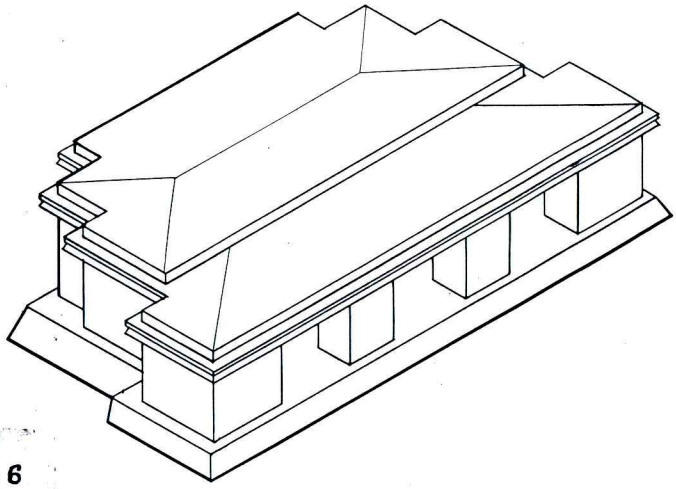

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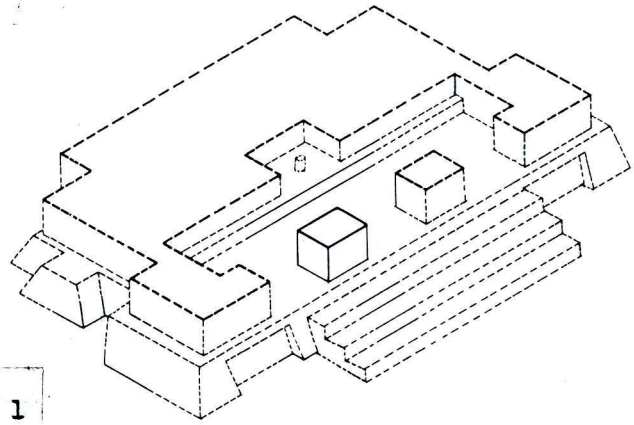
Str. U-3 Roof Reconstructions



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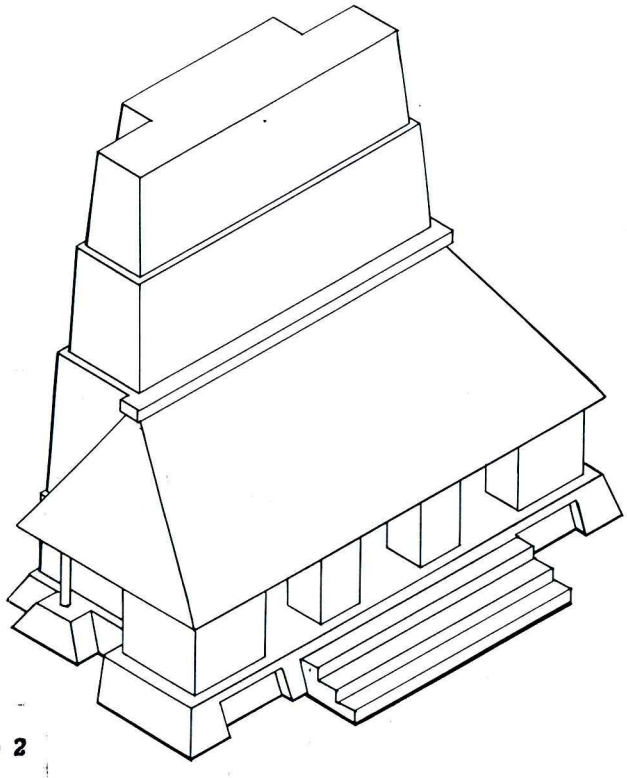

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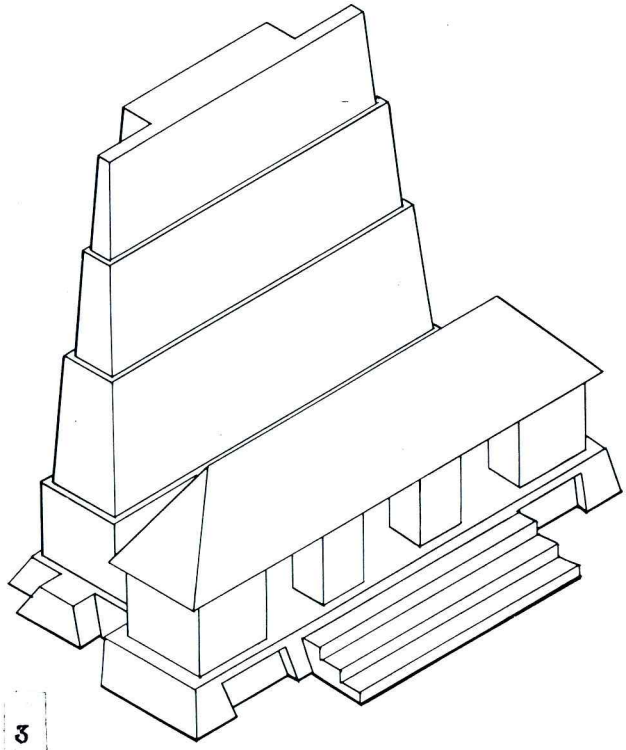

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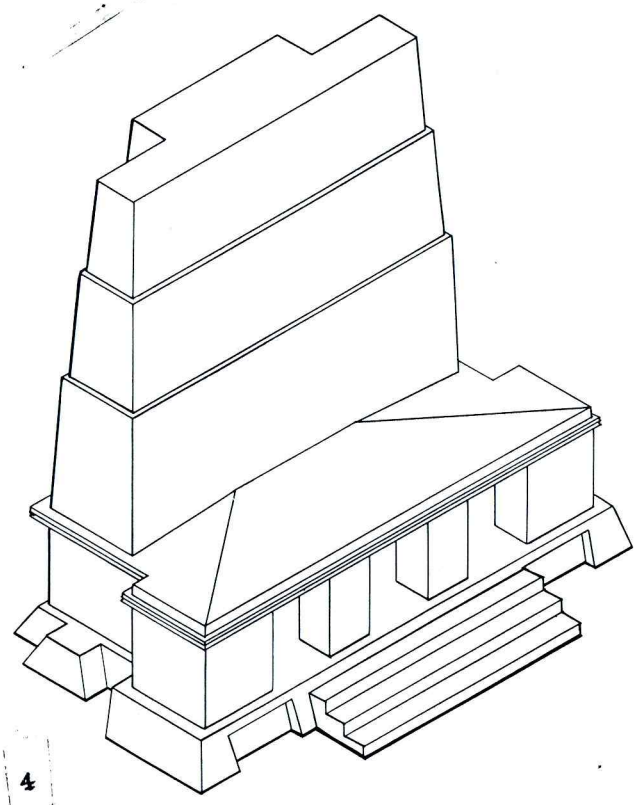

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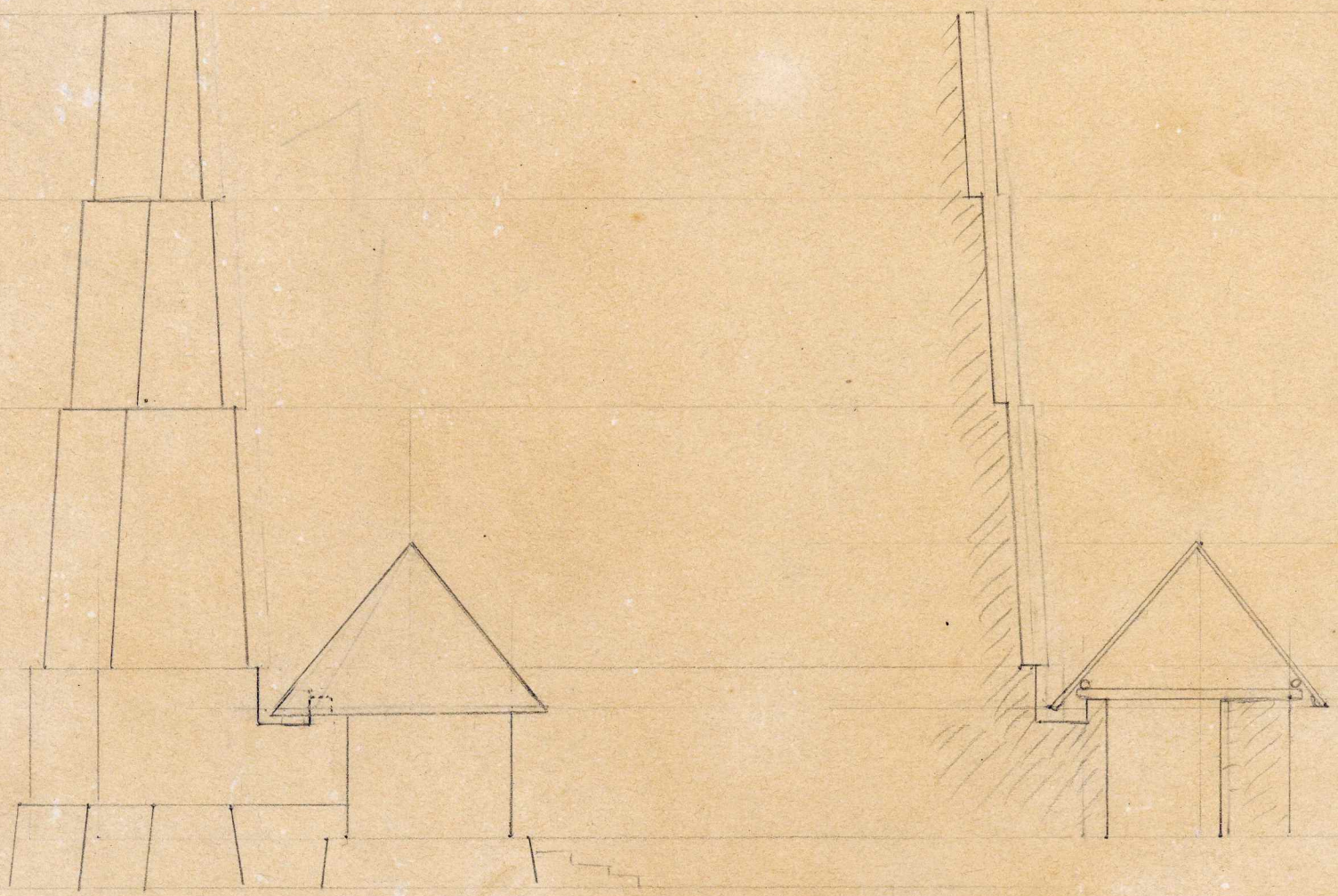

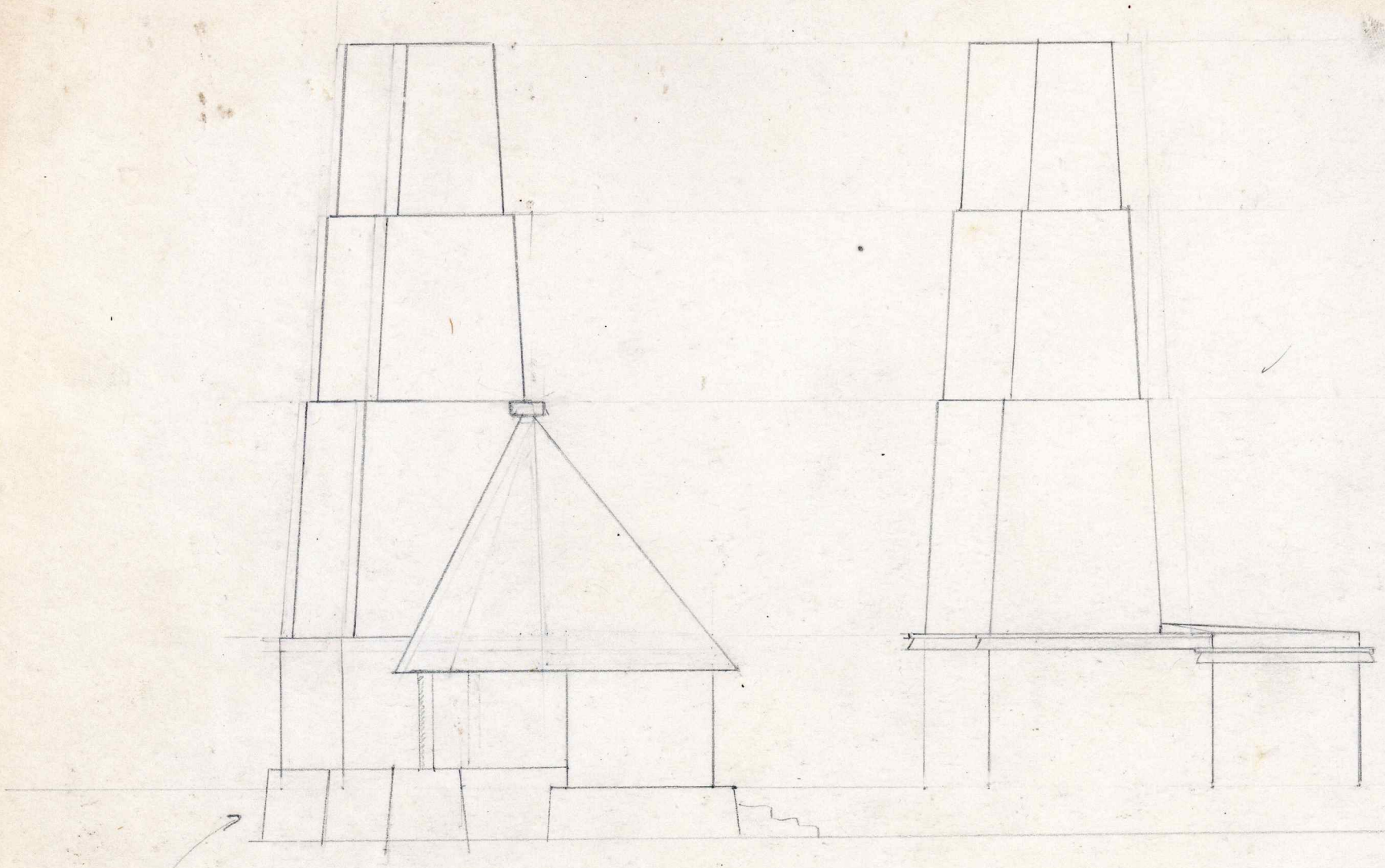
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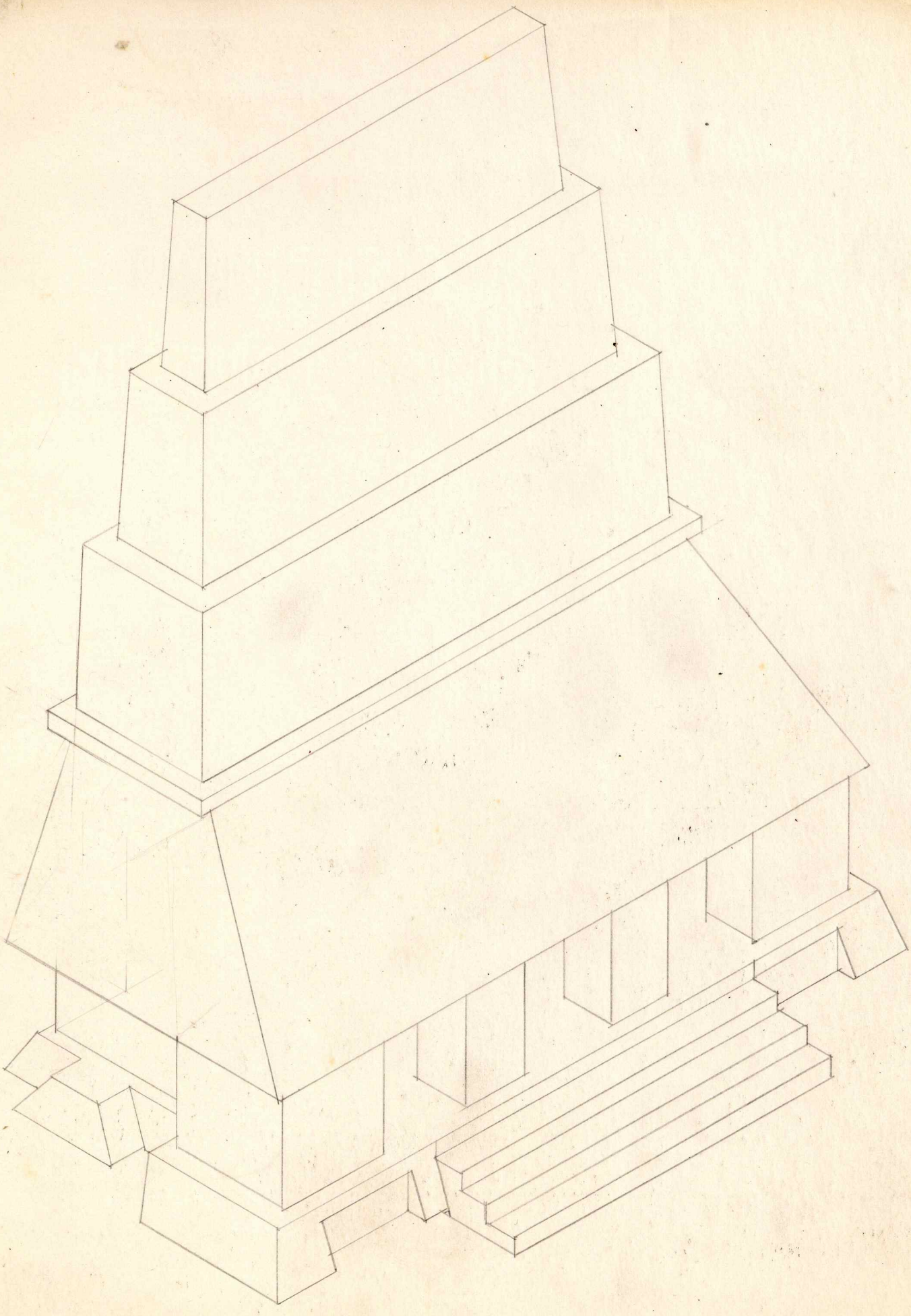

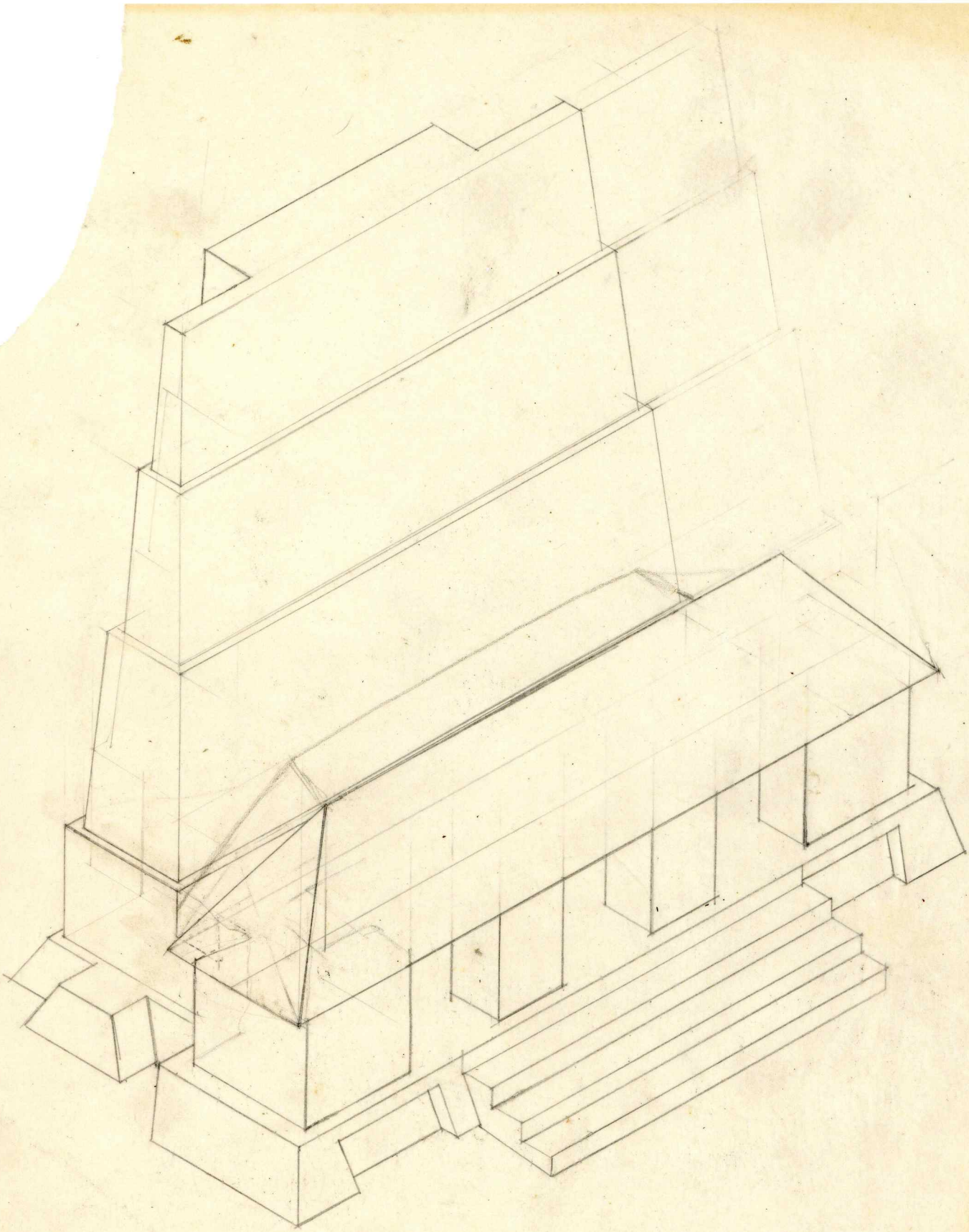

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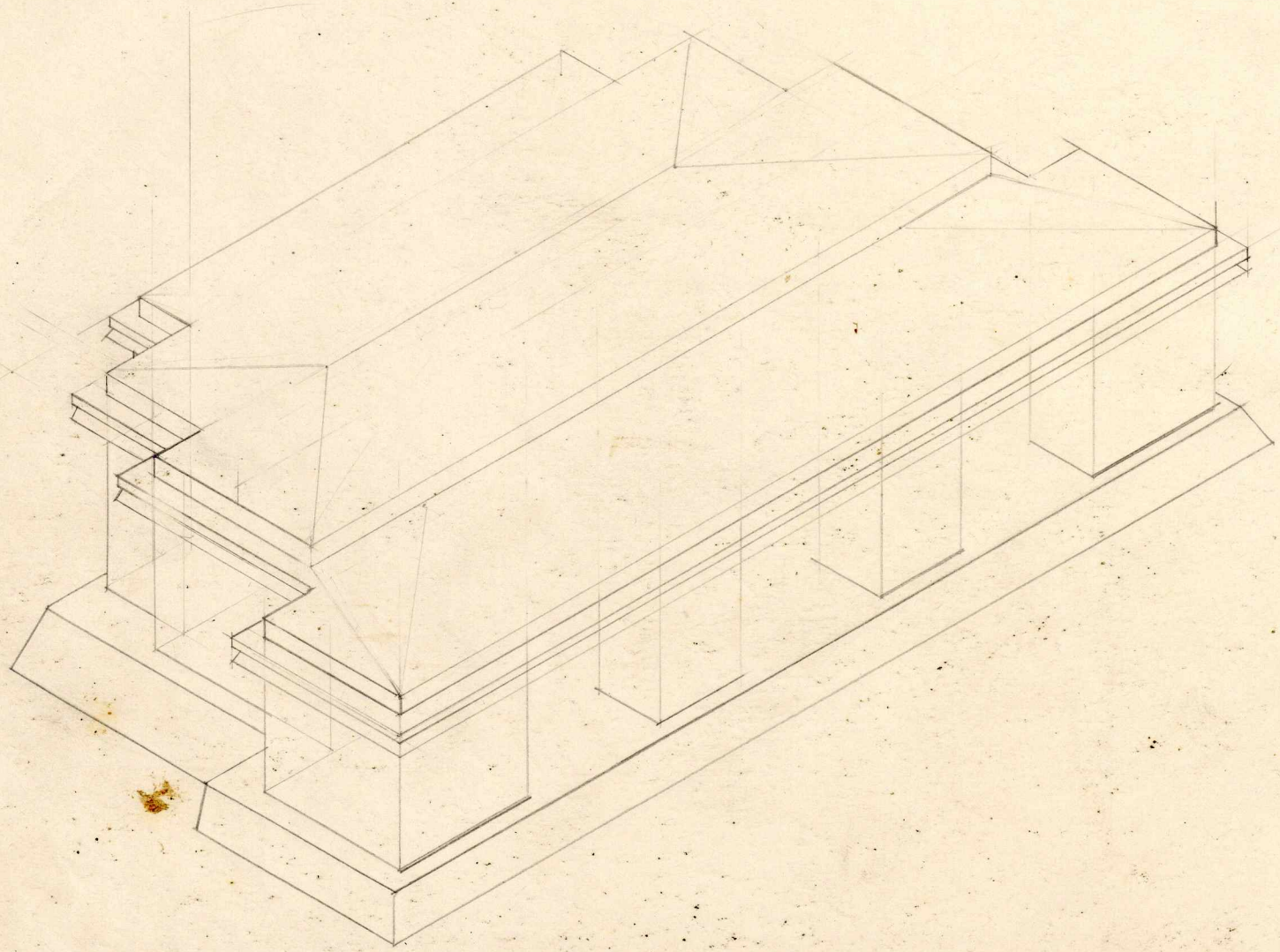

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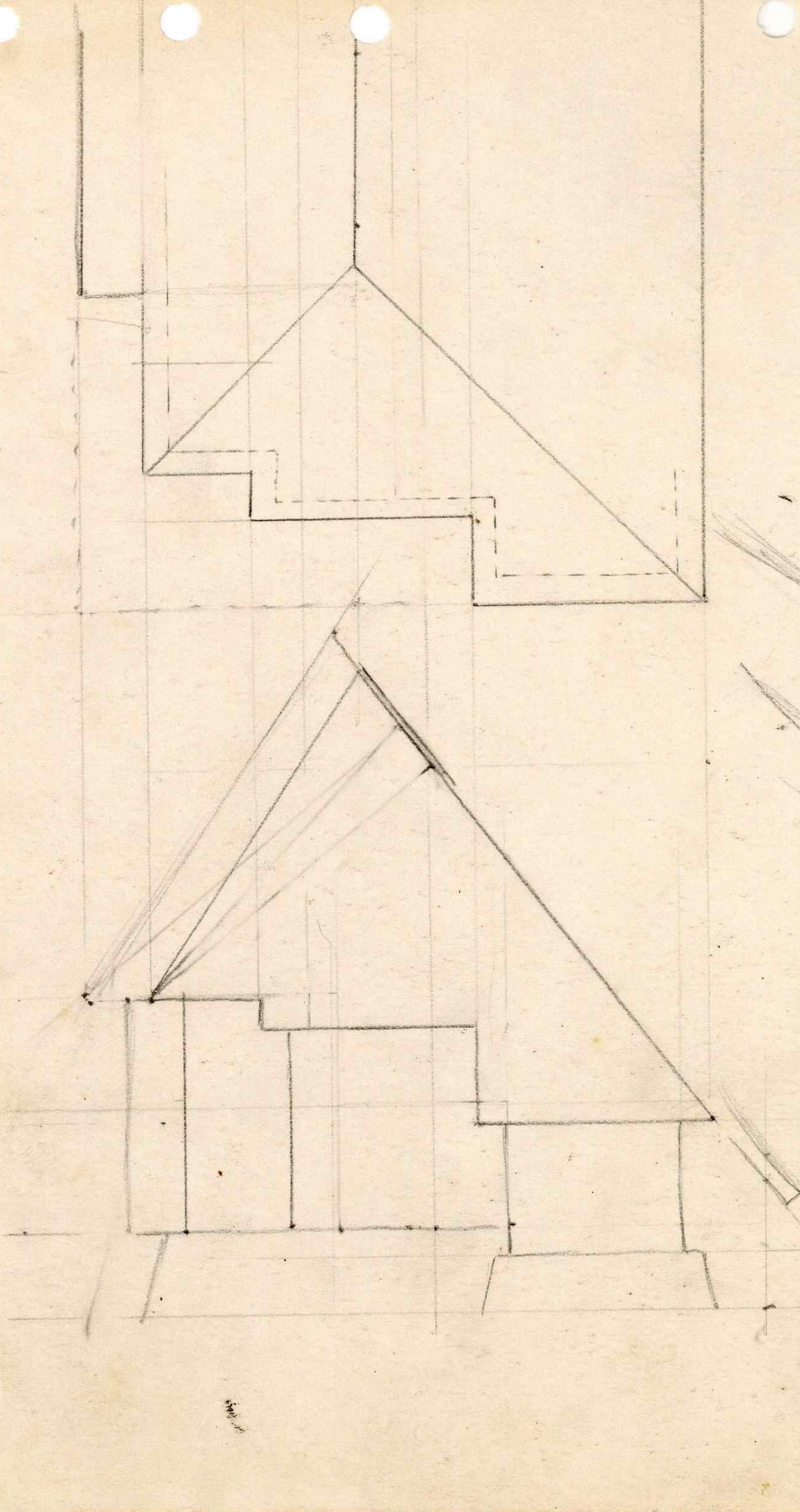

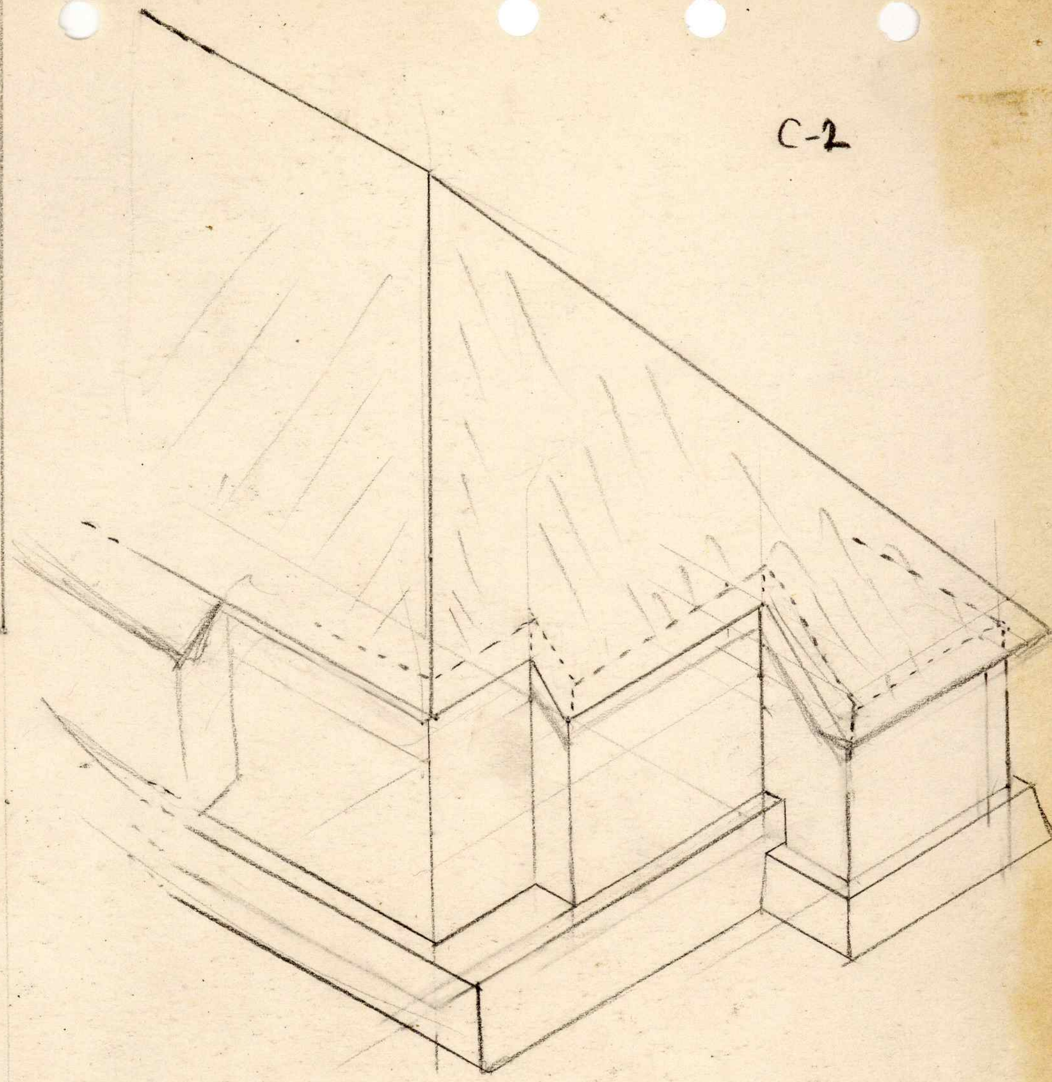

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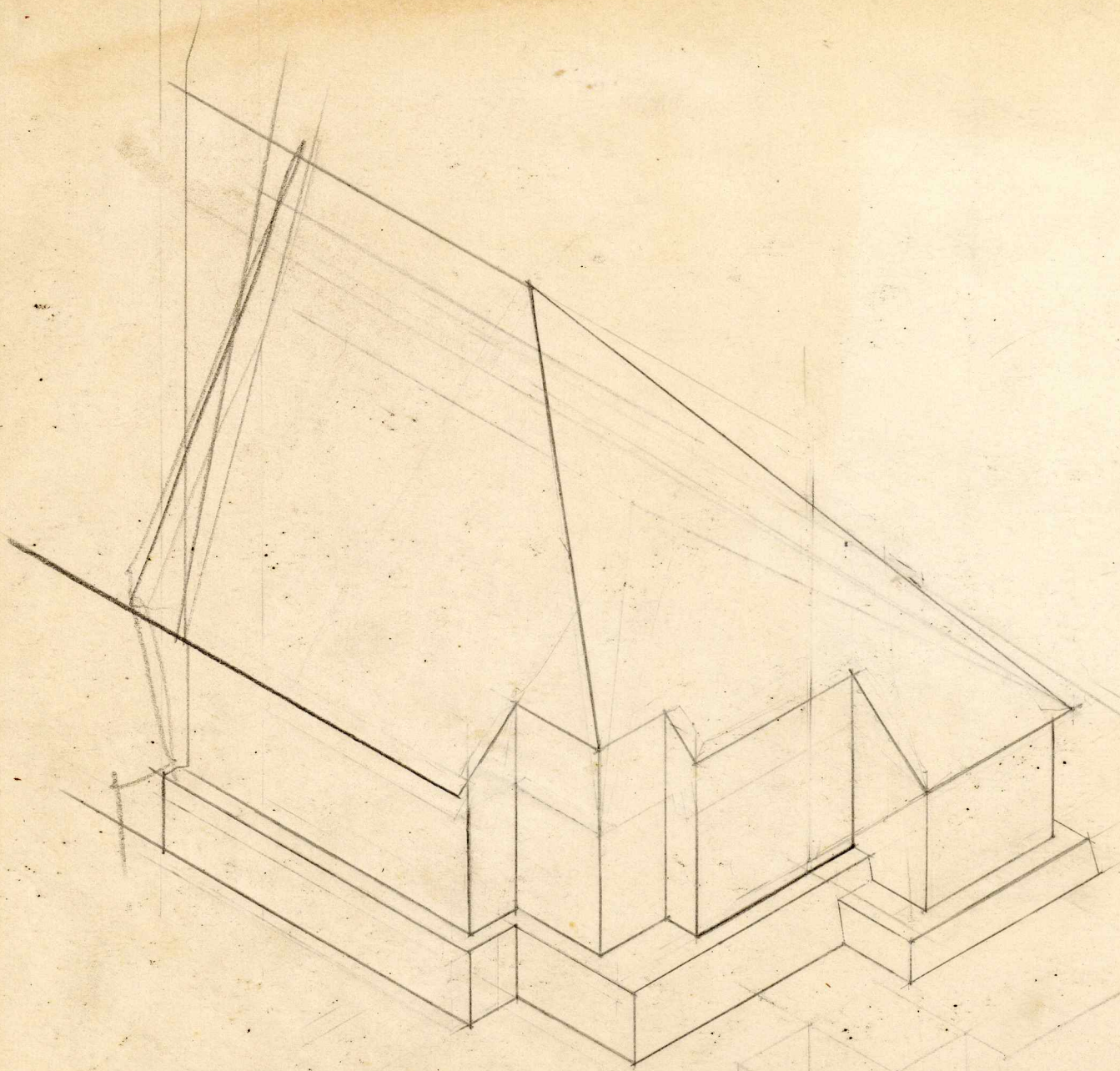

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