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Artikel: Some folded slab constructions carried out recently

Autor: Samuely, Felix J.

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Some folded slab constructions carried out recently

Über einige neuere Faltwerkkonstruktionen

Algumas lages dobradas construídas recentemente

Quelques dalles pliées construites récemment

FELIX J. SAMUELY
London

Folded slab construction has been found to be an economical substitute where the very convenient «shell» type of roof was required but was too expensive, With the series of straight planes in folded slabs, local bending has to be taken into account, a disadvantage offset by the simpler formwork. In most cases precast concrete units, forming part of the finished structure, can be used as permanent formwork. Also, the variety of shapes available in folded slabs is sufficient to satisfy most aesthetic requirements. The author has carried out a number of buildings where the roofs have been designed as folded slabs in a composite construction of precast and insitu concrete, and also some from precast units only In the latter cases, the precast members were unified by means of post-tensioning.

Exact methods of calculation of such folded slabs have been admirably described in a number of books, and it will be assumed that they are generally well-known, but as such structures are invariably highly statically indeterminate, a method of consecutive approximations following the actual behaviour of reinforced concrete has much to commend it, and will lead to any desirable degree of accuracy.

For example, fig. 1 shows a cross section of a School Assembly Hall at Wigan. At each intersection or «crank», the loads can be resolved into two components in the direction of the slabs which, acting as very deep beams, can transmit loads to supports. Therefore, in the first approximation, each crank is assumed to be a support, and in this example a slab over four spans results, acting as shown in fig. 1a. The bending moment and reactions can be determined, and the reactions are resolved in the components along the outline of the roof, as shown in fig. 1. Each slab, which acts as a deep beam in the longitudinal direction of the buil-

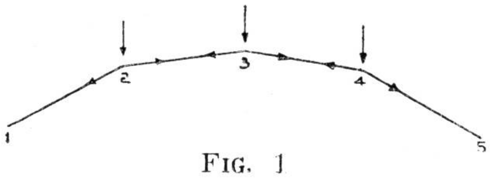

FIG. 1

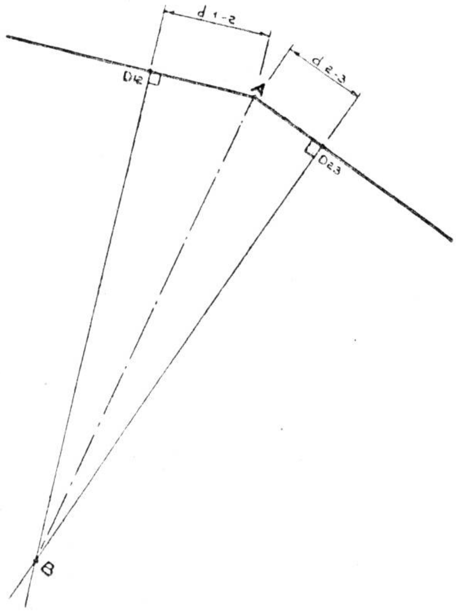

FIG. 1-B

FIG. 1-A

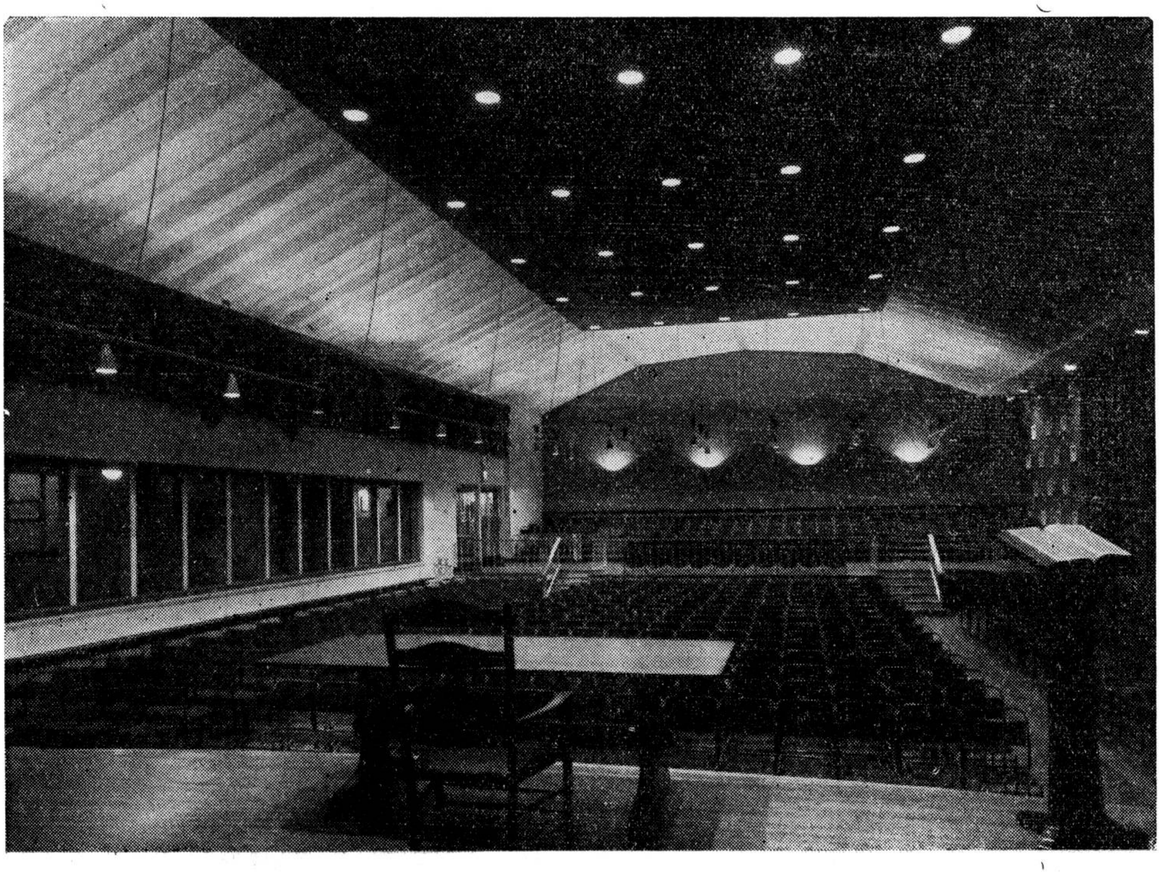

FIG. 2

ding, has to take two of these components, which may either add to or subtract from each other. With reasonably acute angles this may be the final stress distribution. However, with obtuse angles at the cranks, there may be considerable deformation. If deformation is appreciable,

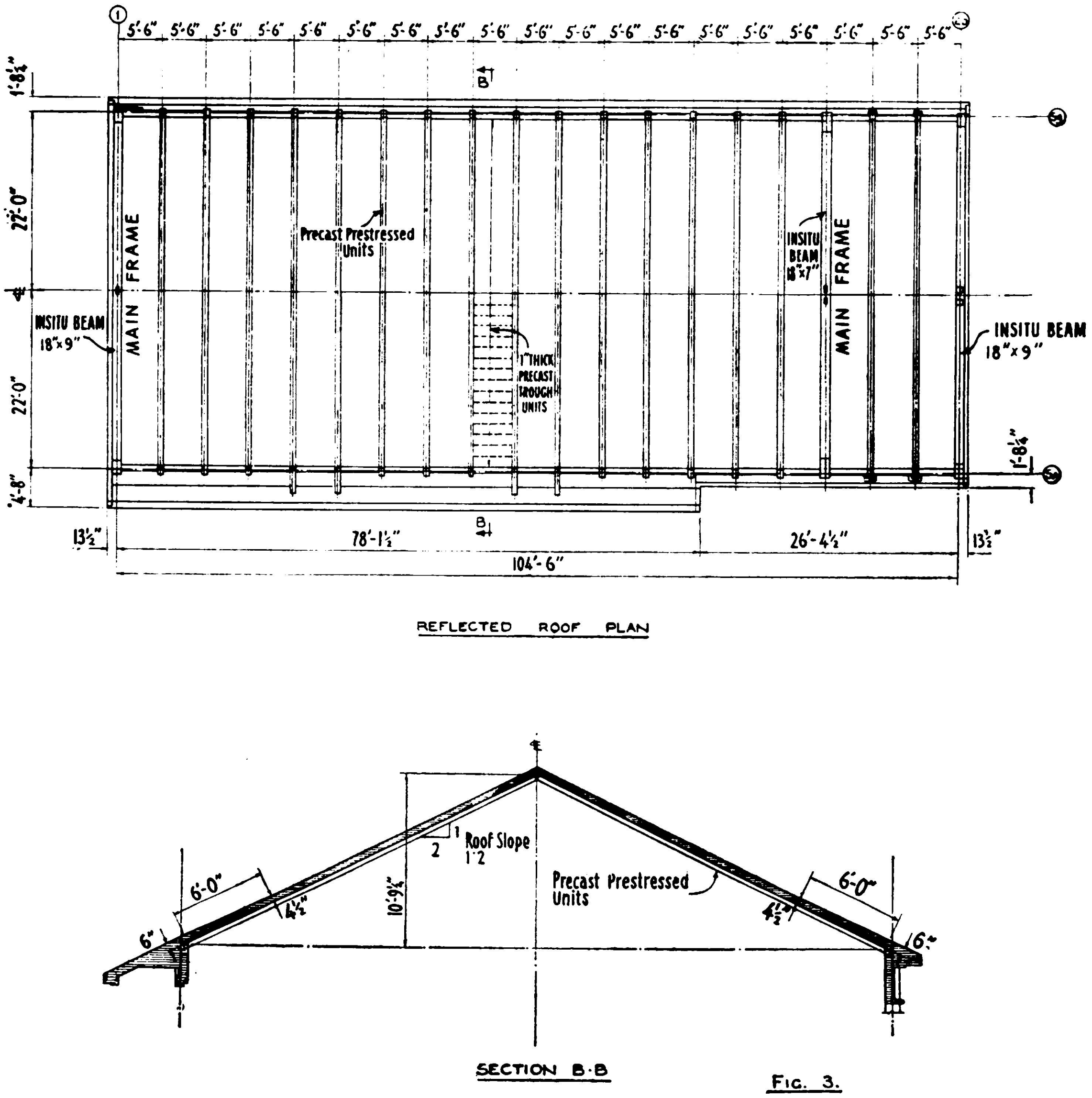

FIG. 3

the stress distribution will be altered. Taking point 2 (fig. 1b), the deformation in the centre of the slab 1,2 may be marked as d_{1-2} and of slabs 2,3 as d_{2-3}. Assuming the slabs can have unlimited deflection on their weakest axis, the final deflection can be to a point anywhere on lines drawn at 90° at points D_{12} and D_{23} and as their point of intersection is at B, AB is the deflection. If similar deflections are calculated for all cranks, and the beams shown in fig. 1a recalculated with supports having the given deflections, a new bending moment diagram and reactions will result, which resolve differently in the planes 1-2, 2-3, 3-4, etc.

This new stress distribution will be nearer the truth than the original one. If there is considerable difference between these and the original deflections, the method must be repeated sufficiently to make sure that the progression of deflections converges. Non-convergence of the progres-

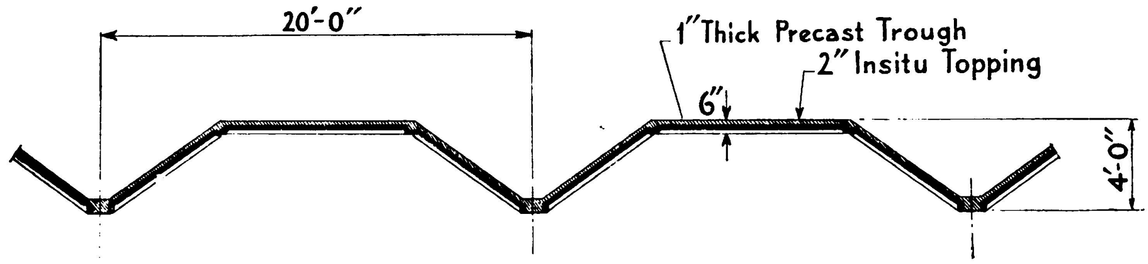

FIG. 4

sion, with too obtuse angles, would indicate that the construction is unsuitable. This particular roof, which is 75'0" × 45'0", consists of precast concrete troughs, temporarily supported along the horizontal intersections. Steel reinforcement above the troughs takes the tension stresses

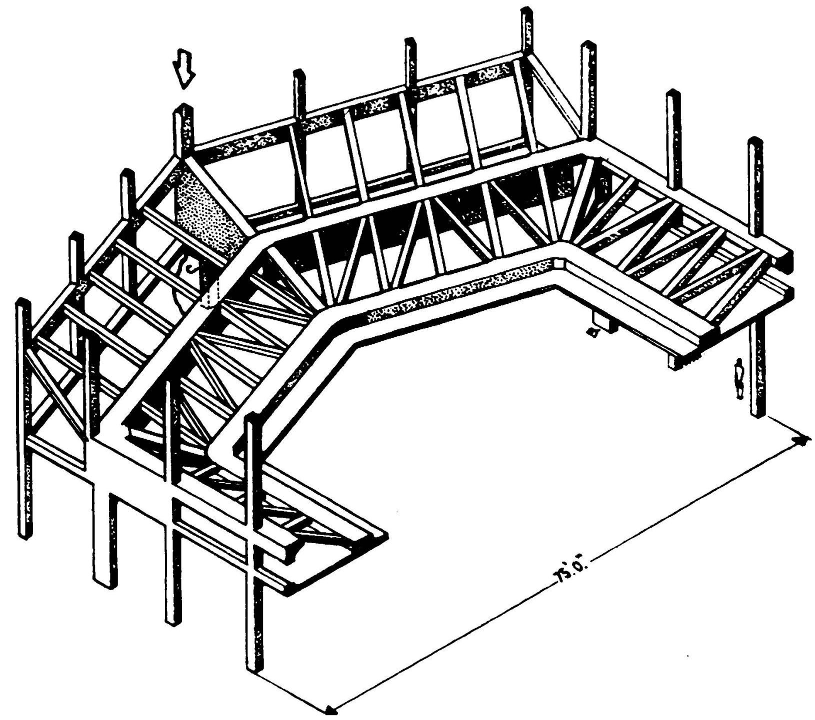

FIG. 5

at eaves, and the roof is finished with $1\,{}^1/_2''$ of insitu concrete. Advantageously, the weight is that of the thickness of the troughs and topping ($2\,{}^1/_2''$), but the stiffness, that of the 6" depth. Fig. 2 shows the finished Assembly Hall.

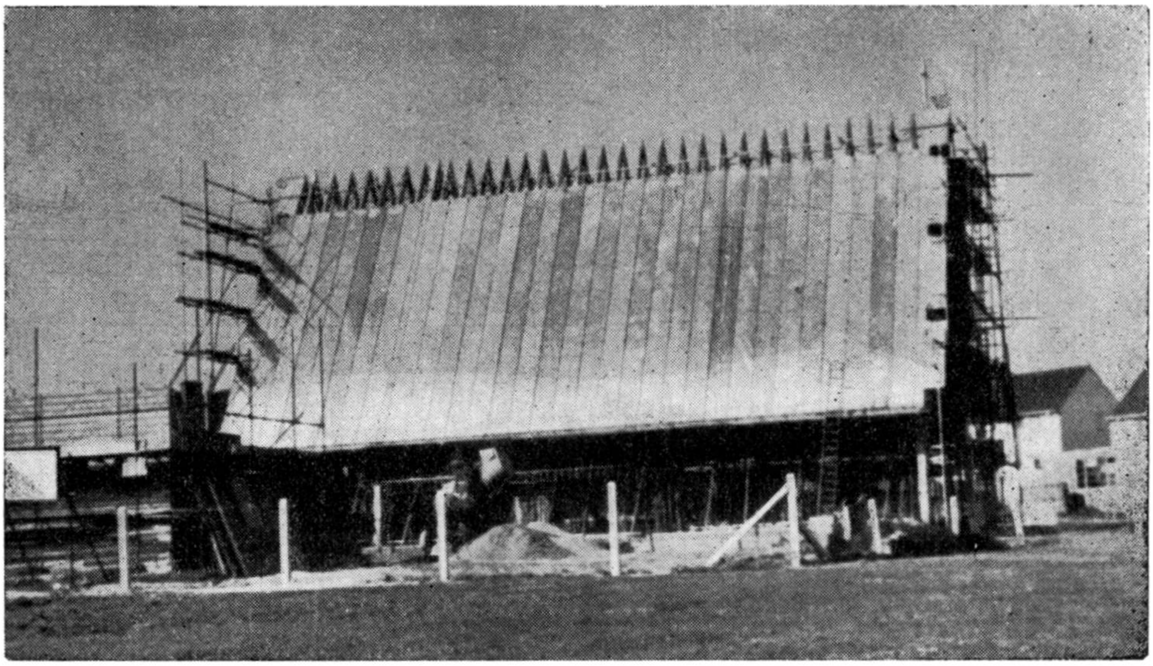

Fig. 6

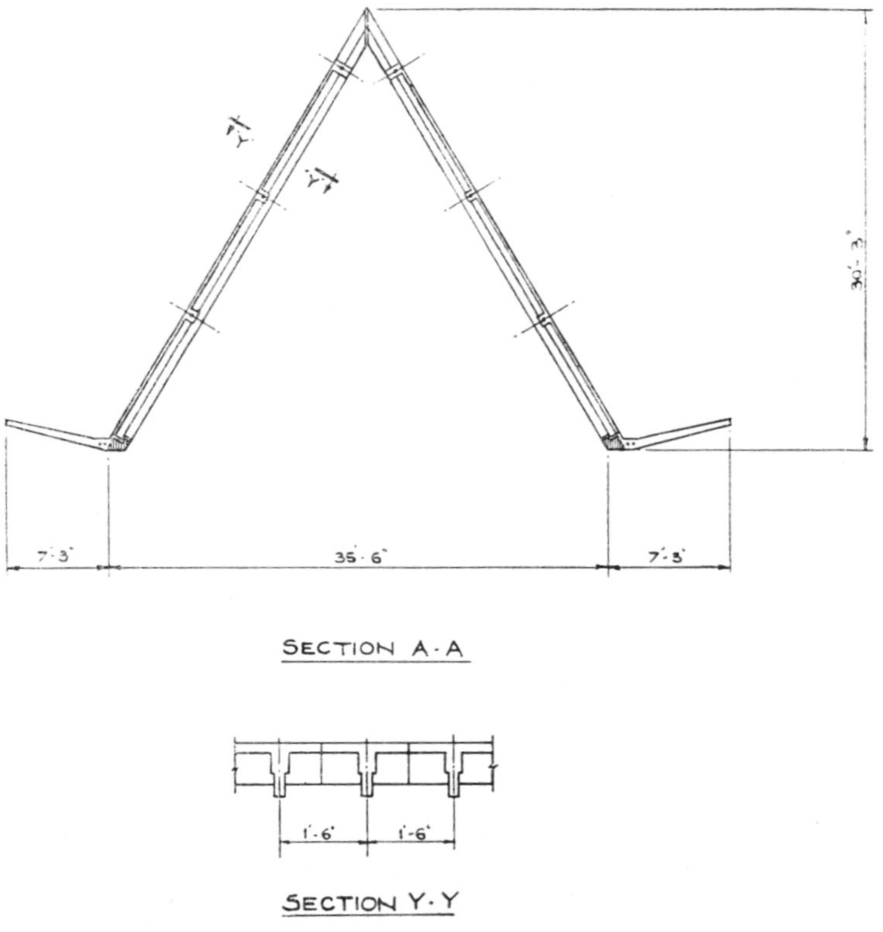

Fig. 7

Fig. 3 and 3a shows another Assembly Hall, at Hatfield, 44′0″ × 88′0″, with a 16′6″ cantilever. Here the inclined roof slabs consist of prestressed planks, with precast troughs between, the whole covered with insitu concrete. Prestressed units were also used as tie members at either end of the building.

Fig. 4 shows the cross section of a similar roof used for laboratories in East Anglia.

Apart from roofs this construction can be used wherever slabs meet an angle. Fig. 5 shows it used for a gallery in an Assembly Hall.

Care must be taken where a slab is steeper than 1:2, as then expensive top formwork is required for the insitu concrete. To avoid this, use only precast units and post-tension them, as described before.

Figs 6 and show a small church constructed in this way. Each slab consists of a series of prestressed tee units, with flanges uppermost, as shown in section Y-Y. The tees were grouted together and then post-tensioned through the flanges to produce compression over the whole area and make it possible for the whole plane AB to act as a beam. The two planes AB and A^1B^1 do not actually touch, but loads can be resolved into their direction at C, which is rigidly connected to both planes.

SUMMARY

The contribution refers to folded slab construction which covers areas in a manner similar to shell construction. The general calculation is explained, and, in particular, how it is possible to deal with highly statically indeterminate constructions of this type in stages, so that any degree of approximation can be achieved.

ZUSAMMENFASSUNG

Der Aufsatz behandelt Faltwerke, die Räume in ähnlicher Weise wie Schalenkonstruktionen überdecken. Es wird die allgemeine Rechnungsmethode erklärt und besonders erläutert, wie es möglich ist, hochgradig statisch unbestimmte Konstruktionen dieser Art in stufenweiser Näherung zu behandeln, so dass jeder gewünschte Näherungswert erreicht werden kann.

RESUMO

O autor descreve lajes dobradas utilizadas em coberturas. Explica-se o cálculo geral e como é possível calcular estruturas estàticamente indeterminadas deste tipo por aproximações sucessivas de forma a conseguir um dado grau de precisão.

RÉSUMÉ

L'auteur décrit des dalles pliées utilisées comme voiles de couverture Il rend compte de la méthode générale de calcul et explique comment il est possible de traiter par approximations successives les structures statiquement indéterminées de ce genre, de façon à obtenir un degré de précision donné.