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Design of Large Span Composite Floor

Dimensionnement d'un plancher mixte de grande portée

Bemessung von Verbunddecken grosser Spannweite

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INTRODUCTION

The large span composite floor is a composite space truss structure which steel upper chords are replaced with r.c. rib-slab. It's a space structure that the members act as a whole with the beams and the slabs throgh appropriate connections. It could make the most of the mechanical properties of the two materials and could strengthen whole rigidity of the structure. In China built several multistory and tall buildings and the results are very satisfied. Those are the Changsha Texile Building (column distance 12m, Fig. 1) and the Xinxiang Department Store (span 35m, Fig. 2) and the Rehearsal Hall of Changsha Opear and Dance Drame House (span 21m, Fig. 3) etc.

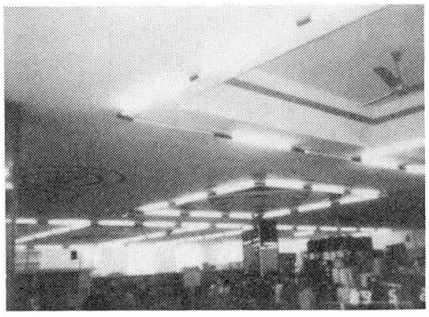

Fig. 1

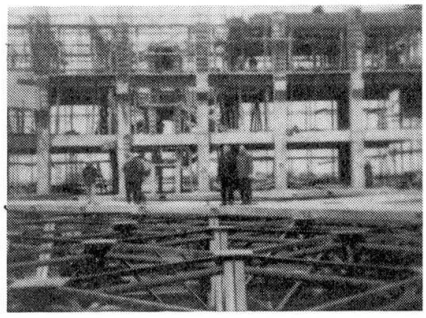

Fig. 2

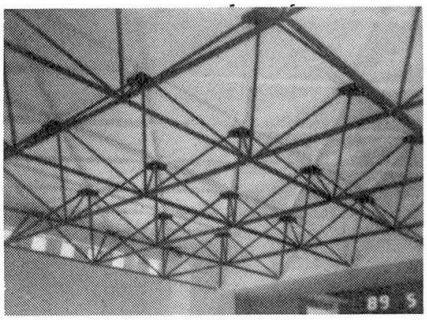

Fig. 3

STRUCTURAL ANALYSIS

The composite space truss can be analyzed in three mechanical models:

1) Finite Element Method The discrete rib-slab in the structure into beam elements and plate elements which carried the axial force and the plane force and the bending moment. But the web members and the lower chords remain carrying axial force.

2) Equivalent Sandwich Plate Method The rib-slabs are regarded as the upper layer and the web members and the lower chords are regarded as the sandwich layer and the lower layer respectively. The differential equation on the above basis is seted, the solution is obtained with the Analytic Method.

3) Equivalent Space Truss Method According as energy principl, the rib-slab is idealized as a three-way or four-way planar truss system. The complex composite structure may be assumed as an equivalent space truss system which can be solved by the Matrix Displacement Method.

STRUCTURAL DESIGN

Basic Assumption for Design and Calculation:

1) The plane rigidity of the composite floor is limitless.
2) The connections between the floor with the columns (or the walls) are hinged joints.
3) The floor trasmit axial force only in the horizontal direction.

Structural Shape Various kinds of the space truss are applicable to composite floor. But the space truss of orthogonal and ortholaid types and the ortholaid square pyramid space grids are better.

Upper Joints The axial force and the shearing force and the bending moment are transmited tegether in the upper joints. The joints must have enorgh regidity.

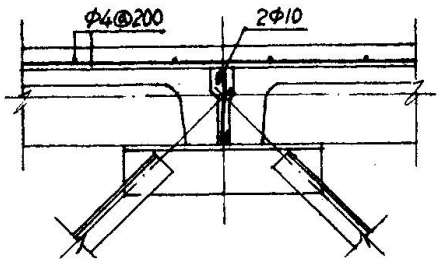

Fig.4

STRUCTURE MEASUREMENT

The measurements of the stress and the deflection on the composite floor has proved: (Fig.5,6,7)

1) Within the calculated loads, the structural members are working in the elastic stage.
2) The largest deflection of the joints is 1/600-1/800 that of the floor's span.
3) The rib-slab is a compression-bending members and the lower chords and the webs remain carrying axial force.
4) The rigidity of the upper joints will affect the space rigidity of whole structure and the internal force of the members.
5) The measure is to 70-90 per cent that of the calculation.

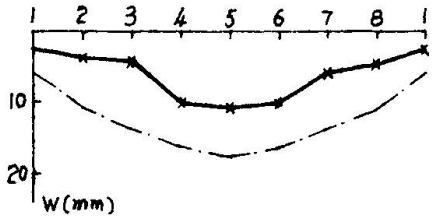

Fig.5 Max-defleetion of the joints

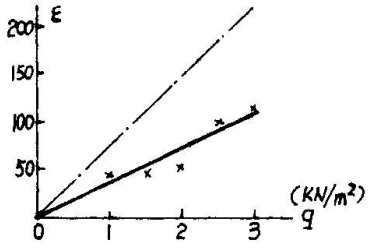

Fig.6 Lood-strain of the slab

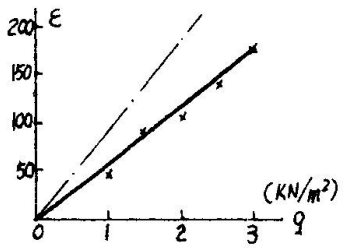

Fig.7 Lood-strain of the member

——The measurment —·— The calculation

ECONOMICAL ANALYSIS

The economic indexes of the composite floor and the r.c. floors are comparable in folowing Table..

Floor'stype	Deadweight	Concrete	Steel	Timber	Cost (¥ yuan/m²)			
	(kN/m²)	(m³/m²)	(kg/m²)	(m³/m²)	Floor	Column	Fundation	Total
Mushroom-slab	9.25	0.37	43.6	0.025	70.50	67.55	104.8	242
Groined-slab	8.25	0.33	43.6	0.024	75.33	46.60	92.2	214
Beam-slab	7.50	0.30	35.4	0.018	52.20	51.20	87.3	196
Rib-slab	6.25	0.25	31.6	0.016	50.80	37.40	75.4	166
Com-sp-truss	1.80	0.06	26.6	0.003	58.40	31.50	63.0	153