TOPIC SCHEDULE

LECTURE			*PRACTICAL*
week		**Topics**	**Topics**
8.		Building materials and their applications: CONCRETE, REINFORCED CONCRETE	

Today's Lecture: Building materials: Concrete and Reinforced concrete

A form of cement was used even in roman times, however, the development of building materials and engineering techniques - especially our knowledge on reinforced concrete - has allowed the use of concrete in abundance only with the beginnnig of the 20th century. Today reinforced concrete is the primary structural material of all significant engineering and architectural constructions ranging from dams to apartment buildings.

I. Concrete:

a) Physical Properties: Density of concrete: 2000 kg/m3 (must learn)

b) Concrete as a cementitious material

In English the term "cementitious" material includes those which mixed with water first to form a paste. Aggregate may or may not be added. The paste is temporarily plastic and maybe moulded or deformed. But later it hardens or sets into a rigid mass. These cementitious materials are: -cements, -limes, -gypsum.

The major role of cement is as part and as a binding material of concrete. Concrete consists of: cement, water and aggregates. Aggregates are defined as follows: inert (it does not take part in any chemical process) material, which when bonded together into a conglomerated mass by a matrix, forms concrete. Aggregate include sand, gravel, crushed stone or light weight aggregate, such as perlite, to obtain a better thermal insulation due to the loss of strength. Cement mixed with fibres produces fibre cement sheets: plain, corrugated or moulded.

Thus concrete is an intimate mixture of mineral aggregate and the binding material, such as Portland cement. Its popularity over the last hundred years has been due to many factors; not the least being the ease with which it can be moulded. To mould concrete it is simply poured between shuttering or framework and left to set.

c) The manufacturing process of concrete products:

Concrete can be mixed by hand or by machine. To obtain correct proportion of material, a gauge box is used. Thus for 4:2:1 mix, 4 boxes of coarse aggregate, 2 boxes of fine aggregate and sand, 1 box of cement are measured mixed together.

The water-cement ratio in Hungary is0,45, in the tropics is it is usually 0,5-0,55. Dry materials take up approximatively 50 % more space before being mixed with water into concrete and compacted into position.
For placing concrete, the framework must be cleaned out and brushed with mould oil or white – washed (both have a bound-breaking effect), in order to facilitate striking. Compacting can be done either by hand or by mechanical means.

After the concrete is set itis necessary to keep it moist for several days in order that it can be thoroughly cured. This enables the strength of the concrete to increase with the passage of time. It will also increase its impermeability, reduce shrinkage and harden the surface against abrasion. Striking time varies with the climate, and type of cement, etc. Vertical formwork can be removed after two days, horizontal after three, while beams and slabs need to be propped without shuttering for a further week.

II. Reinforced Concrete

a) Physical Properties: Density of reinforced concrete: 2400 kg/m3 (must learn)

The observation that concrete first has a plastic past consistency, which can take up the shape of any mould and can incorporate anything with considerable adhesion gave the idea that the insufficient tension –strength of the concrete, which is far behind its compressive strength, could be substituted by inserting steel bars into all parts of the concrete elements, wherever tensile stresses emerge. This is termed "reinforced concrete" and abbreviated as

R.C. This concept of a composite structure provided unique properties, which example its rapid, and multilateral application. Current development of reinforced concrete products focus on the enchancement of the processes and the end products of the materials (concrete enchancement with resins, reinforcement with glass, carbon fibres, pre tensioning etc.)

b) Types of reinforced concrete products (simple, must-learn list):

Structural:	pre-manufactured stairs, beams, pillars, slab elements and combinations
	on-site manufactured 3d concrete structures
	combination: on-site manufacturing of built-in elements
Other:	pre-manufacturing of decorative elements
	other manufactured concrete products (concrete blocks, units etc.)

LEARN COMPONENTS OF SKELETON FRAME STRUCTURES FROM ENCLOSED EXAMPLES, BE PREPARED TO SKETCH AND NAME COMPONENTS.

APPLICATIONS FIELDS OF CONCRETE AND REINFORCED CONCRETE (must-learn simple list)

1. Load bearing and supporting constructions
1.1. Load bearing beams (big height for shorter span and smaller loads)
1.2. Load bearing walls, columns

2. Concrete coverings
2.1. Floor coverings
2.2. Wall coverings

REFERENCE:

In English the term "cementitious" material includes those which mixed with water first to form a paste. Aggregate may or may not be added. The paste is temporarily plastic and maybe moulded or deformed. But later it hardens or "sets" into a rigid mass.

These cementitious materials are: -cements, -limes, -gypsum.

The major role of cement is as part and as a binding material of concrete. Concrete consists of: cement, water and aggregates. Aggregates are defined as follows: inert /it does not take part in any chemical process/ material, which when bonded together into a conglomerated mass by a matrix, forms concrete.

Aggregate include sand, gravel, crushed stone or light weight aggregate, such as: perlite, slag, vermiculite, and pumice, to obtain a better thermal insulation due to the loss of strength. Concrete may also be aerated, the air entraining concrete has a better heat insulation capacity, but inferior strength. Cement mixed with asbestos fibres produces asbestos cement sheets: plain, corrugated, or moulded.

Thus concrete is an intimate mixture of mineral aggregate and the binding material, such as Portland cement. Its popularity over the last hundred years has been due to many factors; not the least being the ease with which it can be moulded. To mould concrete it is simply poured between shuttering or framework and left to set. D41-44

- The observation that concrete first has a plastic paste consistency, which can take up the shape of any mould and can incorporate anything with a considerable adhesion gave the idea that the insuffient tension-strength of the concrete, which is far behing its compressive strenth, could be substituted by inserting steel bars into all parts of a concrete element, wherever tensile stresses emerge. This is termed "reinforced concrete" and abbreviated as R.C. This concept of a composite structure provided unique properties, which explains its rapid, and multilateral application.

- There are many kinds of cement: normal, quick setting, and hydrophobic, etc. Aggregates are either crushed stone or gravel. Crushed stone is normally better, but more sand has to be added.

- Aggregates are coarse of fine. Coarse is retained on a No.4 sieve /3/16 inch≈4.7 mm≈5.0 mm/, while the fine aggregate passes through. D40

Concrete can be mixed by hand or by machine. To obtain correct proportion of material, a gauge box is used. Thus for a 4:2:1 mix, 4 boxes of coarse aggregate, two boxes of fine aggregate and sand, and one box of cement are measured out and mixed together. /That is an average mix. For a waterproof concrete, a 3:1,5:1 mix is used./

A general formula for the mixes:

Cement	Fines	Coarse
1	1	2
1	1,5	3
1	2	4
1	3	6

The coarse is twice that of the fines

Nowadays concrete is mixed mainly by machine and more care is given to the correct proportions. Generally it is now based on one cwt. /50 kg/ bag of cement, which is approximately 0.035 m^3 thus for a 4:2:1 mix a 0.071 m^3 volume gauge box is used. The mix then consists of two boxes of coarse aggregate - one box of fine aggregate and one bag of cement. /Although many prefer the former somewhat inexact way./

The new efficient machines are fitted with skips or hoppers, which weigh the material, thus eliminating the need for measurement.

One mix is called a batch. When sand and fine aggregate is damp it normally swells or "bulks". The bulking factor varies with the weather, but as a general rule it may be taken to be 25 % more in a damp or humid condition.

The strength of the concrete depends to a large extent on the amount of cool, clean water used in the mixing. Only enough water should be added and no more to enable the concrete to be compacted. This amount is usualy specified by weight and stated as a fraction of the cement used.

$$\frac{\text{weight of water}}{\text{weight of cement}} = \text{water/cement ratio}$$

An example:

What quantity of water should be needed for each bag of cement in the mix, if the water/cement ratio is given as 0.45? 0.45x50 = 22.5 kg = 22.5 litres.

/In the tropics, the water/cement ration is usually 0.5-0.55./
Dry materials take up approximatively 50% more space before being mixed with water into concrete and compacted into position. Thus 4:2:1 boxes of cement and aggregate produce an equivalent of 4.66 boxes of concrete /and not 7 boxes./.
The explanation is that the smaller aggregates fill up the gaps between the larger. If a cube contains a maximum size sphere, which can be inserted, a certain amount of vacant space is left over. If the same cube is filled with smaller spheres, but the diameter of spheres is identical, the cubature of the gaps remains unchanged. One can fill up the cube most densely when a definite variety of diameters is used.

For placing concrete, the framework must be cleaned out and brushed with mould oil or white-washed /both have a bound-breaking effect/, in order to facilitate striking. Compacting can be done either by hand or by mechanical means. Hand-ramming is normally done with wooden tampers or steel-rods, helped by hammering the outside of the formwork. Mehcanical tamper: an internal vibrator /"poker"/ is held by hand.

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In certain developing countries, the sandy soil itself is mixed with lime or cement and blocks produced in this way are used as inexpensive masonry units. The process is called soil stabilization.

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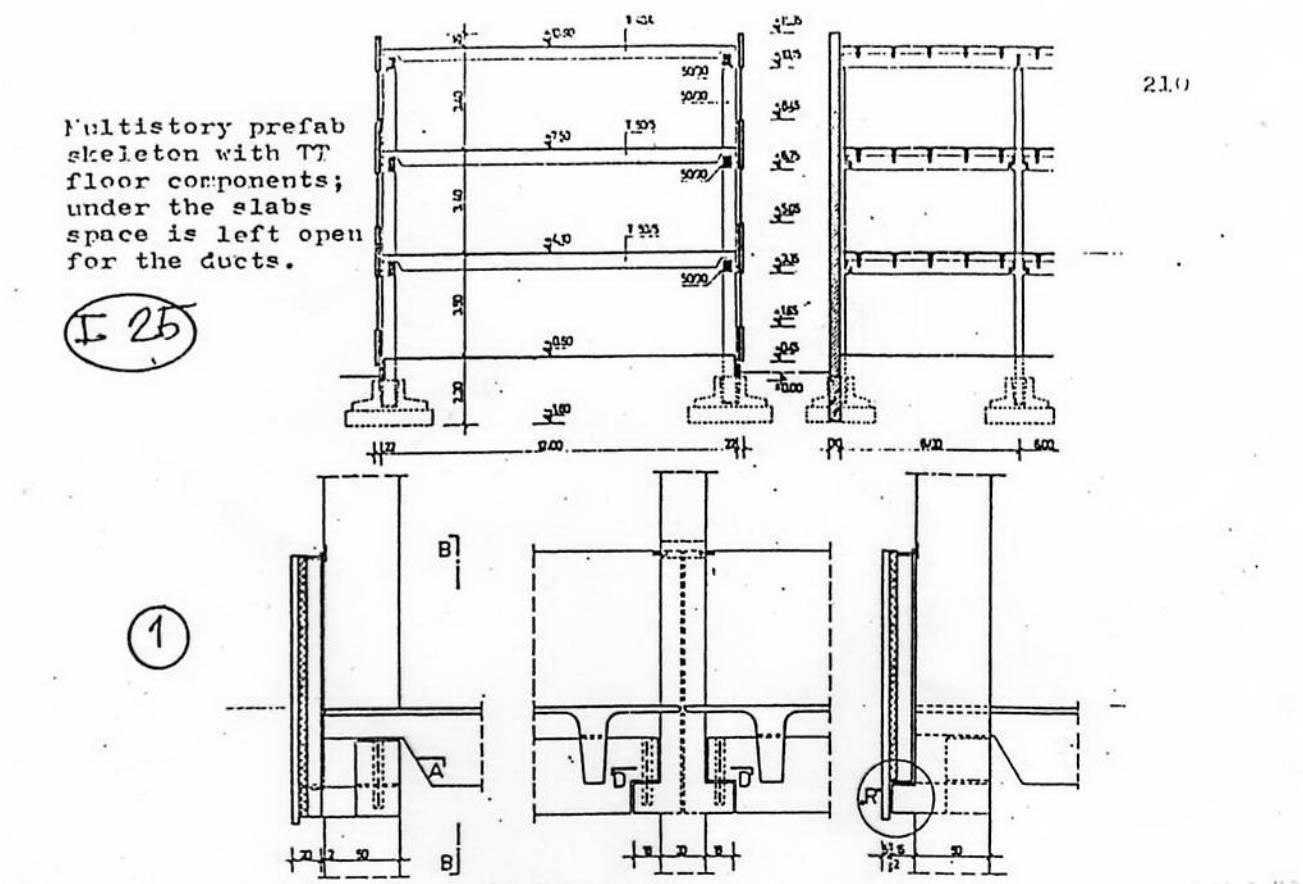
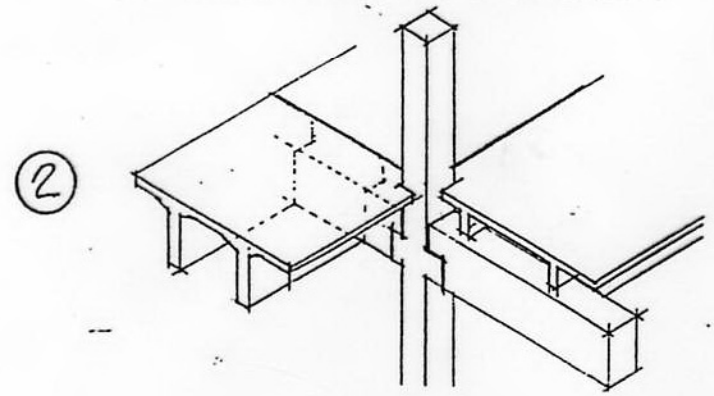
In the ancient times metals were used nearly exclusively as jointing element, roof coverings or tools. Metal fixing in stone structures was made of bronze or lead, while in timber structures later iron-nails, screws and bolts were used. Lead and bronze sheets appeared as roofing materials.
The progress of the steel industry at the end of the 18th century offered

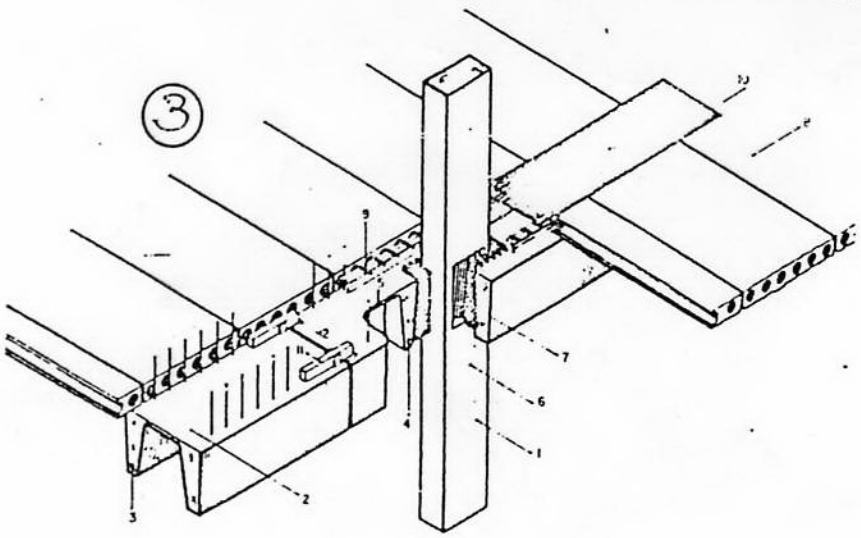
PRE-FABRICATED STRUCTURES:



Multistory prefab skeleton with TT floor components; under the slabs space is left open for the ducts.

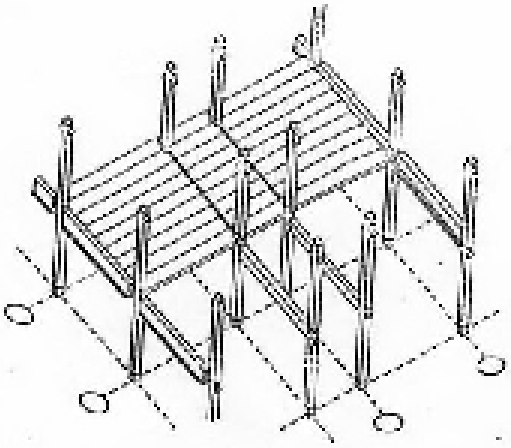
I. 25

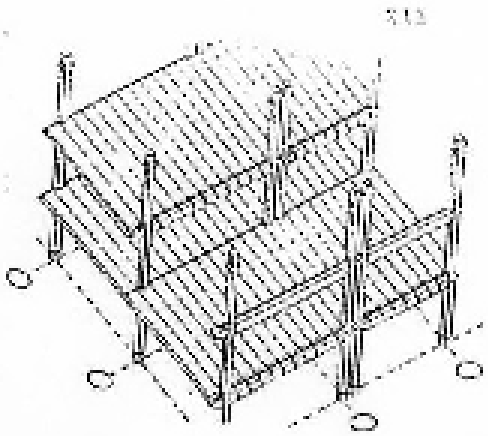




FLOORS OF PREFABRICATED RC SKELETON FRAMES

Multistory prefab skeleton with hollocore slabs. The joint of the inverted trough beam and pier is effected with wedge shaped grouting.





UNIVAZ skeleton with holow core floor floor slabs in longitudinal and cross arrangement

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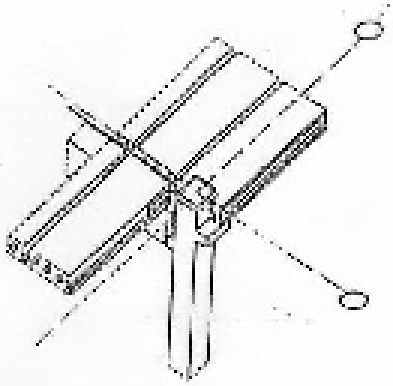

FLOORS OF PREFABRICATED PC SKELETON FRAMES

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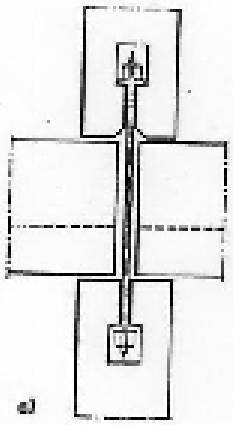
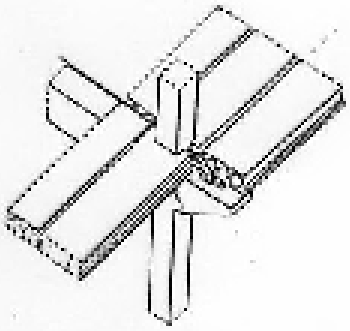
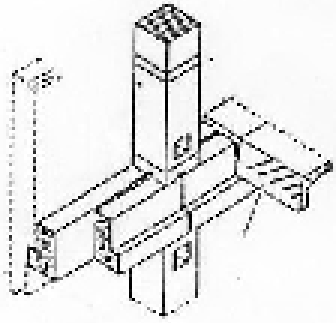


a)

Yrv system. The spanning direction can be selected free. Starting from any quarter of the piller's section.





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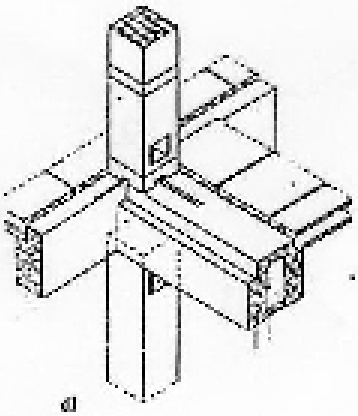
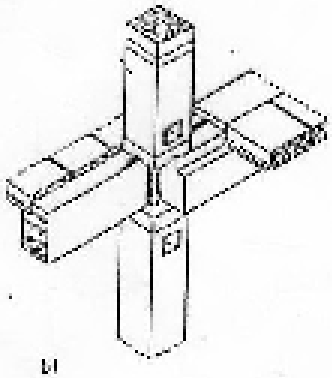
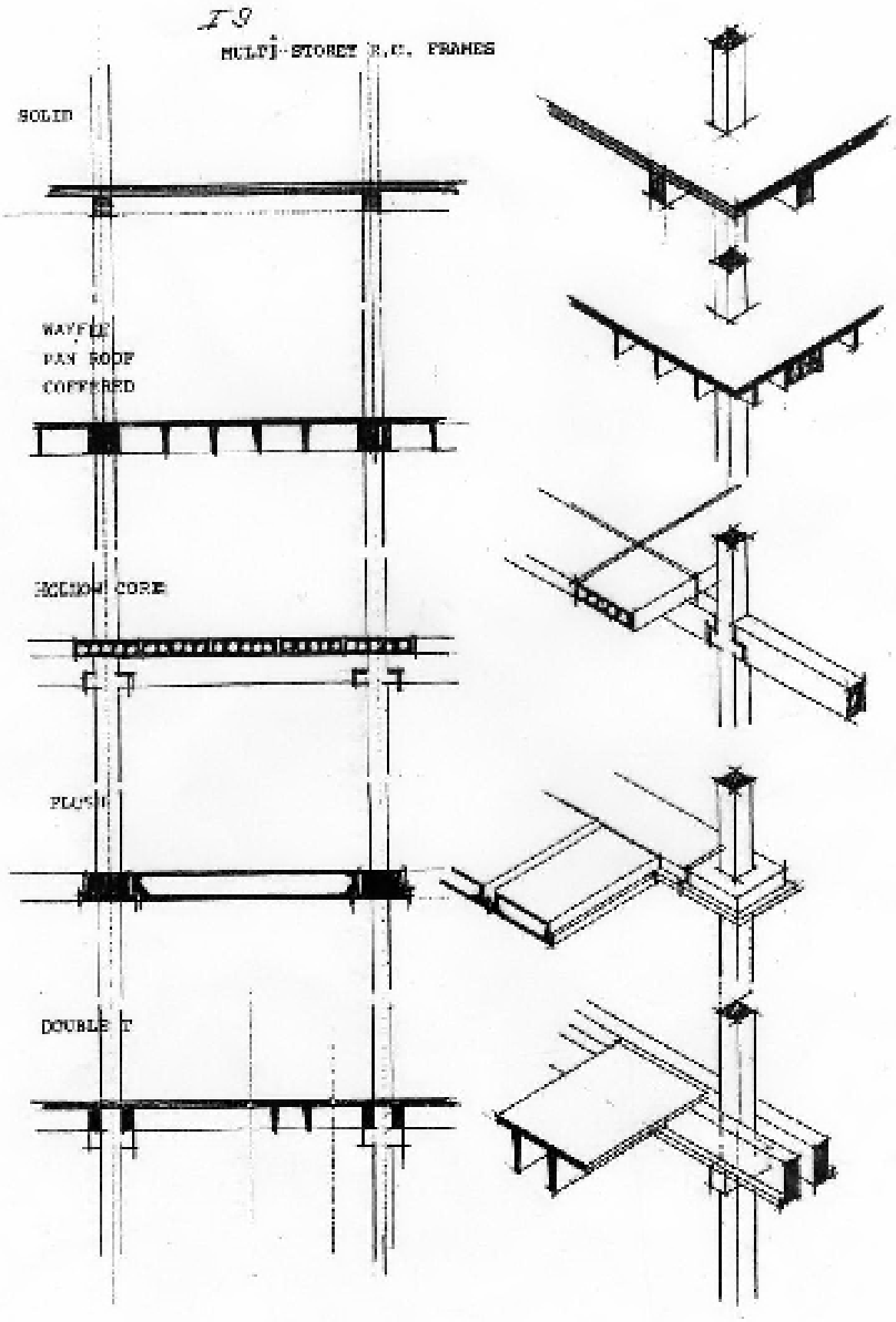
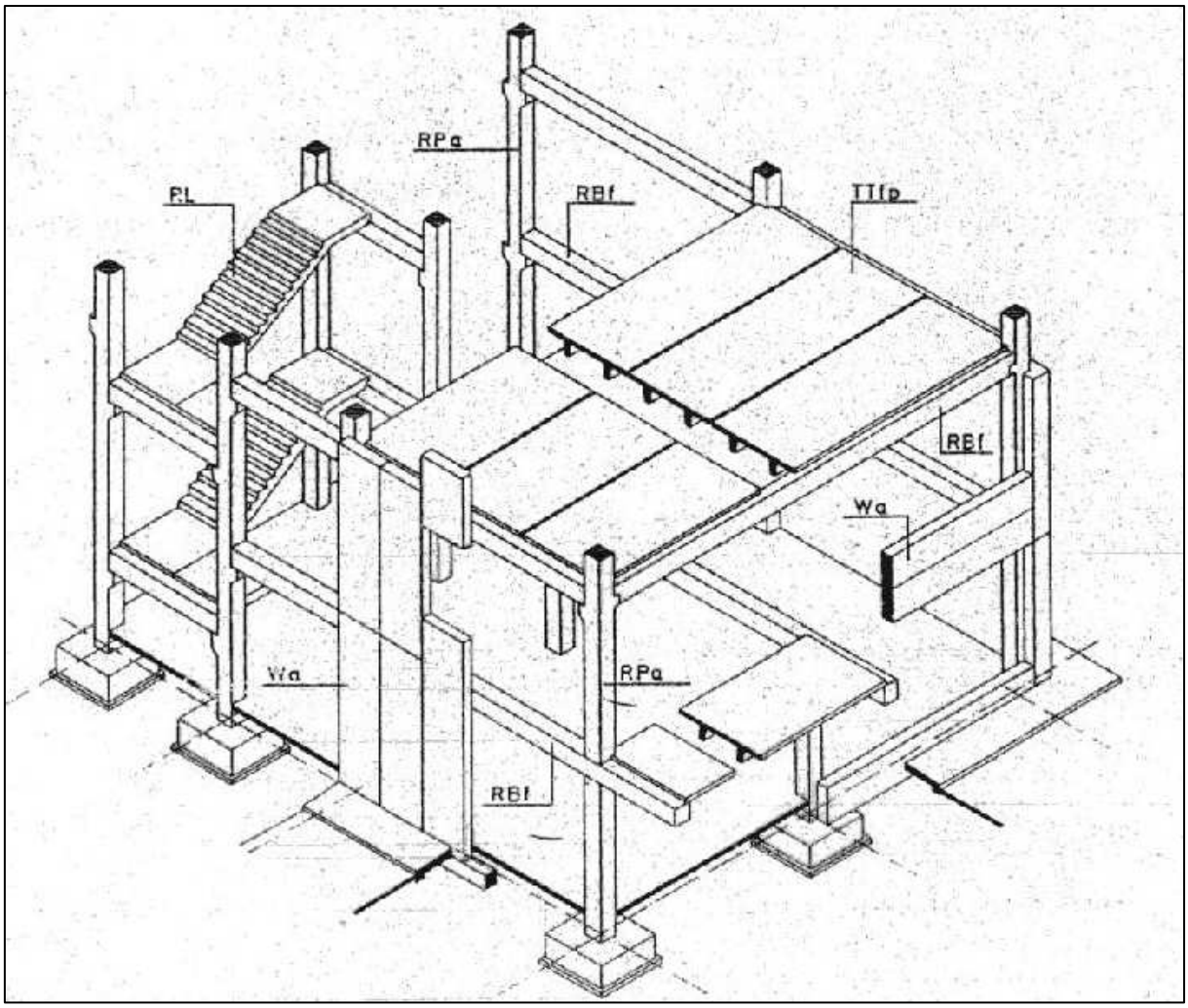


d)



b)


MULTI-STOREY R.C. FRAMES
SOLID
WAFFLE
PAN ROOF
COFFERED
DOUBLE T


RPa
RBf
TTp
RL
RBf
Wa
Wa
RPa
RBf