Nadar Saraswathi College of Engineering & Technology

NSCET E-LEARNING PRESENTATION

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DEPARTMENT OF CIVIL ENGINEERING

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CE 6016 – PREFABRICATED STRUCTURES

R.Vijayalakshmi,M.E.,MISTE.,
Assistant Professor
Nadar Saraswathi College of Engineering & Technology,
Vadapudupatti, Annanji (po), Theni – 625531.

UNIT III DESIGN PRINCIPLES

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Syllabus

- Disuniting of structures
- Design of cross section based on efficiency of material used
- Problems in design because of joint flexibility
- Allowance for joint deformation

Contents

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Disuniting of Structures

Disuniting of structures

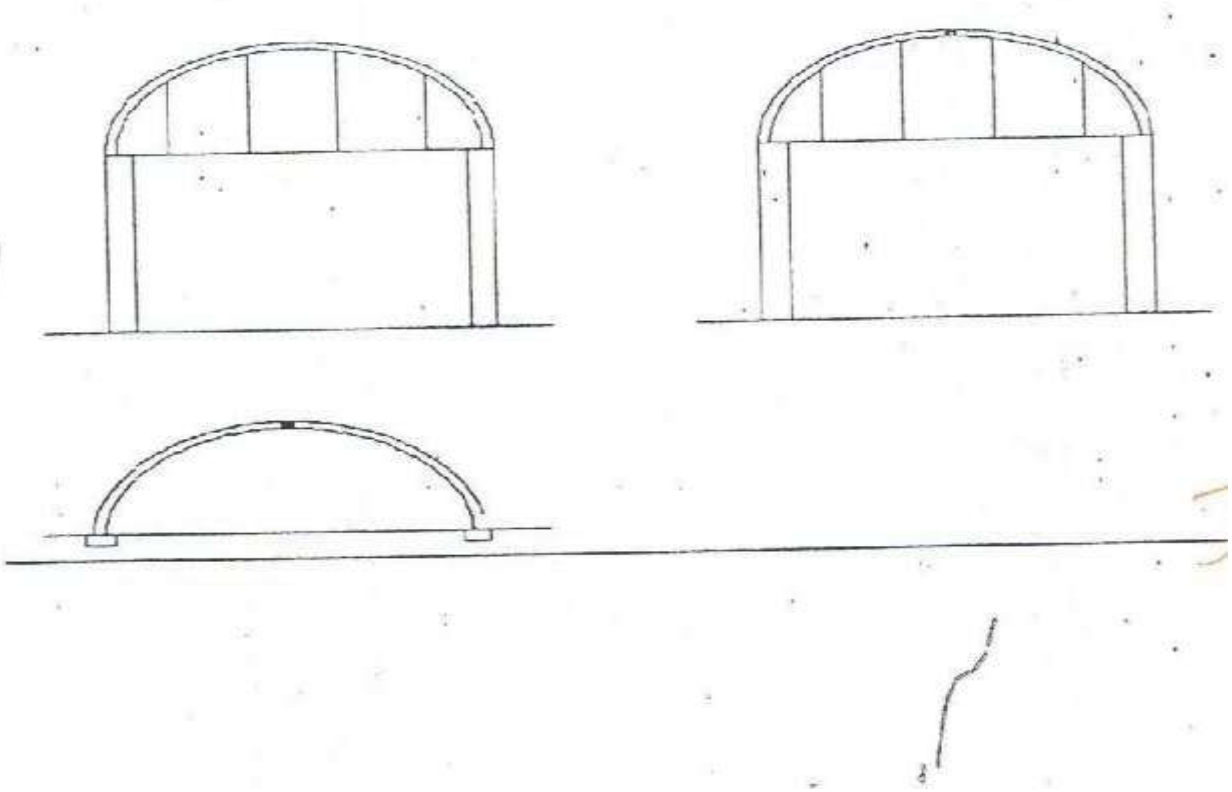
- The solution of problems connected with the transportation and placing of structures demands as a rule their disunity into smaller members

- In general there is a trend towards the use of large members because of reasons like lower cost in hoisting, savings in joint cost and speed construction

- Advances in the construction technology also lead to the use of larger members

- Disuniting is performed in places having minimum moment

Two hinged and three hinged arches



Straight members disunited at point of minimum moment

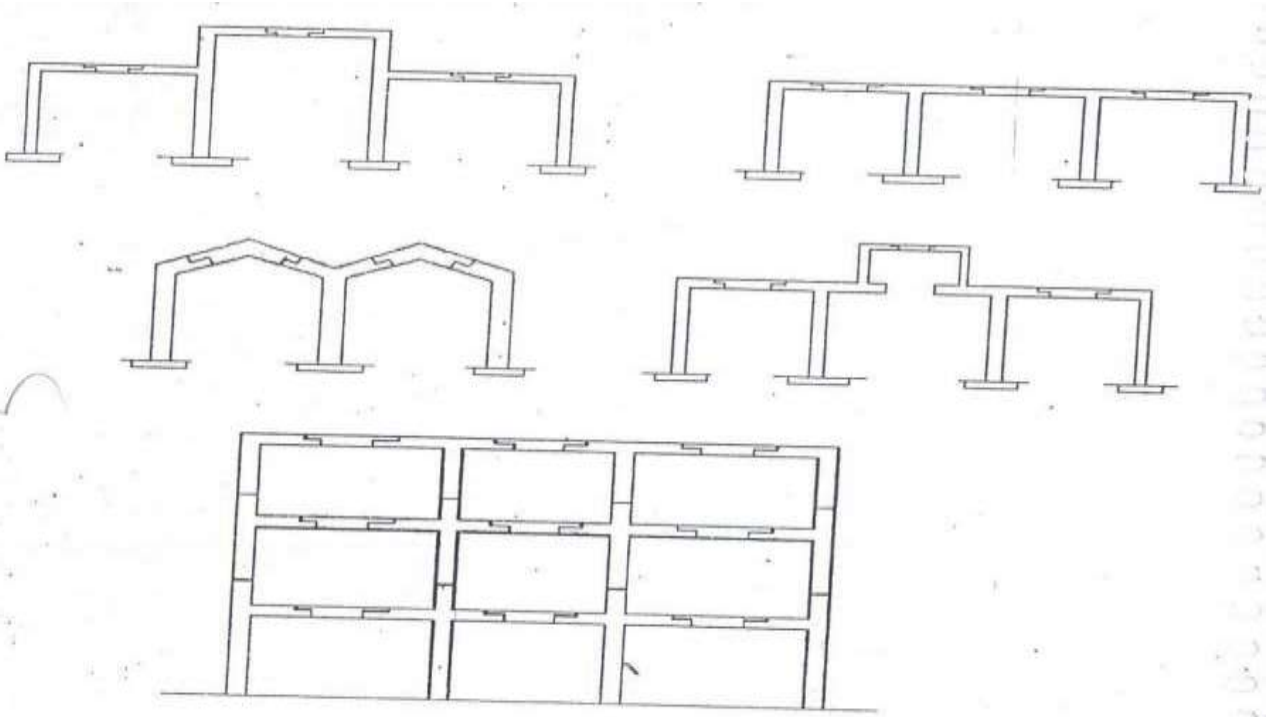


Fig 1.5 Structures disunited at points where the moments are smallest

System of Disuniting

- Systems consisting of linear members disunite at joints

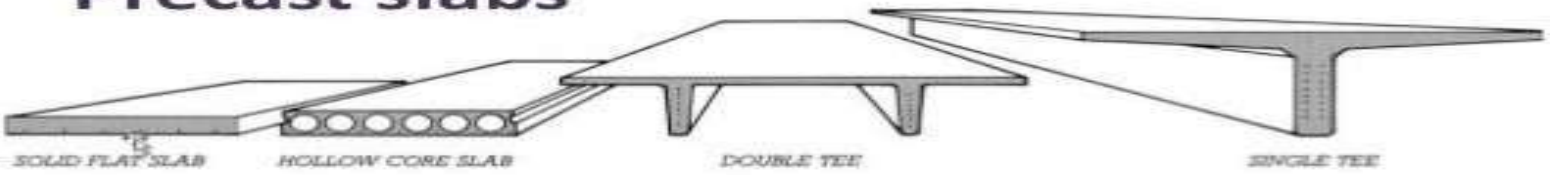
- Systems for prefabrication of entire rigid frames

- Systems consisting of L, T and U shaped or straight members disuniting at points of minimum moments

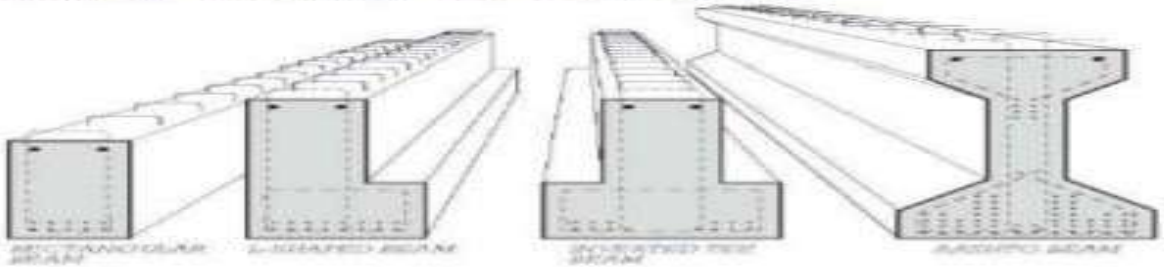
Design of cross section based on efficiency of material used

Precast concrete structural elements

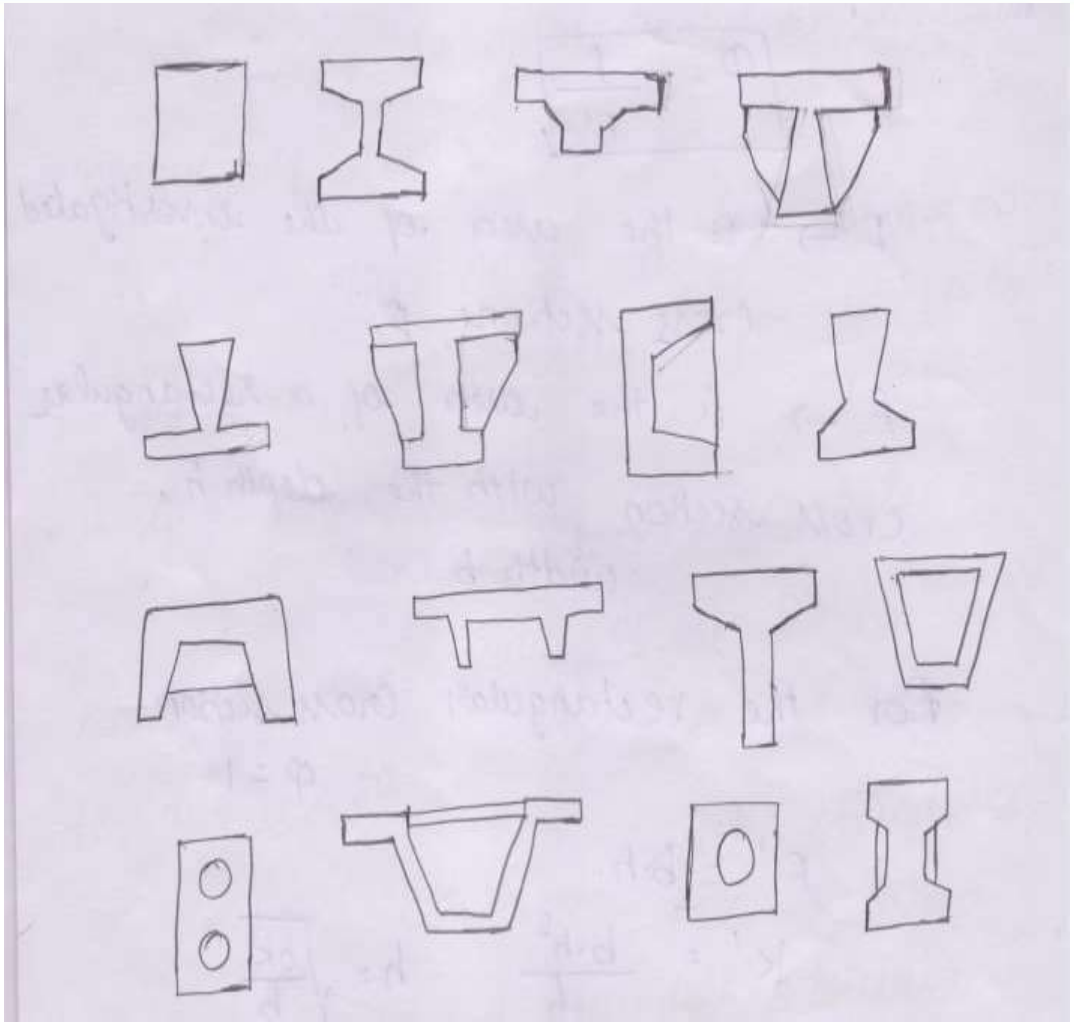
Precast slabs



Precast Beam & Girders



Cross Section for precast structures – Beams & Columns



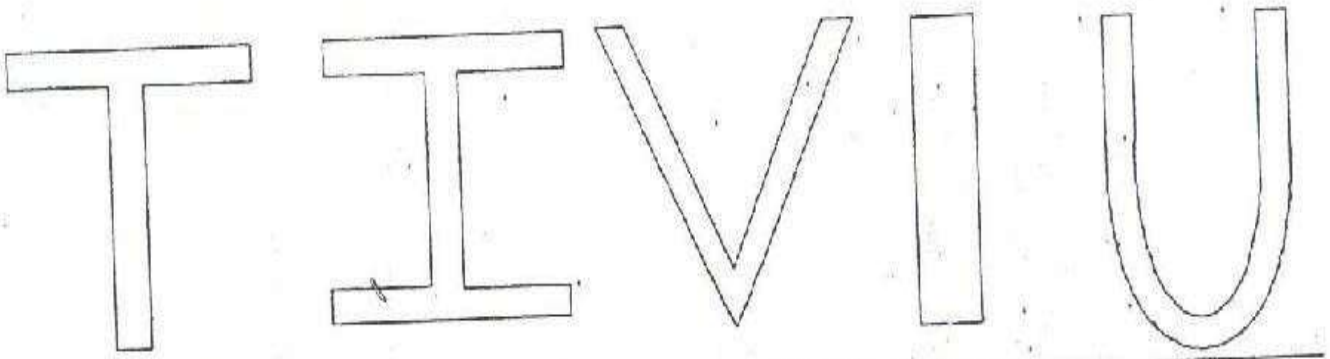


*Fig1.4*System consisting of Structures disunited at points where the moments are smallest Moments

- One of the great advantages of precast reinforced concrete structures over monolithic ones lies in the possibility of forming cross section which from the viewpoint of the theory of strength of materials
- The economy of cross section is measured by the form factor Φ value of which is

$$\Phi = F / F'$$

F = area of the investial cross sections

F' = area of a rectangular cross section which the depth h,width b

- For Rectangular cross section Φ = 1

- For I , T , U & V shaped section, $\Phi < 1$.
- For reinforced concrete structures their cross section being not homogenout the relation is not so simple and the value of suppliesonly an approximate measure of savings
- For I profile steel section $\Phi = 0.31$ to 0.33
- For prestressed concrete section $\Phi = 0.45$ to .50

Fretted structures, Trusses and Virendeel

- There is generally no difference between construction between
fretted and solid beams

- The reason for different openings in the body of the fretted beams is merely to obtain savings in the materials and to lessen the dead load

Virendeel

- The use of reinforced concrete structures having divided cross section as have virendeel columns and truss is becoming increasingly common due to economic and aesthetic reasons
- The manufacturing of these structures in a horizontal position requires less material for their shuttering, their reinforcement and concreteing is lso fairly simple.
- Other structures like tubes, pipes can be easily fitted to these strucures

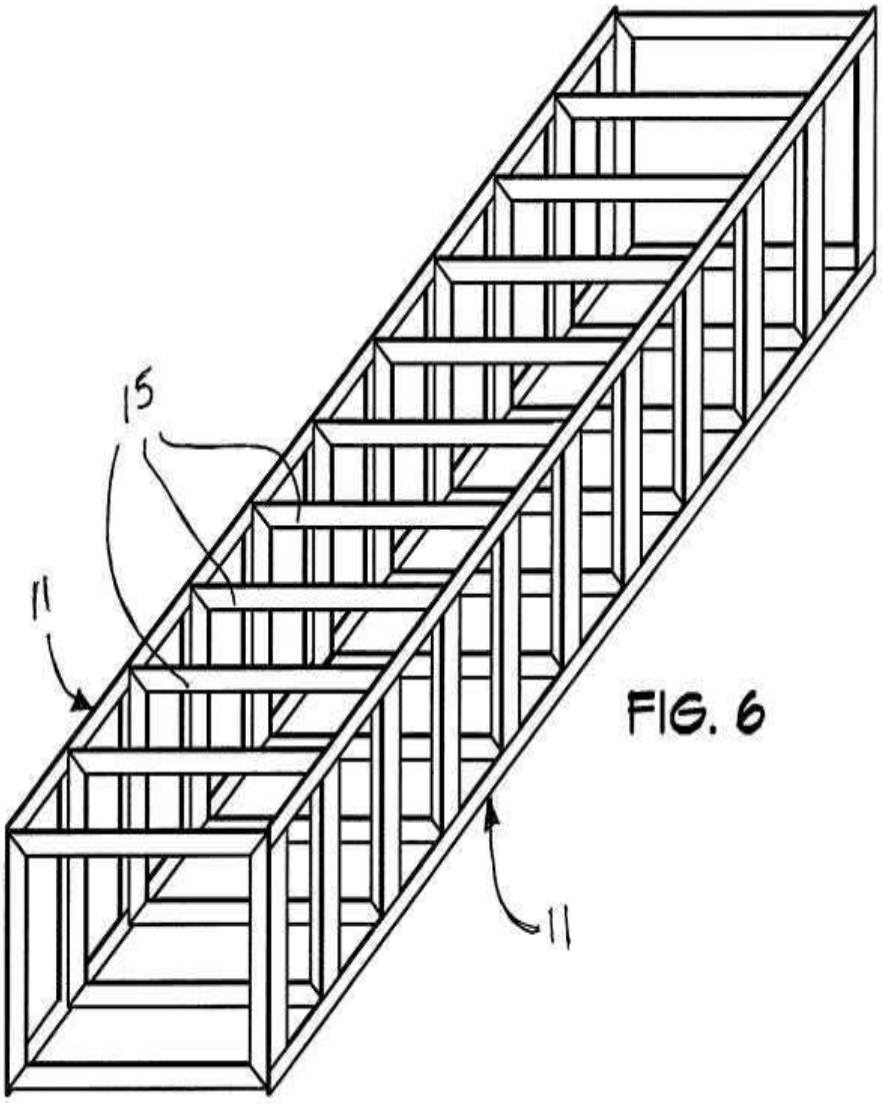


FIG. 6

Joints and problems in Joints due to Joints flexibility

Dimensioning of joints

- While lengthening of steel bars for joint the reinforcement in the precast and cast insitu joint will be different hence reinforced concrete code book is necessary for design

- Then lengthening of tensioned steel bars should be avoided, but if such a lengthening should be inevitable proper welded joints should be provided

- Best welded lengthening is an arc-welded joint consisting of four welds and two laps

Problems in design because of joints flexibility

- General design
  - Based on architecture
  - Based on structural analysis

General design Based on Architecture

- Modern layout in dimensions and gridlines setting out as this will enable
easy standardization in precast design

- Suitable size of panels position of joints and edge details

- Standardization of sections will ensure the minimizing of panel types and major design variation as far as possible

General design Based on Structural system

- Overall structure framing design and stability at various stages of construction
- Selection of structural elements to be precast
- Types of connection design to ensure structural adequacy and practically insitu execution
- Connection design to allow for panel tolerences, adequate space within joints to avoid rebar elasticity and congestion

Functions of joints

The joints between internal and external wall panels should be designed to resist all the forces such as lateral force , vertical forces etc . The joints should be capable of resisting of forces , and avoin excess deflection and cracking.

Major consideration in design of precast concrete systems

- Load assessments and load paths
- Establishment of suitable structural form or system
- Precast components selection and panelization with stardization

Joints and connections

- In precast connection design apart from strength requirement, other consideration such as ease of manufacturing, election and tolerance for work efficiency

- In theory all joint connection can be designed with structural adequacy for its performance needs with precast elements manufacture as per design

- All joints shall also cater for water tightness, durability, fire and aesthetic conditions

Type of Precast joint

- Compressive joint
- Tensile joint
- Shear joint
- Flexural and torsion joint

- Compressive joint

Using direct bearing as intermediate medium such as mortar

- Tensile joint

Use of steel splice connections, welding of cast in steel plates, lapping, grouting or starter / site laid rebars

- Flexural and torsional joint

Moment joint connection can be achieved with force coupling
using splice, bolting, welding, composite joint casting with rebars etc..,

Allowance and joining of prefabricated members

- Precast reinforced structure are of many types
- Load carrying structural members
- Space bordering members
- Surface forming structural members

- Load carrying structures can be divited into main groups according to their disuniting into members or by dividing prefabrication having identical dimensions

Design of joint:

- It must be based on relevant standard specific codes of practice or recommendation must be relevant

- Loading under working condition
- Stability of structures
- Loading condition during construction
- Effect of shrinkage, creep and temperature
- Unequal settlement

joint Flexibility

The joint flexibility means that when disuniting structures the member is designed as rigid or semi-rigid in which the columns and beams are connected together in such a way there is flexibility at the joint. It is called joint flexibility. The joint which holds two parts hence that one can swing relative to another part.

Dimensional tolerance

In the prefabricated structure the major work is joining the members . The dimensions are varied while fixing the elements hence the limits of deviation of the positioning in assembly of prefabricates. It is called dimensional tolerance or dimensional deviation.

joint deformation

The joint deformation is occurred when the joints are in disuniting structure. The joints are flexible then some deformation is occurred at the joints. The joint deformation refers to how the joint behaves in regard to the far field stresses.

Ductility of joint

The joint which carries two or more elements fixed together. The joint should be designed to carry the loads such as dead load, live load, wind load etc. When the joint should take heavier load which is greater than the ultimate load, then the joint gets more elongated. It is called ductility of joints.