



**UTM**  
UNIVERSITI TEKNOLOGI MALAYSIA

Faculty of  
Civil Engineering



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# Frame classification

# connections

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# Joints in frame

The effects of the behaviour of the joints in analysing frame structure, may generally be neglected, however if such effects are significant. they should be taken into account.

To know whether the joint behaviour is significant or not, joint are classified into:

- Simple
  - joint may be assumed not to transmit bending moments;
- Continuous
  - the behaviour of the joint may be assumed to have no effect on the analysis;
- Semi-continuous
  - the behaviour of the joint needs to be taken into account in the analysis

# Types of construction

## Simple

- connections between members are assumed not to develop moments
- joint pin connected
- necessary to maintain stability against sway
- elastic analysis

## Semi-continuous

- some degree of connection stiffness is assumed
- joint semi-rigidly connected
- Limitation in the design specifications
- elastic or plastic analysis
- elastic-plastic analysis
- elasto-plastic analysis

## Continuous

- connections between members capable to develop full strength/stiffness
- joint rigidly connected
- elastic analysis or plastic analysis









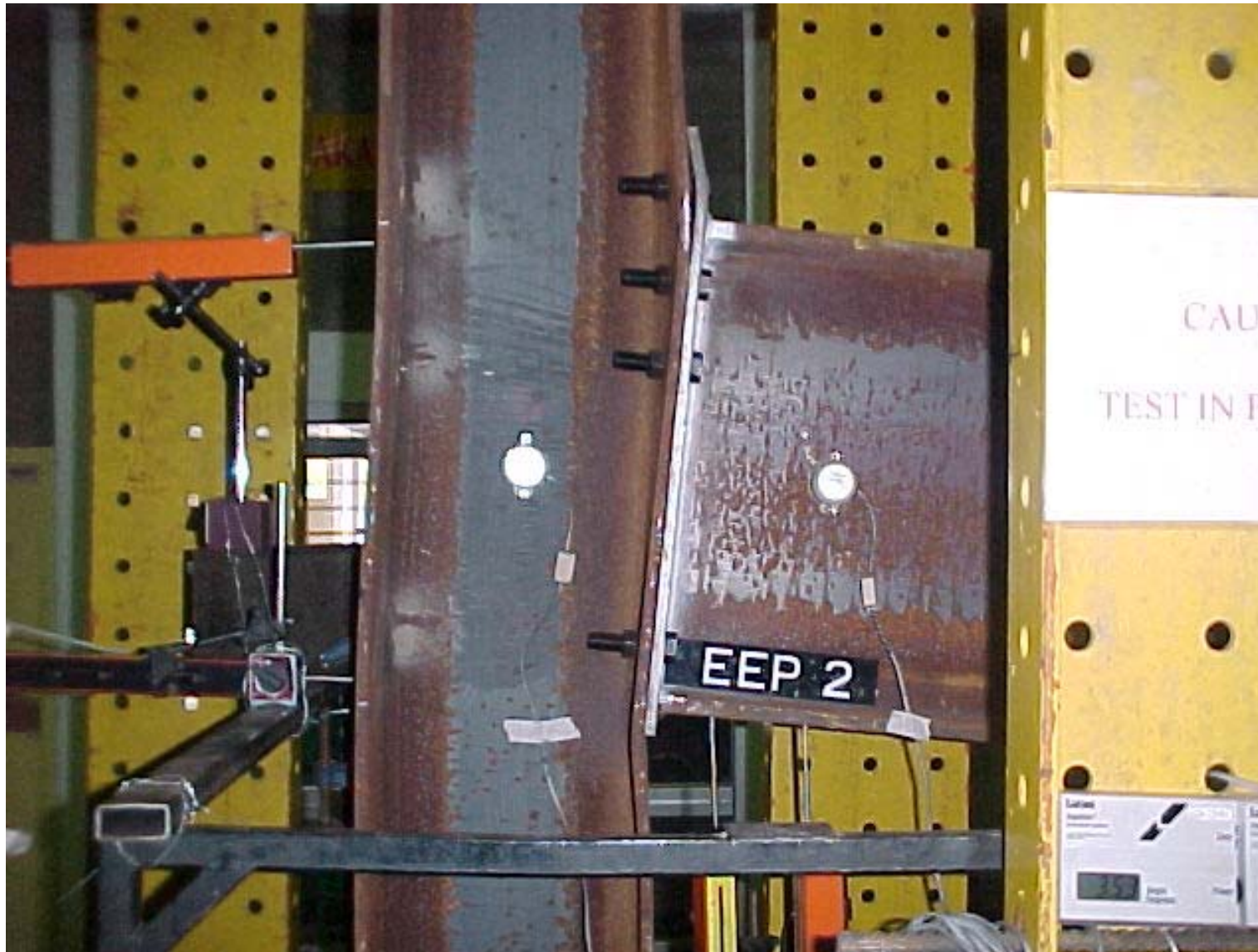




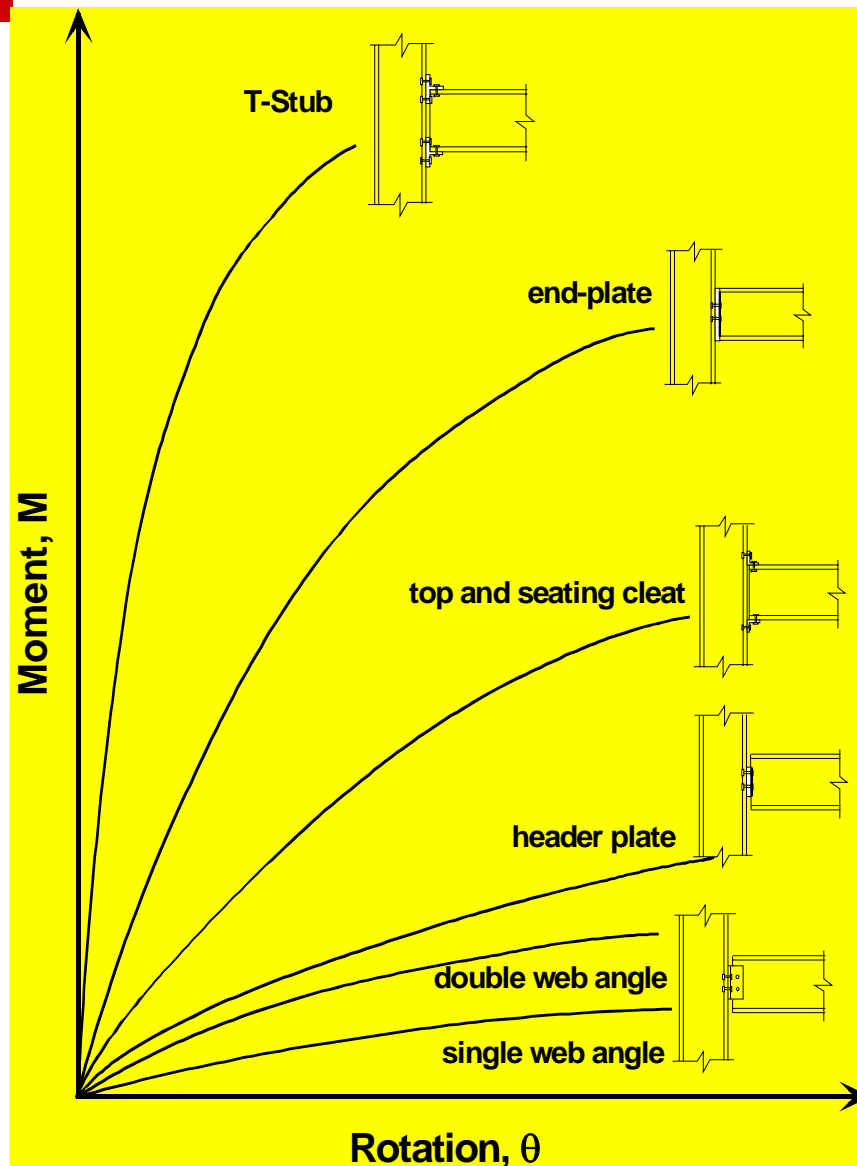








# Typical Joints Expressed In Term of M- $\phi$ Curves



- Simple construction
  - Double angle web cleats
  - Flexible end plates
  - Fin plates
  
- Semi-continuous construction
  - Flushed end plates
  - Extended end plates
  
- Continuous Construction
  - Welded
  - Mini-haunch

## Joints in frame – EC3

Connections can be classified according to:

### 1) Moment Resistance

- full strength (continuous design)
- partial strength (semi-continuous design)
- nominally pinned (simple construction design).

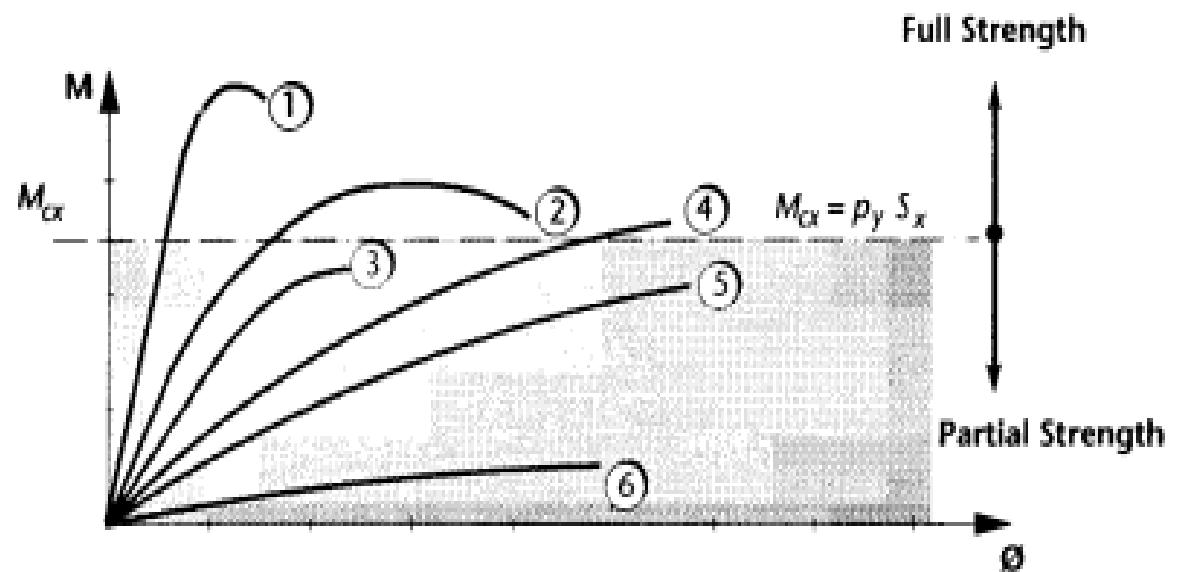
### 2) Rotational Stiffness

- rigid, semi-rigid, and nominally pinned

### 3) Rotation Capacity - ductility

# 1. Moment Resistance

- Full strength - a connection with moment resistance at least equal to that of the member.
- Partial strength - a connection with moment resistance, which is less than that of the member.
- Nominally pinned - a connection, which is sufficiently flexible with moment resistance not greater than 25% of  $M_{cx}$ .

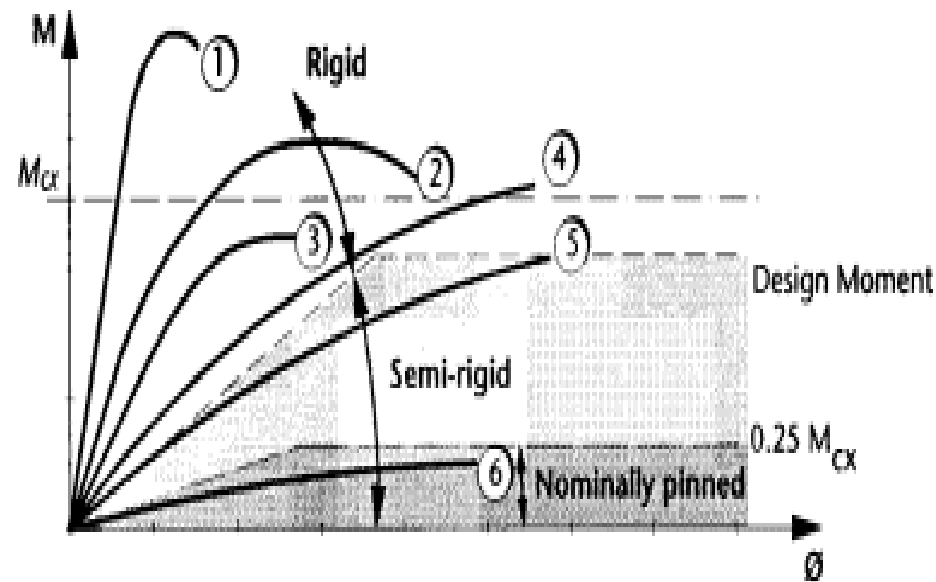


(a) CLASSIFICATION BY STRENGTH

# 1. Moment Resistance

- **Continuous design** is a design of frame where connections are considered as rigid joints for elastic analysis and full strength joints for plastic analysis.
- **Semi-continuous design** is a design of frame where semi-rigid connections are modelled as rotational springs and partial strength connections are modelled as plastic hinges.
- **Simple construction design** is a design of frame where the connections are assumed not to develop moments that affect the connected members.

## 2. Rotational Stiffness

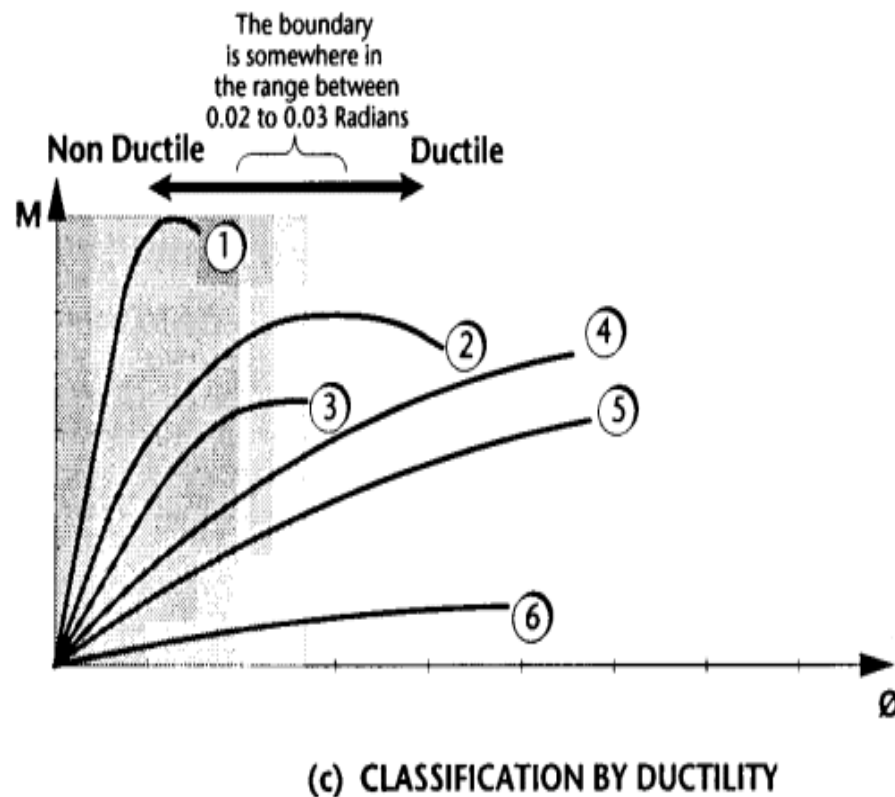


(b) CLASSIFICATION BY RIGIDITY

- Rigid - a connection which is stiff enough for the effect of its flexibility on the frame bending moment diagram to be neglected and with minimum deformation and rotation.
- Semi-rigid - a connection, which is too flexible to quantify as rigid but is not a pin.

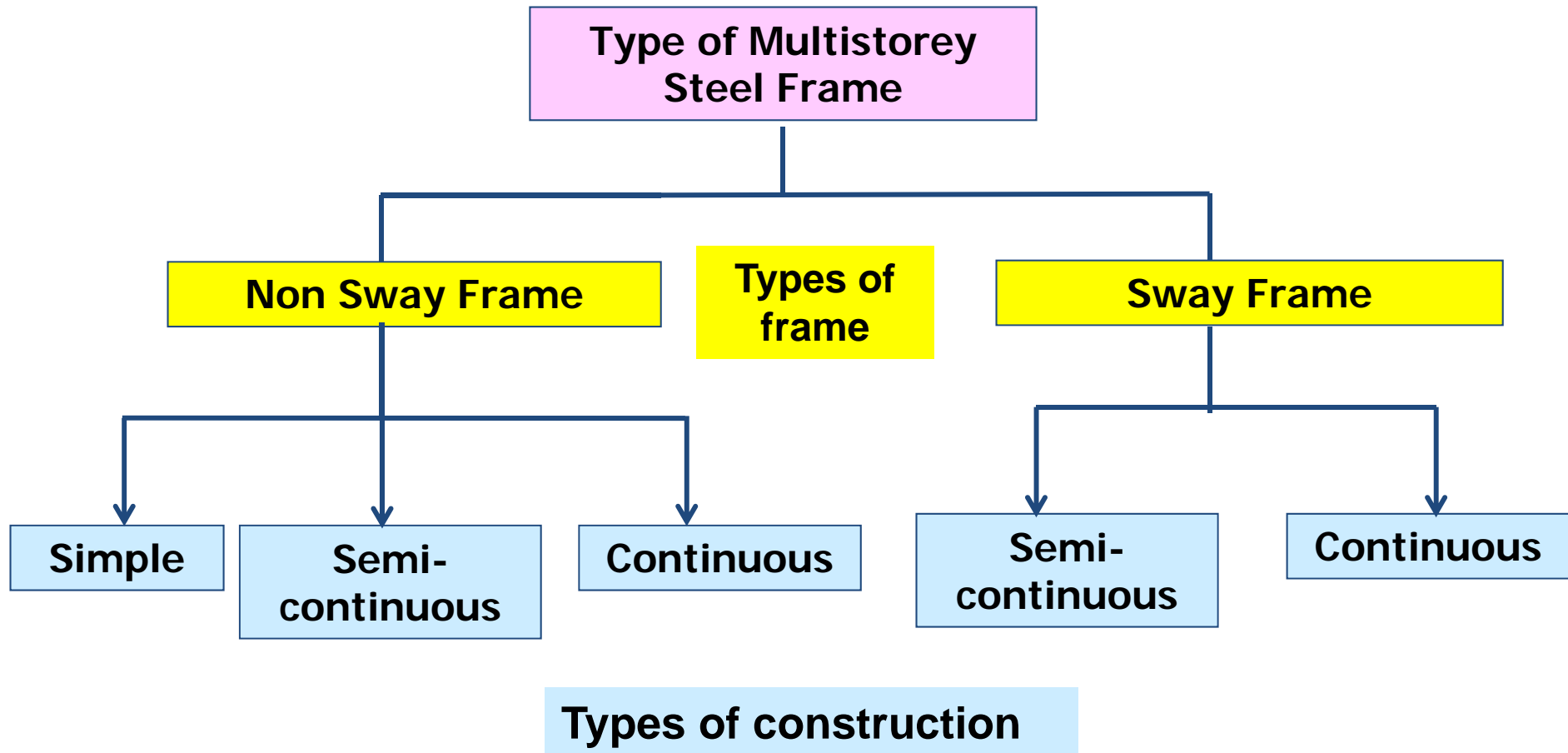


## 3. Rotation Capacity



- **Ductile connection - a connection, which has a capacity to rotate sufficiently to form a plastic hinge.**

# Relationship between type of frame and construction



## Summary

- The frame has first to be **idealised**
- Then a **frame classification** is carried out
  - sway-non sway
  - type of construction - connections
- then the **method of analysis** is will be selected ...  
(refer next section)